

Heparin

Observational study of activated clotting times in heparinized pediatric hemodialysis patients

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Introduction

Heparin sodium, the most widely used anticoagulant in adult hemodialysis patients, has been demonstrated to be safe and effective in preventing catheter and blood circuit path clotting¹⁻⁹. Unfortunately, the dosing of heparin sodium in pediatric patients is based on a limited number of studies¹⁰⁻¹². Most hemodialysis treatment protocols prescribe a heparin loading dose of 10-20 units/kg to quickly achieve adequate anticoagulation, followed by a continuous infusion of 5-10 units/kg per hour^{10,12}. Other dosing algorithms have not been evaluated in pediatric patients.

Due to the rapid turn-around time needed to adjust heparin infusions, ACT values are measured using point of care testing. At Loma Linda University the Hemocron Signature Elite (ITC, Piscataway, NJ 08854) will be used¹³. At Stanford University an iSTAT (Abbott Point of Care Inc. East Windsor, NJ 08520) ACT device. Research has demonstrated a reasonable correlation between the iSTAT standard laboratory testing¹⁴⁻¹⁷. No comparison studies of these two devices have been performed.

Study design

A two-center, prospective, observation study where prospective data from 100 pediatric acute and chronic hemodialysis patients will be collected.

Subject recruitment

One hundred subjects will be recruited for the study. Subjects may be removed from the observation study at any time at the discretion of the child's parents or physician. We anticipate that forty patients will have ACT values within the desired range for hours 1, 2 and 3.

Inclusion Criteria

Acute and chronic pediatric hemodialysis patients 0-21 years of age at Loma Linda University and Stanford University

Exclusion Criteria

Age greater than 21 years of age or concurrent treatment with another medication that affects ACT values.

Collection of Baseline data

Collected baseline subject data will include:

1. Name

Heparin

2. Date of birth

The information collected (above) will be stored in a binder and desktop computer in A1120A. The patient will be provided with a unique identifier that will be used for all subsequent data entry.

The following data will be entered on the PedStudy website (<http://pedstudy.org>)

1. Gender
2. Ethnicity
3. Cause of renal disease necessitating hemodialysis
4. Date of initiation of hemodialysis
5. Weight
6. Height

Data collected at the time of treatment includes:

1. Site
2. Date of observation
3. Time of HD start
4. Initials of prescribing Pediatric Nephrologist
5. Initial heparin push dose
6. Heparin infusion rate
7. ACT values
 - a. 0 hour
 - b. 1 hour
 - c. 2 hour
 - d. 3 hour
 - e. Any additional ACT data
8. ACT times
 - f. 0 hour
 - g. 1 hour
 - h. 2 hour
 - i. 3 hour
 - j. Any additional ACT data
9. Additional heparin given (Yes, No)?
10. Additional dose in (units)
11. Time at which additional dose was given after starting hemodialysis
12. Medicine received which interacts with heparin (Yes, No)?
13. Loss of circuit due to clotting (Yes, No)?

Primary Outcome Measure

We will determine the optimal and simplified equation for heparin dosing in pediatric hemodialysis patients. Consideration will be given to developing age-specific recommendations if possible. To derive a formula, we will need to specifically evaluate heparin dosing in those subjects who achieved ACT target values. We will assess heparin dose relative to:

1. Ethnicity
2. Gender

Heparin

3. Weight
4. Body surface area
5. Body mass index
6. Blood volume ($BV = aH^3 + bW - c$; where $a = 0.000417$ for males and 0.000414 for females, $b = 45$ for males and 32.8 for females, $c = 30$ mL)
7. Plasma volume ($PV = \text{Blood volume}(1 - (\text{hematocrit}/100))$).

Secondary variables to be studied

We will evaluate:

1. The frequency at which ACT values are within the target ranges
2. ACT relative to time for children who receive a single dose of heparin
3. ACT area under the curve relative to heparin dosing.
4. Change in heparin dosing over time for chronic hemodialysis patients.

Study design

Once consent has been obtained the subject will enter the study. All subjects within a weight group will receive heparin therapy as written by their Pediatric Nephrologist (Suggested heparin doses are written below). Heparin doses are based on reports by Geary et al¹⁰ and Ozen et al¹² which suggest a 10-20 units/kg initial dose, followed by a continuous infusion of 5-10 units/kg per hour.

	Subject weight	Push	Additional (per hour)
Heparin dosing	20-24.9 kg	500	250
	25.0-29.9 kg	600	300
	30-34.9	700	350
	35-39.9	800	400
	40-44.9	900	450
	45-49.9	1000	500
	50-54.9	1100	550
	55-59.9	1200	600
	60- 64.9	1300	650
	65-74.9	1500	700
75-84.9	1700	800	

The subjects will have ACT studies performed at 0, 1, 2 and 3 hours into their dialysis treatments. If the subject is found to have sub-therapeutic ACT levels, then an additional dose (5-10 units/kg) and a 10-25% dose change will be prescribed by the dialysis physician.

Quarterly ACT monitoring is performed at the Loma Linda University and Stanford University Pediatric Hemodialysis Facilities for chronic patients, so that there is no additional cost or inconvenience involved in the study. ACT values are also routinely monitored for the first two-three acute hemodialysis treatments to insure that the heparin dose is sufficient.

Heparin

There is no risk to the subjects who participate in this study.

Why is this important?

Hemodialysis-dependent children routinely receive heparin for all of their hemodialysis sessions. The correct dosing of heparin reduces the risk of bleeding, circuit clotting and costs.

Heparin

References

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