

TITLE: Citrate CRRT Anticoagulation Protocol

STATEMENT:

The Citrate CRRT anticoagulation Protocol is designed to provide the Bedside Care giver with specific instructions for maintaining adequate Citrate anticoagulation during CRRT treatment.

Citrate anticoagulation may not be used in patients who have contraindication for anticoagulation such as those with active bleeding, septic/cardiogenic shock, thrombocytopenia, lactic acidosis and liver cirrhosis or failure.

In patients with contraindications for citrate, KDIGO suggest using either unfractionated or low-molecular-weight heparin instead of other anticoagulants

SCOPE:

The Advanced Technologies Specialist will implement this provider ordered protocol for Citrate and Calcium drips as soon as the patient is placed on CRRT support and be managed by the bedside nurse.

ELABORATION:

1. This protocol helps meet quality measures to ensure safety, quality and consistency/standardization in patient care.
2. The protocol is included in the CRRT order sets.
3. Standard concentrations for the drips will be utilized
 - a. Anticoagulant Citrate Dextrose solution (1000 ml bag)
 - i. Each 100 ml contains 2.45g dextrose, 2.2g sodium citrate, 730 mg citric acid

b. Calcium Drips

- i. Calcium Chloride 8g mixed in 1L Normal Saline
- ii. Calcium Gluconate 24 g mixed in 1 L Normal Saline

PROTOCOL

1. Prime CRRT Circuit per ordered prescription.
2. Place a 3-way high flow stop cock to both the “red access line” and “blue-return” ports of the CRRT circuit. Attach the Citrate ACD(A) Solution 1000cc to a regular IV pump and then attach it to the “arterial- red” stop cock.
3. When ready to start, the Citrate rate in ml/hr will be 1-1.5 x the blood flow rate of the CRRT machine (ml/min). (eg Start Citrate at 150 mls/hr if the BFR is 100 ml’s/min)
 - i. If patient has liver dysfunction, start the citrate rate at 1.0 x BFR.
 - ii. Do not set Citrate rate higher than 2.0 x the blood flow rate.
 1. High potential of placing patient into “Citrate Lock”
4. Set up the Calcium infusion (ie. 8gms Calcium Chloride in 1L NS or 24 gms of Calcium Gluconate in 1L of NS) as ordered via “blue return line” with high flow stopcock or another central access line. This will run at 30-50% of the Citrate flow rate in ml/hr. (eg Citrate rate = 150 ml/hr then CaCl rate = 60 ml/hr)
5. Set the flow rates in CRRT machine as ordered.
6. Connect the CRRT machine circuit to the dialysis catheter as per procedure and press start.

7. Check Patient iCa (Drawn from patient, not from CRRT circuit)
 - a. 1 hour after initial start of CRRT
 - b. Every 2 hours x 2
 - c. Every 4 hours while stable on CRRT
 - i. Stable is defined as patient iCa in range per Table 1 and being in physician ordered blood pressure ranges.
 - d. If patient stable on CRRT Recheck iCa
 - i. 2 hours after
 1. CRRT interruptions: recirculation, Patient trips, Circuit restarts
 2. Any Calcium drip or Citrate ACD-A rate change/pause.
 - ii. 1 hour after any corrective bolus of Calcium
 1. Bolus dose stated in Table 1

8. Titrate the Calcium infusion according to the calcium sliding scale below from patient iCa measurements :

Table 1		
Patient ionized Ca ⁺⁺ (mmol/L)	Calcium Infusion Adjustment	
	> 20 kg	< 20 kg
iCal > 1.3	↓ rate by 10ml/hr	↓ rate by 5 ml/hr
iCal 1.1-1.3 (Optimum Range)	No adjustment	
iCal 0.9-1.1	↑ rate by 10ml/hr	↑ rate by 5 ml/hr
iCal < 0.9	↑ rate by 20 ml/hr and give a bolus of Calcium Chloride 10mg/kg up to 1g max dose	↑ rate by 10 ml/hr and give a bolus 10mg/kg of Calcium Chloride
NOTIFY MD IF Calcium INFUSION RATE > 150 ml/hr; For patients <10kg, NOTIFY MD IF Calcium INFUSION RATE >15ml/kg/hr		

9. RN to notify Renal Fellow if Patient's $iCa < 0.9$ mmol/L does not improve with bolus of calcium stated in Table 1.

- a. Physician may consider holding Citrate for 1 hour and resuming infusion at 30% of the Citrate flow rate and giving bolus with 10 mg/kg of CaCl and increase Calcium infusion rate by 10 ml/hr.

10. If the filter clots/clogs, stop the Citrate and Calcium infusions and discontinue the filter.

11. Troubleshooting and Potential complications

- a. Citrate "Lock"/Toxicity

- i. Occurs when the total calcium rises with a low ionized calcium.

1. This is due to the citrate infusion rate exceeds the clearance on dialysis/CRRT and from impaired hepatic metabolism.
2. The total- to ionized-calcium ratio is used to detect citrate accumulation with an optimal cutoff at 2:1.
3. Metabolic acidosis with increased anion gap OR metabolic alkalosis
4. Sudden and unexpected hypotension, Long QT, bradycardia, cardiac arrhythmia, decreased cardiac output

- b. Hypocalcemia

- i. Consider if you see a sudden drop in patient heart rate and blood pressure.

- c. Avoid systemic ionized calcium levels >1.3 mmol, may be harmful

REFERENCES:

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