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Measuring serum albumin levels at 0 and 24h: Effect on the accuracy of clinical evaluations in the prediction of burn-related mortality

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ABSTRACT

Objectives: To evaluate whether measuring serum albumin levels in clinical assessments affects the accuracy of mortality predictions in large burns and to compare patients' serum albumin levels at hour 0(Alb0h) and hour 24(Alb24h) following their admission.

Methods: This prospective observational study was performed at an academic burn unit. Aged between 16 and 65, patients who presented with burns on more than 20% of total body surface area (%TBSA) were included. Patients with severe comorbidities, concomitant trauma or referred from other centres were excluded from the study. The main variables in the study were Alb0h, Alb24h and Abbreviated Burn Severity Index (ABSI) scores. The primary outcome was in-hospital mortality.

Results: In a population of 105 patients, %TBSA, being female, inhalational injury, Alb0h, Alb24h and ABSI score (p < 0.001) and the presence of a full thickness injury (p = 0.008) were associated with mortality. In the multivariable analysis, ABSI scores and Alb24h remained in the model (OR, 2.32 and 0.06, respectively). The area under curves (AUCs) were 0.94, 0.97 and 0.97 for ABSI, ABSI+Alb0h and ABSI+Alb24h, respectively. No significant difference among the AUCs was seen, but adding Alb0h and Alb24h improved the mortality predictions of ABSI by 5 (4.7%) and 4 (3.8%) patients, respectively. Alb0h (at 3.5 g/dL) and Alb24h (at 2.4 g/dL) showed 84–85% and 88–85% sensitivity-specificity for mortality, respectively.

Conclusion: Measuring serum albumin levels in clinical assessments slightly increases the accuracy of mortality predictions; however, different cut-off points for Alb0h and Alb24h needs to be considered to avoid interpretation errors.

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1. Introduction

Determining a prognosis in the initial hours and days after a patient's presentation is one of the most interesting topics in burn injury research. Different scoring systems have evolved over time. The most studied scoring systems are the Abbreviated Burn Severity Index (ABSI) [1], the Belgian Outcome of Burn Injury [2], the Baux and the Revised Baux [3,4], the Acute Physiology and Chronic Health Evaluation (APACHE) [5] and the Simplified Acute Physiology Score (SAPS) [6]. Research comparing these scoring systems has shown that ABSI, one of the oldest scoring systems, is also one of the most accurate scoring systems [1,7,8]. ABSI score calculations consider five components: age, gender, the percentage of burns to a patient's total body surface area (%TBSA), the presence of an inhalational injury and the presence of a full thickness injury [9]. Like most of the scoring systems used in burn injury, clinical evaluations are undertaken to measure or determine the ABSI components.

In addition to clinical evaluations, the use of paraclinic measures to predict mortality has been examined in the literature. White blood cell count, neutrophil count, C-reactive protein [10], serum procalcitonin [11,12], biomarkers (e.g., interleukin-6 [13] and interleukin-8 [14]) and proteomic data analysis [15] have all been studied in the prediction of burn-injury-related outcomes such as sepsis and mortality; however, each method suffers from a number of limitations. Serum albumin levels have been associated with mortality in different acute [16,17] and chronic [18–21] medical conditions, traumas [22] and burn injuries [23]. In the few studies performed to date, measuring patients' serum albumin levels in the first 24h of their admission to burn units has shown some accuracy in the prediction of mortality and organ failure [23–25].

The clinical assessments used in the calculations of the abovementioned scoring systems and patients' serum albumin levels appear to have mortality-predicting capabilities that are independent of one another. We conducted this prospective study to determine whether using patients' ABSI scores and serum albumin levels increases the accuracy of each factor. Further, given that serum albumin levels may decrease during the acute inflammatory process of a burn injury [26] and during resuscitation with crystalloids in the first 24h (dilutional hypoalbuminemia) [27], we proposed that patients' serum albumin levels at hour 0 (Alb0h) and hour 24 (Alb24h) following their admission may have different capabilities in the prediction of mortality. Thus, we assessed both levels to determine which, if any, was the most accurate at predicting mortality.

2. Methods

2.1. Study design and settings

This prospective observational study was conducted at the Shafa Hospital Burn Center (SHBC), a burn centre with an annual admission rate of 400 patients and a Burn Unit Emergency Room (BUER) annual census of 4500. The SHBC is the main referral burn centre in the southeast of Iran.

ABSI was selected over other scoring systems for two reasons. First, other scoring systems are rarely used in routine practice at SHBC. Second, the literature shows that ABSI is one of the most accurate scoring systems for the assessment of burn injury prognoses. Diagnoses of inhalational injuries were made for patients with suspected mechanism of burns (e.g., history of smoke inhalation or being trapped in a closed space) or signs of inhalational injury (e.g., facial or nasal hair burns, soot in the oropharyngeal space or upper airways and/or carbonaceous sputum) using direct laryngoscopy under proper sedation in the ED, followed by fiberoptic bronchoscopy according to the condition of the patients at the discretion of the managing team. All bronchoscopies were performed in the first 48h of patients' arrival.

The Parkland formula is used in the management of adult patients with burns to more than 10–15% of their %TBSA. The adequacy of resuscitation is monitored using a combination of methods, including clinical parameters, urine output charts, base deficits, serum lactate levels, calculation of lactate clearance and central venous pressure measurements. If necessary, infusions of colloids are started 24h after admission at the discretion of the physician in charge.

The Institutional Review Board of Kerman University of Medical Sciences approved this study.

2.2. Study population

Any patient aged between 16 and 65 who presented with large burns (i.e., burns to more than 20% of their %TBSA) was included in the study. The exclusion criteria defined for this study was the presence of any co-morbid condition (e.g., uncontrolled diabetes, renal failure, end stage liver disease and severe cardiovascular disease) that could potentially affect the outcome of the burn injury. For a number of co-morbid conditions, some medical test results (i.e., recent laboratory test results) could be used for confirmation, such as a recent hemoglobin A1C level above 7.0% for confirmation of uncontrolled diabetes. However, in the case of more complex and timely diagnoses (i.e., renal failure or end stage liver disease), previously documented medical records were considered as the main source of information. Additionally, patients referred from another centre, patients suffering from concomitant trauma (who were later referred to the Trauma Center) and malnourished (i.e., based on the definition of the European society of clinical nutrition and metabolism) or debilitated patients were excluded from this study.

2.3. Study protocol

Serial sampling was undertaken from 1 December, 2015 to 1 November, 2016. Venous blood samples were taken from each patient at hours 0 (i.e., all samples were taken in the first hour of arrival at the BUER) and 24 (i.e., all samples were taken from hours 23–25) of admission to the BUER. Serum levels of albumin were measured using a colorimetric (spectrophotometric) assay by an auto-chemistry analyzer (i.e., DIRUI CS 400, China). The reagents used were produced by Man lab. Company (Elitech group, France). The patients (and/or their