# Sodium Citrate 4% as an Alternative to Heparin 1,000 U/ mL for Maintaining Catheter Patency in Children

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## Background

- Central venous catheters (CVCs) are the first line of vascular access placed for children requiring hemodialysis (HD) or therapeutic plasma exchange (TPE).
- Maintaining patency when the CVC is not in use is critical in preventing premature removal
- Our current strategy to maintain CVC patency involves locking both lumens with heparin 1,000 u/mL.
- Heparin inactivates thrombin but is associated with adverse side effects including bleeding, heparin induced antibodies, and biofilm formation.
- Sodium citrate 4% (SC) prevents clotting by lowering ionized calcium and is an alternative, but the potential for hypocalcemia from inadvertent flushing led to safety inquiries.
- We calculated a safe SC exposure using caffeine citrate, a drug used to treat apnea of prematurity and showed lower citrate exposure for SC compared to caffeine citrate even if both CVC lumens are flushed.

**A formulation comparison of exposure for each medication was calculated. Based on a 5 kg infant, we assumed to have a 1 mL fill volume per lumen . The standard dose for of caffeine citrate for AOP is 40 mg/kg (2mL/kg)**

| Medication | Dose | Exposure |
|---|---|---|
| **Caffeine Citrate** | 2 mL/kg | 133 mg citrate |
| **Sodium Citrate (4%)** | 2 mL | 80 mg citrate |
| **Heparin 1,000 units/ mL** | 2 mL | 2,000 units (400 units/kg) |

- Adult literature revealed efficacy as an anticoagulant lock and demonstrated minimal risk of bleeding, however, pediatric evidence is lacking

## Methods

- We conducted a prospective crossover study assessing the efficacy and safety of locking CVCs with heparin vs. SC in children receiving HD or TPE. Patients were randomized to begin locks with SC or heparin and would crossover every 3 procedures for a maximum of 24 procedures until one of the fowling end points:
  1. Catheter change
  2. Termination of respective therapy
  3. Completion of study
- **Primary Outcome:** number of CVC occlusions tissue plasminogen activator (tPA) doses to declot CVCs using each locking solution

| Catheter Occlusion Definitions | |
|---|---|
| **Mild** | Difficulty aspirating / flushing but resolved with normal saline power flush |
| **Moderate** | Difficulty aspirating/ flushing (not achieving prescribed BFR) requiring the use of tPA |
| **Severe** | Difficulty aspirating/ flushing (not achieving prescribed BFR) requiring CVC exchange |

- **Secondary Outcomes**: CVC replacement secondary to clotting, inability to achieve prescribed blood flow (BFR), CLABSI rates, and bleeding events.
- Statistical significance was assessed using chi-square analysis; a p-value of <0.05 was considered to be significant.

## Results

- Between June 2018 and November 2019, 17 patients were enrolled in the study HD (8) and TPE (10).

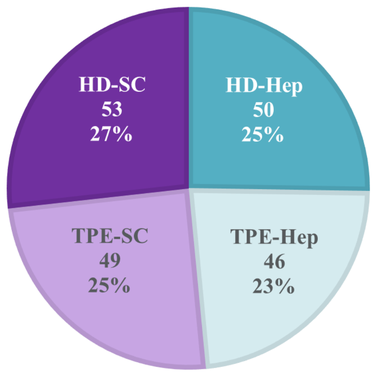


**Figure 1. Procedure Count by Locking Solution**

- A combined 198 procedures were completed with 102 (51.5%) having SC dwelling since the prior treatment.
- No significant difference in the number of tPA doses between heparin and citrate (p = 0.8)
- These totals include all tPA doses even when not clinically needed for occlusion

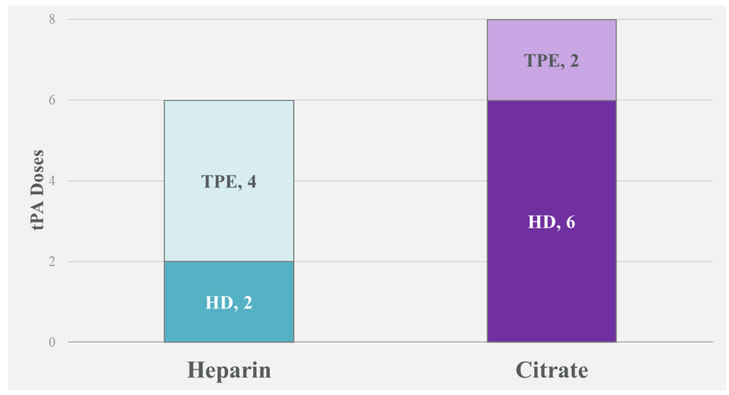


**Figure 2. Total tPA Doses**

- Incidents of adverse events measured as secondary outcomes does not significantly differ by locking solution
- No CVCs required replacement and no bleeding events were observed

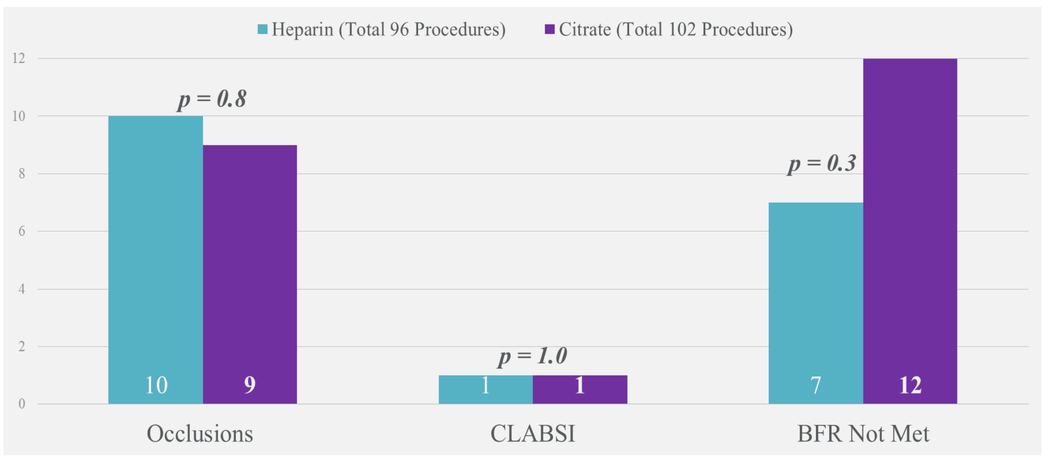


**Figure 3. Incidents of Adverse CVC Events by Locking Solution**

## Conclusion

Our study found SC to be equally efficacious as heparin at maintaining CVC patency for children with similar low incidences of CVC dysfunction and CLABSI rates.