DVT and Thromboembolism in Trauma: Too Much or Not Enough?

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Outline

• Background
• Pathogenesis
• Risk Factors and Incidence
• Management Guidelines
• Compliance
• Brain Injury
• Conclusion
Background

- Deep Vein Thrombosis (DVT) and Thromboembolism (TE) are a potentially preventable cause of morbidity and mortality in Trauma
- Association with trauma first noted in 1934
- Clinical spectrum of VTE ranges from asymptomatic DVT and ‘silent’ emboli, to rapidly fatal and unpredictable PE
- A range of prophylactic measures exist:
  - Chemical: Low Molecular Weight Heparin
  - Mechanical: Sequential Calf Compressors
  - IVC filter: for the prevention of PE only
Pathogenesis

- Virchow triad:
  - Venous stasis
  - Venous Injury
  - Hypercoagulability
Pathogenesis

- Pathogenesis specifically in trauma:
  - Intimal injury
  - Platelet adhesion and activation
  - Generation of thrombin
  - Local inflammation:
    - Generation of cytokines
    - Inhibition of fibrinolytic system
Risk Factors

Thromboembolism After Trauma
An Analysis of 1602 Episodes From the American College of Surgeons National Trauma Data Bank

M. Margaret Knudson, MD, FACS, Danagra G. Ikossi, MD, Linda Khaw, BA,
Diane Morabito, RN, MPH, and Larisa S. Speetzen, BA

Ann Surg 2004
### TABLE 1. Risk Factors Associated With VTE (Univariate Analysis)

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥ 40 yrs. (n = 178,851)</td>
<td>2.29 (2.07–2.55)</td>
</tr>
<tr>
<td>Pelvic fracture (n = 2,707)</td>
<td>2.93 (2.01–4.27)</td>
</tr>
<tr>
<td>Lower extremity fracture (n = 63,508)</td>
<td>3.16 (2.85–3.51)</td>
</tr>
<tr>
<td>Spinal cord injury with paralysis</td>
<td>3.39 (2.41–4.77)</td>
</tr>
<tr>
<td>(n = 2,852)</td>
<td></td>
</tr>
<tr>
<td>Head injury (AIS ≥ 3) (n = 52,197)</td>
<td>2.59 (2.31–2.90)</td>
</tr>
<tr>
<td>Ventilator days &gt;3 (n = 13,037)</td>
<td>10.62 (9.32–12.11)</td>
</tr>
<tr>
<td>Venous Injury (n = 1,450)</td>
<td>7.93 (5.83–10.78)</td>
</tr>
<tr>
<td>Shock on admission (BP &lt;90 mmHg)</td>
<td>1.95 (1.62–2.34)</td>
</tr>
<tr>
<td>(n = 18,510)</td>
<td></td>
</tr>
<tr>
<td>Major surgical procedure (n = 73,974)</td>
<td>4.32 (3.91–4.77)</td>
</tr>
</tbody>
</table>

p <.0001 for all factors.
**TABLE 2. Independent Risk Factors for VTE (Multivariate Logistic Regression)**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Odds ratio (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (\geq 40) years</td>
<td>2.01 (1.74–2.32)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Lower extremity fracture (AIS (\geq 3))</td>
<td>1.92 (1.64–2.26)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Head injury (AIS (\geq 3))</td>
<td>1.24 (1.05–1.46)</td>
<td>0.0125</td>
</tr>
<tr>
<td>Ventilator days &gt;3</td>
<td>8.08 (6.86–9.52)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Venous injury</td>
<td>3.56 (2.22–5.72)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Major operative procedure</td>
<td>1.53 (1.30–1.80)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>
Incidence

• Geerts et al 1994. NEJM
  – 349 high risk trauma patients without prophylaxis
  – Dx via venography at 7-21 days post injury
  – 58% with DVT (18% above the knee)
  – 2% with PE (mortality 43%)
  – 1093 patients with pelvic #, LL# or immobilisation for >2/7
  – US surveillance in all
  – 46% received some form of prophylaxis at some stage
    > Pelvic #: 13% (1.3% PE)
    > Pelvic and LL #: 15% (0.99% PE)
    > LL#: 9% (0.63% PE)
    > Immobilisation >2/7: 12.6% (0.81% PE)
Incidence

  - 243 patients with spinal cord injury
  - 21% incidence of symptomatic VTE
  - Mortality 3.3%

  - 450,375 patients (1994-2001)
  - All VTE events: 0.36%
  - PE: 0.13%
  - Mortality in patients with PE: 18.7%
Challenge

Risk of VTE:
- Injuries
- Co-morbidities
- Mortality

Risk of Treatment:
- Bleeding (1-3%)
- IVC filters
- Mortality

William H. Geerts, David Bergqvist, Graham F. Pineo, John A. Heit, Charles M. Samama, Michael R. Lassen and Clifford W. Colwell

*Chest* 2008;133;381-453
DOI 10.1378/chest.08-0656
Current Guidelines

**CLINICAL MANAGEMENT UPDATE**

The Journal of *TRAUMA®* Injury, Infection, and Critical Care

**Practice Management Guidelines for the Prevention of Venous Thromboembolism in Trauma Patients: The EAST Practice Management Guidelines Work Group**

Frederick B. Rogers, MD, Mark D. Cipolle, MD, PhD, George Velmahos, MD, PhD, Grace Rozycki, MD, and Fred A. Luchette, MD


2002
EAST Practice Management Guidelines

- Risk factors for venous thromboembolism after injury
- The use of low-dose heparin for DVT/PE prophylaxis
- The role of arteriovenous foot pumps in the prophylaxis of DVT/PE in the trauma patient
- The use of pneumatic compression devices in the prevention of DVT/PE
- The role of low-molecular weight heparin in venous thromboembolism prophylaxis in trauma patients
- The role of the vena cava filter in the prophylaxis of PE
- The role of ultrasound in diagnostic imaging for DVT in trauma
- The role of venography in the diagnosis of DVT in trauma patients
EAST Practice Management Guidelines

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Role of LMWH

- Level I: No sufficient data
- Level II: LMWH can be used for VTE prophylaxis in patients with:
  - Pelvic fractures requiring fixation of bed rest >5 days
  - Complex LL fractures
  - Spinal cord injury with complete or incomplete motor deficit
- Level III:
  - ISS>9 should receive LMWH as their primary mode of VTE prophylaxis
  - LMWH has not been sufficiently studied in the head injured patient with intracranial bleeding to justify use*
Pneumatic Compression Devices

- Level I: No sufficient data
- Level II: No sufficient data
- Level III: May have some benefit in isolated studies (Patients who have a contraindication to LMWH)
Compliance with Guidelines

Chemical Prophylaxis and/or mechanical prophylaxis

- Challenges:
  - Risks and benefits of prophylaxis (particularly chemical) are hard to quantify and define in complex multi-trauma patients
  - In the setting of injuries that have a higher risk of complication from bleeding, many doctors delay the initiation of prophylaxis
    - EG: Brain Injury with bleeding
      - Solid organ injury treated non-operatively
  - Mechanical prophylaxis is not always possible
Compliance with Guidelines

- At best, 50% of high risk patients receive some form of VTE prophylaxis within 2-4 days
- Initiation of VTE prophylaxis after 4 days is associated with a 3x increased risk of VTE
Potential Contraindications

• Spinal Cord Injury:

• TBI with intracranial haemorrhage
  – Phelan 2012. J Neurotrauma
ALL TBI

Cranotomy or ICP monitor?

No

Do patients have any of the following MODIFIED BERNE-NORWOOD CRITERIA?
1. Subdural hematoma >8 mm?
2. Epidural hematoma >8 mm?
3. Confusion or intraventricular hemorrhage >2 cm?
4. Multiple contusions per lobe?
5. Subarachnoid with abnormal CT-angiogram?

Yes

MODERATE RISK TBI

Repeat CT scan at 24 hours post-injury stable?

No

LOW RISK TBI

Initiate enoxaparin at 24 hours post-injury

Yes

HIGH RISK TBI

Repeat CT scan at 72 hours post-injury stable?

No

Consider prophylactic filter

Yes

Initiate enoxaparin at 72 hours post-injury

Parkland Protocol
Conclusion

- Multi-trauma is a risk factor for VTE disease and subsequent complications
- True incidence is variable however may be as high as 21% in patients receiving prophylaxis, and 58% in those not
- Incidence of PE is low, however mortality rates approach 45%
- Treatment Guidelines do not specifically address patients with contraindications to chemoprphylaxis
- Risk of bleeding complicating various injuries is the most common reason for patients not being treated
- Current evidence supports the use of LMWH in selected patients with TBI
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