Venous Thromboembolism Among Pediatric Orthopaedic Trauma Patients: A Database Analysis

Samir Sabharwal, Daniel Guzman, Caixia Zhao, Sanjeev Sabharwal
Disclosures

• I have nothing to disclose.
Background

• Virchow’s Triad (1856)
  • Stasis, Endothelial Injury, Hypercoagulability

• National Hospital Discharge Survey (1979-2001)
  • 0.49 VTE cases per 10,000 children per year

• Risk factors
  • Central venous catheter
  • Inherited hypercoagulable state
  • Infection
  • Trauma
  • Malignancy
  • Chronic inflammation
  • Immobility
Study Aim

Assess Prevalence, Risk Factors, Mortality Rate of Venous Thromboembolism (VTE) Among Pediatric Orthopaedic Trauma Patients
Materials & Methods

• Kids Inpatient Database (KID), 2012

  • Developed by Agency for Healthcare Research and Quality (AHRQ) for the Healthcare Utilization Project (HCUP)

  • Published every 3 years

  • Largest publicly available all-payer pediatric (<21 years) inpatient care database in the US
Materials & Methods

• Case-Control Study
  • Analyses - Univariate & Multiple Logistic Regression (SAS 9.3)

• Study Population:
  • Upper Limb Fractures (CCS 229)
  • Lower Limb Fractures (CCS 230)
  • Vertebral Fractures (ICD-9 805.00-806.99)
  • Pelvic Fractures (ICD-9 808.00-808.99)
  • Multi-Site Fractures
Materials & Methods

• Cases: VTE (pooled with DVT & PE)
  • ICD-9 415.0; 415.11-415.13; 415.19;
    453.40-453.42; 453.81-453.87; 453.89

• Putative Risk Factors:
  • Osteomyelitis
  • SCI
  • CVC
  • Internal Fixation
  • External Fixation
  • Age
  • Obesity
  • Coagulopathy
  • Diabetes
  • Chronic Blood Loss Anemia
  • Gender
  • Length of Stay
Results

- **KID 2012 (All Hospitalized Pediatric Patients)**
  - 3,195,782 Patients
  - VTE: 7,736 Cases (0.24%)
  - Population Mortality Rate: 0.53%

- **Study Population (Pediatric Orthopaedic Trauma Patients)**
  - 57,183 Patients
  - VTE: 387 Cases (0.68%)
  - Population Mortality Rate: 0.91%
# Prevalence and Mortality

<table>
<thead>
<tr>
<th></th>
<th>All Fractures</th>
<th>Upper Limb</th>
<th>Lower Limb</th>
<th>Vertebral</th>
<th>Pelvic</th>
<th>Multi-Site</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Patients</strong></td>
<td>57,183</td>
<td>22,236</td>
<td>21,238</td>
<td>5,192</td>
<td>1,633</td>
<td>6,884</td>
</tr>
<tr>
<td><strong>Patients with VTE (%)</strong></td>
<td>387 (0.68)</td>
<td>47 (0.21)</td>
<td>128 (0.60)</td>
<td>58 (1.12)</td>
<td>24 (1.47)</td>
<td>130 (1.89)</td>
</tr>
<tr>
<td><strong>Mortality Among Patients with VTE (%)</strong></td>
<td>* (1.8)</td>
<td>* (6.4)</td>
<td>* (0.8)</td>
<td>* (1.7)</td>
<td><em>(0)</em></td>
<td>* (1.5)</td>
</tr>
</tbody>
</table>

For cells with fewer than 10 patients, an asterisk (*) replaces the numerical figure, per HCUP patient protection guidelines.
Continuous Variables – Mean Comparisons

• Age
  • VTE Cases: 17 Years
  • Controls: 12 Years
  • $p<0.0001$

• Length of Stay
  • VTE Cases: 22 Days
  • Controls: 4 Days
  • $p<0.0001$

• Cost of Hospitalization
  • VTE Cases: $302,207$
  • Controls: $54,271$
  • $p<0.0001$

\[ t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(N_1 - 1)s_1^2 + (N_2 - 1)s_2^2}{N_1 + N_2 - 2} \left( \frac{1}{N_1} + \frac{1}{N_2} \right)}} \]
## Risk Factors – Univariate & Multivariate Analyses

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unadjusted Odds Ratio (95% CI)</th>
<th>Adjusted Odds Ratio (95% CI)</th>
<th>Adjusted $P$-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVC Placement</td>
<td>9.36 (7.43, 11.79)</td>
<td>3.48 (2.68, 4.50)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Coagulopathy</td>
<td>9.12 (6.71, 12.40)</td>
<td>2.39 (1.68, 3.39)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Spinal Cord Injury</td>
<td>7.99 (5.88, 10.85)</td>
<td>2.08 (1.47, 2.93)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Blood Loss Anemia</td>
<td>6.30 (3.32, 11.96)</td>
<td>2.46 (1.26, 4.79)</td>
<td>0.0082</td>
</tr>
<tr>
<td>Osteomyelitis</td>
<td>3.96 (2.10, 7.49)</td>
<td>1.57 (0.77, 3.14)</td>
<td>0.2086</td>
</tr>
<tr>
<td>External Fixation</td>
<td>3.21 (2.25, 4.58)</td>
<td>1.79 (1.23, 2.60)</td>
<td>0.0022</td>
</tr>
<tr>
<td>Obesity</td>
<td>2.42 (1.50, 3.90)</td>
<td>1.88 (1.15, 3.04)</td>
<td>0.0106</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.87 (0.69, 5.06)</td>
<td>1.67 (0.65, 4.30)</td>
<td>0.2852</td>
</tr>
<tr>
<td>Internal Fixation</td>
<td>0.62 (0.50, 0.76)</td>
<td>0.84 (0.67, 1.04)</td>
<td>0.1239</td>
</tr>
<tr>
<td>Female</td>
<td>0.90 (0.72, 1.12)</td>
<td>1.07 (0.85, 1.33)</td>
<td>0.5581</td>
</tr>
<tr>
<td>Length of Stay</td>
<td></td>
<td>1.04 (1.03, 1.04)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>1.22 (1.21, 1.18)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
Conclusion

- Compared to All Hospitalized Pediatric Patients, Pediatric Orthopaedic Trauma Patients Have Higher Rate of VTE & Mortality
  - VTE Prevalence: 7 per 1,000
  - Population Mortality: 9 per 1,000
  - Case Fatality: 18 per 1,000

- Higher VTE Prevalence in Multi-Site Fractures (19 per 1,000)
- Higher VTE Case Fatality Rate in Upper Limb Fractures (64 per 1,000)

- Significant risk factors:
  - CVC
  - Blood Loss Anemia
  - Coagulopathy
  - Obesity
  - External Fixation
  - Spinal Cord Injury
Discussion – Database Analysis

**Advantages**
- Sample size
- Power
- Rare events

**Limitations**
- Granularity
- Temporality
- Follow-up