Intravenous Enoxaparin in Pediatric Burn Patients: A Retrospective Chart Review

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Abstract #3
IRB Approved

1

Disclosure

- Vonya N. Streetz
- Potential conflicts of interest: none
- Sponsorship: none
- Proprietary information or results of ongoing research may be subject to different interpretations
- Speaker's presentation is educational in nature and indicates agreement to abide by the non-commercialism guidelines provided

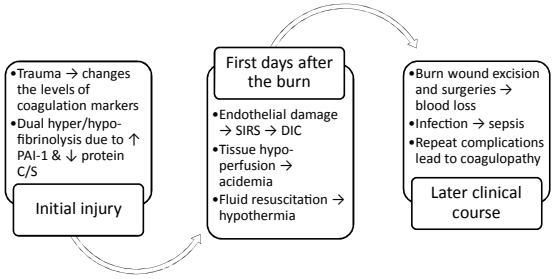
2

Objectives

- At the completion of this program, the participant will be able to:
  - Discuss the potential limitations of administering medications by the SC route in the pediatric burn population
  - Explain how to properly administer and monitor the use of intravenous enoxaparin in pediatric burn patients

3

The Hypercoagulable State



Glas GJ, Levi M, Schultz, MJ. *Journal of Thrombosis and Haemostasis*. 2016;14:865-74.

4

Anticoagulation

- Heparin
  - Intensive monitoring and difficult titration
- Enoxaparin
  - Twice daily dosing and less intensive monitoring
- Concerns with the SC Route
  - Fluid shifts
  - Weight changes
  - SC edema
  - Vasoconstriction
  - Lack of sufficient SC tissue

Top 10 Toddler Fears	
1. The dark	6. Separations
2. Monsters	7. Being alone
3. Weather	8. Costumes
4. Bad dreams	9. Bathrooms
5. Strangers	**10. DOCTORS**

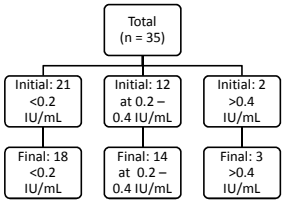
- Twice daily SC injections can lead to significant distress in the pediatric patient.

Cies JJ, Santos L, Chopra A. *Pediatric Critical Care Medicine*. 2014;15(2):e95-e103.

5

SC Enoxaparin in Pediatric Acute Burn Patients

- Study Design
  - Prospective
- Indication
  - Prophylactic
- Enoxaparin Dose
  - Initial: 0.5 mg/kg Q12H by SC route
  - Adjustments: median dose ↑ of 25%



Brown A, Faraklas I, Ghanem M et al. *Journal of Burn Care & Research*. 2013;34(6):628-632.

6

SC Enoxaparin in Pediatric Acute Burn Patients

Patient Demographics and Outcomes

Variable	Total (n = 32)	Final Anti-Xa (<0.2 IU/mL)	Final Anti-Xa (0.2 – 0.4 IU/mL)	P Value
Age (yrs.)	8 (3 – 11)	7 (2 – 10)	11 (5 – 12)	0.031
%TBSA	16 (10 – 30)	26 (14 – 36)	12 (7 – 23)	0.018

Findings:
- Burn size was larger in those who did not reach target.
- Younger children were less likely to achieve target range.

Questions:
- Are the standard dosing regimens as set forth by CHEST sufficient?
- Do different age groups require different dosing strategies?

7

Brown A, Faraklas I, Ghanem M et al. *Journal of Burn Care & Research*. 2013;34(6):628-632.

IV vs. SC Enoxaparin in Critically Ill Infants and Children

- Study Design
  - Retrospective, single-center
- Indication
  - Prophylactic and treatment
- Sample Size (n)
  - 96 for treatment
  - 43 for prophylactic
- Enoxaparin Dose
  - Initial: 0.5 mg/kg Q12H
- Infusion Time
  - 30 minutes

Results – Treatment
- IV enoxaparin resulted in a higher first peak anti-Xa level than SC
  - (0.55 [0.33 – 0.81]) vs. (0.38 [0.26 – 0.51]); p = 0.07
- Median first peak anti-Xa level within target was higher with IV than SC
  - (0.67 [0.61 – 0.79]) vs. (0.56 [0.51 – 0.70]); p = 0.024

8

Diab YA, Ramakrishnan K, Ferrell B et al. *Pediatric Critical Care Medicine*. 2017;18(5):e207-e214.

IV vs. SC Enoxaparin in Critically Ill Infants and Children

Comparison of Prophylactic Enoxaparin (Target Anti-Xa 0.1 to 0.3 IU/mL)

Variable	IV Enoxaparin	SC Enoxaparin	P Value
Age (months)	7 (4 – 17)	12 (7 – 22)	0.15
Weight (kg)	6.8 (4 – 9.3)	8.5 (7.2 – 11.9)	0.14
Time to achieve target range (days)	2 (1– 5)	1.5 (1 – 3.5)	0.26
No. dose adjustments	2 (0.75 – 3)	2 (0 – 3)	0.012

Findings:
- The dosing requirements were not statistically different between the two groups.
- The IV group did require more dose adjustments.

Conclusions:
- Administering IV enoxaparin as a 30 minute infusion mimics the SC route.

9

Diab YA, Ramakrishnan K, Ferrell B et al. *Pediatric Critical Care Medicine*. 2017;18(5):e207-e214.

Methods

- Study Type
  - Retrospective chart review
- Time Frame
  - November 26, 2016 to September 17, 2017
- Dosing and Administration
  - 10 mL total volume administered over 30 minutes
- Anti-Xa Monitoring
  - Ordered to be drawn 4 hours after the end of the 3rd infusion

Data Collected
- Patient demographics
- Burn wound characteristics
- Respiratory status
- Renal function
- Hematological status
- Operative procedures
- Blood transfusions
- Bleeding events
- Enoxaparin dosing and anti-Xa levels (0.1 – 0.3 IU/mL goal)

10

Case #1

Enoxaparin Usage

Date	Dose	Anti-Xa (IU/mL)
Start: 11/27/16 **End:** 11/30/16	1 mg/kg SC (40 mg)	0.5
Start: 12/01/16 **End:** 12/28/16	0.5 mg/kg IV (17 mg)	0.3, 0.2 (x3), 0.4 (x2)
Start: 12/29/16 **End:** 1/14/17	0.33 mg/kg IV (14 mg)	0.2, 0.5
Start: 1/15/17 **End:** 3/15/17	0.3 mg/kg IV (12 mg)	0.3, 0.2 (x4)
Start: 3/31/17 **End:** 5/5/17	0.3 mg/kg IV (12 mg)	N/A

- Patient Characteristics
  - 10 y/o/m; 42.5 kg
- TBSA (%) Burn
  - 75% (2nd and 3rd degree)
- Respiratory Status
  - Intubated on Day #1
- Operations
  - 19 total
- Blood Transfusions
  - 25 total

11

Case #2

Enoxaparin Usage

Date	Dose	Anti-Xa (IU/mL)
Start: 7/22/17 **End:** 7/23/17	1 mg/kg SC (16 mg)	N/A
Start: 7/24/17 **End:** 7/28/17	0.5 mg/kg SC (6.6 mg)	0.21
Start: 7/28/17 **End:** 8/2/17	0.5 mg/kg IV (6.6 mg)	0.25

- Patient Characteristics
  - 2 y/o/f; 13.2 kg
- TBSA (%) Burn
  - 24% (2nd and 3rd degree)
- Respiratory Status
  - Never intubated
- Operations
  - 1 total
- Blood Transfusions
  - None

12

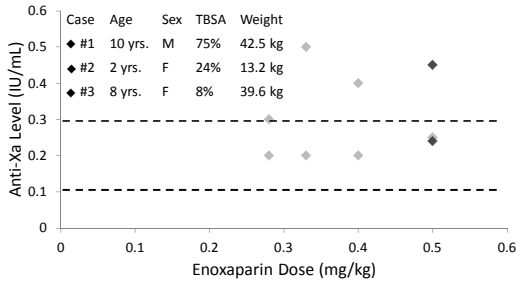
Case #3

Enoxaparin Usage		
Date	**Dose**	**Anti-Xa (IU/mL)**
Start: 8/5/17 **End:** 8/6/17	1 mg/kg SC (40 mg)	N/A
Start: 8/7/17 **End:** 8/14/17	0.5 mg/kg IV (20 mg)	0.24, 0.45
Start: 8/14/17 **End:** 8/16/17	0.35 mg/kg IV (14 mg)	N/A

- Patient Characteristics
  - 8 y/o/f; 39.6 kg
- TBSA (%) Burn
  - 8% (2nd degree)
- Respiratory Status
  - Never intubated
- Operations
  - 2 total
- Blood Transfusions
  - None

13

Anti-Xa Levels Achieved



14

Safety Data

- VTE
  - Per radiologic study
- Major Bleed
  - ICH
  - Hemorrhage resulting in ≥ 2 g/dL ↓ in Hgb
  - Hemorrhage requiring ≥ 2 units (40 mL/kg) of blood products
- Failure
  - New VTE or progression ≥ 2 cm or recurrence

Platelet Counts				
Case	**Admit**	**High**	**Low**	**Discharge**
#1	286	588	68	510
#2	247	697	196	661
#3	305	529	187	529

- Patient Outcomes
  - VTE: 0/3
  - Major Bleed: 0/3
  - Failure: 0/3

15

Discussion

STUDY RESULTS

IV administration may effectively be used to achieve adequate prophylactic anti-Xa levels in pediatric burn patients.

Average dosage required to achieve anti-Xa levels in the desired range correlated with those used with the SC route.

No major AEs, bleeding events or treatment failures occurred.

FUTURE RESEARCH

Does therapeutic enoxaparin dosing differ among age groups?

Are there correlations between TBSA (%) burned and dose of enoxaparin necessary?

Are there correlations between number of VTE risk factors present and dose of enoxaparin necessary?

16

Self-assessment Question #1

Which of the following is a potential limitation of using the subcutaneous route of administration for enoxaparin in pediatric burn patients?

A) Increased anxiety
B) More intensive monitoring than heparin
C) Insufficient absorption
D) Both A and C

17

Self-assessment Question #2

When administering enoxaparin by the intravenous route, how long should the infusion last in order to mimic the release characteristics and peak levels of the subcutaneous route?

A) 10 minutes
B) 15 minutes
C) 30 minutes
D) Administer as IV push

18

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19