Impact of Fluid Overload on Patients Receiving Continuous Dialysis for Acute Kidney Injury

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Introduction

- Fluid accumulation has been increasingly understood to be associated with negative outcomes in the setting of critical illness
- In patients with severe acute kidney injury (AKI) treated with renal replacement therapy (RRT), the presence of fluid overload has been associated with chronic dialysis-dependence (non-recovery) and mortality
- Volume overload has been defined as a percentage of baseline body weight increase across many studies, but a clear cut-point has yet to be defined (e.g. 5 or 10%)
- Establishing an ideal volume balance target at which outcomes are improved in adults is needed

Methods and Materials

- We conducted a single-center retrospective cohort study of patients treated with CRRT for AKI from April 1, 2016 to March 30, 2020
- Daily fluid balances were obtained for 72 hours prior and 7 days after CRRT initiation
- Cumulative fluid balance in liters was then calculated as a percentage of ICU admission weight in kilograms:
  [(fluid balance (liters in – liters out)/weight in kilograms at hospital admission] x 100
- Positive volume balance defined as cumulative fluid balance in excess of +5% ICU admission weight within 7 days
- Negative volume balance defined as cumulative fluid balance in excess of -5% ICU admission weight within 7 days
- Associations between volume balance, baseline demographics, and clinical outcomes (duration of treatment, dialysis dependence, and inpatient/30-day/90-day mortality) were explored

Table 1. Demographics by Seven Day Volume Balance

	Negative	Neutral	Positive	p-value
N	305	566	371	
Age	62 (46, 71)	65 (54, 74)	66 (58, 73)	<0.001
Sex				0.034
Female	115 (37.7)	235 (41.5)	176 (47.4)	
Race				0.41
Black	157 (51.5)	324 (57.2)	216 (58.2)	
White	104 (34.1)	168 (29.7)	112 (30.2)	
Other	44 (14.4)	74 (13.1)	43 (11.6)	
Baseline sCr	1.5 (1, 2.7)	1.4 (1, 2.65)	1.1 (0.9, 1.8)	<0.001
DM2	27 (8.9)	76 (13.4)	50 (13.5)	0.11
HTN	158 (51.8)	297 (52.5)	185 (49.9)	0.73
CAD	140 (45.9)	240 (42.2)	131 (35.3)	0.015
CHF	191 (62.6)	331 (58.5)	165 (44.5)	<0.001
COPD	62 (20.3)	110 (19.4)	71 (19.1)	0.92
Weight at ICU Admit (kg)	87 (71, 104)	90 (74, 110)	79 (65, 92)	<0.001
Vasoactive Use at ICU Admit	183 (60)	374 (66.1)	258 (69.5)	0.033
SOFA at ICU Admit	8 (5, 12)	9 (6, 12)	9 (5, 12)	0.43
72H Pre Vol (L)	1.02 (-0.27, 3.19)	0.93 (-0.05, 3.74)	1.75 (0.12, 4.04)	0.012

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Results

Figure 1. Kaplan-Meier Estimates of Inpatient Mortality

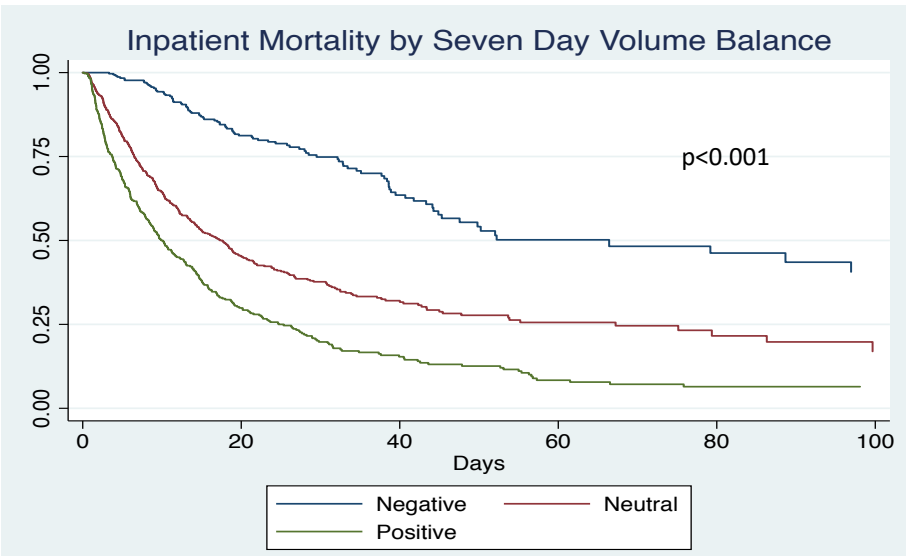

Table 2. Outcomes by Seven Day Volume Balance

	Negative	Neutral	Positive	p-value
N	305	566	371	
7D Post Vol (L)	-8.24 (-11.73, -5.68)	0.34 (-1.54, 2.07)	8.11 (5.43, 12.86)	<0.001
CRRT Days	6 (3, 12)	3 (1, 7)	2 (1, 6)	<0.001
Hospital Days	25 (15, 39)	13 (6, 27)	9 (3, 20)	<0.001
90 Day RRT (N=476)	34 (16.3)	24 (11.5)	3 (5.0)	0.052
90 Day Mortality	116 (38.0)	388 (68.6)	324 (87.3)	<0.001

Table 3. Multivariate Cox Proportional Hazards Model

Predictor	Hazard Ratio (95% CI)	p-value
Volume Balance (Neg v Neutral)	0.51 (0.36-0.71)	<0.001
Age	1.002 (0.993-1.013)	0.606
Sex	1.10 (0.82-1.49)	0.500
Baseline sCr	0.91 (0.84-0.99)	0.028
DM2	1.16 (0.80-1.69)	0.437
CAD	0.88 (0.65-1.19)	0.402
CHF	0.93 (0.68-1.23)	0.623
Baseline Weight (kg)	0.997 (0.992-1.003)	0.382
Vasoactive Use	1.08 (0.80-1.44)	0.622
72H Pre Vol (L)	1.006 (0.970-1.043)	0.730

Variables selected for inclusion in the model were those found with significantly different (p<0.1) distributions across volume balance groups

Limitations and Conclusions

- In a large single-center cohort of CRRT patients, we have found negative volume balance (greater than 5% weight reduction from ICU admission weight over 7 days after treatment with CRRT initiated) to be a significant and independent predictor of 90-day survival
- Given the nature of data abstraction from the electronic medical record, we are likely underestimating the number of patients that remain dependent on RRT
- As a retrospective single-center cohort the results cannot be interpreted to imply a causal relationship between negative volume balance and mortality and the results may not be generalizable
- Clinical trials to study ideal volume management targets are needed