Int J Burn Trauma 2021;11(3):197-201
www.IJBT.org /ISSN:2160-2026/IJBT0131849

Original Article

Prognosis value of revised Baux score among burn patients in developing country

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Received February 13, 2021; Accepted May 6, 2021; Epub June 15, 2021; Published June 30, 2021

Abstract: The aims of this study was to determine prognosis value of revised Baux score for burn patients in developing country. A retrospective study was conducted on all burn hospitalized patients at National Burn Hospital, Hanoi, Viet Nam during a period from 01/1/2015 to 31/12/2019. Collected criteria included age, burn extent, inhalation injury, death or survive, Baux and revised Baux score of each patients. AUC and SMR was compared between two scores. Prognosis value of revised Baux score was also classified according to age groups. The results showed that AUC of revided Baux score was significantly higher than that of Baux score (0.96 vs. 0.95; p=0.001). SMR of revised Baux score was closer to 1 than that of Baux score (1.03 vs. 1.14 respectively). For revised Baux score, AUC was highest in adult patients (0.98±0.01) followed by elderly and pediatric patients. In addition, SMR was 0.99 in adult group, 0.77 in elderly patient and was 4.36 in pediatric patients. In conclusion, the revised Baux score is more accurate than the Baux score but should only be recommended to apply in prognosis for adult and elderly burn patients in developing country.

Keywords: Burn, revised Baux score, mortality

Introduction

Despite progress in diagnosis and treatment, mortality rate among patients with severe burns remain high, especially in developing countries. The use of prognosis score may help the health facility to evaluate and optimally use resources in burn care and therapy [1]. The Baux score which predicts mortality based on the sum of the patient's age and burn extent was introduced and widely used since 1961 [2]. Over time, with the development of science and technology, many new technologies have been applied in burn care and treatments such as fluid resuccitation, early excision and skin graft, early enteral nutrition, skin substitues leading to improve mortality rate. Therefore, the Baux score has been considered to be no longer appropriate and accurate to evaluate the mortality of burn patients [3, 4]. On that basis, the revised Baux (rBaux) score was proposed in 2010 by Osler and has been evaluated and widely applied in developed countries [5-7]. Currently, the rBaux score has not been widely evaluated in developing countries, where there are limitations in the application of advanced techniques and resources in burn care. In this study, we compared the predictability of the rBaux and Baux score to find out the applicable value of rBaux score in patients admitted to the National Burn Hospital in Hanoi, Viet Nam.

Patients and methods

Inclusive and exclusive criteria

A retrospective study was conducted on all burn hospitalized patients at National Burn Hospital, Hanoi, Viet Nam during a period from 01/1/2015 to 31/12/2019. Patients who died in the first 24 h after burn or were transferred to other health care facilities were excluded from this study.

Data collection and processing

Collected criteria included age, gender, burn surface area, present of inhalation injury and death. Patients were clasified into three groups of age: children (equal and under 19 year old),

Table 1. Patient characteristics (n=15.975)

Criteria	Mean	Min-Max
Children, n (%)	7713 (48.3)	
Adult, n (%)	7633 (47.8)	
Elderly, n (%)	629 (3.9)	
Male, n (%)	10816 (67.7)	
Age (year)	22.6±0.17	0.02-99
Burn extent (% TBSA)	12.18±0.12	0.01-100
Inhalation injury, n (%)	317 (1.98)	
Death, n (%)	499 (3.12)	

TBSA: total body surface area.

adult (20-64 year old) and elderly (from and over 65 year old).

Baux and rRaux scores were calculated as guided [2, 5]:

Baux score = age (years) + burned area (%)

rBaux score = age (years) + burned area (%) + (17 × I)

In which: I =1 if the patient suffered inhalation injury; I =0 if patients did not suffer inhalation injury.

The standard mortality ratio (SMR) was also determined as follows: SMR = actual death/predicted death [8]. In which, the number of predicted deaths was calculated by the number of patients with Baux or rBaux score from and over 100. The meaning of SMR is explained as follows: the closer the SMR is to 1, the more accurate the prediction is.

SMR =1 means the forecast is 100% accurate.

SMR <1 means predictability is higher than reality.

SMR >1 means the predictability is lower than reality.

The area under the curve (AUC) of each score was calculated. The AUC and SMR of rBaux score were also classified arcording to age groups. There is no discriminative power when AUC is less than 0.5. AUC of Baux and rBaux score was compared using ROC test. Cutoff point was determined as Jouden index: J = max (Se+Sp-1).

In which, J is Jouden index; Se is sensitivity; Sp is specificity.

Intercooled Stata version 14.0 software was used and P<0.05 was considered as significant level.

Ethic issue

This is a retrospective study without intervention on animal or human and the proposal was proposed to the hospital ethic committee without rejection.

Results

Patient characteristics

There were 15975 burn patients who enrrolled in this study admitted to the National Burn Hospital during a period from 1/1/2015 to 31/12/2019. Children accounted for 48.3% followed by adult (47.8%) and elderly patients (3.9%). In addition, male was predominant (67.7%) with 1.98% of patients suffered inhalation injury. Overall mortality rate was 3.12% (**Table 1**).

AUC and SMR results

It can be seen from **Table 2** that, AUC of rBaux score was signigicantly higher than that of Baux score (0.96 vs. 0.95; p=0.001). Moreover, higher sensitivity was also recorded for rBaux score (90.38% vs. 89.59% respectively).

Calculated SMR value is indicated in **Table 3**. It is noted that, SMR of rBaux score was closer to 1 than that of Baux score (1.03 vs. 1.14 respectively).

Distribution of AUC and SMR of rBaux score according to age groups is indicated in **Table 4**. The value of AUC was highest in adult patients (0.98±0.01), followed by elderly group (0.93±0.01) and pediatric group (0.91±0.02). In addition, SMR was quite close to ideal value (0.99) in adult. Meanwhile, the SMR value was 0.77 for elderly patient and was 4.36 for pediatric patients.

Discussion

Using prognostic scales to evaluate the prediction of death for burn patients is useful method to identify the group of patients that need to focus on treatment, saving resources, costs as well as set directions. An optimal prognosis

Table 2. AUC of Baux and rBaux score

Score	Cutoff point	Sensitivity (%)	Specificity (%)	AUC ± SE	95% CI	p
Baux	70.63	89.59	91.77	0.95±0.01	0.94-0.96	0.001
rBaux	70.63	90.38	91.70	0.96±0.01	0.95-0.97	

AUC: area under curve; SE: standrt error; CI: confident interval.

Table 3. SMR of Baux and rBaux score

Score	Observed death	Predicted death	SMR
Baux	499	437	1.14
rBaux		486	1.03

SMR: SMR: standard mortality ratio.

score should meet required conditions including high degree of accuracy, simplicity, and ease of application. Following the Baux score, number of predictive scales which have been developed also consider influencing factors other than age. The abbreviated burn severity index (ABSI) score was introduced in 1982 by Tobiasen and colleagues. This model used age, gender, burn extent, inhalation injury and the present of deep burn to predict mortality rate [9]. In 1998, Ryal introduced a score using three factors including age, burn surface area and inhalation injury [10]. Model of Mc Gwin and colleagues in 2008 used age, burn extent and inhalation injury, co-trauma and pneumonia [11]. Also in 2008, Gomez et al. proposed the Fatality by Longevity, APACHE II score, Measured Extent of burn, and Sex (FLAMES) score [12]. In 2009, the Belgian Outcome of Burn Injury (BOBI) score was developed by Belgian Outcome in Burn Injury Study Group based on groups of age, burn surface area and present of inhalation injury [13]. It is interesting to note that, the clinical use of these scores is still limited, the reason could be due to most of these formulations are so complicated. Meanwhile, both Baux and rBaux score are simple, easy to apply in clinical practice and being used in predicting for burn patients around the world [14, 15].

The AUC is one of the criteria to evaluate the prognosis level of the scale and most authors considered AUC from 0.9 and above as high accurate [16]. Since rBaux Score was introduced by Osler, numerous reports have been published about the prognosis value of this score by using AUC value. Panter et al. evaluated prognosis value of prognosis scores on 492 burn in intensive care unit (ICU) and found that rBaux was the best prognosis sore with AUC of 0.919 [14]. In 2013 Dokter and colleagues studied on 4389 burn patients and concluded that the rBaux score was simple and accurate with a higher predictive value of death than the Baux score (AUC: 0.96 compared to 0.81) [7]. Lip et al. also demonstrated that the rBaux score had the best AUC value of 0.94 to predict burns mortality [16]. Study by Halgas et al. also concluded that the rBaux score was both accurate and easy to calculate [17]. In addition, study by Heng et al. indicated that rBaux score and updated Charlson comorbidity index were independent factors influencing mortality rate of severe burn patients [18]. Recently, Choi and colleagues studied on 183 patients with severe burns in ICU, found that rBaux was the best predictor of mortality, duration of ICU stay, mechanical ventilation time, while the ABSI was the best predictor of total hospitalization time [19]. In our study, the AUC of both scores was over 0.9 but higher for rBaux (0.96 vs. 0.95 respectively). In addition, SMR of the rBaux score was closer to 1 than that of Baux score (1.03 vs. 1.14 respectively). So in generally, both scores can be used for clinically application but the rBaux score has higher predictive value.

It is noted that, the application of prognosis scores in practice shows the difference in accuracy of prognosis scores between different age groups. Current study indicated that for pediatric burn patients, the prognosis value of rBaux score less accurate and should be considered when clinically applied. Study by Taylor et al. indicated that the “One size fits all” models for predicting outcomes do not accurately reflect the outcomes for seniors and children with burns and they suggested to develop age-specific scales for prognosis of death amongst pediatric and senior burn patients [20]. In fact, children are not small adults, their functions and organs are not fully developed, so the pathological progression is often severe and treatment results are not the same as adults. Moreover, children often have a higher rate of

Table 4. AUC of rBaux score by age groups

Age group	AUC ± SE	95% CI	Observed death	Predicted death	SMR
Children	0.91±0.02	0.85-0.96	48	11	4.36
Adult	0.98±0.01	0.96-0.97	379	382	0.99
Elderly	0.93±0.01	0.90-0.96	72	93	0.77

AUC: area under curve; SE: standrt error; CI: confident interval; SMR: standard mortality ratio.

superficial burns, less burn extent and lower rate of inhalation injury. Therefore, risk factors such as age, burn area, and inhalation injury should be considered more carefully in patient prognosis. Study by Muller et al. on 4094 burn patients of all ages found the lowest mortality was in patients under 20 years of age [21]. Spies and coworkers studied on 1072 hospitalized children using regression equation to evaluate the risk factors for death found that if all variables were integrated into the model, the results were predicted with 97% accuracy. However, If only using demographic characteristics inlcuding age, burn extent and inhalation injury, the results were predicted with an accuracy of only 51% [22].

Result form our study indicated that the AUC of rBaux score in elderly group was 0.93±0.01 with SMR of 0.77. It means that predicting value of rBaux in elderly group was accepted but lower than that in adult patients. For elderly, due to the functional impairment of organs, many chronic associated diseases burn injuries cause serious consequences with deeper burn injury, wider burn extent and higher mortality than other age groups [23, 24]. Furthermore, in elderly patients there is a greater challences for fluid resuccitation than other patients leading to pulmonary edema, congestive heart failure [25, 26]. In addition, sepsis along with associated diseases, reduced tolerance to prolonged stress, malnutrition causes an increase in death rates in elderly burn patients [27]. Therefore, it is necessary to evaluate all risk factors in the elderly in order to accurately predict the outcome of death. It is also noted that Osler et al. when proposing the rBaux formula, acknowledged the different predictive accuracy of this formula across different age groups [5]. Therefore, the application of the prognostic scale may have to pay attention to the appropriate age groups.

Our study has some limitations. First, although the majority of patients with severe burns were largely referred to treatment in the National burn hospital, numerous burn patients either did not go to hospital or were managed in general hospitals with severely traumatic conditions with subsequent burns and death. So the actual death toll was likely to be higher. Second, our study included all patients admitted to hospital at all times after burn, some of whom were treated for a while at differently heath care facilities with possible different treatment regimens. This may also affect the patient outcome.

Conclusion

As compared to Baux score, the revised Baux score is significantly higher accuracy. However, revised Baux score should only be recommended to use for adult and elderly burn patients. It is necessary to propose a separate prognostic scale for burns in children.

Acknowledgements

We would like grateful to all staff of National Burn Hospital for helping us to collecting data.

Disclosure of conflict of interest

None.

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