

CITRATE CHECKLIST

Ionized calcium is needed in several steps of the coagulation cascade. Therefore, citrate can be administered pre-filter via the pre-blood pump to prevent coagulation and preserve filter life, by chelating to ionized calcium. However, this is quickly reversed to prevent fatal decreases in systemic ionized calcium, by simultaneously infusing calcium chloride via a central line.

SAFETY

1. Check EACH citrate bag and make sure you have Sodium Citrate ACD-A (not dihydrate)
2. Check EACH dialysis solution bag careful to make sure you have the correct solution.
Prism0Cal looks similar to Prism0sol and has zero potassium, zero glucose and zero calcium).

THREE MAJOR RISKS WITH CITRATE

- 1) **Bradycardia, hypotension, or cardiac arrest due to low systemic ionized calcium.** The most important value to maintain in target is the SYSTEMIC ionized calcium. You have orders for calcium boluses based on severity of hypocalcemia. These can be given by infusion pump or 10 minutes or by IV bolus if patient is symptomatic (keep an amp at the bedside). In the event of sudden bradycardia and hypotension, err on the side of treating hypocalcemia.
- 2) **Citrate toxicity.** Usually develops gradually. A common sign that it is developing is the need to upwardly titrate both the citrate and calcium infusion rates after initial stabilization. Another sign is an increased “Systemic total calcium: Systemic ionized calcium ratio” (called the Citrate Toxicity Screen). Use with caution in patients with moderate or severe liver dysfunction.
- 3) **Electrolyte imbalances.** Risk for hypernatremia and/or metabolic alkalosis (the liver metabolizes citrate to bicarbonate and Sodium Citrate ACD-A has a sodium of 224 mmol/L). Hypoglycemia can develop (PrismOcal has zero glucose), particularly in patients receiving insulin therapy who are not receiving adequate carbohydrates.

HIGH LEVEL DIFFERENCES FROM OTHER CRRT PRESCRIPTIONS

- Citrate (2% Sodium Citrate ACD-A) is run on the Pre Blood Pump and is titrated based on post filter ionized calcium (uncorrected).
- Calcium chloride infusion (7g/500 mL) is mixed in Pharmacy. It runs via a separate central line and is titrated based on systemic ionized calcium (uncorrected).
- Prism**0**CAL is used on both the dialysis and replacement pumps. Potassium is added based on the potassium protocol (minimum of 2 mmol/L). **Prisma0CAL has no potassium, glucose or calcium.**
- Blood flow orders are restricted to 150-200 ml/minute and should be set as close to 150 ml/min as possible. This minimizes citrate and calcium requirements and improves stabilization.
- Initially, set blood flow to 150 ml/minute. If the access is not at least –15 and return at least +15, adjust the flow rate upward in increments of 10 ml/min until minimum pressure achieved. This will prevent access and return alarms. Avoid changing the flow rate unless needed to manage alarms.

CHECKLIST: BEFORE INITIATING THERAPY

☐	Contact CNS/Educator or CN to ensure adequate supply of products.
☐	Review prescription orders. Review prescription and bag contents carefully, as rates and solutions are different from other CRRT therapies
☐	Ensure “NEPH – Continuous Renal Replacement Therapy (CRRT) Citrate VH” Order Set is used (not just the prescription). The Order Set includes all relevant orders including specific lab orders and both calcium infusion and bolus doses.
☐	Ensure your patient has both an arterial line and a separate central line.
☐	Obtain the following baseline blood work: • Liver function tests (baseline evaluation) • Calcium, Serum (CA) - this is the total calcium drawn systemically • Calcium Ionized Whole Blood (CAIBLD) - this is the systemic ionized calcium This provides baseline assessment to guide initial calcium therapy. When sent to core lab it will populate to the CRRT grouper. • Serum potassium (use the GEM to titrate CRRT potassium)
☐	Prepare Solutions: 1. Prime Calcium Chloride Infusion. It needs to run into a central venous line. This will be used for both the continuous infusion and for administering non-urgent bolus dosing. The starting rate is usually 30 ml/hr AFTER correcting a low systemic ionized calcium. 2. Prepare 2 bags of PrismOCal solution (one for dialysis and one for replacement pumps, usual rate is 1,000 ml per pump). These have zero potassium, glucose and calcium. Add potassium according to protocol. 3. Ensure that citrate solution is sodium citrate ACD-A (not citrate dihydrate). This will run on the PBP. You can hang one bag on the centre hook of the PBP or you can use a double spike extension set and hang two at a time. The starting rate is 200-250 ml per hour.
☐	Print a copy of potassium and citrate titration protocols from CCTC Website.

CHECKLIST: SET UP

☐	Review systemic ionized calcium level and treat a low systemic ionized calcium per protocol now.	
☐	Choose “no anticoagulation” for citrate and all CRRT prescriptions in CCTC.	Choosing anticoagulation means you will use the CRRT syringe pump. If chosen in error, load a syringe with plain saline.
☐	Set blood flow rate to 150 ml/h. When you initiate therapy, assess the access and return pressures. If access is less than –15 and/or return is less than +15, increase blood flow rate by 10 ml/hour until pressures are above these levels. Once started, keep flow rates stable unless adjustments are required to manage alarms.	This is different from typical rates and should be kept constant. The goal is 150 ml/h. This minimized citrate and calcium chloride requirements and minimized titration requirements.
☐	Keep the spike on the PBP tubing. You will need it to hand the citrate on the PBP.	
Do not start CRRT therapy until calcium infusion has been infusing for 15 minutes.		

CHECKLIST: INITIATION

☐ Replace systemic ionized calcium (uncorrected) if not already done, using the CRRT electrolyte protocol before initiating therapy.	Help to prevent systemic hypocalcemia.
☐ Start calcium chloride infusion via separate central line 15 minutes before CRRT therapy.	Help to prevent systemic hypocalcemia.
☐ After 15 minutes, hook patient up and begin CRRT.	
☐ Follow lab monitoring requirements listed on next page.	Ordered in Order Set.

LAB MONITORING REQUIREMENTS

TITRATION TIPS

Do not over adjust. If post filter ionized calcium level is close or trending in the right direction, wait till next assessment. If the SYSTEMIC ionized calcium is low, correct to get it in target – **keeping the systemic ionized calcium normal is the most important**. If ionized calcium is out of range by ~0.03 or less, reassess on the next check before adjusting citrate in either direction, **or before reducing** the calcium chloride infusion.

If the citrate level needs to be upwardly titrated repeatedly, review with CCTC Senior Resident or Nephrology to consider changing the post filter target to 0.45-0.55. This reduces the likelihood of citrate toxicity and should still provide adequate anticoagulation of the filter. In a patient with previously stable citrate and calcium chloride infusions begins to require upward titration of both infusions, consider citrate toxicity. Raising the post filter ionized calcium target should be initiated.

HOW TO ORDER LABS:

Post Filter Ionized Calcium:

Draw from blue sampling port on CRRT circuit. Measure on GEM (for ease and speed of results), unless doing Citrate Toxicity Screen. Order label as POC VENOUS and select “Ionized Calcium” option on the GEM. Enter the comment “postfilter” (do not run as a gas or results will be confusing).

Systemic Ionized Calcium:

Draw from arterial line. Measure on GEM unless doing Citrate Toxicity Screen. Order label as POC Arterial Blood gas plus. Run as a regular arterial blood gas sample.

Citrate Toxicity Screen (Total Calcium to Ionized Calcium Ratio)

Calculation: Total Calcium (CA) / Systemic Ionized Calcium (arterial line). Normal value is less than 2.5% Measure Q 24 hours LFTs are normal; Q12H is abnormal function. Time the collection to coincide with routine titration assessment. **When doing Citrate Toxicity screen, send all samples (total calcium, post filter ionized calcium and systemic ionized calcium) together to the core lab** (instead of running on GEM). If sent to core lab, results will then be pulled into the lab section of the CRRT grouper and ratio calculated for you. If you ran the systemic ionized calcium on the GEM but have a total calcium from the same time window, you can manually calculate if you have a Total Calcium from the same time. Document in CRRT grouper.

CORE LAB CODES:

Total Calcium (CA) green top tube

Systemic Ionized Calcium (CAIBLD) – send in blood gas syringe filled to 50%

Postfilter Ionized Calcium (CAIBLDPF) – send in blood gas syringe filled to 50%

One Hour After Initiation

- ☐ Systemic Ionized Calcium (if corrected and uncorrected reported, titrate to uncorrected)
- ☐ Post Filter Ionized Calcium (if corrected and uncorrected reported, titrate to uncorrect).

Q3 hours

Repeat q3h until two consecutive values for both are within target, then blood work q6h

- ☐ Systemic Ionized Calcium (Uncorrected)
- ☐ Post Filter Ionized Calcium (Uncorrected) comment "postfilter"

Other Labs

- LFTS Q12 – 24 hours
- Citrate Toxicity Screen (Q24H with routine ionized calcium assessment, increase to Q12H if hepatic dysfunction)
- All other labs as per usual CRRT including post filter urea/ultrafiltration screen
- Increase glucose and potassium assessment with insulin titrations
- Activate CCTC Electrolyte Replacement Orders as per all CRRT prescriptions

RESTARTING CRRT MACHINE

When restarting a new circuit (after machine has been down or for routine), review the chart to identify the last citrate (PBP) infusion rate and rate of calcium chloride infusion. **INITIATE TREATMENT WITH THE RATES WHEN THE PATIENT WAS PREVIOUSLY IN TARGET.**

Prior to initiating treatment, measure a SYSTEMIC IONIZED CALCIUM on the GEM. Treat a low value with a calcium chloride bolus (per protocol), then start Calcium Chloride infusion 15 minutes before hook up.

Recheck SYSTEMIC IONIZED CALCIUM in 1 hour to ensure it is within normal range AND bolus if necessary to get to steady state (do not reduce the infusion at this point).

Repeat both post filter and systemic ionized calcium levels 3 hours before starting therapy and follow protocol. If post filter is close to desired range or systemic ionized calcium is above range, you can wait to adjust and reassess in 3 hours.

Always correct a low systemic ionized calcium (bolus is preferred if running at previously successful infusion rate).