



Shaping Tomorrow's Nephrology: Insight-Driven Kidney Care

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EFFLUENT FLUID IONIZED CALCIUM MONITORING IS NON-INFERIOR TO POST-FILTER MONITORING FOR REGIONAL CITRATE ANTICOAGULATION IN CONTINUOUS RENAL REPLACEMENT THERAPY: THE EFFLUENT-CRRT RANDOMIZED CONTROLLED TRIAL

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Objectives : Continuous renal replacement therapy (CRRT) with regional citrate anticoagulation (RCA) requires precise ionized calcium (iCa) monitoring to ensure circuit patency and patient safety. Standard post-filter iCa measurement necessitates frequent blood sampling, contributing to iatrogenic anemia and increased nursing workload. Effluent fluid iCa monitoring represents a novel, bloodless alternative. This trial aimed to evaluate whether effluent iCa monitoring is non-inferior to standard post-filter monitoring for guiding RCA in critically ill patients.

Methods : We conducted a single-center, randomized controlled non-inferiority trial at West China Hospital of Sichuan University. A total of 76 critically ill patients requiring CRRT-RCA were randomly assigned in a 1:1 ratio to anticoagulation guided by effluent fluid iCa (intervention group; target 0.2–0.4 mmol/L) or standard post-filter iCa (control group; target 0.25–0.35 mmol/L). The primary outcome was filter lifespan, with a pre-specified non-inferiority margin of –4.8 hours. Secondary outcomes included circuit clotting scores, metabolic complications (hypocalcemia, alkalosis, acidosis), citrate accumulation, and blood loss. Analysis was performed by intention-to-treat.

Results : The median filter lifespan was 66.9 hours (IQR, 42 to 72) in the effluent group and 70.0 hours (IQR, 52 to 72) in the post-filter group. The mean difference in filter lifespan was 3.96 hours (one-sided 95% CI, 4.72), confirming non-inferiority as the upper confidence limit did not exceed the –4.8-hour margin. The 72-hour circuit survival rate was similar between groups (55.3% vs. 57.9%, $p=0.82$). Safety profiles were comparable: hypocalcemia occurred in 8.2% vs. 7.6% ($p=0.72$), metabolic alkalosis in 4.3% vs. 4.8% ($p=0.81$), and citrate accumulation in 2.1% vs. 2.4% ($p=0.88$) for the effluent and post-filter groups, respectively.

Conclusions : Effluent fluid iCa monitoring is non-inferior to standard post-filter monitoring for managing RCA during CRRT. This bloodless strategy effectively maintains circuit patency without increasing metabolic complications, offering a safe, cost-effective alternative that reduces iatrogenic blood loss and nursing workload.

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Table 1. Baseline Characteristics of the Study Population

Characteristic (Total 76) mean ± SD	Effluent Fluid iCa Group (n=38) mean ± SD	Post-Filter iCa Group (n=38) mean ± SD
Age, years 55.9±12.3 (95% CI: 52.8 to 58.9)	58.4±9.7 (95% CI: 55.3 to 61.5)	55.2±11.9 (95% CI: 51.3 to 59.1)
Male sex, n (%) 62(81.6)	30(78.9)	32(84.2)
Blood Paramaters		
Prothrombin time (PT) seconds 14.7 ± 6.4 (95% CI: 13.3 to 16.2)	15.2 ±5.5 (95% CI: 13.4 to 17.0)	14.3 ±7.1 (95% CI: 12.0 to 16.6)
Serum creatinine (umoI/L) 259.1±205.2 (95% CI: 212.2 to 306.0)	267.2±227.4 (95% CI: 192.5 to 341.9)	251.1±182.3 (95% CI: 191.2 to 311.0)
INR 1.53 ± 1.24 (95% CI: 1.25 to 1.81).	1.68 ± 1.65 (95% CI: 1.14 to 2.22).	1.39±0.67 (95% CI: 1.17 to 1.61)
Hemoglobin, g/L, 80.7±12.3 (95% CI: 77.9 to 83.5)	81.1 ± 12.4 (95% CI: 77.0 to 85.2)	80.4 ±12.0 (95% CI:76.4 to 84.3)
Platelet count, x10 ⁹ /L, 160.8 ±118.9 (95% CI: 133.6 to 188.0)	143.6±92.8 (95% CI: 113.1 to 174.1)	178.0±139.5 (95% CI: 132.1 to 223.9)



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Kaplan-Meier Estimates of Filter Lifespan

