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Research Article

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Prediction of Survival in Severe Burned Patients through Abbreviated Burn Severity Index

Albana Aleksi, Monika Belba*

Service of Anesthesiology, Service of Burns, University Hospital Center "Mother Teresa", Tirana, Albania

***Corresponding author**
Monika Belba, Service of Anesthesiology, Service of Burns, University Hospital Center "Mother Teresa", Tirana, Rruga e Dibres Nr 372, Tirane, Albania

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Abstract

Introduction: *Many predictive models for mortality are developed to identify the most important factors which can influence the outcome and many prognostic scores are created and are validated in many studies according to the characteristics of each country*

Objectives: *This study aims to describe the characteristics of the patients admitted to our Intensive Care Unit(ICU) for the period in the study and to observe how the ABSI score can predict an outcome.*

Patients And Methods: *This study is an observational retrospective cohort study that observed adult burn patients (≥ 20 years old) hospitalized in the ICU of the Burn Service in UHCT during 2014-2019. Logistic regression analysis was used to determine the relationship between mortality and possible contributing variables of the ABSI score. The discriminative power of the revised ABSI score was assessed by receiver operating characteristics curve analysis*

Results: *Inhalation injury and presence of full-thickness burn had a strong relationship with mortality. ROC analysis as a valuable tool to evaluate predictive model revealed that ABSI score assessed outcome with a high accuracy AUC=0.973.*

Conclusions: *The ABSI score is a great representation of the mortality hazard at admission to the burns center and may be utilized to complement the existing referral criteria for triage choices.*

Keywords: Burns, Mortality, Survival

Introduction

Burn injury is a severe traumatic injury with considerable morbidity and mortality. The clinical course of severely burned patients may be difficult and the outcome tends to be poor in patients with multiple comorbidities and especially in those with an inhalational injury. Burns is a global public health problem, accounting for an estimated 180 000 deaths annually with the majority of these occur in low- and middle-income countries [1]. During the last century, over 40 new or modified mortality prediction models have been presented and validated to assess mortality risks in populations with severe burns [2-7]. Many predictive models for mortality are developed to identify the most important factors which can influence the outcome and many prognostic scores are created and are validated in many studies according to the characteristics of each country like Revised Baux score, Ryan score, Belgium Outcome Burn Injury (BOBI) score [8-10]. Abbreviated Burn Severity Injury Score (ABSI) is one of them [11].

This study aims to describe the characteristics of the patients admitted to our Intensive Care Unit (ICU) for the period in the study and to observe how the ABSI score can predict the outcome.

Material and Methods

Settings

The study is performed in the ICU of the service of burns and plastic surgery near the University Hospital Center in Tirana, Albania during 2014-2019.

Study design

The study was retrospective clinical and analytical regarding outcome after severe burns. The data used are obtained by the analysis of the medical records of 871 patients hospitalized with burns in the ICU of the service of burns.

Information collected included: Year of admission, Age, Gender (Male, Female), Etiology of burns (Scalds; Flame; Electrical;

Chemical; Others), Body Surface Area (BSA) (%) burned: (0-10%;11-20%;21-30%;31-40%; 41-50%; 51-60%; 61-70%;71-80%; 81-90%; 91-100%), Degree (Partial-thickness; Full-thickness), Presence of Inhalation injury (Yes; No). Inhalation injury included cases when there was exposure to flame, steam, or products of combustion together with laboratory findings and with positive bronchoscopy findings below the vocal cords. Length of Hospital Stay (LOS) (days), Outcome (Deaths; Survivors) and Categorization according to ABSI score (Very low 2-3 points), (Moderate 4-5 points), (Moderately severe 6-7 points), (Serious 8-9 points), (Severe 10-12 points), (Maximum > 12 points).

This retrospective study is approved by the Ethics Committee at the Ministry of Health and Social Protection in Tirana. Patients with Steven-Johnson, Toxic Epidermal necrolysis as well as with degloving injuries were excluded from the study.

Study protocol

The ABSI originally published in 1982 ranges between 2 and 18 points, resulting in six risk categories. The ABSI considers the following risk factors: female gender (1 point), increasing age in groups of 20 years (1–5 points), increasing Total Burned Surface Area (TBSA %) in groups of 10 years(1–10 points), presence of inhalation injury (1 point) and presence of full-thickness burns (1 point). (Figure 1). ABSI was applied in all our patients on admission and the outcome was evaluated as an actual and predictive one.

Parameter	Finding	Points	Parameter	Finding	Points
Sex	Female	1	TBSA (%)	1–10	1
	Male	0		11–20	2
Age (years)	0–20	1		21–30	3
	21–40	2		31–40	4
	41–60	3		41–50	5
	61–80	4		51–60	6
	81–100	5		61–70	7
Inhalation injury	Yes	1		71–80	8
	No	0		81–90	9
Full thickness burn	Yes	1		91–100	10
	No	0			

ABSI	Threat to life	Probability of survival %
2–3	Very low	≥ 99%
4–5	Moderate	98
6–7	Moderately severe	80–90
8–9	Serious	50–70
10–11	Severe	20–40
≥ 12	Maximum	≤ 10

Figure: 1-ABSI score and probability of survival

Statistical analysis

SPSS 23 software was used for the conduction of the statistical analysis. Descriptive Statistics were conducted to summarize data for the central tendency (Mean) and variability (Standard Deviation). Logistic regression analysis was used to determine the relationship between mortality and possible contributing variables of the ABSI score (Age, TBSA, presence of Inhalation burn, Presence of Full-thickness burns, and gender). The discriminative power of the revised ABSI score was assessed by receiver operating characteristics curve analysis. Statistical significance was defined as $p<0.05$.

Results

The mean age of the included patients was 24.6±26.7 years, the median was 21 years with a minimum of 1 year and a maximum of 93 years. Of the 871 patients, 434(49.8%) were children and teens up to 20 years old, 437(50.2%) were adults, and the elderly more than 20 years old. (Table 1). Overall, males outnumbered the females in burn ICU admissions in 532 cases (61.1%) versus 339 cases (38.9%), and the Male: Female ratio was 1.56:1. Of all burns 46%(401) were burns from the flame, 43.8%(382) were burns from scalds, 5.1 %(45) were chemical burns,4.7%(41) were electrical burns, and while 0.2%(2) were burns from other causes.

Table1: Demographic, clinical and burn injury characteristics 2014-2019 (n=871)

Age, mean(SD)	24.6(26,7)
Gender, % female (n)	38.9(339)
Group ages	
Children(0-20y),%(n)	49.8(434)
Adults and elderly (>20y),%(n)	50.2(437)
Etiology of burns, %(n)	
Scalds	43.9(382)
Flame	46.0(401)
Electrical	4.7(41)
Chemical	5.2(45)
Others	0.2(2)
TBSA%, mean(SD)	25.9(19.2)
Full-thickness burn, %(n)	17.9(156)
Inhalation injury, %yes (n)	18.2(159)
Time of hospitalization, mean(SD)	2.8(2.9)
LOS , mean(SD)	12.9(17.3)
ABSI, mean(SD)	5.6(3.0)
Mortality ,%(n)	7.8(68)

The mean TBSA (%) was 25.9±19.2 % (Table 1). Full-thickness burns were present in 17.9 % (156 patients), Inhalation injury was present in 18.2% of patients (n=159). Time to hospitalization was 2.8±2.9 hours. The mean LOS was 12.9±17.3 days. Mortality was 7.8% (68 deaths of 871 patients.

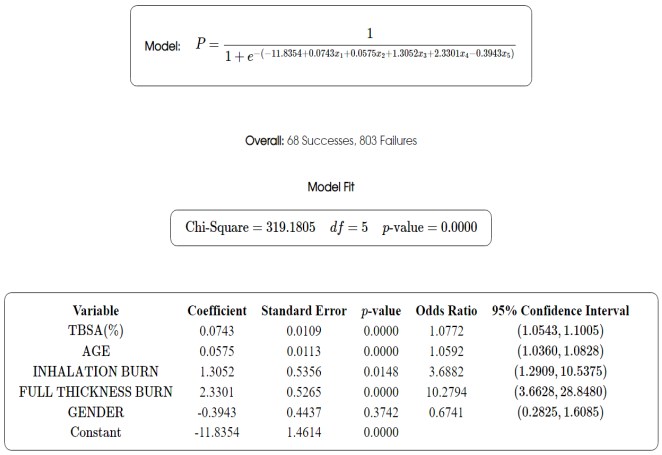
We used the ABSI score to calculate our patients' probability of death. The predicted mortality was compared with observed mortality. For all patients mean ABSI score was 5.6±3.0.In table 2 we have made categorization according to the ABSI score and we have calculated the actual survival of our patients. Concretely with Maximum points, there were 47 patients from which only 6 or 12.6% had survived so the actual survival in this group was 12.7% a little better than predicted. With 10-11 points which corresponds

to the Severe group, there were 43 patients from which 31 were survivals with the actual survival of 72% which is almost double the prediction. The same situation is for serious, moderately severe, moderate, and very low groups where the actual probability of survival is better than prediction.

Table 2: -ABSI score and actual probability of survival

Categorization according to ABSI points	%(n)	Probability of survival (%)	Actual survival,% (n)
MAXIMUM (>12 points)	5(47)	<10	12.7(6)
SEVERE(10-11 points)	9(43)	20-40	72(31)
SERIOUS(8-9 points)	11(95)	50-70	86(82)
MODERATELY SEVERE (6-7 points)	20(170)	80-90	98.8(168)
MODERATE(4-5 points)	32(278)	98	100(278)
VERY LOW(2-3 points)	27(238)	>99	100(238)

Logistic regression analysis was used to determine the relationship between mortality and possible contributing variables of the ABSI score (Age, TBSA, presence of Inhalation burn, Presence of Full-thickness burns, and gender). We have presented in figure 2.

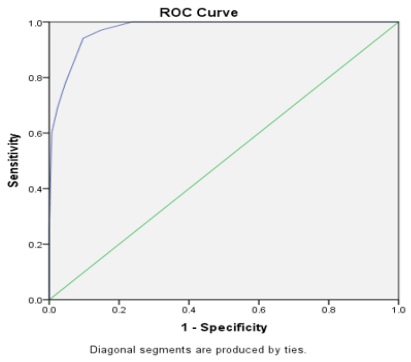


Variable	Coefficient	Standard Error	p-value	Odds Ratio	95% Confidence Interval
TBSA(%)	0.0743	0.0109	0.0000	1.0772	(1.0543, 1.1005)
AGE	0.0575	0.0113	0.0000	1.0592	(1.0360, 1.0828)
INHALATION BURN	1.3052	0.5356	0.0148	3.6882	(1.2909, 10.5375)
FULL THICKNESS BURN	2.3301	0.5265	0.0000	10.2794	(3.6628, 28.8480)
GENDER	-0.3943	0.4437	0.3742	0.6741	(0.2825, 1.6085)
Constant	-11.8354	1.4614	0.0000		

Figure 2:- Logistic regression analysis for mortality and the contributing factors of ABSI score

From logistic regression, there is a positive relationship for the presence of inhalation burn as well as for the presence of full-thickness burn and a negative relationship for females. Being in the inhalation group puts the patient at 3.6 times greater odds of the probability for a bad outcome while having full-thickness burns puts the patient at 10.2 times greater odds for a bad outcome. Contrary females were at lesser odds for the bad outcome while for TBSA and age there was a very low association with a bad outcome.

The discriminative power of the revised ABSI score was assessed by receiver operating characteristics curve analysis (figure 3). ROC analysis as a valuable tool to evaluate predictive models assessed accuracy quantitatively as AUC=0.973 which is high accuracy.



Area Under the Curve

Test Result Variable(s): ABSI

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.973	.006	.000	.962	.985

The test result variable(s): ABSI has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

Figure 3: The discriminative power of the revised ABSI score was assessed by receiver operating characteristics curve analysis.

Discussion

Mortality prediction models are certainly useful for severity assessment in the burn population because risk stratification and standardization enable to compare groups of patients with the same risk of death. This because the crude mortality gives little information on neither severity nor the mortality risk. Evaluation of the distribution of risk factors is therefore an essential part of outcome prediction [12].

Our data indicate that the ABSI score is still an accurate and valuable tool in the prediction of burn patient mortality. In the present study, the ABSI scoring system shows very good performance in predicting mortality. As an area under the curve (AUC) of more than 0.9 indicates high accuracy, the AUC of the ABSI model was 0.973. This is by other studies [12,13]. Our results regarding ABSI are comparable with some authors, although others share the opinion that mortality is overestimated with this score [14,15].

Although the actual survival is better than prediction through the ABSI score we can classify patients immediately on admission and can be helped them better. Especially patients with full-thickness burns and with the presence of inhalation burn should be resuscitated with strict monitoring.

Conclusions

Survival after the burn injury has consistently moved forward over the final few decades. Patient mortality is, in any case, still

the essential outcome measure for burn care. Scoring frameworks point to utilize the foremost prescient premorbid and damage variables to surrender an anticipated probability of passing for a given patient. Age and burn surface area range in our patients has a small effect as a portion of the regression equation for ABSI as a predictive score for a bad outcome, whereas inhalational damage and presence of full-thickness burn remain the mainstays of burn prognostication. The ABSI score is a great representation of the mortality hazard at admission to the burns center and may be utilized to complement the existing referral criteria for triage choices.

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