ADULT CRRT CITRATE PROTOCOL (PRISMAFLEX)

Date of Origin: October 2017 Date of Revision: January 2018

Pre – Initiation

1. Obtain patient ionized calcium (iCa^{++}) and renal panel just before starting CRRT.
    a. If iCa^{++} < 1 mmol/L, contact physician for further instructions. Consider calcium chloride dose (1 gm $CaCl_2$ IV) prior to initiation. There are situations where administration of calcium chloride is not advised, such as in cases of severe hyperphosphatemia.

2. Set up, prime and program flow rates per physician orders.

3. Citrate ACD-A infused via the Pre-Blood Pump (PBP) on the Prismaflex CRRT machine.

4. Calcium chloride (20 mg/mL in NS) infusion line connected to the return extension line port.

Initiation

1. Citrate ACD-A via PBP rate (mL/hour) is selected per physician orders. Recommended start is 2.5 times the blood flow rate (mL/min) at blood flow rate 60 or 100 ml/min and 2 times the blood flow rate at blood flow rate of 150 ml/min (may use 2.5 times very rarely for blood flow 150 too).

2. The initial calcium chloride infusion is based on filter effluent rate and patient systemic albumin level. It is prescribed by the nephrologist or the ICU physician (in 5 D only) based on the effluent rate and the last measured serum albumin. The goal systemic iCa^{++} is also prescribed by the physician either standard 1.15 mM (range 1.05-1.25 mM) OR high 1.3 mM (range 1.2-1.4 mM).

3. Ensure the calcium chloride infusion is started just prior to starting the CRRT machine.

Initial Flow Rate Recommendations table 1

Blood Flow Rate (mL/min)	Citrate Rate (PBP) (mL/hour)	Calcium Chloride Rate (mL/hour)
60 (Very Rare)	150	Per physician orders
100	250	Per physician orders
150	300*	Per physician orders

*The physician may order higher ACDA flow rate up to 375 ml/hour very rarely

Maintenance/Monitoring

1. Patient iCa^{++} "Systemic" – is drawn via arterial or peripheral line (labeled "**arterial**" sample)

2. Circuit iCa^{++}– is drawn post-filter from return (blue) sample port (labeled "**circuit**" sample)

3. Circuit is checked:
    a. Draw circuit iCa^{++} 12 hours after initiation and every 12 hours thereafter.
4. Patient iCa^{++} levels
    a. Within 1 hour before start of CRRT and at 2, 4 and 6 hours after start. This is the period with greatest risk of citrate build up. Call the physician if patient iCa^{++} is outside the No Change range of Table 2 (goal 1.05-1.25 mM) OR Table 3 (goal 1.2-1.4 mM) for advice on Ca-rate adjustments.
    b. Every 6 hours thereafter and use Table 2 OR Table 3 to make Ca-rate adjustments.
5. Titration Guidelines – Adjust rates according to table below
    a. The ACDA flow is fixed per physician order and is NOT titrated based on any iCa^{++} results.
    b. The calcium infusion is adjusted per Table 2 (Standard calcium dosing table) for goal systemic ionized calcium of 1.15 mmol/L (range 1.05 -1.25 mmol/L) OR Table 3 (High calcium dosing table) for goal systemic ionized calcium of 1.3 mmol/L (range 1.2-1.4 mmol/L). The calcium infusion is adjusted only every 6 hours unless otherwise ordered by the physician in MiChart.

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Table 2 (Standard Calcium Dosing): Systemic ionized calcium target of 1.05 -1.25 mmol/L
136 mM $CaCl_2$ Infusion Rate Adjustment Based on Systemic iCa^{++} Every 6 hours

	The patient's ionized calcium level checked every 6 hours				
	Less than <0.95 mmol/L	0.95 – 1.04 mmol/L	**1.05 - 1.25 mmol/L**	1.26 – 1.4 mmol/L	**More than >1.4 mmol/L**
Current Ca-infusion Flow Rate mL/h	**Increase** Rate +**20%**; notify ICU and Nephro fellows	**Increase** Rate +**10%**	**No Change**	**Reduce** Rate -**10%**	**Reduce** Rate -**20%**; notify ICU and Nephro fellows
<=15	+2 ml/h	+1 ml/h	No change	-1 ml/h	-2 ml/h
16-25	+4 ml/h	+2 ml/h	No change	-2 ml/h	-4 ml/h
26-35	+6 ml/h	+3 ml/h	No change	-3 ml/h	-6 ml/h
36-45	+8 ml/h	+4 ml/h	No change	-4 ml/h	-8 ml/h
46-55	+10 ml/h	+5 ml/h	No change	-5 ml/h	-10 ml/h
56-65	+12 ml/h	+6 ml/h	No change	-6 ml/h	-12 ml/h
66-75	+14 ml/h	+7 ml/h	No change	-7 ml/h	-14 ml/h
76-85	+16 ml/h	+8 ml/h	No change	-8 ml/h	-16 ml/h
86-95	+18 ml/h	+9 ml/h	No change	-9 ml/h	-18 ml/h
96-105	+20 ml/h	+10 ml/h	No change	-10 ml/h	-20 ml/h

Table 3 (High Calcium Dosing): Systemic ionized calcium target of 1.2 -1.4 mmol/L
136 mM $CaCl_2$ Infusion Rate Adjustment Based on Systemic iCa^{++} Every 6 hours

	The patient's ionized calcium level checked every 6 hours				
	Less than <1.1 mmol/L	1.1 – 1.19 mmol/L	**1.2 - 1.4 mmol/L**	1.41 – 1.55 mmol/L	**More than >1.55 mmol/L**
Current Ca-infusion Flow Rate mL/h	**Increase** Rate +**20%**; notify ICU and Nephro fellows	**Increase** Rate +**10%**	**No Change**	**Reduce** Rate -**10%**	**Reduce** Rate -**20%**; notify ICU and Nephro fellows
<=15	+2 ml/h	+1 ml/h	No change	-1 ml/h	-2 ml/h
16-25	+4 ml/h	+2 ml/h	No change	-2 ml/h	-4 ml/h
26-35	+6 ml/h	+3 ml/h	No change	-3 ml/h	-6 ml/h
36-45	+8 ml/h	+4 ml/h	No change	-4 ml/h	-8 ml/h
46-55	+10 ml/h	+5 ml/h	No change	-5 ml/h	-10 ml/h
56-65	+12 ml/h	+6 ml/h	No change	-6 ml/h	-12 ml/h
66-75	+14 ml/h	+7 ml/h	No change	-7 ml/h	-14 ml/h
76-85	+16 ml/h	+8 ml/h	No change	-8 ml/h	-16 ml/h
86-95	+18 ml/h	+9 ml/h	No change	-9 ml/h	-18 ml/h
96-105	+20 ml/h	+10 ml/h	No change	-10 ml/h	-20 ml/h

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6. Notify Physician for the following:
    a. Unexpected clotting in the extracorporeal system – poor access flow is likely.
    b. Ionized calcium >20% outside goal range as specified in Table 2 OR 3.
    c. Circuit iCa^{++} > 0.5 mmol/L
    d. If patient iCa^{++} < 1 mmol/L

Standards and Precautions:

1. Routine labs done at *least* daily include: renal panel.
2. Basic dialysate bags contain*: Na 136 mEq/L, Cl 115 mEq/L, HCO_3 25 mEq/L, Mg 1.5 mg/dL, K 2 mEq/L; there is NO calcium, phosphorus or glucose.*
3. *Additional modifications (as needed per physician order): KCl (add 1-2 mEq/L, for total K 3 or 4 mEq/l) and/or $KHPO_4$ (at 0.75 mmol or 1.5 mmol/L) and/or bicarbonate (add 5 to 25 mEq/L for total 30 to 50 mEq/L).* If the sum of dialysate plus replacement fluid rate changes, it must be accompanied by a ***proportional*** adjustment to the calcium infusion rate. If such a change is warranted, call nephrology or ICU physician (only in 5 D) to discuss.

   EXAMPLE: Replacement fluid plus dialysate fluid rate decreased from 3000 mL/hr to 2000 mL/hr (ie. 33% decrease), then calcium chloride infusion rate must be decreased by 33% at the same time. Call nephrology to suggest that change (the nurse will not be making this change without an order).
4. The calcium pump must be paused (or turned off) when the blood pump stops for any period of time (more than several minutes) to avoid unneeded calcium administration to the patients.
5. For therapy interruptions (e.g. diagnostic tests, surgery in OR, catheter change, system clotting and replacement, line reversal), **restart** all the CRRT system settings, citrate- and calcium infusions at the rates they were prior to stopping therapy unless otherwise ordered by the physician. Resume patient iCa^{++} checks every 6 hours. For patients with lactate >4 at restart, do patient iCa^{++} checks as for a new start (within 1 hour of CRRT pre-initiation, and at 2, 4, and 6 hours and then every 6 hours) unless instructed otherwise by the physician.
6. Additional calcium chloride doses for treatment of low systemic ionized calcium should be infused into central venous access over 10 minutes.