Effect of Continuous Renal Replacement Therapy Liberation patterns on outcomes: A retrospective analysis of the Worldwide Exploration of Renal Replacement Outcomes Collaborative in Kidney Disease (WE-ROCK)

Erin K. Stenson[1], Issa Alhamoud[2], Rashid Alobaidi[3], Gabriella Bottari[4], Sarah Fernandez[5], Dana Fuhrman[6], Francesco Guzzi[7], Eleonora Marinari[4], Tahagod Mohamed[8], Catherine Morgan[3], Theresa Mottes[9], Tara Neumayr[10], Nicholas Ollberding[11], Valeria Raggi[4], Zaccaria Ricci[12], Emily See[13], Natalja Stanski[11], Huaiyu Zang[11], Emily Zangla[14], and Katja M. Gist[11] on behalf of WE-ROCK Investigators

[1] University of Colorado, [2] University of Iowa, [3] University of Alberta, [4] Bambino Gesu Children's Hospital, [5] Gregorio Maranon University Hospital, [6] University of Pittsburgh Medical Center, [7] Santo Stefano Hospital, [8] Nationwide Children's Hospital, [9] Ann & Robert Lurie Children's Hospital, [10] Washington University, [11] Cincinnati Children's Hospital Medical Center, [12] AOU Meyer, [13] Royal Children's Hospital, [14] University of Minnesota

Abstract

Study Purpose: Continuous renal replacement therapy (CRRT) is an important supportive care modality used in critically ill children, but little is known regarding CRRT liberation and outcomes. We aimed to characterize the association between liberation patterns and outcomes, including mortality.

Methods: The Worldwide Exploration of Renal Replacement Outcomes Collaborative in Kidney Disease (WE-ROCK) study is an international multicenter observational study (32 centers, 7 nations) conducted from 2018-2021 in patients aged 0-25 years treated with CRRT for acute kidney injury (AKI) or fluid balance (FB). Patients with previous dialysis dependence, ECMO use, or those who received CRRT for a different indication were excluded. Patients were categorized into 3 liberation categories based on first liberation attempt: failed liberation (resumption of any dialysis modality within 72 hours), success (no receipt of CRRT for ≥72 hours), or not attempted within the first 28 days of enrollment. Multivariable logistic regression was used to identify factors associated with successful CRRT liberation.

Results: 990 children who received CRRT were included: 321 (33%) had liberation failure, 340 (34%) had liberation success, and 329 (33%) had no liberation attempt. Children who successfully liberated had lower ICU mortality (6.5%) compared to children with liberation failure (22%) and children without liberation attempts (78%)(p <0.001). After adjusting for sepsis at admission and illness severity parameters at CRRT initiation (vasopressor-inotrope score, PELOD-2 score, % FB), children with higher urine output prior to CRRT initiation had higher odds of successful CRRT liberation (OR 1.22) while children with immunologic co-morbidities had lower odds of successful CRRT liberation (OR 0.50), Table 1.

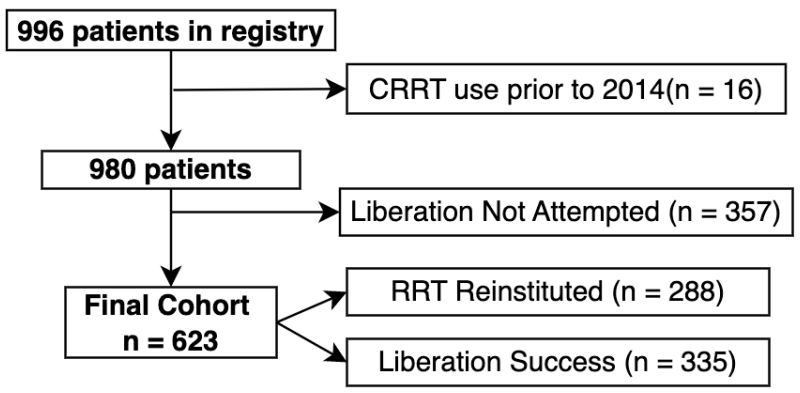
Conclusion: Inability to liberate from CRRT was common in this retrospective multicenter analysis, higher among children with immunologic co-morbidities, and associated with high mortality rate. Higher urine output prior to CRRT initiation was associated with higher odds of liberation success.

Introduction

- Continuous renal replacement therapy (CRRT) is an important supportive care modality used in critically ill children
- Little is known regarding CRRT Liberation and outcomes
- We aimed to describe the liberation patterns and factors associated with successful liberation among pediatric patients receiving CRRT

Methods and Materials

- WE-ROCK Database, included 990 patients (age 0-25 years) from 32 centers and 7 nations (2015-2021) for AKI and pathologic fluid balance
- Excluded patients with prior dialysis dependence, ECMO use, or other CRRT indication
- Multivariable logistic regression model was used to estimate the odds ratio (OR) and 95% confidence interval (CI) to identify factors associated with liberation success.
- Kaplan-Meier cumulative probability of CRRT successful liberation was estimated for patients with liberation attempt
- Liberated: no receipt of CRRT or other dialysis for ≥72 hours after discontinuing CRRT
- Reinstituted: resumed CRRT or other dialysis within 72 hours after discontinuing CRRT
- Not Attempted: no attempt at CRRT liberation within first 28 days after CRRT initiation



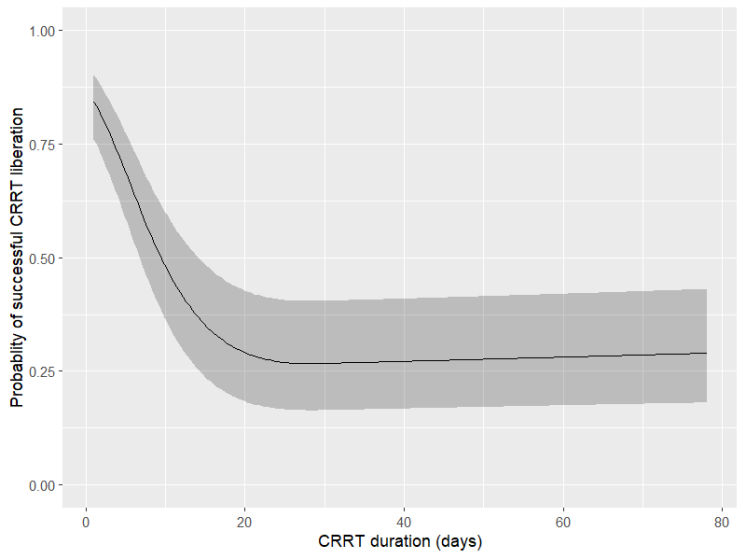
Results

Multivariable regression model predicting successful CRRT liberation

Variable	Reference	Contrast	OR (95%CI)
Weight (kg)	11.6	55.0	0.85 (0.66-1.11)
Non-Comorbidities	No	Yes	0.93 (0.55-1.58)
Primary Comorbidities: Cardiac	No	Yes	1.14 (0.73-1.80)
Primary Comorbidities: Nephrologic/Urologic	No	Yes	**0.52 (0.31-0.90)***
Primary Comorbidities: Oncologic	No	Yes	0.70 (0.44-1.12)
Primary Comorbidities: Immunologic	No	Yes	**0.47 (0.25-0.89)***
Sepsis at ICU admission	No	Yes	0.72 (0.49-1.06)
Vasopressor-Inotrope Score at CRRT Initiation	0.0	20.0	**1.25 (1.04-1.50)***
PELOD-2 Score at CRRT Initiation	4.0	9.0	1.20 (0.93-1.55)
% fluid balance (ICU admit to CRRT Initiation)	2.4	18.1	1.02 (0.92-1.12)
Time from ICU admission to CRRT Initiation (days)	1.0	6.0	0.93 (0.84-1.03)
Urine output (24h prior to CRRT Initiation) (ml/kg/h)	0.1	1.2	**1.22 (1.04-1.42)***

Odds ratio (OR) and 95% confidence intervals (CI) obtained by logistic regression accounting for the nesting of patients within centers via the Huber-While cluster sandwich estimator of variance. For continuous predictors such as weight, the odds ratio was computed when the variable was set to its 75th percentile versus its 25th percentile.
* denotes significance p<0.05

Probability of successful CRRT liberation according to duration of CRRT days



A logistic regression of successful liberation on CRRT duration was fitted and the conditional effect plot of CRRT duration generated. The model was adjusted for the same variables as in the prior multivariable model above. CRRT duration (days) is significantly associated with decreased probabilities of successful liberation (interquartile range OR = 0.174; 95% CI = 0.108–0.278).

CRRT duration	Probablity of successful CRRT liberation	95% CI
9	0.516	(0.401, 0.630)
15	0.352	(0.238, 0.485)
21	0.284	(0.178, 0.421)

Conclusions

- **Inability to liberate from CRRT was common**
- **Higher urine output and higher VIS prior to CRRT association was associated with liberation success**
- **Patients with comorbidities (nephrologic and immunologic) associated with CRRT reinstitution**
- **CRRT duration is significantly associated with decreased probability of successful liberation**