Journal of the Formosan Medical Association (2016) 115, 1046–1052

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.jfma-online.com

ORIGINAL ARTICLE

Using acute kidney injury severity and scoring systems to predict outcome in patients with burn injury

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Received 7 September 2016; received in revised form 16 October 2016; accepted 28 October 2016

KEYWORDS
acute kidney injury;
Acute Physiology and Chronic Health Evaluation;
burn;
prognosis;
Sequential Organ Failure Assessment

Background/Purpose: Acute kidney injury (AKI) is a frequent complication of severe burn injury and is associated with mortality. The definition of AKI was modified by the Kidney Disease Improving Global Outcomes Group in 2012. So far, no study has compared the outcome accuracy of the new AKI staging guidelines with that of the complex score system. Hence, we compared the accuracy of these approaches in predicting mortality.
Methods: This was a *post hoc* analysis of prospectively collected data from an intensive care burn unit in a tertiary care university hospital. Patients admitted to this unit from July 2004 to December 2006 were enrolled. Demographic, clinical, and laboratory data and prognostic risk scores were used as predictors of mortality.
Results: A total of 145 adult patients with a mean age of 41.9 years were studied. Thirty-five patients (24.1%) died during the hospital course. Among the prognostic risk models, the Acute Physiology and Chronic Health Evaluation III system exhibited the strongest discriminative power and the AKI staging system also predicted mortality well (areas under the receiver operating characteristic curve: 0.889 vs. 0.835). Multivariate logistic regression analysis identified total burn surface area, ventilator use, AKI, and toxic epidermal necrolysis as independent risk factors for mortality.

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

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http://dx.doi.org/10.1016/j.jfma.2016.10.012

Conclusion: Our results revealed that AKI stage has considerable discriminative power for predicting mortality. Compared with other prognostic models, AKI stage is easier to use to assess outcome in patients with severe burn injury.

Introduction

Acute kidney injury (AKI) is a common, harmful, and potentially treatable complication responsible for increased medical expenditure and poor outcomes in hospital settings.[1–3] Its incidence varies from 28% to 75%, depending on the etiologies, and has increased in the past decade.[4–8] In addition, AKI developed after admission to a burn unit is associated with 20-fold increased mortality and long-term complications.[9] Even a minor acute reduction in kidney function is associated with an adverse prognosis. In 2012, the Kidney Disease Improving Global Outcomes (KDIGO) Group modified the definition of AKI, merging it with that of the Acute Kidney Injury Network (AKIN) and risk of renal failure, injury to the kidney, failure of kidney function, loss of kidney function, and end-stage renal failure (RIFLE) criteria. The criteria defined AKI as occurring in patients who exhibited a 0.3 mg/dL increase in serum creatinine within 48 hours, a 1.5-time increase in serum creatinine from baseline within 7 days, or urine volume less than 0.5 mL/kg/h for 6 hours (http://kdigo.org/home/guidelines/acute-kidney-injury/). Acute Physiology and Chronic Health Evaluation (APACHE) II and APACHE III, the Sequential Organ Failure Assessment (SOFA) score, and the Organ System Failure (OSF) score have been used to predict mortality in patients with burns.[10–13] However, these risk models are complex and difficult to use clinically. Although research has argued that RIFLE and AKIN also predict outcome, so far no study has examined the new AKI staging developed by the KDIGO Group. Thus, this study compared the efficacy of using these scores in accurately predicting mortality in a burn unit.

Methods

Study design, patient information, and data collection

This is a *post hoc* analysis of prospectively collected data from the intensive care burn unit at a tertiary care referral center in Taiwan. The Institutional Review Board of the study hospital approved the study and waived the need for informed consent because there was no breach of privacy. The study protocol was approved by the Institutional Review Board of the Chang Gung Memorial Hospital (CGMH; Taipei, Taiwan; IRB approval number: 201600665B0). Patients admitted to the burn unit between July 2004 and December 2006 were enrolled in the database. Patients who were receiving dialysis, aged under 18 years, or reported prior organ transplantation were excluded.

The diagnosis and severity of AKI were confirmed based on data obtained within 3 days after patient admission using the KDIGO Clinical Practice Guidelines for Acute Kidney Injury.[14,15] The hourly urine amount was recorded by the nursing staff as intensive care unit (ICU) routine. In determining the short-term outcome, the primary end point of this research was mortality. Three-month mortality was considered the secondary outcome. After hospital discharge, 3-month follow-up examinations were performed by reviewing the follow-up records. None of the patients was lost to follow-up in the study period.

Patient demographics; reason for admission; clinical and laboratory information; APACHE II, APACHE III, and SOFA scores; ICU length of stay; and hospital mortality data were recorded from the health information system in CGMH.[16,17] A simple model for classifying AKI severity was developed as follows: non-AKI (0 points), Stage 1 (1 point), Stage 2 (2 points), and Stage 3 (3 points).[6,18]

Statistical analysis

Descriptive statistical results were expressed as mean ± standard error. All variables were tested for normal distribution using the Kolmogorov–Smirnov test. The Student *t* test was used to compare the means of continuous variables and normally distributed data. Categorical data were tested using the χ^2 test or Fisher's exact test. Calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test (C statistic) to compare the number of observed and predicted deaths in the different risk groups for the entire range of death probabilities. The discrimination of each receiver operating characteristic curve was assessed using the area under the curve, which was compared using a nonparametric approach. Area under the receiver operating characteristic (AUROC) curve analysis was also conducted to estimate cutoff values, sensitivity, specificity, overall correctness, and positive and negative predictive values. Finally, cutoff points were calculated by determining the optimal Youden index (sensitivity + specificity − 1). Cumulative survival curves over time were generated using the Kaplan–Meier approach and compared using the log rank test. All statistical tests were two-tailed; a p value < 0.05 was considered statistically significant. Data were analyzed using SPSS 13.0 for Windows (SPSS Inc., Chicago, IL, USA).

Results

Overall, 145 consecutive patients with a mean age of 41.9 years were investigated. AKI was diagnosed in 52 patients (35.8%). Thirty-five patients died during hospitalization