



COMPARISON OF FILTER LIFETIME BETWEEN HYPERTONIC VERSUS ISOTONIC REGIONAL CITRATE ANTICOAGULATION DURING CONTINUOUS KIDNEY REPLACEMENT THERAPY



AKI & CRRT Conference

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Introduction

- Continuous Kidney Replacement Therapy (CKRT) has become an important tool for rescuing organ support for critical care patients worldwide.
- Regional Citrate Anticoagulation (RCA) is used to prolong circuit lifetime especially in patients with high risk of bleeding.
- Owing to current evidence, there is no data showing the difference of isotonic and hypertonic citrate in terms of patient outcomes and CKRT circuit survival.
- The objective of this study is to find whether there is a difference of hypertonic and isotonic regional citrate anticoagulation (RCA) in terms of circuit lifetime and its related factors, and patient outcomes in a real-world practice.

Methods and Materials

- This is a single center retrospective cohort study of critical care patients who needed CKRT during their admission in King Chulalongkorn Memorial Hospital, Bangkok, Thailand.
- The time frame was between February 2023 to September 2023.
- Data of patients receiving CKRT during their ICU admission were collected and analyzed. Demographic data, baseline characteristic and patient outcomes were recorded.
- Factors related to circuit clotting such as blood transfusion, circuit ionized calcium, citrate doses, filtration fraction and CKRT prescription were studied.

Results

- 199 filters were evaluated from 97 patients, 98 filters in hypertonic RCA and 101 filters in isotonic RCA.
- Three most common underlying diseases in both groups were hypertension (65% vs. 54%), cardiac diseases (47% vs. 50%), and diabetes mellitus (49% vs. 33%) similarly.
- Most common cause of acute kidney injury (AKI) was septic associated AKI (38% vs. 43%).
- The most frequent indication for CKRT initiations were volume overload (48% vs. 42%), oliguria/anuria (58% vs. 60%), and uremia (37% vs. 44%).
- Baseline characteristics between two groups were equally balanced except for underlying of end stage kidney diseases (ESRD), to be higher in hypertonic groups.

Table 1: Baseline characteristics

Characteristics	Hypertonic N=51	Isotonic N=46	p-value
Age (years)	67 (56-77)*	70 (60-80)	0.33
Male	31/50 (62)	27/45 (60)	0.84
Medical ICU	34/49 (69)	34/44 (77)	0.39
Underlying disease			
Hypertension	33 (65)	25 (54)	0.30
End Stage Kidney Disease	22 (43)	5/45 (11)	<0.001
Chronic Kidney Disease	15 (29)	13 (28)	0.90
Diabetes Mellitus	25 (49)	15/45 (33)	0.12
Cause of AKI			
SEPTIC	19/50 (38)	19/44 (43)	0.61
ISCHEMIC	18/50 (36)	14/44 (32)	0.67
Nephrotoxic	2/50 (4)	6/43 (14)	0.088
Indications of RRT			
Oliguria/anuria	29/50 (58)	27/45 (60)	0.84
Volume overload	24/50 (48)	19/45 (42)	0.57
Uremia	18/49 (37)	20/45 (44)	0.45
Severity			
SOFA	11 (4)	12 (3)	0.092
Apache II	21 (7)	21 (6)	0.75
On vasopressor	37 (73)	38 (83)	0.24
On mechanical ventilation	40/50 (80)	42 (91)	0.12
Outcome			
RRT days	6 (4-9)	6 (4-10)	0.93
28-day Mortality	26/46 (57)	29 (63)	0.52
ICU Length of stay	9 (6-19)	16 (6-27)	0.27

Results

- The mean total FLT were significantly different between hypertonic and isotonic citrates (median of 72 hours (IQR 45-72) in hypertonic vs. 52 hours (IQR 28-72) in isotonic group, p-value <0.001). The analysis using adjusted filter lifetime showed similar results (median of 72 hours (IQR 72-72) in hypertonic vs. 56 hours (IQR 26-72) in isotonic group, p-value <0.001).
- The Kaplan-Meier plot on filter lifetime was shown in Figure 1, with significant difference with Log-rank test of p <0.001.

Table 2: Filter lifetime between 2 citrate formulas

Outcomes	Hypertonic	Isotonic	p-value
Total filter lifetime (hours), median (IQR)	72 (45-72)	52 (28-72)	<0.001
Total actual filter lifetime (hours), mean (SD)	78 (37)	58 (36)	<0.001
Adjusted actual filter lifetime (hours), mean (SD)	95 (32)	63 (40)	<0.001

Figure 1: Kaplan-Meier on Filter Lifetime (FLT)

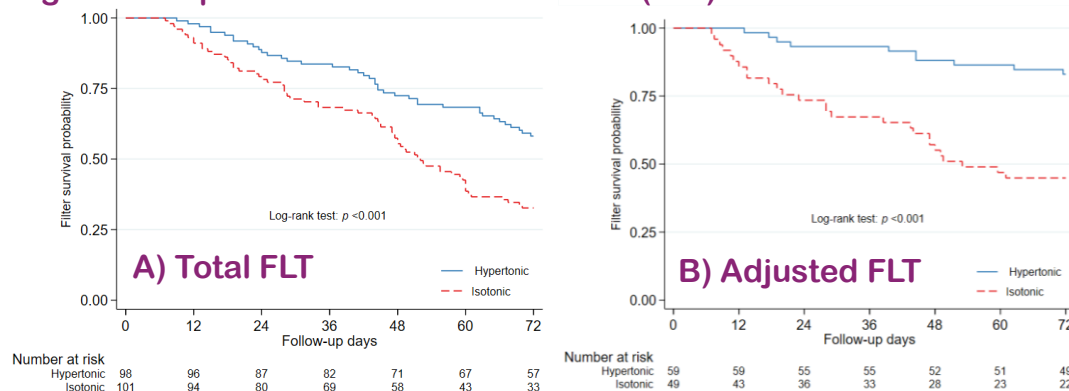


Table 3: Uni- and multi-variate analyses of factor affecting premature clots

Factors	Univariate analysis		Multivariable analysis	
	Unadjusted HR (95% CI)	p-value	Adjusted HR (95% CI)	p-value
Hypertonic	Reference	Reference	Reference	Reference
Isotonic	4.81 (1.96, 11.8)	0.001	4.30 (1.68, 11.0)*	0.002*
Filtration Fraction	1.06 (1.03, 1.09)	<0.001	NA	NA
BFR	1.37 (1.11, 1.68)	0.003	NA	NA
Net UF	1.01 (1.00, 1.02)	0.188	-	-
Sieving coefficient^a	0.41 (0.23, 0.72)	0.002	1.00 (0.69, 1.45)	0.997
Circuit ionized Ca^a	0.45 (0.22, 0.91)	0.027	0.38 (0.22, 0.66)	0.001
Corrected citrate doses^a	0.44 (0.28, 0.70)	<0.001	0.47 (0.32, 0.70)	<0.001
RBC transfusion	0.89 (0.71, 1.10)	0.280	-	-
Platelet transfusion	0.85 (0.70, 1.03)	0.097	0.89 (0.76, 1.02)	0.095
FFP transfusion	1.00 (0.92, 1.09)	0.997	-	-

^aData was aggregated from multiple measurements (days) using mean.
^bData was aggregated from multiple measurements (days) using median due to skewness of the data.
*Adjusted for imbalance baseline characteristics (p < 0.10)
** Adjusted for imbalance baseline characteristics (p < 0.10) which is significant or marginally significant in the univariate analysis including ESRD, SOFA score and sCr at baseline and significant CRRT factors (p < 0.05). NA: CRRT factors which had p < 0.05 but shown multicollinearity with the other factors and were excluded from the adjusted model.

Discussion

- Hypertonic RCA had a significant longer filter lifetime and diffusive therapy may prolong circuit lifetime compared with convective or mixed therapy.
- This is one of the first retrospective cohorts, describing difference in citrate type used in CKRT and their relationships with circuit performance. It was also a routine to research utilization in our institution which will lead to an improvement in our practice.

Limitations

- Some of the important information were lost such as circuit pressure monitoring, calcium supplement rates or vascular access problems that might affect filter lifetimes.
- The patients were not randomized, so the type of citrates were chosen by the physician's familiarity.

Conclusions

Hypertonic RCA had a significant longer filter lifetime compared to isotonic RCA. However, more data on a well-constructed randomized controlled trial is needed to confirm these findings.



THE 29TH INTERNATIONAL CONFERENCE ON ADVANCES IN CRITICAL CARE NEPHROLOGY AKI & CRRT 2024

MARCH 12-15, 2024 SAN DIEGO, CALIFORNIA