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

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*Injury 2013.*




# Outline

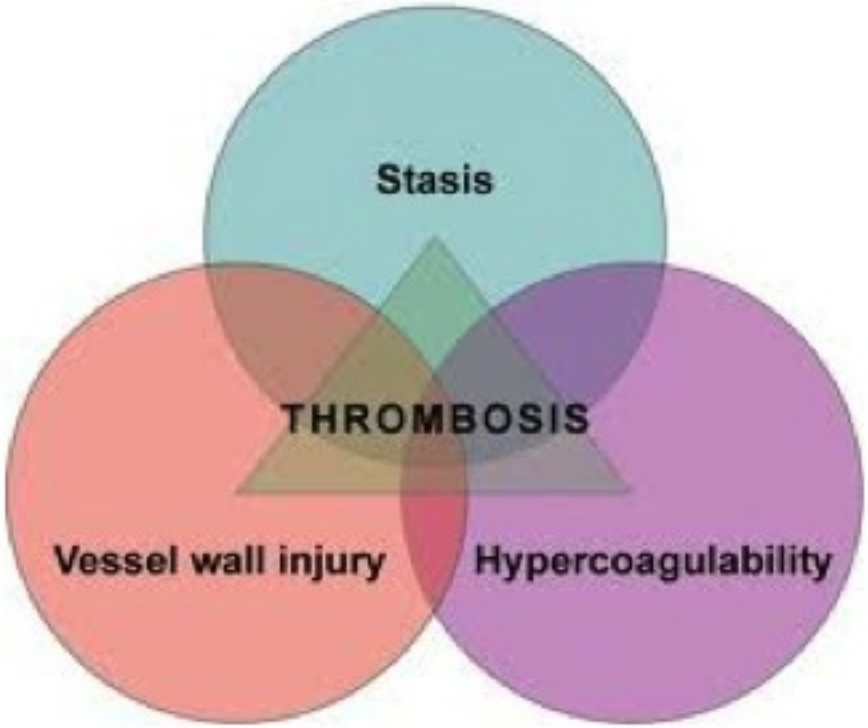
- Background
- Pathogenesis
- Risk Factors and Incidence
- Management Guidelines
- Compliance
- Brain Injury
- Conclusion

# 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

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ORIGINAL ARTICLE

## 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**

# Knudson et al 2004

**TABLE 1.** Risk Factors Associated With VTE (Univariate Analysis)

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

p <.0001 for all factors.

# Knudson et al 2004

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**TABLE 2.** Independent Risk Factors for VTE (Multivariate Logistic Regression)

| Risk Factor | Odds ratio (95% CI) | p-value |
|---|---|---|
| Age ≥ 40 years | 2.01 (1.74–2.32) | <.0001 |
| Lower extremity fracture (AIS ≥ 3) | 1.92 (1.64–2.26) | <.0001 |
| Head injury (AIS ≥ 3) | 1.24 (1.05–1.46) | 0.0125 |
| Ventilator days >3 | 8.08 (6.86–9.52) | <.0001 |
| Venous injury | 3.56 (2.22–5.72) | <.0001 |
| Major operative procedure | 1.53 (1.30–1.80) | <.0001 |

# 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%)**
- *Britt et al 2003. Am Surg.*
  - 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

- *Green et al 2003. Am J Phys Med Rehabil*
  - 243 patients with spinal cord injury
  - **21% incidence of symptomatic VTE**
  - **Mortality 3.3%**
- *Knudson et al 2004. Ann Surg*
  - 450,375 patients (1994-2001)
  - **All VTE events: 0.36%**
  - **PE: 0.13%**
  - **Mortality in patients with PE: 18.7%**

# Challenge

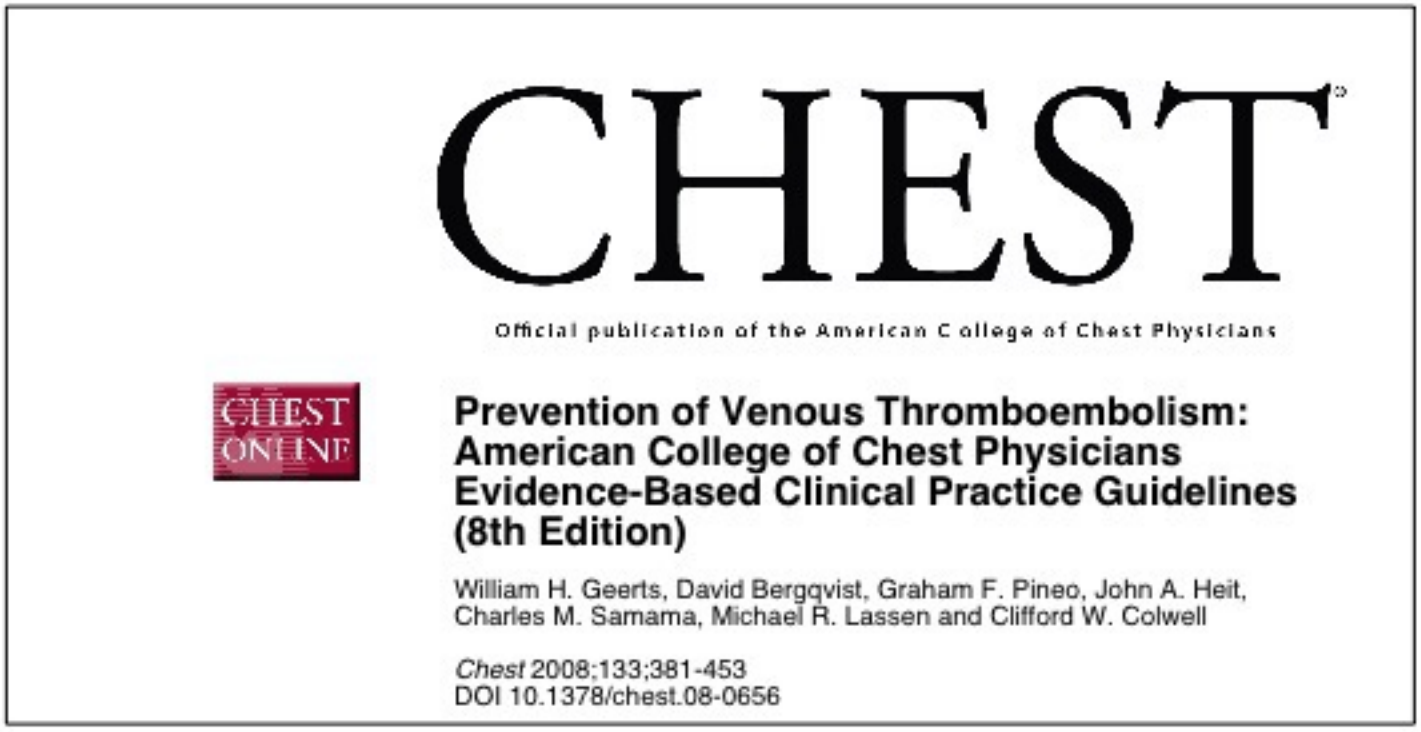
**Risk of VTE:**

- Injuries
- Co-morbidities
- Mortality

**Risk of Treatment:**

- Bleeding (1-3%)
- IVC filters
- Mortality

# Current Guidelines



CHEST

Official publication of the American College of Chest Physicians

CHEST ONLINE

**Prevention of Venous Thromboembolism: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition)**

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

**2008**

# Current Guidelines

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*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*

*J Trauma*. 2002;53:142–164.

**2002**

# EAST Practice Management Guidelines

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- 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

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- 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

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## 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

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

**The Practice of Venous Thromboembolism Prophylaxis in the Major Trauma Patient**

*Avery B. Nathens, MD, PhD, MPH, Megan K. McMurray, PharmD, Joseph Cuschieri, MD, Emily A. Durr, PharmD, Ernest E. Moore, MD, Paul E. Bankey, MD, Brad Freeman, MD, Brian G. Harbrecht, MD, Jeffrey L. Johnson, MD, Joseph P. Minei, MD, Bruce A. McKinley, MD, Frederick A. Moore, MD, Michael B. Shapiro, MD, Michael A. West, MD, PhD, Ronald G. Tompkins, MD, ScD, and Ronald V. Maier, MD*

**2007**

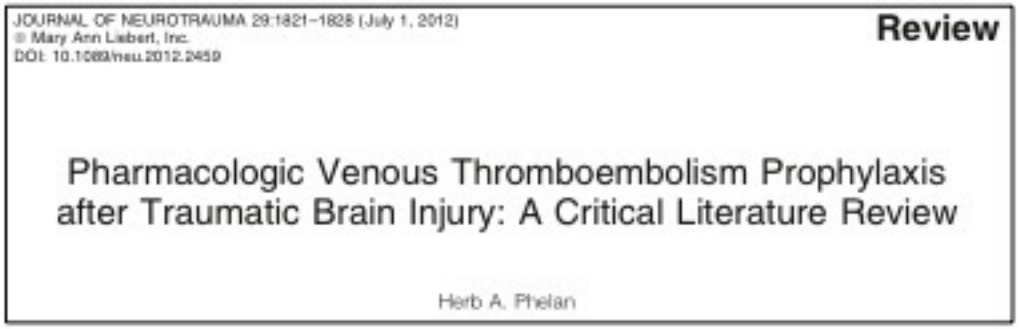
**2004**

**Venous thromboembolism after trauma**

M. Margaret Knudson and Danagra G. Ikossi

# Potential Contraindications

- Spinal Cord Injury:
  - Spinal Cord Injury Thromboprophylaxis Investigators. 2003. J Trauma
- TBI with intracranial haemorrhage
  - Norwood et al 2008. J Trauma
  - Kurtoglu et al 2004. World J Surg
  - Phelan 2012. J Neurotrauma


JOURNAL OF NEUROTRAUMA 29:1821–1828 (July 1, 2012)
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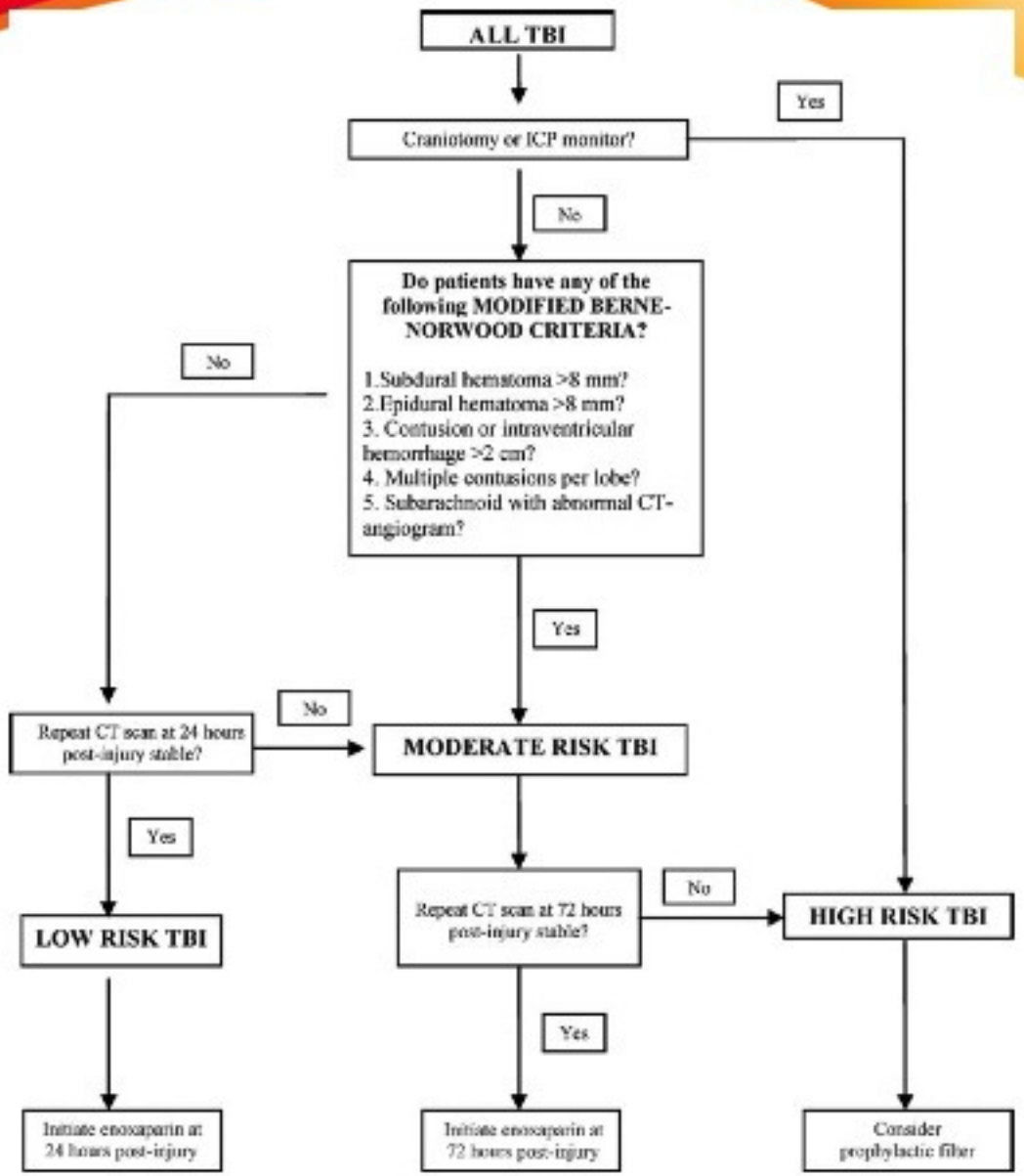
DOI: 10.1089/neu.2012.2459

Review

Pharmacologic Venous Thromboembolism Prophylaxis after Traumatic Brain Injury: A Critical Literature Review

Herb A. Phelan




## 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

**Thank-you!** ka.martin@alfred.org.au

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