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The impact of C-reactive protein-to-albumin ratio on mortality in patients with acute kidney injury requiring continuous renal replacement therapy: A multicenter retrospective study

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Objectives: The C-reactive protein-to-albumin ratio (CAR) is a prognostic marker in various diseases that represents patients' inflammation and nutritional status. We aimed to investigate the prognostic value of CAR in critically ill patients with severe acute kidney injury (AKI) requiring continuous renal replacement therapy (CRRT).

Methods: We retrospectively collected data from eight tertiary hospitals in Korea from 2006–2021. The patients were divided into quartiles according to CAR levels at the time of CRRT initiation. The primary outcome was the in-hospital mortality rate. The secondary outcomes were the 7- and 30-day mortality. Cox regression analyses were performed to investigate the effect of CAR on in-hospital mortality. The mortality prediction performance of CAR was evaluated using the area under the curve (AUC), net reclassification improvement (NRI), and integrated discrimination improvement (IDI).

Results: In total, 3995 patients who underwent CRRT were included, and the in-hospital mortality rate was 67.3% during the follow-up period. The 7-day, 30-day, and in-hospital mortality rates increased toward higher CAR quartiles (all $P < 0.001$). After adjusting for confounding variables, the higher quartile groups had an increased risk of in-hospital mortality (quartile 3: adjusted hazard ratio [aHR], 1.15, 95% confidence interval [CI], 1.02–1.30, $P = 0.023$; quartile 4: aHR, 1.33; 95% CI, 1.18–1.50, $P < 0.001$). Combination of CAR with Assessment and Chronic Health Evaluation II (APACHE II) or Sequential Organ Failure Assessment (SOFA) scores significantly increased predictive power than that of each severity score alone in AUC, NRI and IDI (all $P < 0.05$).

Conclusions: A high CAR is associated with increased in-hospital mortality in critically ill patients requiring CRRT. The combined use of CAR and severity scores provides better predictive performance for mortality than the severity score alone.

Table 1. Cox regression analyses for in-hospital mortality in CAR quartile groups

Table 1. Cox regression analyses for in-hospital mortality in CAR quartile groups

	Model 1		Model 2		Model 3		Model 4	
	HR (95% CI)	<i>P</i>	aHR (95% CI)	<i>P</i>	aHR (95% CI)	<i>P</i>	aHR (95% CI)	<i>P</i>
Quartile 1	Reference		Reference		Reference		Reference	
Quartile 2	1.08 (0.96–1.20)	0.203	1.07 (0.96–1.20)	0.239	1.07 (0.95–1.19)	0.257	1.11 (0.98–1.26)	0.098
Quartile 3	1.19 (1.07–1.33)	0.002	1.18 (1.06–1.32)	0.003	1.20 (1.07–1.34)	0.001	1.15 (1.02–1.30)	0.023
Quartile 4	1.43 (1.28–1.60)	<0.001	1.41 (1.27–1.58)	<0.001	1.40 (1.26–1.57)	<0.001	1.33 (1.18–1.50)	<0.001

Model 1: unadjusted.

Model 2: adjusted for age and sex.

Model 3: adjusted for age, sex, hypertension, and CCI.

Model 4: adjusted for age, sex, hypertension, CCI, APACHE II score, and mechanical ventilator use.

Abbreviations: CAR, C-reactive protein-to-albumin ratio; HR, hazard ratio; aHR, adjusted hazard ratio; CI, confidence interval; CCI, Charlson Comorbidity Index; APACHE II, Acute Physiology and Chronic Health Evaluation II.

Table 2. Comparison of the AUC and predictive power of prognosis for in-hospital mortality**Table 2.** Comparison of the AUC and predictive power of prognosis for in-hospital mortality

Variables	AUC (95% CI)	<i>P</i>	NRI (95% CI)	<i>P</i>	IDI (95% CI)	<i>P</i>
CAR	0.580 (0.564–0.595)	Reference				
CRP	0.555 (0.540–0.571)	<0.001				
APACHE II	0.665 (0.646–0.684)	Reference	Reference		Reference	
APACHE II + CAR	0.674 (0.656–0.693)	0.016	0.151 (0.084–0.223)	<0.001	0.007 (0.004–0.010)	<0.001
SOFA	0.669 (0.650–0.687)	Reference	Reference		Reference	
SOFA + CAR	0.677 (0.658–0.695)	0.004	0.134 (0.065–0.204)	<0.001	0.007 (0.004–0.010)	<0.001
APACHE II + SOFA	0.697 (0.679–0.715)	Reference	Reference		Reference	
APACHE II + SOFA + CAR	0.702 (0.683–0.720)	0.036	0.130 (0.060–0.200)	<0.001	0.005 (0.003–0.007)	<0.001

Abbreviations: AUC, area under the curve; CI, confidence interval; NRI, net reclassification improvement; IDI, integrated discrimination improvement; CAR, C-reactive protein-to-albumin ratio; CRP, C-reactive protein; APACHE II, acute physiology and chronic health evaluation II; SOFA, sequential organ failure assessment.