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Recovery or Progression: Kidney Function Trajectories and the Risk of End-stage Kidney Disease after Continuous Kidney Replacement Therapy in Sepsis-Associated Acute Kidney Injury

Seung Hee Jeong, Ju Hwan Oh, A Young Cho, In O Sun, Ha-Eun Lee
Department of Internal Medicine-Nephrology, Presbyterian Medical Center, Korea, Republic of

Objectives : Sepsis is a major cause of acute kidney injury (AKI). Sepsis-associated AKI (SA-AKI) requiring continuous kidney replacement therapy (CKRT) is associated with high mortality, and survivors may develop permanent kidney damage. This study investigated the risk of end-stage kidney disease (ESKD) based on kidney function trajectories in survivors of SA-AKI requiring CKRT.
Methods : From 2011 to 2024, 820 adult patients received CKRT for SA-AKI. After excluding those with preexisting ESKD on dialysis, in-hospital deaths, and missing serum creatinine (SCr) data, 119 patients were included (Figure 1). Acute kidney disease (AKD) was defined at 7 days after CKRT initiation as follows: a ≥35% decrease in estimated glomerular filtration rate, a ≥50% increase in SCr, or the need for kidney replacement therapy. Progression was defined as meeting AKD criteria at 90 days. Patients were classified into four groups: early recovery, late progression without AKD, late recovery after AKD, and early progression (Figure 1). The primary outcome was the development of ESKD among the kidney function trajectory groups.
Results : The development of ESKD significantly differed among the groups (Figure 2A). The early recovery group showed the lowest risk (1/47, 2.1%), whereas the early progression group showed the highest (18/29, 62.1%). ESKD developed in 3/6 (50.0%) of the late progression without AKD group and 3/37 (8.1%) of the late recovery after AKD group. In multivariable analysis (Figure 2B), the early progression group (hazard ratio [HR] 77.010, $P<0.001$) and the late progression without AKD group (HR 22.635, $P=0.003$) were significant predictors of ESKD, along with preexisting CKD and older age. Lower Glasgow Coma Scale (GCS), hemoglobin, and serum albumin were associated with early progression (Figure 2C).
Conclusions : Survivors of SA-AKI requiring CKRT exhibited distinct kidney function trajectories. The early progression group had the highest ESKD risk, associated with lower GCS, hemoglobin, and serum albumin.

Figure 1.jpg

Figure 1. Study population

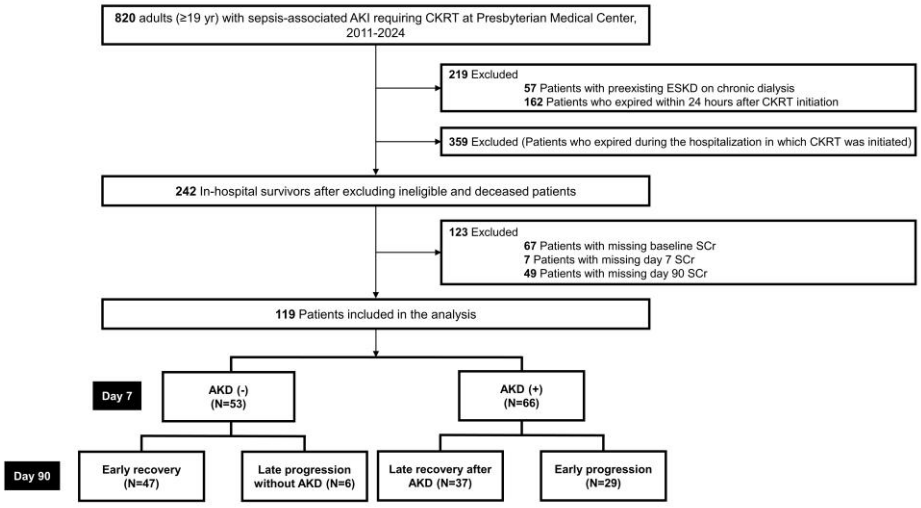

Figure 1.jpg

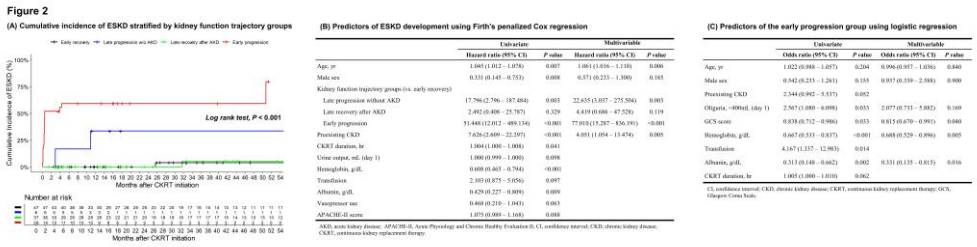

Figure 2

(A) Cumulative incidence of ESKD stratified by kidney function trajectory groups

(B) Predictors of ESKD development using Firth's penalized Cox regression

	Univariate		Multivariable	
	Hazard ratio (95% CI)	*P* value	Hazard ratio (95% CI)	*P* value
Age, yr	1.045 (1.012 – 1.078)	0.007	1.061 (1.016 – 1.110)	0.006
Male sex	0.331 (0.145 – 0.733)	0.008	0.371 (0.233 – 1.300)	0.185
Kidney function trajectory groups (vs. early recovery)				
Late progression without AKD	17.796 (2.796 – 187.484)	0.003	22.635 (3.037 – 275.504)	0.003
Late recovery after AKD	2.492 (0.408 – 25.787)	0.329	4.419 (0.686 – 47.528)	0.119
Early progression	51.448 (12.012 – 489.134)	<0.001	77.010 (15.287 – 836.191)	<0.001
Preexisting CKD	7.626 (2.609 – 22.297)	<0.001	4.051 (1.054 – 13.474)	0.005
CKRT duration, hr	1.004 (1.000 – 1.008)	0.041		
Urine output, mL (day 1)	1.000 (0.999 – 1.000)	0.098		
Hemoglobin, g/dL	0.608 (0.465 – 0.794)	<0.001		
Transfusion	2.103 (0.875 – 5.056)	0.097		
Albumin, g/dL	0.429 (0.227 – 0.809)	0.009		
Vasopressor use	0.468 (0.210 – 1.043)	0.063		
APACHE-II score	1.075 (0.989 – 1.168)	0.088		

AKD, acute kidney disease; APACHE-II, Acute Physiology and Chronic Healthy Evaluation II; CI, confidence interval; CKD, chronic kidney disease; CKRT, continuous kidney replacement therapy.

(C) Predictors of the early progression group using logistic regression

	Univariate		Multivariable	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Age, yr	1.022 (0.988 – 1.057)	0.204	0.996 (0.957 – 1.036)	0.840
Male sex	0.542 (0.233 – 1.261)	0.155	0.937 (0.339 – 2.588)	0.900
Preexisting CKD	2.344 (0.992 – 5.537)	0.052		
Oliguria, <400mL (day 1)	2.567 (1.080 – 6.098)	0.033	2.077 (0.733 – 5.882)	0.169
GCS score	0.838 (0.712 – 0.986)	0.033	0.815 (0.670 – 0.991)	0.040
Hemoglobin, g/dL	0.667 (0.533 – 0.837)	<0.001	0.688 (0.529 – 0.896)	0.005
Transfusion	4.167 (1.337 – 12.983)	0.014		
Albumin, g/dL	0.313 (0.148 – 0.662)	0.002	0.331 (0.135 – 0.815)	0.016
CKRT duration, hr	1.003 (1.000 – 1.010)	0.062		

CI, confidence interval; CKD, chronic kidney disease; CKRT, continuous kidney replacement therapy; GCS, Glasgow Coma Scale.