The Impact of Continuous Renal Replacement Therapy on In-Hospital Mortality Among Patients Receiving Extracorporeal Membrane Oxygenation

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Introduction

In critically ill patients, the concurrent treatment with continuous Renal replacement therapy (CRRT) alongside extracorporeal membrane oxygenation (ECMO) has increased.

Integrating CRRT can benefit volume management and kidney function support in patients with AKI, but its effect on mortality is not well-defined.

We aimed to evaluate the in-hospital mortality and chronic kidney disease incidence among patients receiving ECMO support when they were on CRRT for AKI or for reasons outside of AKI, with those who did not need CRRT.

Methods and Materials

A Retrospective study was conducted among critically ill patients receiving ECMO with or without CRRT at Mayo Clinic from 2015 to 2021.

Population: Adult (>18 years) critically ill patients receiving ECMO therapy
Exclusion: on ECMO < 48 hrs. and no research authorization

The patients were classified into three groups based on their treatment: 1) ECMO alone, 2) ECMO with CRRT for volume management without AKI, and 3) combined ECMO and CRRT for AKI.

Statistical Analysis: Chi-square was used for categorical data. ANOVA or Kruskal-Wallis test for continuous variable. Univariable and multivariable logistic regression was used to evaluate in-hospital mortality and CKD incidences and the association between CRRT and ECMO.

Outcomes:
-1st In-hospital mortality rate
-2nd The incidence of CKD after discharge

Results

Of 202 patients receiving ECMO, the overall in-hospital mortality rate was 56%. In the ECMO alone group, ECMO with CRRT for those without and with AKI, the in-hospital mortality rate was 39%, 92%, and 65%, respectively.

Post-discharge the overall CKD incidence was 44%. For the ECMO alone, ECMO with CRRT for those without and with AKI, CKD incidence rates were 54%, 15%, and 46%, respectively.

Outcome: In-hospital Mortality

	In-hospital Mortality (%)	Univariable Analysis		Multivariable Analysis	
		OR (95% CI)	*P* value	OR (95% CI)	*P* value
ECMO alone	39%	ref		ref	
ECMO with CRRT (no AKI)	92%	18.3 (4.08-82.4)	<0.001	10.84 (1.35-87.11)	0.016
ECMO with CRRT (AKI)	65%	3.02 (1.51-6.03)	0.002	20.04 (2.70-148.69)	0.006

Conclusions

Receiving CRRT is associated with an increased risk of in-hospital mortality and CKD after discharge in patients with ECMO treatment, likely due to the impact of volume overload and AKI.

Further comprehensive studies are required to assess contributed factors to predict and mitigate risks for better patient outcomes.

Baseline Characteristics

characteristic	Total (n=202)	ECMO alone (n=109)	ECMO with CRRT (Volume) (n=30)	ECMO with CRRT with AKI (Clearance) (n=63)	P-value
Age	57±17	58±16	66±14	52±17	0.008
Male, n (%)	123(61)	65(59)	17(57)	41(66)	0.60
Race, white	172(85)	93(85)	28 (93)	51(80)	0.51
BW admission	86±20	85±21	83±16	89±21	0.34
BMI	29±6	29±6	29±5	30±7	0.66
comorbidities					
Diabetes	41(22)	20(19)	10(36)	11(19)	0.16
Hypertension	101(54)	56(54)	20(71)	25(43)	0.056
CHF	58(31)	31(30)	13(46)	14(25)	0.12
CAD	40(20)	20(18)	13(43)	7(11)	0.001
Stroke	101(54)	56(54)	20(71)	25(43)	0.056
Cirrhosis	25(13)	14(14)	3(11)	8(14)	0.90
Sepsis during admit	85(43)	32(30)	15(50)	38(61)	<0.001
APACHE III score	102±35	95±33	101±33	116±34	0.005
SOFA at ICU	11±3	11±3	12±3	13±3	0.03
AKI stage					<0.001
Stage1	55(27)	31(28)	24(80)	0	
Stage2	45(22)	16(15)	0	29(46)	
Stage3	43(21)	9(8)	0	34(54)	
Laboratory					
Sodium	142±5	140±5	144±3	143±5	<0.001
Potassium	4.4±0.7	4.1±0.6	4.6±0.8	4.7±0.8	<0.001
Chloride	100±6	100±6	100±4	100±166	0.76
HCO3	18±5	18±5	17±5	18±6	0.93
Calcium	10.3±1.8	9.5±1.6	10.9±1.8	10.7±1.7	0.001
Phosphorus	5.2±1.6	4.8±1.4	5.8±1.5	5.6±1.7	0.001
Magnesium	2.3±0.5	2.2±10.5	2.2±0.4	2.4±1.6	0.02
Albumin	2.8±0.6	2.8±0.7	2.6±0.6	2.7±0.6	0.47
pH	7.24±0.16	7.23±0.16	7.28±0.14	7.27±0.16	0.36
Hb	7.7 (6.9, 8.8)	7.7 (6.9, 8.9)	7.8 (7.15, 8.6)	7.6 (6.9, 8.8)	0.50
Platelet x 10^3	71 (43, 113)	75 (52, 154)	70 (36, 90)	56 (40, 78)	0.06

Outcome: CKD after discharge

	CKD 90 days after discharge (%)	Univariable Analysis		Multivariable Analysis	
		OR (95% CI)	*P* value	OR (95% CI)	*P* value
ECMO alone	54%	ref		ref	
ECMO with CRRT (no AKI)	15%	1.1 (0.28-4.28)	0.89	10.84 (1.35-87.11)	0.016
ECMO with CRRT (AKI)	46%	2.09 (0.83-5.25)	0.12	20.04 (2.70-148.69)	0.006

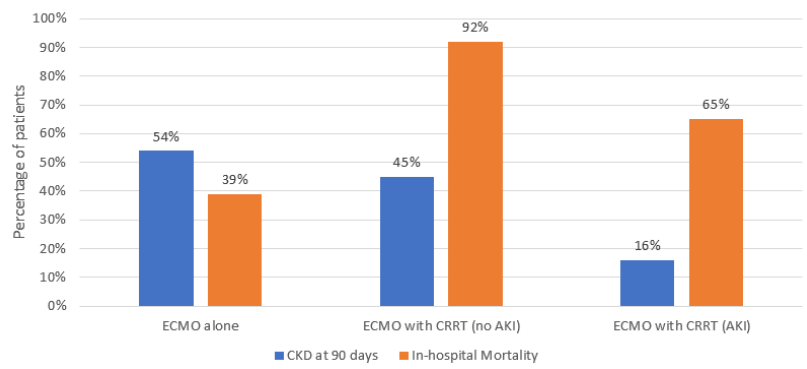

Figure 1. In-hospital Mortality and CKD at 90 days between 3 groups. 1)ECMO alone. 2) ECMO with CRRT in patients without AKI. 3) ECMO with CRRT in patients with AKI.