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ORIGINAL PAPER

ABSI scoring system for burns: concerns and modifications in a developing country

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Abstract

Background Burns are a major health problem worldwide. In some countries, they are the fourth leading cause of death in trauma patients. Every year, more than 200,000 deaths occur because of diverse types of burns, and the majority of these deaths occur in low-income countries. The incidence of burn mortality depends on both patient factors (age, gender, and comorbidities) and burn factors (depth and total burn surface area (TBSA)). Mortality prediction for burn patients is important not only to determine the prognosis of individual patients but to assess the performance of the burn institute and the quality of the health care the patients receive. Many mortality or survival prediction models have been developed, modified, and validated. The abbreviated burn scoring index (ABSI) is one of the most commonly used scores for assessing patients' mortality. It was reviewed, modified, and validated in this study.

Methods This is a retrospective analysis of cases admitted to Kasr Al-Ainy Burn Unit (KABU), Cairo University Hospitals, Egypt, over a period of 5 years (January 2012 to December 2016). The data were analyzed using the ABSI scaling system.

Results The predicted survival using the ABSI was the same as the actual survival for all age groups except children less than 10 years and pregnant females, who had actual survival rates that differed from those predicted.

Conclusion ABSI is one of the best indicators of the mortality and well-being of burn patients. A modification of the ABSI score that added one point for children less than 10 years yielded closer predicted and actual survival rates and this change was statistically significant. A larger number of pregnant females is needed to validate the scoring system for pregnant patients. Close attention and care are always recommended for these two special high-risk groups.

Level of Evidence: Level II, risk / prognostic study.

Keywords Burns · ABSI · Children · Pregnant · Egypt

Introduction

Burns are a major health problem worldwide. In some countries, it is the fourth leading cause of death in trauma patients. Every year, more than 200,000 deaths occur because of diverse types of burns, and the majority of these deaths occur in low-income and developing countries [1–3].

The incidence of burn mortality depends on patient factors, such as age, gender, and comorbidities, and burn factors, such as depth and total burn surface area (TBSA).

Mortality prediction is crucial for determining the prognosis of each patient. Additionally, these scores help to assess the performance of the burn centers and the care the patients receive.

Many mortality or survival prediction models have been developed, modified, and validated.

An early model was based on two major risk factors: increasing age and TBSA. This model used the sum of both risk factors to describe the mortality probability in percentage form. Despite its easy application, this model had major limitations for determining long-term survival [4].

Other common mortality prediction models are summarized as follows:

The Baux index was originally described in 1961. Osler et al. modified it to create the rBaux. The index is based on age, TBSA, and the presence of inhalational injury [5].

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The modified Bull grid is based on age (17 group) and TBSA (20 group); the probability of death ranges from 0 to 100% [6].

The Rayan et al. model is based on three risk factors: age > 60 years, TBSA > 40%, and inhalation injury. Patients are classified into four categories, with the probability of death rated as 0.3%, 3%, 33%, and 90% [6].

The abbreviated burn severity index (ABSI) is based on five main risk factors: female gender (1 point), age (5 points), TBSA (10 points), inhalation injury (1 point), and full-thickness burn (1 point). The survival probability ranges from < 10 to > 90% [7].

Burns due to various accidents are ubiquitous among Egyptians, although they may be underreported or not documented. The lack of well-equipped burn centers in Egypt led the government to establish new burn centers, which will open in Cairo University Hospitals within a few months. The aim of this study was to identify the mortality rates of patients who presented at the Kasr Al-Ainy Burn Unit (KABU) using the ABSI. The findings will provide a clear image of patients' needs and will eventually lead to a better service.

Patients and methods

This is a retrospective analysis of the cases admitted to KABU, Cairo University Hospitals, Egypt, from January 2012 to December 2016. Patients with incomplete data and those who were discharged upon their request or left before the completion of treatment were excluded from the study.

The data were analyzed using the ABSI score. Data were coded and entered using the Statistical Package for Social Sciences (SPSS) version 24. The data are summarized using the mean, standard deviation, median, minimum and maximum for quantitative data and frequency (count), and relative frequency (percentage) for categorical data. Comparisons between quantitative variables were performed using the non-parametric Mann-Whitney test [8]. *P* values less than 0.05 were considered statistically significant.

The prediction of mortality was assessed using the ABSI score (Table 1). The differences between the predicted mortality and actual mortality were assessed and statistically analyzed (Table 2).

Table 1 Tobiasen's abbreviated burn severity index score (ABSI) [6]

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			

Table 2 Survival interpretation for ABSI [6]

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

Results

A retrospective study was conducted over a 5-year period using the medical files of 1233 patients. Total mortality, surviving patients, and sex distribution are summarized in Table 3.

The patients were grouped into six score groups, and the difference between the actual survival and the predicted survival rates was calculated (Table 4). The results are summarized in Table 5.

A further analysis showed a significant difference between the actual and predicted mortality in children (age under 10 years) (Table 6). The total number of admitted children was 420 (34% of the entire population).

The ABSI was modified by adding one extra point for patients below the age of 10 years. The patients were reassessed to determine the predicted and actual survival (Table 7).

Table 3 Summary of total number of patients, survived patients, and sex distribution. The following table demonstrates the four risk factors in ABSI score and number of the involved patients

Total	Survival	Mortality
1233	987	246
	80%	20%
Total	Male	Female
1233	817	416
	66%	34%

Table 4 Number of patients versus age, TBSA, inhalational injury and depth of burns

Age	Points	No. of patients
0–20	1	604
21–40	2	438
41–60	3	161
61–80	4	27
81–100	5	3
TBSA%		No. of patients
0–10%	1	79
11–20%	2	277
21–30%	3	334
31–40%	4	174
41–50%	5	124
51–60%	6	64
61–70%	7	42
71–80%	8	42
81–90%	9	38
91–100%	10	56
Females	1	416
Inhalation injury	1	46
Full thickness	1	87

The results of a comparison of the ABSI and the modified ABSI showing the difference between the predicted and actual survival in children are shown in Table 8.

The minimum difference between the actual and predicted survival when the original score was used was < 21.5%. However, after modification of the score, the difference declined to < 1.5%. The maximum difference was still 15% for both scores. This difference was statistically significant, with a p value < 0.001.

When groups of children were analyzed individually, 21 patients (5%) who were scored as a group [9, 10] had a predicted survival of 50–70%; the actual survival was 25.6%, with a difference of − 21.5%. After the modification (by adding one point), the same group showed no difference between the predicted and actual survival percentages. The second group [8, 11] comprised 56 patients (13.3%) [8, 11] with a predicted survival of 80–90%; the actual survival was 71.4%, with a difference of − 8.6%. After the modification, there was no difference between the predicted and actual survival rates. The third group [6, 7] comprised 208 patients (49.5%) with a predicted survival of 98%; the actual survival was 91.3%, with a difference of − 6.7%. After modification, there was no difference between actual and predicted survival. These results are summarized in Table 9.

Nine pregnant females were assessed again individually, and the mortality score was applied. There was a significant difference between the actual and predicted survival rates (Table 10).

The results of adding an extra point to the scores of pregnant females and a reassessment of the difference between the actual and predicted mortality are shown in Table 11.

A comparison of the ABSI and modified ABSI results in terms of the predicted and actual survival in pregnant women was performed (Table 12). The minimum

Table 5 ABSI score for all patients and difference between the actual and predicted survival

ABSI score group	Survived patients	Actual survival %	Predicted survival %	Difference
2–3	166/166	100%	> 99%	Within range
4–5	450/472	95.3%	98%	< 2.7%
6–7	283/285	83.5%	80–90%	Within range
8–9	71/143	49.6%	50–70%	< 0.4%
10–11	14/86	16.2%	20–40%	< 3.8%
12–13	4/74	5.4%	> 10%	Within range

Table 6 ABSI in children (age less than 10 years)

ABSI score group	Survived patients	Actual survival %	Predicted survival %	Difference
2–3	124/124	100%	> 99%	Within range
4–5	190/208	91.3%	98%	< 6.7%
6–7	40/56	71.4%	80–90%	< 8.6%
8–9	6/21	28.5%	50–70%	< 21.5%
10–11	1/7	14.2%	20–40%	< 5.6%
12–13	1/4	25%	> 10%	> 15%

Table 7 Modified ABSI on children (age group ≤ 10 years)

ABSI score group	Survived patients	Actual survival %	Predicted survival %	Difference
2–3	27/27	100%	> 99%	Within range
4–5	198/205	96.5%	98%	< 1.5%
6–7	90/107	84.1%	80–90%	Within range
8–9	15/29	51.7%	50–70%	Within range
10–11	3/7	42.8%	20–40%	> 2.8%
12–13	2/8	25%	> 10%	> 15%

Table 8 Comparison between the ABSI and modified ABSI in age group ≤10 years

	ABSI					Modified ABSI					*P* value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Children difference (%)	5.49	5.27	6.70	21.50	15.00	0.44	2.42	1.50	1.50	15.00	< 0.001

difference between the actual and predicted survival was − 50%. The maximum difference was 10%. After the ABSI modification of adding one extra point for pregnant females, the minimum difference between the actual and predicted survival was − 20%, and the maximum difference became 30%. However, this modification was not statistically significant (p value 0.730).

As illustrated in Table 13, the number of patients was insufficient to determine whether the modification was accurate.

Discussion

Burns remain a major health care problem, especially in low-socioeconomic status countries. Burn management requires a well-staffed specialized center to improve the patient's outcomes and minimize the mortality and morbidities that may result from post-burn disabilities, contractures, and disfigurements.

KABU is a specialized burn center in Cairo, Egypt. It serves the capital as well as many other governates in Egypt due to the lack of proper burn centers outside the capital. With the verge of opening a new burn center, analysis of mortality and patterns of burns presented to KABU is crucial [11].

Several scores have been created and used to assess mortality rates among burn patients. These scores help to set priorities when dealing with burn patients, providing a plan of treatment, and determining whether the patient's management was adequate. Each score has its own limitations.

The ABSI is one of the most commonly used and easily applied scores. It divides the probabilities of mortality into six groups according to five risk factors (age, sex, TBSA, full thickness burns, and inhalation injury). Its superiority is due to the inclusion of five risk factors in its calculation, which yields predicted survival rates that more closely resemble actual values.

The ABSI was applied retrospectively to medical records in KABU over 5 years (a total of 1233 patients). The overall mortality incidence was comparable to what the ABSI score predicted.

Further analysis indicated that children (younger than 10 years) have a higher incidence of mortality compared to the predicted survival rates obtained using the ABSI, i.e., actual mortality is higher than the predicted mortality. This difference was troublesome because all the patients received the same level of medical care. The data were reanalyzed after the addition of one extra point for any patient in this age group (children less than 10 years). When the results were re-evaluated, the accuracy of the scoring was optimized by minimizing the difference between the actual and predicted survival (p value < 0.001). Age is an important risk factor affecting survival in burn patients, and awarding one point to all patients from 1 to 20 years simply does not make sense. This is because children have different physiologic responses to burn, smaller weights, and different anabolic and catabolic

Table 9 ABSI and modified ABSI in children

		ABSI		Modified ABSI	
		Count	%	Count	%
Children difference (%)	− 21.5	21	5.0%	0	.0%
	− 8.6	56	13.3%	0	.0%
	− 6.7	208	49.5%	0	.0%
	− 5.6	7	1.7%	0	.0%
	− 1.5	0	.0%	205	53.5%
	0	124	29.5%	163	42.6%
	2.8	0	.0%	7	1.8%
	15	4	1.0%	8	2.1%

Table 10 ABSI for pregnant females

ABSI score group	Survived patients	Actual survival %	Predicted survival %	Difference
2–3	–	–	–	–
4–5	3/3	100%	98%	> 2%
6–7	2/2	100%	80–90%	> 10%
8–9	0/1	0%	50–70%	< 50%
10–11	0/1	0%	20–40%	< 20%
12–13	0/2	0%	> 10%	–

Table 11 Modified ABSI in pregnant

ABSI score group	Survived patients	Actual survival %	Predicted survival %	Difference
2–3	–	–	–	–
4–5	2/2	100%	98%	> 2%
6–7	2/2	100%	80–90%	> 10%
8–9	1/1	100%	50–70%	> 30%
10–11	0/2	0%	20–40%	< 20%
12–13	0/2	0%	> 10%	Within range

Table 13 ABSI and modified ABSI in pregnant

		ABSI		Modified ABSI	
		Count	%	Count	%
Pregnant difference (%)	− 50	1	11.1%	0	.0%
	− 20	1	11.1%	2	22.2%
	0	2	22.2%	2	22.2%
	2	3	33.3%	2	22.2%
	10	2	22.2%	2	22.2%
	30	0	.0%	1	11.1%

states than adults. In addition, children are more prone to malnutrition due to their low socioeconomic standards, having illiterate parents that might delay their hospital presentation, and of course, illiterate behavioral management that complicates the burns, e.g., placing toothpaste over the burnt areas. Furthermore, child abuse is a threat that remains present in many low socioeconomic status areas.

The other risk group of patients was pregnant females. A paucity of published studies had evaluated the outcome of burns in pregnancy. Although pregnancy greatly affects the outcome of burns among females, it was not included as a risk factor in any of the burn score systems. In the present study, the pregnant females exhibited a higher mortality incidence than predicted despite receiving the same medical service as the other patients. Parikh et al. considered the TBSA the main risk factor in determining the outcome of pregnant females [9]. Maghsoudi et al. concluded in their study of 50 pregnant females that the mortality of both mother and fetus reached 100% if the TBSA was more than 44%. [10].

This difference can be explained by the physiologic changes of pregnancy and the changes in immunologic responses secondary to pregnancy. Furthermore, pregnant females have a higher anabolic state, different fluid shifts, hormonal changes, mood disturbances, suicidal ideation (especially among illiterate females with unplanned pregnancy), blood changes, and, of course, an increased incidence of nutritional deficiencies, especially in underserved places with low socioeconomic status. These factors put pregnant females at an increased risk of mortality and should receive special attention from health care providers.

When the ABSI was applied to pregnant females, the difference between the actual and predicted survival was − 50%. This special category of patients was re-evaluated to determine whether modifying their survival score could achieve a more accurate indicator of survival. This modification also entailed adding an extra point. Unfortunately, the statistical analysis was insignificant (p value 0.730) due to the small sample size (nine patients over 5 years).

Finally, predicting survival in burn patients is of utmost importance for individually assessing which patients are at the greatest risk and thus effectively triaging the patients according to available resources. In addition, assessments of the medical services provided by the burn center require improving resources or updating management regimens.

Conclusion

ABSI is one of the best indicators for mortality and patient outcomes among burn patients. Modifying the score by adding one point for children under 10 years yielded closer predicted and actual survival rates, and the change was statistically significant. A larger number of pregnant females is needed to validate the scoring system for this group. Close attention and care are always recommended for these two special high-risk groups.

Table 12 Comparison between the ABSI and modified ABSI in pregnant females

	ABSI					Modified ABSI					
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	*P* value
Pregnant difference (%)	4.89	19.03	2.00	50.00	10.00	1.56	15.36	2.00	20.00	30.00	0.730

Compliance with ethical standards

Conflict of interest Mostafa Ahmed Abo El Soud, Rama Ahmed Ali, Ahmed A. Taha, and Seifeddine Marwan Khirfan declare that they have no conflict of interest.

Ethical approval For this kind of retrospective study formal consent from a local ethics committee is not required.

Informed consent Written and verbal consent was obtained from the patients.

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