Heparin for Arterial Lines in Neonates

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Close to Practice: Research at the Point of Care
June 6, 2013
Arterial lines commonly used in NICU

- Monitoring BP
- Access for frequent blood work

Types of arterial lines

- Umbilical arterial lines (UAL)
- Peripheral arterial lines (PAL)
Background

* Complications UAL
  * Catheter occlusion
  * Thrombosis

* Prevention of complications
  * Catheter design and materials
  * Tip placement
  * Heparin infusions
Heparin

- Helps reduce blood clots from forming
- Infusion required
- Exact amount required unknown
  - Balance between patency and bleeding
  - No standard
  - 0.25 to 1 unit/mL studied
Heparin is a high risk medication
  - Can cause bleeding

Mixing error in Texas in 2008
  - 14 to 17 babies received heparin overdose – 100 x
    - 2 possible deaths ??? heparin
  - No commercially available solution
  - Solution was mixed incorrectly in pharmacy
Safety Concern

* Size of bag in relation to size of patient
What led to study

* Standardize practice across region
  * 1 site Heparin 2 units/mL in 0.9% NaCl
  * 1 site Heparin 1 unit/mL in 0.45% NaCl
The Controversy

- In Canada a premixed bag of heparin is available
  - 2 units/mL 0.9% Sodium Chloride (1000 mL bag)
  - No evidence using this solution in literature

- Pharmacy mixed heparin solution
  - 1 unit/mL 0.45% Sodium Chloride (60 mL syringe)
  - Evidence supporting this concentration in the literature
The Decision

- Commercially available solution
  - Preferred when possible
  - Reduce mixing errors by pharmacy and nursing

- Evaluate safety and efficacy
Objectives

- Heparin 2 units/mL compared to 1 unit/mL
  - Occlusion rate
  - Duration of patency
  - Bleeding complications

- Number of changes required
  - Base solution, concentration, or rate
Method

* Chart review
  * Planned to review charts at 2 sites
    * Patients identified through lab report of arterial gases
    * Excluded patients if no heparin infused through a UAL

* Data collected
  * Catheter occlusion
  * Patency duration
  * Any documented bleeding
  * Heparin concentration and solution
  * Infusion rate
Chart Review

* First site
  * 295 charts from 2006 to 2009
    * 66 – UAL

* Did not meet study criteria
  * 167 – PAL
  * 62 - no heparin, charts not available, patient transferred
66 neonates

- Mean gestational age - 27.3 weeks (range 24 to 40)
- Mean birth weight of 1040 grams (range 460 to 4075)
- All 66 received heparin at a concentration of 2 units/mL
  - 60 initially received the commercially available solution
  - 6 received a solution prepared on the ward
    - Using 0.45% NaCl
Findings

* Elective removal – 82%
* Removal due to occlusion – 11%
  * Literature – occlusion ~ 13%
* Duration of patency – 141 hours (range 2-336)

* Bleeding complications
  * 1 neonate had a GI bleed
  * 17 neonates IVH (3 grade 3 or 4)

* Mean heparin dose 29.3 units/kg/day (range 7.2 to 55)
  * Literature - 25 to 220 units/kg/day
Findings

* Change solution to 0.45% NaCl - 35%
  * Ward mixed solution - 44%

* 58 neonates less than 1500 grams
  * 48% required 0.45% NaCl

* Orders did not match infusion – 7.6%

* Study stopped and results reported to team
Discussion

* Heparin is a high risk medication
  * Prefer to have only 1 heparin solution
  * If more than 1 solution
    * Increase risk of mixing errors
      * Preparing for line insertion - confusion
    * Issues with pump programming
    * Prescribing issues
Minimize unexpected complications
  * Hyperchloremic metabolic acidosis
  * Hypernatremia
    * Fluid administration increases the risk of:
      * Respiratory distress syndrome
      * Patent ductus arteriosus
      * Bronchopulmonary dysplasia
    * Hypernatremia or large changes in sodium level
      * Intraventricular hemorrhage and impaired functional outcomes
Recommendation

- Commercially available Heparin 2 units/mL 0.9% NaCl
  - Not recommended as standard solution
    - For very low birth weight neonates
  - Does not eliminate pharmacy or ward mixing of heparin
    - Almost half required a reduced sodium chloride solution
  - Multiple heparin solutions used
FH changed regionally to:

* Heparin 1 unit/mL 0.45% NaCl for arterial lines
* 1 solution ONLY
  * < 1500 g infuse at 0.5 mL/hr
  * ≥ 1500 g infuse at 1 mL/hr
* Pharmacy prepared 60 mL syringes (at tertiary sites)
Further Research

- Following neonates prospectively to determine:
  - Number of elective removals
  - If removed for complications – why
  - Duration of patency
  - Any changes in rates
Questions


