Comparative Outcomes of Acute Kidney Injury Before and After Extracorporeal Membrane Oxygenation Initiation: A Retrospective Cohort Study

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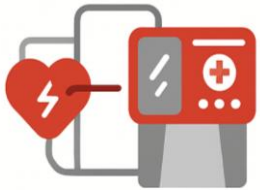
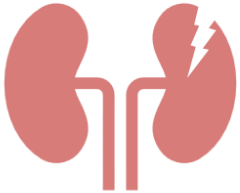
Introduction



ECMO-supported patient

Ischemia reperfusion injury
Systemic inflammation
Hemodynamic instability
Nephrotoxins
Immune reaction
Circulatory alterations
hemolysis
etc.



Up to 25-85% developed AKI[1]

Factors Contributing to AKI in ECMO[2]

Patient related factors	ECMO-related factors
Pre-existing comorbidities	Ischemia–reperfusion injury
Nephrotoxic medications	Hemolysis
Inflammatory state and sepsis	Oxidative stress & inflammation
Hemodynamic instability	Circulatory alterations
Indications for ECMO	Duration of ECMO

Objective: This study aimed to **evaluate the incidence, timing, and clinical outcomes** of AKI in ECMO-treated patients, focusing on the differences between AKI occurring before versus after ECMO initiation.

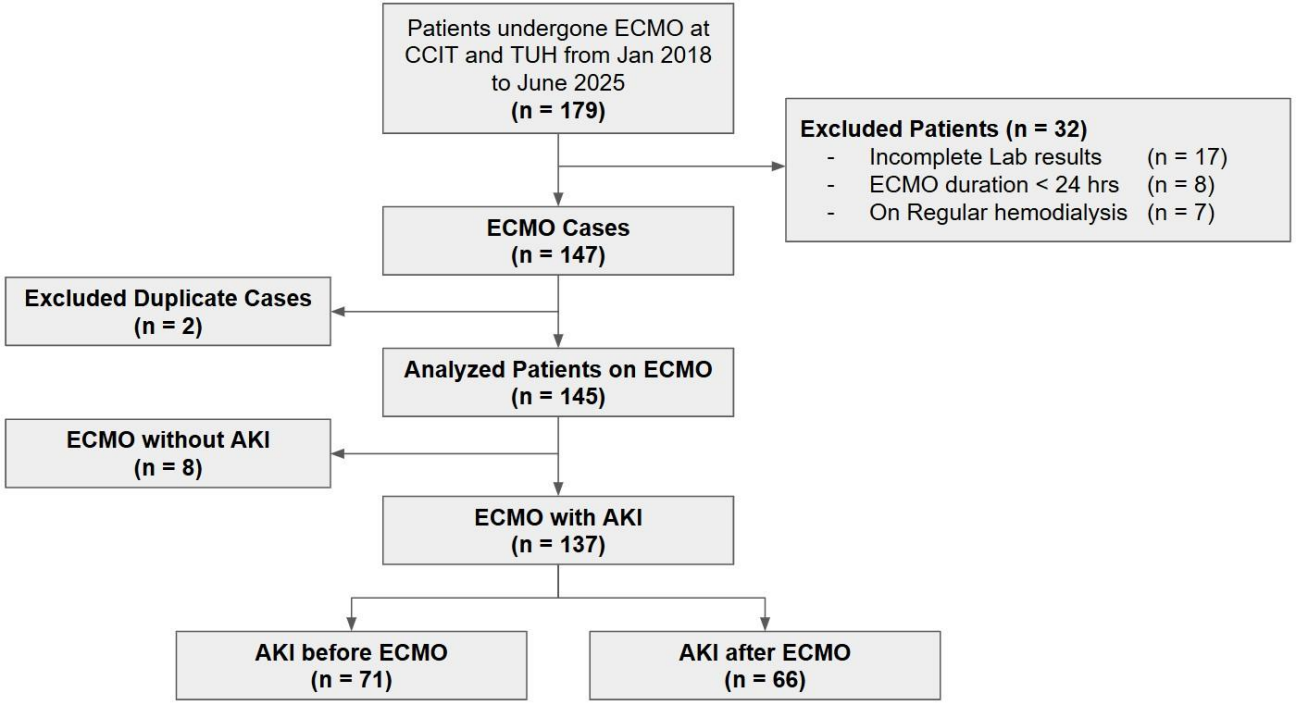
[1]. Thongprayoon C, et al.. J Clin Med. 2019;8:981; [2] Ostermann, M., Lumlertgul, N. Acute kidney injury in ECMO patients. Crit Care 25, 313 (2021).

Materials and Methods

- A retrospective cohort study at Thammasat University Hospital and Central Chest Institute of Thailand from January 2018 till May 2025.
- Patients were divided into three groups: patients who developed AKI before and after ECMO initiation, and patients who had not developed AKI.
- Data collection from electronic records: demographics, AKI data, ECMO prescription, treatment received and complications developed during ECMO initiation.
- Logistic regressions were used to identify factors associated with in-hospital mortality.

Primary outcomes: In-hospital mortality of patients who developed AKI before and after ECMO initiation.
Secondary outcomes: Hospital lengths of stays, RRT requirements, and complications associated with AKI before and after ECMO initiation.

Figure 1: Flowchart of the study



Result

Table 1 Baseline Characteristics

	Total N = 45	No AKI N = 8	Before ECMO N = 71	After ECMO N = 66	P-value
Age, y	56.4±15.9	46.7±14.4	58.0±15.1	55.8±16.6	0.69
Gender, male, n (%)	87 (60.0)	4 (50.0)	48 (67.6)	35 (53.0)	0.18
BMI, kg/m^2	24.0±5.6	21.3±3.7	24.1±5.9	24.3±5.5	0.33
Comorbidity, n (%)					
DM type-2	79 (54.5)	1 (12.5)	41 (57.7)	37 (56.1)	0.88
Hypertension	62 (42.8)	3 (37.5)	28 (39.4)	31 (46.9)	**0.048**
Dyslipidemia	31 (21.4)	0	18 (25.4)	13 (19.7)	0.64
CKD	59 (40.7)	3 (37.5)	34 (47.9)	22 (33.3)	0.23
CAD	79 (54.5)	1 (12.5)	41 (57.7)	37 (56.1)	0.22

Table 1 Baseline Characteristics

	Total N = 45	No AKI N = 8	Before ECMO N = 71	After ECMO N = 66	P-value
ECMO Prescription					
Pump speed	2987.6±692.7	3087.1±790.5	2972.9±552.3	2992.4±816.1	**0.008**
Blood flow rate, (L/min)	3.2±1.0	2.8±1.1	3.3±1.0	3.2±1.0	0.96
Cardiac index	1.9±0.6	1.9±0.6	1.9±0.6	1.9±0.6	0.97
Indication for ECMO, n (%)					0.48
Cardiogenic shock	59 (40.7)	5 (62.5)	30 (42.3)	24 (36.4)	
Post-cardiotomy	77 (53.1)	3 (37.5)	38 (53.5)	36 (54.5)	
Bridging for transplantation	9 (6.2)	0 (0)	3 (4.2)	6 (9.1)	
Duration of ECMO, d	6 (3,9)	5.5 (3,14)	6 (3,8)	6 (4,12)	0.37

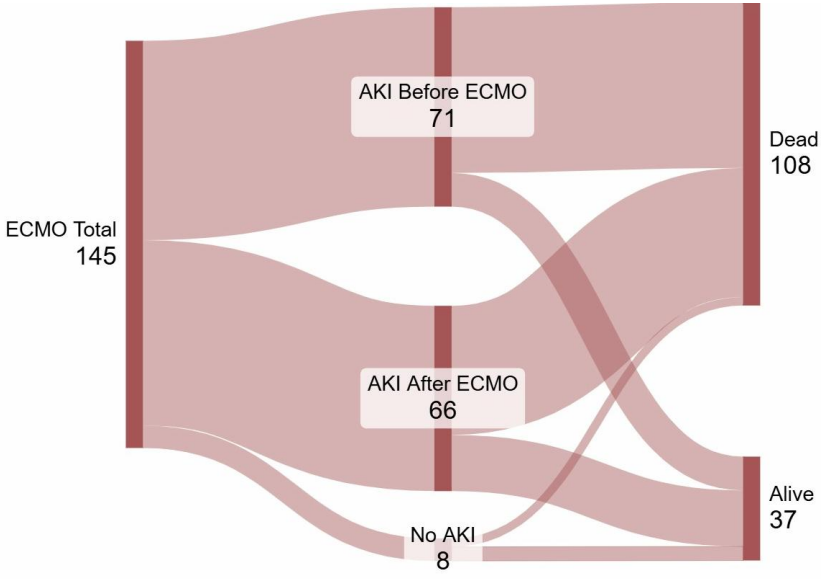
Table 1 Baseline Characteristics

	Total N = 45	No AKI N = 8	Before ECMO N = 71	After ECMO N = 66	P-value
Laboratory at ECMO initiation					
Hct, %	30.5±7.4	38.3±4.9	29.9±7.9	30.7±6.7	0.46
BUN, mg/dL	38.0 (24.1,69.6)	10.9 (9.0,13.4)	58.1 (37.2,77.3)	25.5 (16.4,37.3)	**0.0001**
sCr, mg/dL	1.9±1.4	0.9±0.4	2.6±1.8	1.3±0.6	**<0.001**
Sodium, mmol/L	144.2±7.9	141.7±5.5	145.2±7.6	142.9±8.3	0.70
Potassium, mmol/L	4.3±0.8	4.0±0.4	4.5±0.9	4.1±0.6	**0.009**
Bicarbonate, mmol/L	22.7±6.0	28.3±2.5	21.2±5.9	24.3±5.7	0.44
AST, U/L	59 (29,323)	31 (24.5,50.5)	127 (39,1000)	46 (27,108)	**0.0004**
ALT, U/L	44 (20,159)	31 (16,48.5)	67 (25,540)	31 (18,70)	**0.0024**
TB, mg/dL	1.1 (0.7,2.5)	0.8 (0.6,0.9)	1.6 (0.9,4.1)	0.9 (0.6,1.7)	**0.0013**
DB, mg/dL	0.5 (0.2,1.3)	0.2 (0.1,0.3)	0.9 (0.3,2.3)	0.3 (0.2,0.8)	**0.0002**
Albumin, g/L	3.1±0.9	3.5±0.6	2.9±0.8	3.3±0.9	0.24

Result

Table 2 Outcomes between AKI Before-After ECMO

	Total N = 145	No AKI N = 8	Before ECMO N = 71	After ECMO N = 66	p-value
ICU mortality, n (%)	108 (74.5)	3 (37.5)	59 (83.1)	46 (69.7)	**0.009**

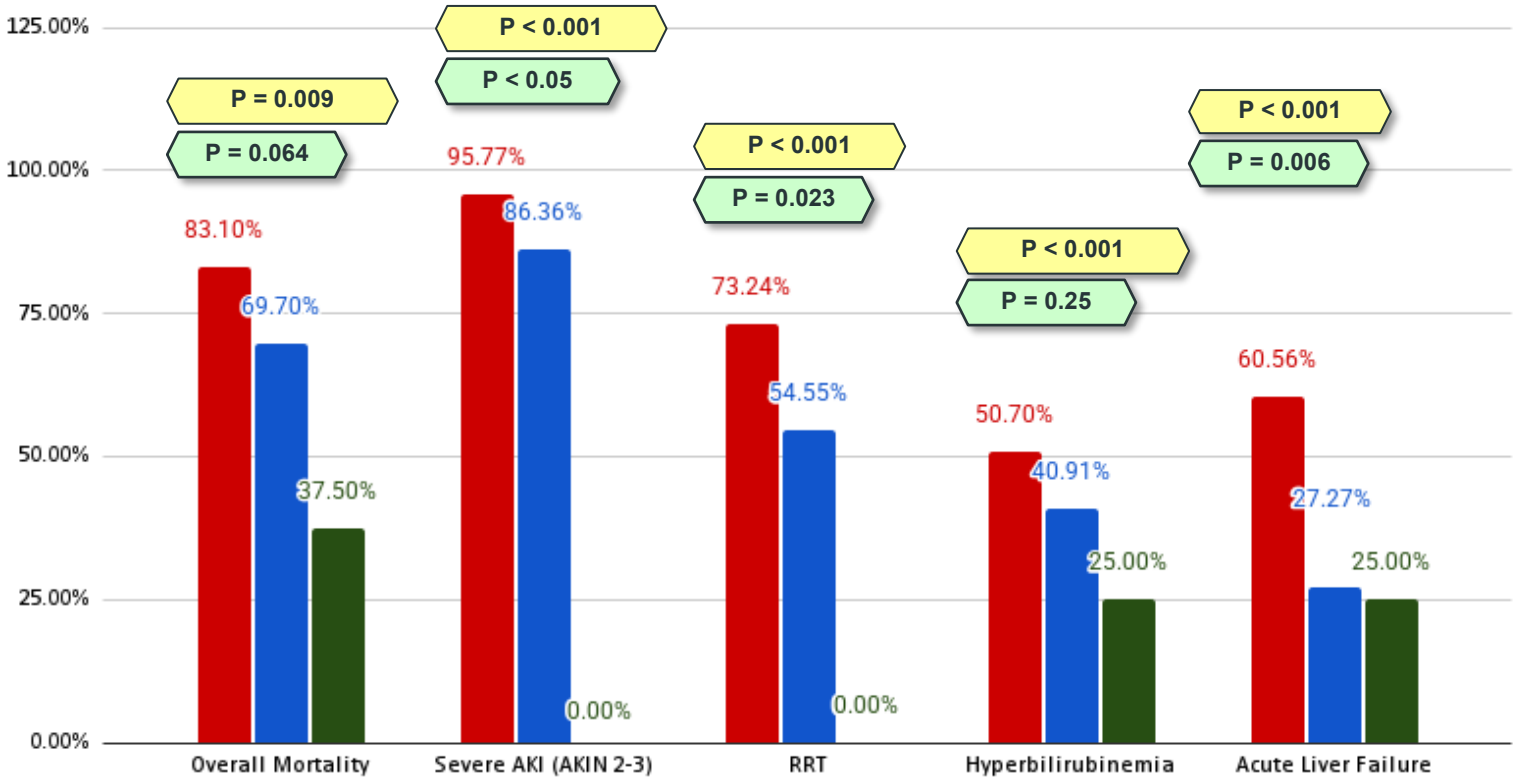


Result

Table 2 Outcomes between AKI Before-After ECMO

	Total N = 145	No AKI N = 8	Before ECMO N = 71	After ECMO N = 66	p-value
ICU mortality, n (%)	108 (74.5)	3 (37.5)	59 (83.1)	46 (69.7)	**0.009**
In-hospital mortality, n (%)	108 (74.5)	3 (37.5)	59 (83.1)	46 (69.7)	**0.009**
ICU lengths of stay, days	14 (7,23.5)	19.5 (10.5,23)	13 (6.5,20)	16.5 (6.5,28)	0.31
Hospital lengths of stay, days	24 (11,32)	23.5 (19.5,24.5)	20.5 (10,28)	26 (15.5,40)	0.15
Severe AKI (AKIN 2-3)	125 (86.2)	0 (0)	68 (95.8)	57 (86.4)	**<0.001**
RRT	80 (60.7)	0 (0)	52 (73.2)	36 (54.5)	**<0.001**
Hyperbilirubinemia	65 (44.8)	2 (25)	36 (50.7)	27 (40.9)	0.26
Acute liver failure	63 (43.4)	2 (25)	43 (60.6)	18 (27.3)	**<0.001**

Figure 3 Bar Chart of Outcomes of AKI before ECMO, after ECMO, and No AKI



P value for AKI before ECMO and after ECMO

P value for AKI before ECMO , after ECMO, and no AKI

Table 3 Univariate and Multivariate logistic regression of ICU mortality

	Univariable		Multivariable	
	OR (95% CI)	**P-value**	**OR (95% CI)**	**P-value**
Age	1.02 (0.99–1.04)	0.10		
BUN at ECMO initiation	1.00 (0.99-1.03)	0.44		
Cr at ECMO initiation	1.44 (0.91-2.27)	0.12		
Potassium at ECMO initiation	3.38 (1.03-11.0)	**0.043**	3.25 (0.93-11.5)	0.07
Before ECMO-AKI	8.19 (1.72-39.00)	**0.008**	3.05 (0.07-133.8)	0.58
After ECMO-AKI	3.83 (0.83-17.6)	0.08		
RRT	3.57 (1.64-7.79)	**0.001**	0.74 (0.20-2.79)	0.66
Severe AKI	6.0 (2.21-16.24)	**<0.001**	1.11 (0.07-17.6)	0.94

Discussion

- **Among patients with AKI before and after ECMO initiation, in-hospital mortality did not** significantly differ between AKI before versus after ECMO ($p = 0.064$).
- There were significant differences between AKI before and after ECMO in terms of:
  - **RRT requirement** (73.2% vs. 54.5%, $p = 0.023$)
  - **Severity of AKI** (95.8% vs. 86.4%, $p < 0.05$)
  - **Hospital length of stay** (median 20 vs. 26 days, $p = 0.18$)
  - **Acute liver failure** (60.6% vs. 27.3%, $p < 0.006$)
- In multivariable analysis, timing of AKI (before vs after ECMO) **was not** an independent predictor of mortality.

Outcomes of Acute Kidney Injury Before and After Extracorporeal Membrane Oxygenation Initiation

AKI before vs after ECMO
P = 0.064

	PRIMARY OUTCOME	SECONDARY OUTCOMES			
	In-hospital Mortality	RRT requirements	Hospital lengths of stays (days)	Severe AKI	Acute Liver Failure
AKI before ECMO (N = 71)	83.1%	73.2%	20 days (10, 28)	95.8%	60.6%
AKI after ECMO (N = 66)	69.7%	54.5%	26 days (15.5, 40)	86.4%	27.3%
No AKI (N = 8)	37.5%	0%	23 days (19.5, 24.5)	0%	25%
	P = 0.009	P < 0.001	P = 0.009	P < 0.001	P < 0.001

Retrospective Cohort Study

AKI on ECMO (N = 137)

AKI before vs after ECMO

Outcomes of Acute Kidney Injury Before and After Extracorporeal Membrane Oxygenation Initiation

Retrospective Cohort Study

Thammasat University hospital & Central Chest Institute of Thailand

AKI on ECMO (N = 137)

AKI before vs after ECMO

	PRIMARY OUTCOME	SECONDARY OUTCOMES			
	In-hospital Mortality	RRT requirements	Hospital lengths of stays (days)	Severe AKI	Acute Liver Failure
AKI before ECMO (N = 71)	83.1%	73.2%	20 days (10, 28)	95.8%	60.6%
AKI after ECMO (N = 66)	69.7%	54.5%	26 days (15.5, 40)	86.4%	27.3%
P value	P = 0.064	**P = 0.023**	P = 0.18	**P < 0.05**	**P = 0.006**

Conclusion: our study demonstrates that AKI is highly prevalent among ECMO patients and is associated with increased mortality and complications. The timing of AKI was not an independent predictor of mortality, suggesting that outcomes are primarily driven by underlying illness severity and multi-organ dysfunction. Further prospective studies are needed to validate these findings, explore early biomarkers, and establish standardized renal support strategies in ECMO patients.

Thank You