

## ***CITRATE ANTICOAGULATION: USING NORMOCARB***

### **Purpose:**

Calcium plays a critical role in the initiation of clotting. Citrate is used to bind calcium and prevent blood from clotting (it is added to packed red blood cells for this reason). Citrate is added to packed red blood cells to prevent clotting.

Citrate administered prefilter will produce effective anticoagulation to the filter. Post filter ionized calcium levels are measured to titrate the citrate infusion with a goal for the post filter ionized calcium of .25-.35.

Systemic ionized calcium **MUST** be normal. Cardiac conduction and contractility and BP are among the important functions of calcium. Systemically, an infusion of calcium chloride must be administered to ensure immediate normalization of the systemic calcium. The calcium chloride infusion is titrated to maintain a systemic (arterial line) ionized calcium level of 1.0 – 1.3.

Citrate administered prefilter allows the filter to be regionally anticoagulated without anticoagulating the patient. Thus, citrate is indicated in a patient who cannot be anticoagulated systemically, but requires anticoagulation to prevent filter clotting.

Ionized calcium is the biologically active portion of serum calcium; total calcium (measured with a standard CCTC 1) is not an appropriate marker.

### **Setup:**

- o A calcium chloride infusion of 8 gm in 1/L is infused systemically. It must run via a central line that is not part of the dialysis circuit. Administration via the return side of the dialysis catheter causes mixing of the calcium with the access blood (this would result in higher citrate infusion requirements).
- o A premixed bag of Citrate ACD is infused via Colleague pump and connected to the PRISMA filter set at the point where the anticoagulant syringe is normally connected. Citrate is obtained from HMMS. While priming, turn the infusion on to allow some of the citrate to run into the circuit.
- o Dialysis is mixed up by the nurses as an electrolyte solution (normocarb) added to a 3 liter bag of STERILE WATER.
- o The PRISMA is primed as per normal routine. Heparin can be added to the priming solution if heparin is not contraindicated. If heparin cannot be used, prime with plain normal saline.

### **Lab Samples:**

- o Systemic ionized calcium: draw from arterial line and order as CAIBlood. The goal is 1.0 – 1.3. The calcium chloride infusion is adjusted to maintain this level. If the systemic ionized calcium falls below .75, an order to give 1 gm calcium chloride bolus IV over 1 hr should be considered.
- o Post filter ionized calcium: draw from blue port of filter and order as CAIBlood PF. The goal is .25-.35. The citrate is adjusted to maintain this level.
- o Initial samples should be obtained 1 hour after starting dialysis. Repeat q3h until 2 levels within range, then q6h.

### Dialysate Solution:

- o Hemosol contains calcium, which increases citrate requirements if used for with citrate anticoagulation protocols. Therefore, a dialysis solution that is free of calcium is being used.
- o The dialysis solution must be mixed by the nurse by adding 1 240 ml bottle of normocarb electrolyte solution to 3 liter of sterile water for irrigation. **ALWAYS ENSURE THAT THE NORMOCARB HAS BEEN ADDED; USING STERILE WATER WITHOUT ELECTROLYTES TO DIALYZE WOULD RESULT IN PROFOUND ELECTROLYTE ALTERATIONS. DO NOT MIX BAGS IN ADVANCE FOR THE NEXT SHIFT...**you want to be certain the normocarb has been added. To make it easier for the oncoming shift, change the bag early if a bag change is expected within the first 30 minutes of the shift. To change a bag early, choose “bag change”.
- o **\*CHECK THE BAG CAREFULLY TO MAKE SURE THE 3 LITER BAG IS STERILE WATER AND NOT .9 NaCl.** Normcarb contains sodium, adding it to .9 NaCl would increase the sodium concentration.
- o A 3 liter solution provides a final concentration of Na 140 Mg 1.5 Cl 106.5 and HCO<sub>3</sub> 35.
- o **Normocarb dialysate has NO POTASSIUM**, therefore, add KCl per protocol as per Hemosol BO
- o Start Dialysis at 1000 ml/hr. If replacement rates are increased to correct high bicarb levels, reduce dialysate rate by an equal amount (e.g if replacement rates increase to 200 ml/hr, decrease dialysate to 800 ml/hr).

### Calcium Chloride:

- o If starting a new treatment where ionized calcium levels are not known, check the ionized calcium level before initiating dialysis to ensure it is normalized before citrate is started.
- o Before beginning dialysis, start the calcium chloride infusion via central access. Begin at the previous rate if restarting the treatment. Run the calcium infusion at least 15 minutes before starting dialysis to minimize the risk of inducing systemic hypocalcemia during citrate initiation.
- o If the filter clots and you reset right away, leave the calcium chloride infusing. If the filter is down for a prolonged period, stop the calcium chloride infusion and restart 15 minutes before beginning the treatment.
- o Measure systemic ionized calcium levels (arterial line) one hour after starting treatment and with post filter ionized calcium levels.
- o Adjust the calcium chloride infusion up or down as follows to maintain a systemic ionized calcium level of 1.0-1.3:
  - o If <.75: increase by 10 ml/hr and call MD (consider 1 gm bolus over 1 hr)
  - o If .75-1.0: increase by 5 ml/hr
  - o If 1.0-1.3: no change
  - o If >1.3: decrease by 5 ml/hr

### **Citrate:**

- o Ensure calcium chloride is already running before starting citrate
- o Start citrate at 150 ml/hr. Titrate according to post filter ionized calcium 1 hour after starting treatment.
- o Adjust the citrate infusion up or down as follows to maintain a post filter ionized calcium level of .25-.35:
  - o If < .25: decrease by 10 ml/hr
  - o If .25-.35 no change
  - o If .35-.45 increase by 10 ml/hr
  - o If >.45 increase by 20 ml/hr

### **Replacement**

- o Replacement must be saline. DO NOT use hemosol (as it contains calcium and bicarb). DO NOT add bicarb to the .45 NaCl.
- o Add a "Y" connector to the .45 and .9 NaCl and hang both bags onto the centre hook of the replacement side to reduce the frequency of bag changes.
- o Treatment is started with NO replacement. Increased replacement rates may increase the citrate clearance, therefore, replacement is avoided.
- o Citrate is metabolized to bicarbonate which can lead to a rise in the serum bicarbonate level. If bicarb levels rise, replacement is started to reduce bicarb levels.
- o Replacement is usually started at rates between 100-200 ml/hr.
- o For every increase in the replacement, reduce the dialysate rate by an equal volume (e.g. if replacement is increased by 100 ml/hr, reduce the dialysis rate by 100 ml/hr). (The dialysis solution has bicarb).
- o Replacement initially is .9 NaCl alternating with .45 Saline. Higher replacement rates can lead to hypernatremia; if this happens, obtain an order to change all bags to .45 NaCl.

### **Blood Flow Rates:**

Initiate treatment with blood flow at 100 ml/hr. If tolerated maintain blood flow at 100 ml/hr. With the Prismaflex™ you may need to increase the blood flow rate to eliminate false access or return disconnect alarms. Rates above 100 ml/hr do not significantly alter clearance, but may impact citrate requirements.

### **Fluid Removal:**

- o **When starting a new treatment, do not begin fluid removal for 10 minutes to ensure BP is being maintained.**
- o After approximately 10 minutes, begin fluid removal as follows:
- o **Set fluid removal volume to:**  
**Citrate volume + calcium chloride volume + desired fluid removal**
- o When charting, create a column to record the hourly citrate rate and the calcium chloride rate in the anticoagulant section.
  - o In the fluid removal section, record the net fluid removed (the fluid removed – [citrate rate + calcium chloride rate])
  - o The running total of fluid removed should be the net total. Do not add up the calcium chloride or citrate volumes and include in your intakes...this just requires you to add up large output totals that contain the same volumes, requiring unnecessary subtraction. Keep it simple and record **net** removal as you go.

**Line Patency:**

- If the therapy is being stopped, maintain line patency with citrate.
- Draw up a volume of undiluted citrate from the bag that is equal to the volume in each limb plus .1 mL and instill into the catheter.

**Problems to Watch for:**

- Citrate is rapidly metabolized to bicarbonate, and frequently causes a rise in the serum bicarbonate level. High bicarbs are treated with higher replacement rates.
- Increasing the normal saline replacement can lead to hypernatremia; if this happens, change replacement to .45
- Treat low potassium, magnesium and phosphate as per protocol.

**CITRATE TOXICITY:**

- Most common when the liver is dysfunctional (liver converts citrate to bicarb)
- Suspect if patient suddenly requires increasing doses of citrate to achieve desired effect.
- A total calcium:ionized calcium ratio that is >2:1 or increased anion gap could indicate citrate toxicity.

**IMPORTANT POINTS:**

- Systemic hypocalcemia can cause hypotension, decreased cardiac output, cardiac arrest and muscle tetany. Always think “is this patient hypocalcemic” if BP changes occur.
- DO NOT use calcium channel blocking agents.
- Support the systemic calcium level by starting the calcium chloride before starting the citrate infusion
- Watch BP carefully when initiating citrate. Wait until BP is stable before starting fluid removal.
- The fluid removal must be set to the citrate + calcium chloride + desired fluid removal rate. Keep the math simple...only record the net fluid removed.