

# Prophylaxis Against Venous Thromboembolism (VTE) in Pediatric Trauma

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# Disclosure Statement

- I disclose no conflict of interest relative to this educational activity.

# Successful Completion

- To successfully complete this course, participants must attend the entire event and complete/submit the evaluation at the end of the session.
- Society of Trauma Nurses is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

# Objectives

- 1. Briefly review epidemiology of VTE in pediatric trauma
- 2. Identify sub-populations at high risk for VTE
- 3. Discuss prophylaxis strategies
- 4. Highlight challenges with initiating prophylaxis

# Pediatric VTE Epidemiology

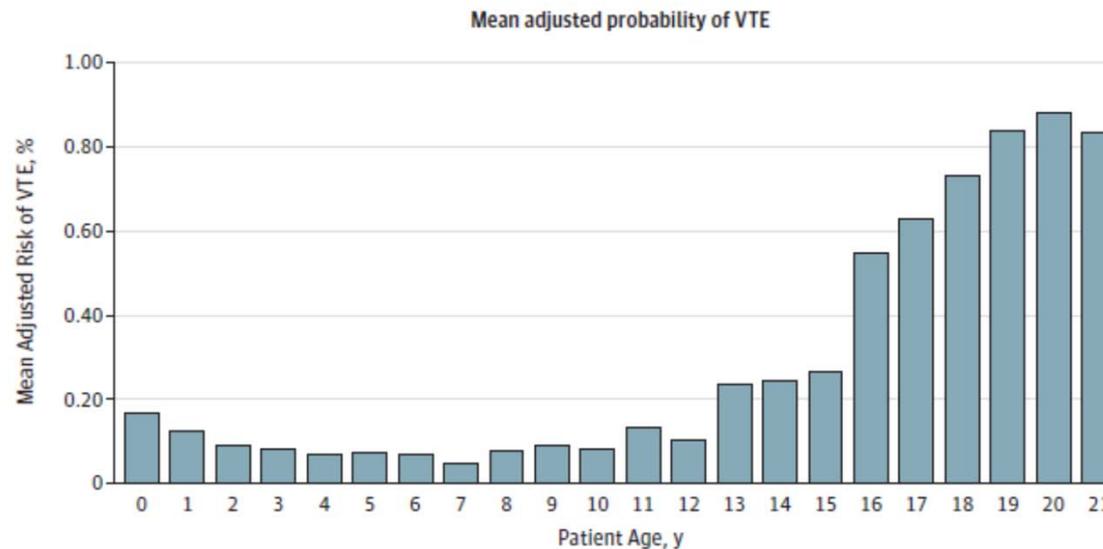
- Incidence of pediatric VTE is rising in hospitalized children [1]
  - 70% increase over a 7 year period
- The Solutions for Patient Safety (SPS) initiative found:
  - VTE accounts for 16% of all serious safety events in hospitalized children [2]
    - 2<sup>nd</sup> largest contributor to harm (CLABSI is 1<sup>st</sup>)

1. Raffini L, et al. Dramatic increase in venous thromboembolism in children's hospitals in the United States from 2001-2007. *Pediatrics*. 2009;124:1001-8.

2. Children's Hospitals' Solutions for Patient Safety. SPS prevention bundles [cited 2017 June 13]. Available from: <http://www.solutionsforpatientsafety.org/for-hospitals/hospital-resources/>.

# VTE Epidemiology in Pediatric Trauma

- In trauma specifically, 0.3-0.8% of hospitalized children per year will develop VTE [3,4]
  - ~ 750-2000 children per year



[4]

3. Candrilli SD, et al. Effect of injury severity on the incidence and utilization-related outcomes of venous thromboembolism in pediatric trauma inpatients. *Pediatr Crit Care Med*. 2009;10(5):554-7.

4. Van Arendonk K, et al. Venous thromboembolism after trauma: When do children become adults? *JAMA Surg*. 2013;148(12):1123-30.

# Why is this important?

- Morbidity and Mortality
- Cost
  - Pediatric patients with VTE have [5]:
    - Longer length of stay by median of 8.1 days (95% CI: 3.9-12.3)
    - Excess average cost of \$27,686 (95% CI: \$11,137 - \$44,235) while hospitalized
      - Compared to hospitalized patients with similar age and condition(s)

# Developing the PMG

- Convened team with representatives from:
  - Critical care
  - Hematology
  - Surgery
- Formulated our PICO questions
- Literature search
  - 14 articles met inclusion/exclusion criteria

# PICO 1

- In children hospitalized after trauma (P), should pharmacologic VTE prophylaxis be utilized (I), compared to no pharmacologic prophylaxis (C), to reduce the incidence of VTE (O)?
- Pharmacologic prophylaxis = enoxaparin at 0.5 mg/kg/dose subcutaneous every 12 hours

# PICO 1 - Evidence

- Children at high risk for VTE [6]
  - Age
  - Central venous catheters
  - ISS > 9
    - Highest risk cohorts:  $\geq 25$
  - Other: intubation/mechanical ventilation, ICU admission
- Support for pharmacologic prophylaxis
  - Adults [7,8]
    - Two separate meta-analyses of adult patients showed decreased risk of VTE by 48% (particularly when given within 72 hours of surgery or trauma) and did not increase risk of bleeding
  - Pediatrics [9]
    - Non-significant reduction in symptomatic VTE
- Risk of bleeding? Limited to no data
  - In uncontrolled observational studies, the risk of bleeding in surgical adolescents receiving pharmacologic prophylaxis (4%) was similar to adults (2-3%) [10]

6. Mahajerin A, et al. Prophylaxis against venous thromboembolism in pediatric trauma: A practice management guideline from the Eastern Association for the Surgery of Trauma and the Pediatric Trauma Society. *J Trauma Acute Care Surg.* 2017;82(3):627-36.

7. Barrera LM, et al. Thromboprophylaxis for trauma patients. *Cochrane Database Syst Rev.* 2013;3:CD008303.

8. Mismetti P, et al. Meta-analysis of low molecular weight heparin in the prevention of venous thromboembolism in general surgery. *Br J Surg.* 2001;88(7):913-30.

9. Hanson SJ, et al. Effectiveness of clinical guidelines for deep vein thrombosis prophylaxis in reducing the incidence of venous thromboembolism in critically ill children after trauma. *J Trauma Acute Care Surg.* 2012;72(5):1292-7.

10. Stem J, et al. Safety of prophylactic anticoagulation at a pediatric hospital. *J Pediatr Hematol Oncol.* 2013;35(7):e287-91.

# PICO 1 - Recommendation

- Conditional recommendation **for** pharmacologic prophylaxis if “at low risk for bleeding”:
  - $\geq 15$  years of age
  - Post-pubertal but  $< 15$  years of age with ISS  $> 25$
- Recommend **against** pharmacologic prophylaxis:
  - Pre-pubertal children

# PICO 1 – Key Challenge

- What if the patient is bleeding?
- How do we “grade” levels of bleeding?
  - The International Society of Thrombosis and Haemostasis published a position statement [11] to define:
    - “Major”
      - Fatal bleeding, and/or
      - Symptomatic bleeding in a critical area or organ, e.g. intracranial, intraspinal, intraocular, retroperitoneal, intra-articular or pericardial, or intramuscular with compartment syndrome, and/or
      - Bleeding causing a fall in hemoglobin of 2 g/dL or more OR leading to transfusion of two or more “Units” of whole blood or red cells
    - “Minor”
      - Any bleeding that is non-major but requires the attention of a care-giver, provider, intervention, and/or pharmacologic agent

# PICO 1 – Key Challenge

- Pharmacologic prophylaxis is most effective when initiated within 72 hours of hospital arrival [12,13]
- When to initiate pharmacologic prophylaxis if major bleeding is present?
  - Once bleeding is “controlled”
    - Stabilization of hemoglobin, and/or
    - Stabilization of bleed on imaging
    - Will have significant variance in clinical practice until further addressed through research
  - No clear answer but there are ongoing studies evaluating this

12. Gould MK, et al. Prevention of VTE in nonorthopedic surgical patients: Antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2012;141(2 Suppl):e227S-277S. PMID:22315263.

13. Falck-Ytter Y, et al. Prevention of VTE in orthopedic surgery patients: Antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2012;141(2 Suppl):e278S-325S. PMID:22315265.

## PICO 2

- In children hospitalized after trauma (P), should mechanical VTE prophylaxis be utilized (I), compared to no prophylaxis or in addition to pharmacologic prophylaxis (C), to reduce the incidence of VTE (O)?
- Mechanical VTE prophylaxis:
  - Sequential compression devices (preferred) [14]
  - Graduated compression stockings (not preferred) [15]

14. Morris R, et al. Intermittent pneumatic compression or graduated compression stockings for deep vein thrombosis prophylaxis?: a systematic review of direct clinical comparisons. *Ann Surg.* 2010;251(3):393-396.

15. Winslow E, et al. Graduated compression stockings in hospitalized postoperative patients: correctness of usage and size. *Am J Nurs.* 2008;108(9):40-50.

## PICO 2 - Evidence

- Only two studies have **indirectly** evaluated efficacy of mechanical prophylaxis
  - One reported use at discretion of treating team [16]
    - Either medical or surgical – both with high acceptance rates for use
  - One study reported use as part of institutional guidelines [17]
  - Both studies reported a small reduction in VTE but did NOT separate mechanical alone from mechanical + pharmacologic
    - Although the number of patients receiving pharmacologic prophylaxis was quite low
- Both studies suffer from one key flaw: no documentation of actual use
- Neither study reported adverse events.
  - High level of safety from adult data [12]
  - High level of agreement to utilize from pediatric providers [18]

12. Gould MK, et al. Prevention of VTE in nonorthopedic surgical patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2012;141(2 Suppl):e227S-77S.

16. Azu MC, et al. Venous thromboembolic events in pediatric trauma patients: Is prophylaxis necessary? *J Trauma*. 2005;59(6):1345-9.

17. Hanson SJ, et al. Effectiveness of clinical guidelines for deep vein thrombosis prophylaxis in reducing the incidence of venous thromboembolism in critically ill children after trauma. *J Trauma Acute Care Surg*. 2012;72(5):1292-7.

18. Faustino EV, et al. A multinational study of thromboprophylaxis practice in critically ill children. *Crit Care Med*. 2014;42(5):1232-40.

## PICO 2 - Recommendation

- Conditional recommendation **for** mechanical prophylaxis alone or in combination for previously identified high risk groups:
  - $\geq 15$  years of age
  - Post-pubertal but  $< 15$  years of age with ISS  $> 25$
- Important to have appropriately-sized sleeve
- Key challenge is that use will often be excluded due to location of injury (e.g. lower extremities)

## PICO 3

- In children hospitalized after trauma (P), should active surveillance for VTE with ultrasound be performed (I), compared to daily physical examination alone (C), to detect VTE earlier (O)?

## PICO 3 - Evidence

- Only one study evaluated active surveillance with ultrasound [14]
- Objective was to identify VTE in patients contraindicated to receive prophylaxis by institutional guidelines
  - Compared to unselected historical controls, the group found that **asymptomatic** VTE could be detected **3** days earlier
- Challenges:
  - Timing, frequency, and extent of ultrasounds - ?
  - The natural hx of asymptomatic VTE is not defined
    - How many will resolve on their own? How many occur that we don't know about?
  - Adult data has shown screening ultrasounds are not efficacious in reducing VTE [17]
  - Cost-benefit considerations

14. Hanson SJ, et al. Effectiveness of clinical guidelines for deep vein thrombosis prophylaxis in reducing the incidence of venous thromboembolism in critically ill children after trauma. *J Trauma Acute Care Surg.* 2012;72(5):1292-7.

17. Robinson KS, et al. Ultrasonographic screening before hospital discharge for deep venous thrombosis after arthroplasty: the post-arthroplasty screening study. *Ann Intern Med.* 1997;127:439-445.

## PICO 3 - Recommendation

- Conditional recommendation **against** active surveillance for VTE with ultrasound (compared to daily physical examination)

# Summary

- VTE in pediatrics is increasing
- High risk features include:
  - Age  $\geq$  15
  - Post-puberty
  - Higher ISS, particularly  $\geq$  25
- Consider both pharmacologic and mechanical prophylaxis in the high risk groups
  - If pharmacologic prophylaxis used, monitor Hb and any focal area of bleeding

# Thank You

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