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CLINICAL STUDY

SOFA score is superior to APACHE-II score in predicting the prognosis of critically ill patients with acute kidney injury undergoing continuous renal replacement therapy

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ABSTRACT

Background: Acute kidney injury (AKI) is the most common cause of organ failure in multiple organ dysfunction syndrome (MODS) and is associated with increased mortality. This study aimed at determining the efficacy of sequential organ failure assessment (SOFA), and acute physiology and chronic health evaluation II (APACHE-II) scoring systems in assessing the prognosis of critically ill patients with AKI undergoing continuous renal replacement therapy (CRRT). At present, APACHE-II score and SOFA score were also used to evaluate and predict the prognosis of critically ill patients with AKI.

Methods: The predictive value of SOFA and APACHE-II scores for 28- and 90-d mortality in patients with AKI undergoing CRRT were determined by multivariate analysis, sensitivity analysis, and curve-fitting analysis.

Results: A total of 836 cases were included in this study. Multivariate Cox logistic regression analysis showed that SOFA scores were associated with 28- and 90-d mortality in patients with AKI undergoing CRRT. The adjusted HR of SOFA for 28-d mortality were 1.18 (1.14, 1.21), 1.24 (1.18, 1.31), and 1.19 (1.13, 1.24) in the three models, respectively, and the adjusted HR of SOFA for 90-d mortality was 1.12 (1.09, 1.16), 1.15 (1.10, 1.19), and 1.15 (1.10, 1.19), respectively. The subgroup analysis showed that the SOFA score was associated with 28-d and 90-d mortality in patients with AKI undergoing CRRT. APACHE-II score was not associated with 28- and 90-d mortality patients with AKI undergoing CRRT. Curve fitting analysis showed that SOFA scores increased had a higher prediction accuracy for 28- and 90-d than APACHE-II.

Conclusions: The SOFA score showed a higher accuracy of mortality prediction in critically ill patients with AKI undergoing CRRT than the APACHE-II score.

Abbreviations: CRRT: continuous renal replacement therapy; AKI: acute renal injury; SOFA: sequential organ failure assessment; APCHE II: acute physiology and chronic health evaluation II; ROC: receiver operating characteristics curve; DCA: decision curve analysis; MODS: multiple organ dysfunction syndrome; ICU: intensive care unit; MOF: Marshall method; AKIN: acute kidney injury network; CKD: chronic kidney disease; BMI: body mass index; MAP: mean arterial pressure; HB: hemoglobin; WBC: white blood cell; Cr: serum creatinine; Alb: albumin; HCO^{3-}: bicarbonate; K^{+}: potassium; BUN: blood urea nitrogen; CRP: C-reactive protein; GFR: glomerular filtration rate; CCI: Charlson comorbidity index; COPD: chronic obstructive pulmonary disease

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Background

Multiple organ dysfunction syndrome (MODS) is the leading cause of death in patients admitted in the intensive care unit (ICU) [1]. Acute kidney injury (AKI) is a common organ failure syndrome associated with MODS [2–4]. Severe AKI is associated with increased mortality in critically ill patients requiring continuous renal replacement therapy (CRRT) [5,6]. Research shows that prognosis in these patients is related to the number of failed organs and the degree of organ failure [7,8]. Evaluation of organ function in critically ill patients may help to predict the prognosis [9]. Currently available scoring systems such as acute physiology and chronic health evaluation (APACHE), Marshall method (MOF), and MOD score [10,11] are used to calculate the prediction values in ICU patients. APACHE-II is the most widely used; however, this score is not able to predict multiple organ failure [12]. The sequential organ failure assessment (SOFA) score was developed

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and used to describe multiple organ dysfunction using a limited number of routinely measured variables [13]. In recent years, the SOFA score has been widely used in a range of other applications such as in the diagnosis of sepsis and in determining individual treatment strategies or outcomes in patients with sepsis [14]. SOFA has also been used to assess disease severity and predict prognosis in cancer patients [15], acute pancreatitis [16], acute liver failure [17], and acute respiratory distress syndrome (ARDS) [18]. However, the use of SOFA score in assessing the prognosis of patients with AKI undergoing CRRT has not been extensively studied. Therefore, in this study, we hypothesized that the SOFA score might be a valuable prognostic indicator for patients with AKI undergoing CRRT.

Methods

Study design

This retrospective cohort study analyzed data from critically ill patients who underwent CRRT between January 2009 and September 2016. The study aimed at determining the efficacy of SOFA and APACHE-II scoring systems in predicting the prognosis of patients with AKI undergoing CRRT.

Data source

The data in this study were retrieved from the Dryad database which is a curated resource that makes the data underlying scientific publications discoverable, freely reusable, and citable. The analyzed data were provided by Seung Hyeok Han from Yonsei University Health System Severance Hospital and the National Health Insurance Service Medical Center Ilsan Hospital [19,20].

Inclusion criteria

(1) Patients with acute kidney injury network (AKIN) stage 3; (2) patients treated using CRRT.

Exclusion criteria

(1) Age $\leq$ 18 years; (2) preexisting chronic kidney disease (CKD), dialysis or CRRT before the study; (3) pregnancy or lactating; (4) postrenal obstruction; (5) kidney transplantation; and (6) missing SOFA or APACHE-II scores values.

Participants

The study participants included patients undergoing CRRT in the ICU at Yonsei University Health System Severance Hospital and the National Health Insurance Service Medical Center Ilsan Hospital. Data for 2391 patients were retrieved for this study, among the patients, 281 were in AKIN stage 1 and 298 in AKIN stage 2. A total of 1812 patients met the inclusion criteria while 976 were excluded from the study. The exclusion criteria were: age $\leq$ 18 years ($n = 42$), previous CKD, dialysis or CRRT ($n = 585$), pregnancy ($n = 12$), postrenal obstruction ($n = 263$), kidney transplantation ($n = 64$) and missing SOFA or APACHE-II score values ($n = 10$). Therefore, a total of 836 cases met the inclusion for this study.

Clinical and biochemical data collection

Demographic and clinical data including complications, biochemical laboratory test results, and disease severity index at 0 h of CRRT in the ICU were recorded. Data from other variables such as sex, body mass index (BMI), mean arterial pressure (MAP), CRRT indication, comorbidities, hemoglobin (HB), white blood cell (WBC) count, serum creatinine (Cr), phosphate, albumin (Alb), bicarbonate (HCO^{3-}), potassium (K^{+}), blood urea nitrogen (BUN), C-reactive protein (CRP), and glomerular filtration rate (GFR), SOFA score, APACHE-II score, and Charlson comorbidity index (CCI) were recorded.

The outcome indicators

The outcome indicators included a 28-d and 90-d mortality.

CRRT protocol

CRRT initiation was decided by nephrologists based on the development of AKI in ICU patients. Indications for CRRT included metabolic acidosis, intractable hyperkalemia, or uncontrolled volume overload. The CRRT protocol used consisted of continuous venovenous hemofiltration through the internal jugular, subclavian, or femoral veins. The initial CRRT blood flow rate used was 100 mL/min which was increased up to 150 mL/min. The summed targeted dialysis and replacement dose were targeted at all patients.

Statistical analysis

All statistical analyses were performed using EmpowerStats (version numbers: 2018-12-22, Copyright 2009 X&Y Solutions, Inc.) and R software.

(1) Mean ± standard deviation (x ± s) was used for continuous variables of baseline data, and absolute values and percentages were used for categorical variables. (2) Univariate analysis was used to detect the risk associated with 28- and 90-d mortality. (3) Multivariate analyses were adjusted for variables possibly affecting patients' prognosis and to determine the effect of SOFA or APACHE-II scores on the prognosis of critically ill patients with AKI undergoing CRRT. (4) Sensitivity analysis was performed by considering sepsis and non-sepsis to further verify the effect of SOFA or APACHE-II scores on 28- and 90-d mortality. (5) Curve fitting analysis by the least square method was used to further explore the relationship between the SOFA score or APACHE-II score and the prognosis in critically ill patients with AKI undergoing CRRT. $p < 0.05$ was statistically significant.

Results

Baseline characteristics of included patients

The clinical characteristics and laboratory test results of the patients are presented in Table 1. A total of 836 cases met the inclusion and exclusion criteria and were included in the study. The mean age was 62.46 ± 14.49 years and 518 (61.96%) patients were male. The mean BMI was 23.90 ± 4.83 kg/m^2 and the MAP was 77.06 ± 14.72 mmHg. The prevalence of myocardial infarction, congestive heart failure, cerebrovascular disease, peripheral vascular disease, dementia, diabetes, hypertension, and chronic obstructive pulmonary disease (COPD) was 78 (9.33%), 111 (13.28%), 91 (10.91%), 30 (3.59%), 26 (3.11%), 268 (32.10%), 407 (48.68%), and 51 (6.10%), respectively. The number of patients with mechanical ventilation at the beginning of CRRT was 660 (78.95%). The number of deaths on 28 and 90 d was 515 (61.60%) and 598 (71.53%), respectively. The mean SOFA and APACHE-II scores were 12.51 ± 3.52and 27.53 ± 7.90, respectively (Table 1).

Univariate analysis

In univariate analysis, MAP, hypertension, Hb, Cr, and Alb were found to be protective factors, while, mechanical ventilation, phosphate, GFR, APACHE-II score, SOFA score, CCI and CRRT indication were associated with 28-d mortality. BMI, MAP, hypertension, Hb, Cr, and Alb were protective factors while, mechanical ventilation, phosphate, APACHE-II score, SOFA score, CCI score, and CRRT indication were associated with 90-d mortality (see Table 2).

Table 1. The clinical characteristics of patients.

Patient characteristics	Mean ± SD/N (%)
Age, year	62.46 ± 14.49
Sex (M/F)	518/318
BMI, Kg/m^2	23.90 ± 4.83
MAP, mmHg	77.06 ± 14.72
Myocardial infarction, *n* (%)	78 (9.33%)
Congestive heart failure, *n* (%)	111 (13.28%)
Cerebrovascular disease, *n* (%)	91 (10.91%)
Peripheral vascular disease, *n* (%)	30 (3.59%)
Dementia, *n* (%)	26 (3.11%)
Diabetes, *n* (%)	268 (32.10%)
Hypertension, *n* (%)	407 (48.68%)
COPD, *n* (%)	51 (6.10%)
Mechanical ventilation, *n* (%)	660 (78.95%)
K^+, mmol/L	4.73 ± 1.11
HCO^{3-}, mmol/L	16.53 ± 5.63
Phosphate, mmol/L	5.94 ± 2.54
WBC,10^9/L	14.22 ± 13.48
Hb, g/L	96.7 ± 22.8
BUN, mg/dL	57.95 ± 30.81
Cr, mg/dL	3.02 ± 1.74
Alb, g/L	2.61 ± 0.60
CRP, mg/L	103.97 ± 107.49
GFR, %	28.02 ± 20.19
APACHE II score	27.53 ± 7.90
SOFA score	12.51 ± 3.52
CCI score	3.14 ± 2.26
AKI cause	
Sepsis	573 (68.54%)
Nephrotoxin	27 (3.23%)
Ischemia	66 (7.89%)
Surgery	72 (8.61%)
Others	98 (11.72%)
CRRT cause	
Volume overload, *n* (%)	109 (13.04%)
Metabolic acidosis, *n* (%)	183 (21.89%)
Hyperkalemia, *n* (%)	39 (4.67%)
Uremia, *n* (%)	93 (11.12%)
Oliguria, *n* (%)	217 (25.96%)
Other, *n* (%)	195 (23.33%)
28-d mortality	515 (61.60%)
90-d mortality	598 (71.53%)

Multivariate cox regression analysis

Multivariate logistic regression analysis revealed that only SOFA score was associated with 28- and 90-d mortality in patients with AKI undergoing CRRT. However, the APACHE II score was not associated with 28- and 90-d mortality in patients with AKI undergoing CRRT. The adjusted HRs of SOFA score were 1.18 (1.14, 1.21), 1.24 (1.18, 1.31), and 1.19 (1.13, 1.24) for the 28-d mortality and 1.12 (1.09, 1.16), 1.15 (1.10, 1.19), and 1.15 (1.10, 1.19) for the 90-d mortality in the three models. The adjusted HRs of APACHE II score were 1.01 (1.00, 1.02), 1.01 (0.99, 1.03), and 1.00 (0.99, 1.02) for the 28-d mortality and 1.01 (1.00, 1.03), 1.01 (0.99, 1.03), and 1.01 (0.99, 1.03) for the 90-d mortality in the three models (Table 3).

Subgroup analysis based on AKI causes

Subgroup analysis revealed the possible confounding factors associated with 28- and 90-d mortality in

Table 2. The results of univariate analysis.

Exposure	28-d mortality (HR 95%CI, P)	90-d mortality (HR 95%CI, P)
Age	1.00 (0.99, 1.01), 0.88	1.00 (1.00, 1.01), 0.35
Sex		
Man	Reference	Reference
Female	0.95 (0.79, 1.13), 0.54	0.95 (0.81, 1.12), 0.56
BMI	0.98 (0.96, 1.00), 0.05	0.98 (0.96, 1.00), 0.02
MAP	0.98 (0.98, 0.99), <0.01	0.98 (0.98, 0.99), <0.01
Myocardial infarction	0.97 (0.72, 1.29), 0.82	0.92 (0.70, 1.22), 0.57
Congestive heart failure	0.81 (0.63, 1.06), 0.13	0.90 (0.71, 1.14), 0.38
Cerebrovascular disease	0.89 (0.68, 1.18), 0.42	1.04 (0.80, 1.35), 0.79
Peripheral vascular disease	0.73 (0.44, 1.20), 0.22	0.90 (0.57, 1.40), 0.63
Dementia	0.71 (0.42, 1.21), 0.21	0.88 (0.54, 1.42), 0.59
Diabetes mellitus	0.91 (0.76, 1.10), 0.35	0.87 (0.73, 1.04), 0.12
Hypertension	0.70 (0.58, 0.83), <0.01	0.71 (0.61, 0.84), <0.01
COPD	0.91 (0.63, 1.32), 0.62	0.95 (0.68, 1.34), 0.77
Mechanical ventilation	2.10 (1.64, 2.70), <0.01	2.00 (1.60, 2.50), <0.01
K^+	1.04 (0.96, 1.12), 0.36	1.07 (0.99, 1.15), 0.08
HCO^{3-}	0.99 (0.97, 1.01), 0.20	0.99 (0.98, 1.01), 0.36
Phosphate	1.05 (1.02, 1.08), <0.01	1.05 (1.01, 1.08), <0.01
WBC	1.00 (1.00, 1.00), 0.13	1.00 (1.00, 1.00), 0.23
Hb	0.93 (0.89, 0.97), <0.01	0.93 (0.89, 0.96), <0.01
BUN	1.00 (1.00, 1.00), 0.71	1.00 (1.00, 1.00), 0.36
Cr	0.90 (0.85, 0.95), <0.01	0.89 (0.85, 0.94), <0.01
Alb	0.66 (0.57, 0.77), <0.01	0.62 (0.55, 0.71), <0.01
CRP	1.00 (1.00, 1.00), 0.81	1.00 (1.00, 1.00), 0.79
GFR	1.00 (1.00, 1.01), 0.04	1.01 (1.00, 1.01), <0.01
APACHE II score	1.03 (1.02, 1.04) ,<0.01	1.03 (1.02, 1.04), <0.01
SOFA score	1.17 (1.14, 1.21) ,<0.01	1.13 (1.10, 1.15), <0.01
CCI score	1.10 (1.06, 1.13) ,<0.01	1.07 (1.03, 1.11), <0.01
AKI causes		
Sepsis	Reference	Reference
Nephrotoxin	1.08 (0.68, 1.71), 0.75	0.97 (0.61, 1.54), 0.90
Ischemia	1.03 (0.74, 1.43), 0.86	1.02 (0.75, 1.37), 0.92
Surgery	0.78 (0.55, 1.10), 0.15	1.02 (0.75, 1.37), 0.92
Others	1.26 (0.96, 1.66), 0.09	0.88 (0.68, 1.14), 0.32
CRRT causes		
Volume overload	Reference	Reference
Metabolic acidosis	1.44 (1.05, 1.97), 0.02	1.40 (1.05, 1.86), 0.02
Hyperkalemia	1.59 (1.00, 2.51), 0.05	1.65 (1.09, 2.51), 0.02
Uremia	0.94 (0.65, 1.37), 0.76	1.08 (0.77, 1.53), 0.65
Oliguria	1.08 (0.79, 1.47), 0.65	1.13 (0.85, 1.50), 0.41
Others	1.40 (1.02, 1.90), 0.04	1.28 (0.96, 1.70), 0.09

Table 3. The results of multivariate Cox logistic regression analysis.

Exposure	28-d mortality (Adjusted HR 95%CI, *p*)	90-d mortality (Adjusted HR 95%CI, *p*)
Model 1		
SOFA score	1.18 (1.14, 1.21), <0.01	1.12 (1.09, 1.16). <0.01
APACHE II score	1.01 (1.00, 1.02), 0.09	1.01 (1.00, 1.03), 0.04
Model 2		
SOFA score	1.24 (1.18, 1.31), <0.01	1.15 (1.10, 1.19), <0.01
APACHE II score	1.01 (0.99, 1.03), 0.32	1.01 (0.99, 1.03), 0.20
Model 3		
SOFA score	1.19 (1.13, 1.24), <0.01	1.15 (1.10, 1.19), <0.01
APACHE II score	1.00 (0.99, 1.02), 0.61	1.01 (0.99, 1.03), 0.27

Model 1: adjusted for age; sex; BMI; myocardial infarction; congestive heart failure; cerebrovascular disease; peripheral vascular disease; dementia; diabetes mellitus; hypertension; COPD.
Model 2: adjusted for model 1 and CCI; K^+; HCO^{3-}; Phosphate; MAP; WBC; Hb; BUN; Cr; Alb; CRP; GFR.
Model 3: adjusted for model 2 and Mechanical ventilation at CRRT initiation; 2 h urine output at CRRT initiation; CRRTcause; AKI cause.

patients with AKI undergoing CRRT which were also adjusted. The results showed that the SOFA score was a risk factor for 28- and 90-d mortality and that the APACHE-II score was not a risk factor of 28- and 90-d mortality in both sepsis and non-sepsis patients. In sepsis patients, the adjusted HR of SOFA was 1.16 (1.11, 1.20), 1.22 (1.14, 1.30), and 1.17 (1.10, 1.25) for the 28-d mortality, and 1.10 (1.07, 1.14), 1.18 (1.12, 1.26), and 1.14 (1.08, 1.21) for the 90-d mortality in the three models. In non-sepsis patients, the adjusted HRs of SOFA was 1.18 (1.14, 1.21), 1.27 (1.16, 1.39), and 1.22 (1.11, 1.33) for the 28-d mortality, and 1.12 (1.09, 1.16), 1.18 (1.08, 1.28), and 1.14 (1.05, 1.24) for the 90-d mortality in the three models (Table 4).

Table 4. The results of subgroup analysis of multivariate cox regression analysis based on AKI causes.

Exposure	28-d mortality (Adjusted HR 95%CI, *p*)	90-d mortality (Adjusted HR 95%CI, *p*)
Sepsis		
Model 1		
SOFA score	1.16 (1.11, 1.20), <0.01	1.10 (1.07, 1.14), <0.01
APACHE II score	1.01 (1.00, 1.03), 0.17	1.01 (1.00, 1.03), 0.11
Model 2		
SOFA score	1.22 (1.14, 1.30), <0.01	1.18 (1.12, 1.26), <0.01
APACHE II score	1.00 (0.98, 1.03), 0.77	1.01 (0.99, 1.04), 0.29
Model 3		
SOFA score	1.17 (1.10, 1.25), <0.01	1.14 (1.08, 1.21), <0.01
APACHE II score	1.00 (0.98, 1.02), 0.90	1.01 (0.99, 1.03), 0.50
Non-sepsis		
Model 1		
SOFA score	1.18 (1.14, 1.21), <0.01	1.12 (1.09, 1.16), <0.01
APACHE II score	1.02 (1.00, 1.05), 0.07	1.01 (1.00, 1.02), 0.04
Model 2		
SOFA score	1.27 (1.16, 1.39), <0.01	1.18 (1.08, 1.28), <0.01
APACHE II score	1.03 (1.00, 1.07), 0.09	1.02 (1.00, 1.03), 0.11
Model 3		
SOFA score	1.22 (1.11, 1.33), <0.01	1.14 (1.05, 1.24), <0.01
APACHE II score	1.03 (1.00, 1.07), 0.08	1.03 (1.00, 1.07), 0.07

Model 1: adjusted for age; sex; BMI; myocardial infarction; congestive heart failure; cerebrovascular disease; peripheral vascular disease; dementia; diabetes mellitus; hypertension; COPD.
Model 2: adjusted for model 1 and CCI; K^+; HCO^{3-}; Phosphate; MAP; WBC; Hb; BUN; Cr; Alb; CRP; GFR.
Model 3: adjusted for model 2 and Mechanical ventilation at CRRT initiation; 2 h urine output at CRRT initiation; CRRT cause; AKI cause.

Curve fitting analysis

The univariate analysis, multivariate Cox logistic regression analysis, and subgroup analysis all showed that the SOFA score was associated with the prognosis of patients with AKI undergoing CRRT. However, the APACHE-II score was not associated with the prognosis of patients with AKI undergoing CRRT. Therefore, curve fitting analysis was performed to explore the relationship between SOFA score and the prognosis of patients with AKI undergoing CRRT. In these analyses, age, sex, BMI, myocardial infarction, congestive heart failure, cerebrovascular disease, peripheral vascular disease, dementia, diabetes mellitus, hypertension, COPD, CCI, K^+, HCO^{3-}, Phosphate, MAP, WBC, Hb, BUN, Cr, Alb, CRP, GFR, mechanical ventilation at CRRT initiation, 2 h urine output at CRRT initiation, CRRT indication, and AKI cause were also adjusted. SOFA score was found to be associated with 28- and 90-d mortality in patients with AKI undergoing CRRT (Figures 1 and 2).

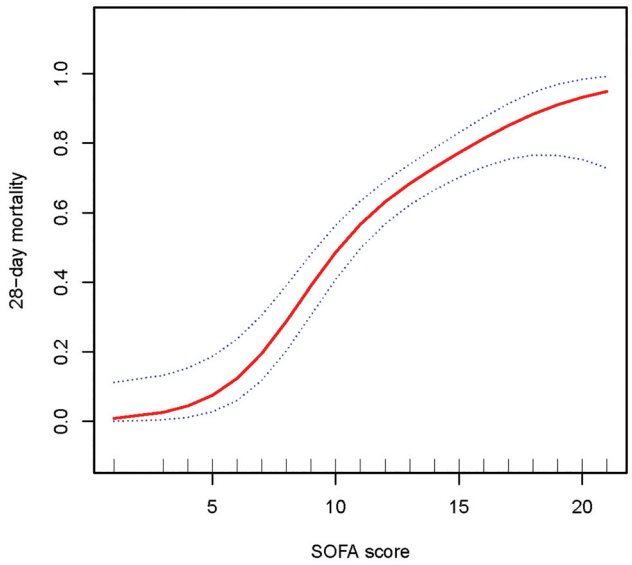

Figure 1. Adjusted smoothing function of SOFA sore for 28-d mortality.

Discussion

This study found that the SOFA score was associated with 28- and 90-d mortality of patients with AKI undergoing CRRT and that as the SOFA score increased, the 28- and 90-d mortality of patients with AKI undergoing CRRT increased obviously. However, the APACHE-II score was not associated with the prognosis of patients with AKI undergoing CRRT.

APACHE-II score is one of the most used predictive scoring systems for critically ill patients and has been widely used in predicting prognosis [21–23]. However, several studies report conflicting predictive accuracy results associated with the APACHE-II score in critically ill patients. In a prospectively defined analysis of a registry-based validation cohort including 3008 patients showed that the AUCs of APACHE-II for ICU mortality and hospital mortality were 0.81 (0.79, 0.82) and 0.77 (0.76–0.79), respectively [24]. A prospective cohort study of 522 patients admitted to the ICU with solid tumors showed that the APACHE-II score had a poor predictive value in-hospital mortality of these patients, with an AUC of 0.62 (0.54, 0.70) [25]. A retrospective cohort study including 104 cases showed that the

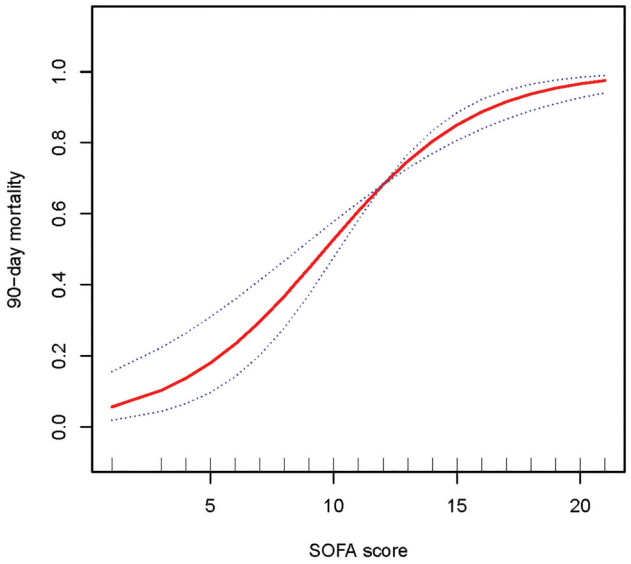

Figure 2. Adjusted smoothing function of SOFA sore for 90-d mortality.

APACHE-II score was a poor predictor of mortality in patients with epileptic status in the ICU and reported an AUC of 0.58 (0.45, 0.72) [26].

The SOFA score which was previously known as the sepsis-related organ failure assessment score [27–29], was used to assess failure in organ function. The SOFA score is based on six different aspects related to respiratory, cardiovascular, hepatic, coagulation, renal, and neurological systems. Recent studies have reported that SOFA is a useful tool in condition evaluation and prognosis prediction in patients with sepsis and it is also a widely used tool in prognosis and condition assessment in other critically ill patients. Bodin Khwannimit's study on 1589 patients with sepsis showed that SOFA score was a good predictor of 30-d and in-hospital mortality among patients with sepsis in the ICU and reported an AUC of 0.88 [30]. In Ming-Chin Yu's study, the SOFA score was found to be reliable in predicting mortality in severe acute pancreatitis with a reported AUC of 0.76 [16]. Another retrospective cohort study including 149 patients with hematological malignancies showed that SOFA score was a suitable prognostic indicator for ICU mortality in patients with hematological malignancies [31].

Yu Gong reported that both APACHE II and SOFA were reliable predictors of in-hospital mortality in critically ill patients with AKI, and these findings were inconsistent with those reported in this study [32]. This was due to the following reasons: 1) The study population was inconsistent in the two studies: the study included patients with AKI, while in the current study patients with AKIN 3 and treated with CRRT were included; 2) the sample size was much larger in the current study, and the study by Yu Gong did not perform multivariate regression analysis. Therefore, the current study provided more conclusive results.

In this study, the APACHE-II score was found to be a poor predictor for 28- and 90-d mortality in patients with AKI undergoing CRRT. However, the SOFA score was a reliable and valuable predictor of prognosis in patients with AKI undergoing CRRT. Acute renal injure is one of the most common types of organ failure in critically ill patients [2–4]. Besides, patients with acute renal failure require CRRT more frequently and especially in those complicated with multiple organ failure. SOFA scores can be used to evaluate organ failure; however, APACHE-II score has a poor performance in predicting organ failure. Therefore, the SOFA score had a higher predictive ability of prognosis in critically ill patients with AKI undergoing CRRT.

SOFA score can be used to predict the prognosis in critically ill patients with AKI undergoing CRRT due to the following advantages when compared with APACHE-II score: 1) SOFA score requires fewer variables, and it is more convenient for clinical application [33]; 2) SOFA score is more suitable for prognosis evaluation in critically ill patients, especially for patients with multiple organ failure [34]; 3) SOFA score is ideal for evaluating organ failure [13].

Strength of the study

1) This study provided evidence that the SOFA score has a higher predictive ability of prognosis of critically ill patients with AKI undergoing CRRT; 2) The findings are more reliable and conclusive compared to results from the previous studies. Several possible confounding factors were adjusted.

Limitations of the study

The study only included patients with AKI undergoing CRRT.

Conclusions

SOFA score was superior to the APACHE-II score in predicting the prognosis of critically ill patients with AKI and undergoing CRRT.

Ethics approval and consent to participate

New ethics approval and consent to participate were not applicable, because the original author had

obtained ethical approval when conducting this study and our study was retrospective study of data reuse.

Consent to publish

The consent to publish was obtained from all authors.

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Author contributions

Hai Wang, Xiao Kang and Yu Shi wrote the manuscript, Jun-Hua Lv, Jiang-li Sun, and Zheng-hai Bai finished the statistical analysis, Hong-hong Pei was responsible for research design, process guidance, and checking and correction.

Disclosure statement

The authors have no conflicts of interest to disclose.

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Data availability statement

Please see the website https://datadryad.org//resource/doi:10.5061/dryad.6v0j9.

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