Venous Thromboembolic Disease: An Update

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University of Kentucky
Department of Surgery
Vascular Surgery
Grand Rounds January 19, 2010
Objectives

• Review the ACCP guidelines for venous thromboembolism prevention and treatment.
• Discuss the implications of upper extremity DVT and its treatment.
• Discuss venous thromboembolism treatment in pregnancy.
• Nothing to declare
### 2002

<table>
<thead>
<tr>
<th>Event</th>
<th>Community</th>
<th>Hospital (within 90 days)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Fatal VTE</td>
<td>193,598</td>
<td>419,825</td>
<td>613,423</td>
</tr>
<tr>
<td>DVT</td>
<td>108,240</td>
<td>268,125</td>
<td>376,365</td>
</tr>
<tr>
<td>PE</td>
<td>85,358</td>
<td>151,700</td>
<td>237,058</td>
</tr>
<tr>
<td>Fatal VTE</td>
<td>106,551</td>
<td>189,819</td>
<td>296,370</td>
</tr>
<tr>
<td>DVT</td>
<td>649</td>
<td>1609</td>
<td>2258</td>
</tr>
<tr>
<td>PE</td>
<td>105,902</td>
<td>188,210</td>
<td>294,112</td>
</tr>
<tr>
<td>Total</td>
<td>300,149</td>
<td>609,644</td>
<td>909,793</td>
</tr>
</tbody>
</table>

2002

• Total VTE exceeded
  – MI (865,000)
  – Strokes (700,000)
Risk Factors for VTE

- Surgery
- Trauma (major or lower extremity)
- Immobility, paresis
- Malignancy
- Cancer therapy (hormonal, chemotherapy, or radiotherapy)
- Previous Venous Thromboembolism
- Increasing age
- Pregnancy and the postpartum period
- Estrogen-containing oral contraception or hormone replacement therapy
- Selective estrogen receptor modulators

- Acute medical illness
- Heart or respiratory failure
- Inflammatory bowel disease
- Nephrotic syndrome
- Myeloproliferative disorders
- Paroxysmal nocturnal hemoglobinuria
- Obesity
- Smoking
- Varicose veins
- Central venous catheterization
- Inherited or acquired thrombophilia
Risk Factors for VTE

- Surgery
- Trauma (major or lower extremity)
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- Smoking
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- Central venous catheterization
- Inherited or acquired thrombophilia
<table>
<thead>
<tr>
<th>Patient Group</th>
<th>DVT prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical patients</td>
<td>10-20%</td>
</tr>
<tr>
<td>General surgery patients</td>
<td>12-40%</td>
</tr>
<tr>
<td>Major Gynecologic Surgery</td>
<td>15-40%</td>
</tr>
<tr>
<td>Major Urologic Surgery</td>
<td>15-40%</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>15-40%</td>
</tr>
<tr>
<td>Stroke patients</td>
<td>20-50%</td>
</tr>
<tr>
<td>Hip or knee arthroplasty</td>
<td>40-60%</td>
</tr>
<tr>
<td>Major trauma</td>
<td>40-80%</td>
</tr>
<tr>
<td>Spinal cord injury</td>
<td>60-80%</td>
</tr>
<tr>
<td>Critical care patients</td>
<td>10-80%</td>
</tr>
<tr>
<td>Patient Group</td>
<td>DVT prevalence</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>----------------</td>
</tr>
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<td>10-80%</td>
</tr>
</tbody>
</table>
Venous Thromboembolic Disease

- Spectrum of disease
  - Asymptomatic
  - Symptomatic
    - Acute Deep Venous Thrombosis (DVT)
      - Limb pain, edema, phlegmasia
    - Pulmonary Embolus (PE)
      - Respiratory distress, heart failure, death
    - Chronic Venous Insufficiency
      - Limb pain, Edema, ulcerations
Venous Thromboembolic Disease

- DVT Symptoms
  - Sudden swelling
  - Limb pain
  - Pain on dorsiflexion of the foot with knee flexed 90 degrees
    - Homans’ sign
    - Not sensitive or specific for DVT
  - Dilated superficial collateral veins
  - Cyanosis or pallor
Venous Thromboembolic Disease

• Extensive thrombosis in the thigh and pelvis may lead to *phlegmasia alba dolens* (inflammation white pain)
  – Pain, pitting edema and blanching

• Complete impediment of venous outflow may lead to cessation of arterial inflow, *phlegmasia cerulea dolens* (inflammation blue pain)
  – Venous gangrene
Venous Thromboembolic Disease

• *Phlegmasia*
  – Treat with thrombolysis or surgery
  – Anticoagulation may not prevent progression in these patients
  – Limb loss possible
Venous Thromboembolic Disease

• Immediate Complications
  – PE 12-33%
    • 200,000 deaths/year
    • Leading cause of preventable in-hospital mortality

• Long-Term Complications (evaluation of 61 pts.)
  – Post-thrombotic Syndrome
    • Pain and swelling 67%
    • Pigmentation 23%
    • Ulceration 5%

Venous Thromboembolic Disease

• Post-Thrombotic Syndrome (20-30% pts. within 5 years)
  – Valvular incompetence
  – Luminal obstruction
  – Both obstruction and incompetence leads to more severe morbidity
Varicosities Post-Thrombotic Syndrome
Venous Stasis Ulcers Post-Thrombotic Syndrome
May-Thurner Syndrome

• Right common iliac vein
  – Ascends vertically into inferior vena cava

• Left common iliac vein
  – Takes a more transverse course
  – Underlies the right common iliac artery
  – External compression causes stasis
  – In pregnant women DVT more common on the left
May-Thurner Syndrome

- Compression of the left common iliac vein by the overlying right common iliac artery
May-Thurner Syndrome

• Compression of the left common iliac vein by the overlying right common iliac artery
Superficial Thrombophlebitis

• Thrombosis of the superficial venous system
  – Not a DVT
  – Local erythema
  – Local tenderness
  – Palpable subcutaneous cord

• Treatment
  – Oral or topical non steroidal anti-inflammatory drugs for symptoms
  – Some advocate 4 weeks of anticoagulation for superficial thrombophlebitis near sapheno-femoral junction
Deep vs.. Superficial Veins

Deep
- Arm
  - Brachial, radial and ulnar

Superficial
- Basilic and cephalic
### Deep vs. Superficial Veins

<table>
<thead>
<tr>
<th></th>
<th>Deep</th>
<th>Superficial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arm</strong></td>
<td>Brachial, radial and ulnar</td>
<td>Basilic and cephalic</td>
</tr>
<tr>
<td><strong>Leg</strong></td>
<td>Femoral, popliteal, PT and AT</td>
<td>Greater and small saphenous</td>
</tr>
</tbody>
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Deep vs. Superficial Veins

Deep
• Arm
  – Brachial, radial and ulnar
• Leg
  – Femoral, popliteal, PT and AT
• DVT

Superficial
• Basilic and cephalic
• Greater and small saphenous
• Superficial thrombophlebitis
## Deep vs. Superficial Veins

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<td><strong>Greater and small saphenous</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>DVT</strong></td>
<td><strong>Superficial thrombophlebitis</strong></td>
</tr>
<tr>
<td><strong>At risk for embolism</strong></td>
<td><strong>No risk for embolism</strong></td>
</tr>
</tbody>
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# Deep vs.. Superficial Veins

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<tr>
<td><strong>DVT</strong></td>
<td><strong>Superficial thrombophlebitis</strong></td>
</tr>
<tr>
<td><strong>At risk for embolism</strong></td>
<td><strong>No risk for embolism</strong></td>
</tr>
<tr>
<td><strong>Anticoagulation</strong></td>
<td><strong>No anticoagulation</strong></td>
</tr>
</tbody>
</table>
Why do I have to do well in school, mommy?

It's so when you grow up, you can get a good job and be a tax slave for the loser kids who didn't do shit in school!
Diagnosis

• Venography
  – Injection of dye into venous system
  – Defect in the column of contrast suggests thrombus
  – Invasive
  – Allergy risk
  – Must be performed in radiology suite
Diagnosis

• Duplex
  – Normal veins collapse with compression
  – Visualize valve movement
  – Acute vs. Chronic
    • Chronic - Increased echogenicity, heterogeneity, irregular surface, contracted vein, large collaterals present, recanalization may be seen
    • Acute – dilated vein
  – Color duplex sensitivity 96% specificity 100%
  – Bedside exam
Diagnosis

• D-dimer
  - Originally described in the 1970’s
  - Cross-linked degradation products
  - Marker for action of plasmin on fibrin
  - Sensitivity 98.4%
  - But positive result can be misleading
    • False positives – liver disease, inflammation, trauma, pregnancy and surgery
  - Negative result rules out DVT
  - Not useful postop
ACCP Guidelines

• Prevention
  – Formal hospital wide policy for prevention of VTE
    • Preprinted orders

• Treatment

## Risk Stratification

<table>
<thead>
<tr>
<th>Risk</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk</td>
<td>Minor surgery in patients &lt;40 years with no additional risk factors</td>
</tr>
<tr>
<td>Moderate risk</td>
<td>Minor surgery in patients with additional risk factors</td>
</tr>
<tr>
<td></td>
<td>Surgery in patients aged 40-60 years with no additional risk factors</td>
</tr>
<tr>
<td>High risk</td>
<td>Surgery in patients &gt;60 years</td>
</tr>
<tr>
<td></td>
<td>Surgery in patients aged 40-60 years with additional risk factors (prior venous thromboembolism, cancer, hypercoagulable state)</td>
</tr>
<tr>
<td>Highest risk</td>
<td>Surgery in patients with multiple risk factors (age &gt;40 years, cancer, prior venous thromboembolism)</td>
</tr>
</tbody>
</table>

From the ACCP guidelines, chest 2008
# General Surgery Patients

<table>
<thead>
<tr>
<th>Patient group</th>
<th>Prophylaxis recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk, minor procedure</td>
<td>Early ambulation</td>
</tr>
<tr>
<td>Moderate risk, major procedure (benign disease)</td>
<td>LMWH</td>
</tr>
<tr>
<td>High risk, major procedure for cancer</td>
<td>LMWH</td>
</tr>
<tr>
<td>Multiple risk factors for VTE</td>
<td>LMWH plus mechanical*</td>
</tr>
<tr>
<td>High bleeding risk</td>
<td>Mechanical thromboprophylaxis</td>
</tr>
<tr>
<td>Laparoscopy, no risk factors</td>
<td>Early ambulation</td>
</tr>
<tr>
<td>Laparoscopy, with risk factors</td>
<td>LMWH, IPC or GCS</td>
</tr>
</tbody>
</table>

*mechanical (graduated compression stockings GCS and/or intermittent pneumatic compression IPC)

From the ACCP guidelines, chest 2008
Prevention

• 5000 units of heparin 2 hours preoperatively, then every 12 hours postoperatively (5 days or until discharged)

• Twice vs. three times daily regimen
  – BID has lower rate of bleeding complications
  – TID trend towards better efficacy in preventing VTE events

• LMWH regimen

From the ACCP guidelines, chest 2008

# Lovenox (enoxaparin)

<table>
<thead>
<tr>
<th>Patient type</th>
<th>Dosing</th>
<th>Duration of therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal surgery</td>
<td>40 mg SC once daily (initiated 2 hours prior to surgery)</td>
<td>• Usual: 7 to 10 days&lt;br&gt;• Administered up to 12 days in clinical trials</td>
</tr>
<tr>
<td>Severe renal impairment (CrCl &lt;30 mL/min)</td>
<td>30 mg SC once daily</td>
<td>• Usual: 7 to 10 days&lt;br&gt;• Administered up to 12 days in clinical trials</td>
</tr>
</tbody>
</table>

• LOVENOX® requires no dose adjustments with moderate (CrCl=30 to 50 mL/min) and mild (CrCl=50 to 80 mL/min) renal impairment; all such patients should be observed carefully for signs and symptoms of bleeding.

LOVENOX® may be largely neutralized (up to 60%) by the slow IV injection of protamine sulfate (1% solution).
Figure 4. Estimated Numbers of DVT, PE, and Attributable Deaths Over a 30-day Period Among a Hypothetical Cohort of 10 000 Acutely Ill Medical Inpatients, by Method of Prophylaxis

- Deep vein thrombosis (DVT)
- Pulmonary embolism (PE)
- Attributable deaths

<table>
<thead>
<tr>
<th>Method of Prophylaxis</th>
<th>DVT</th>
<th>PE</th>
<th>Attributable Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enoxaparin 40 mg qd</td>
<td>532</td>
<td>106</td>
<td>37</td>
</tr>
<tr>
<td>UFH 5000 IU bid</td>
<td>616</td>
<td>122</td>
<td>53</td>
</tr>
<tr>
<td>No Prophylaxis</td>
<td>1392</td>
<td>277</td>
<td>81</td>
</tr>
</tbody>
</table>

Attributable deaths are those due to pulmonary embolism or to adverse reactions to drugs used in prophylaxis or treatment.
**Preprinted Orders**

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**DEPARTMENT OF SURGERY**

**THROMBOSIS RISK FACTOR ASSESSMENT**

Due within 24 hours of admission.

**Name**  
**Age**  
**Sex**  
**Diagnosis**  
**Admission**  
**Elective or Emergency**

Type of surgery planned

Please check all pertinent factors (Each risk factor has value of 1 unless otherwise noted.)

- Age 41 to 60 years (1 factor)
- Age 61 to 70 years (2 factors)
- Age over 70 years (3 factors)
- Anticipated bed confinement over 72 hours (3 factors)
- History of DVT/PE (3 factors)
- Varicose veins
- Obesity (>25% of ideal body weight)
- History of previous major surgery
- Previous immobilization (>72 hours)
- MI
- CHF
- Stroke
- Crystalloid infusion (>5 liters/24 hrs)
- Severe COPD
- Trauma
- Planned operation over 2 hours

**TOTAL RISK FACTORS**

**RISK GROUPS**

**LOW RISK**  
(1 Factor)

**MODERATE RISK**  
(2-4 Factors)

**HIGH RISK**  
(More than 4 Factors)

**RECOMMENDED MODALITIES**

- TED Stockings
- Early ambulation
- TED + SCD
- OR
- Heparin

Please check the modality(s) chosen from the list below and sign/date.

- TED stockings
- TED plus SCD
- Heparin (Regimen: __________________)
- Warfarin (Regimen: __________________)
- Other

**Contraindication to anticoagulants? Yes or No**
If yes, explain: __________________

**Examine Physician’s Signature**  
**Date**

---

FIG. 9. Revised worksheet for the assessment of venous thromboembolic risk in surgical patients.
### Admission Orders - GULLETT, BOBBY

**Com - Admit Orders**

<table>
<thead>
<tr>
<th>Date</th>
<th>Admitting Service</th>
<th>Attending Physician</th>
<th>Ordering Physician Pager</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Admitting Dx</th>
<th>Admitting Condition</th>
<th>Bed Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Admission Orders Note

Please note, placing a patient in Observation is based on medical necessity and not the length of time the patient is expected to be in a hospital bed. Open order to see criteria for observation status.

#### VTE (DVT/PE) Prophylaxis

<table>
<thead>
<tr>
<th>Order</th>
<th>Patient Type</th>
<th>Contraindication Reason</th>
<th>Dose</th>
<th>UOM</th>
<th>Frequency</th>
<th>SCD Bilateral</th>
<th>SCD RLE</th>
<th>SCD LLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>Therapeutic Anticoagulation: Prescribed</td>
<td>Heparin drip started</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>No chemical VTE Prophylaxis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>Low Risk for VTE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>Moderate Risk for VTE/PE</td>
<td>Mobile medical, minor surgery, or admits &lt; 48 hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>High Risk for VTE</td>
<td>General surgery/medically ill patients or patients with limited mobility &lt; one Risk Factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Therapy Choices - 7 Items

<table>
<thead>
<tr>
<th>No additional recommendations</th>
<th>Mobility Orders</th>
<th>Sequential Compression Device</th>
<th>Aspirin, Acetylsalicylic Acid</th>
<th>Heparin Inf.</th>
<th>Enoxaparin Inf. (FROPH/UCASS)</th>
<th>Enoxaparin Inf. (FROPH/UCASS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug Info</th>
<th>OK</th>
<th>Cancel</th>
</tr>
</thead>
</table>

Click here for VTE Assessment Info —>
**Risk Assessment:**

Patients with limited mobility and at least one additional risk factor: consider VTE prophylaxis

<table>
<thead>
<tr>
<th>B. VENOUS THROMBOEMOLISM RISK ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Acute medical illness</td>
</tr>
<tr>
<td>• Age &gt;65</td>
</tr>
<tr>
<td>• Cancer (active or occult)</td>
</tr>
</tbody>
</table>
| • Cancer therapy (hormonal, chemo- or radio-
  therapy, angiogenesis inhibitors)       |
| • Estrogen-based OC or HRT               |
| • Erythropoiesis-stimulating agents      |
| • Immobility, lower-extremity paresis    |
| • Indwelling central venous catheter      |
| • Inflammatory bowel disease             |
| • Inherited or acquired thrombophilia    |
| • Myeloproliferative disorders           |
| • Nephrotic syndrome                     |
| • Obesity                                |
| • Paroxysmal nocturnal hemoglobinuria    |
| • Pregnancy and post-partum period       |
| • Previous VTE                           |
| • Selective estrogen receptor modulators |
| • Smoking                                |
| • Surgery                                |
| • Trauma (major or lower extremity)      |
| • Venous compression (tumor, hematoma, arterial
  abnormality)                           |

<table>
<thead>
<tr>
<th>Population at Risk</th>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Mobile medical patients or minor surgery patient</td>
<td>• Most general surgery patients</td>
<td>• Hip or knee arthroplasty</td>
</tr>
<tr>
<td></td>
<td>• Perceived admit &lt; 48 hrs</td>
<td>• Medical patients with limited mobility and one risk factor</td>
<td>• Hip fracture surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Major trauma</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Spinal Cord Injury</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Suggested Therapy</th>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• No specific recommendation</td>
<td>• Heparin 5000 units SQ q8h</td>
<td>• Enoxaparin 30mg SQ q12h</td>
</tr>
<tr>
<td></td>
<td>• Order for ambulation</td>
<td>• Enoxaparin 40mg SQ daily</td>
<td>• Enoxaparin 40 mg SQ daily</td>
</tr>
<tr>
<td></td>
<td>• +/- SCD’s</td>
<td>• Heparin 5000 units SQ q8h</td>
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<td></td>
<td></td>
<td>• +/- SCD’s</td>
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- Patients at moderate to high risk with bleeding risk should receive mechanical thromboprophylaxis
- Dosing adjustment should be considered for enoxaparin in patients with renal insufficiency (CrCl < 30mI/min) and should be considered in morbidly obese patients (BMI > 40 kg/m2)
### Admission Orders - GULLETT, BOBBY

#### Admission Orders
- **Admit - Place in Observation**
- **Admit - Full (Inpatient)**

#### Admission Orders Note
Please note, placing a patient in observation is based on medical necessity and not the length of time the patient is expected to be in a hospital bed. Open order to see criteria for observation status.

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<tr>
<th>Order</th>
<th>Patient Type</th>
<th>Contraindication Reason</th>
<th>Dose</th>
<th>UOM</th>
<th>Frequency</th>
<th>SCD Bilateral</th>
<th>SCD RLE</th>
<th>SCD ILE</th>
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<tbody>
<tr>
<td>1</td>
<td>Therapeutic Anticoagulation Prescribed</td>
<td>Heparin drip started</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>No chemical VTE Prophylaxis</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>LOW RISK for VTE</td>
<td>Mobile medical, minor surgery, or admits &lt; 48 hours</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>4</td>
<td>MODERATE RISK for VTE</td>
<td>General surgery/medically ill patients or patients with limited mobility + one Risk Factor</td>
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<td></td>
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<tr>
<td>5</td>
<td>HIGH RISK for VTE</td>
<td>Major trauma, hip fracture, hip/knee arthroplasty or spinal cord injury</td>
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#### Therapy Choices - 7 Items

<table>
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<tr>
<th>Order</th>
<th>Item</th>
<th>Dose</th>
<th>UOM</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>6</td>
<td>No additional recommendations</td>
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<td></td>
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<tr>
<td>7</td>
<td>Mobility Orders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sequential Compression Device</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>9</td>
<td>Aspirin (325 mg)</td>
<td></td>
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<tr>
<td>10</td>
<td>Heparin Inf (5000 units)</td>
<td>5000 units</td>
<td>every 8 hours</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Enoxaparin Inf. (150 mg)</td>
<td>30 mg</td>
<td>every 12 hours</td>
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<tr>
<td>12</td>
<td>Enoxaparin Inf. (0.6 mg/kg)</td>
<td>40 mg</td>
<td>every 24 hours</td>
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</table>
**VTE (DVT/PE) Prophylaxis**

<table>
<thead>
<tr>
<th>Order</th>
<th>Patient Type</th>
<th>Contraindication Reason</th>
<th>Dose</th>
<th>UDM</th>
<th>Frequency</th>
<th>SCD</th>
<th>SCD</th>
<th>SCD</th>
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<tr>
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<td>Heparin dep started</td>
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<tr>
<td>☐</td>
<td>NO CHEMICAL VTE PROPHYLAXIS</td>
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<tr>
<td>☐</td>
<td>LOW RISK for VTE</td>
<td>Mobile, medical, minor surgery, or admits &lt; 48 hours</td>
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<tr>
<td>☐</td>
<td>MODERATE RISK for VTE/PE</td>
<td>General surgery/medically ill patients or patients with limited mobility - one Risk Factor</td>
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<tr>
<td>☐</td>
<td>HIGH RISK for VTE</td>
<td>Major trauma, hip fracture, hip/knee arthroplasty or spinal cord injury</td>
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<td>Other (type here)</td>
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</tbody>
</table>

**Admission Orders**

- Admit - Place in Observation
- Admit - Full (Inpatient)

**Protocols/Education**

- Activate Vaccination Protocol
- Smoking Cessation/Education

**Admission Orders Note**

Please note, placing a patient in observation is based on medical necessity and not the length of time the patient is expected to be in a hospital bed. Open order to see criteria for observation status.
### Admission Orders - GULLETT, BOBBY

**Date:** 04 Jan 2011  
**Admitting Service:**  
**Admitting Diagnosis:**  
**Admitting Condition:**  
**Red Type:**  
**Attending Physician:**  
**Ordering Physician:**  
**Ordering Physician Pager:** 000-0000

**Admission Orders:**  
- [ ] Admit - Place in Observation  
- [ ] Admit - Full (Inpatients)

**Protocols/Education:**  
- [x] Activate Vaccination Protocol  
- [ ] Smoking Cessation / Education

**Admission Orders Note:**  
Please note: placing a patient in observation is based on medical necessity and not the length of time the patient is expected to be in a hospital bed. Open order to see criteria for observation status.

---

**VTE (DVT/PE) Prophylaxis**

<table>
<thead>
<tr>
<th>Order</th>
<th>Patient Type</th>
<th>Contraindication Reason</th>
<th>Dose</th>
<th>U/L</th>
<th>Frequency</th>
<th>SCD Bilateral</th>
<th>SCD FILE</th>
<th>SCD LLE</th>
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<td>1. Therapeutic Anticoagulation Prescribed</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. No chemical VTE Prophylaxis</td>
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<td></td>
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<td></td>
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<td>3. LOW RISK for VTE</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Therapy Choices - 7 Item(s):**

- [ ] No additional recommendations
- [ ] Mobility Orders
- [ ] Sequential Compression Device
- [ ] Antithrombotic stockings
- [ ] Heparin Inf.
  - [ ] Enoxaparin Inf. (PROPH/LA005)
  - [ ] Enoxaparin Inf. (PROPH/LA010)

- [ ] Continuous

---

**Drug Info**
### Admit Orders - GULLETT, BOBBY

**Date:** 04-Jun-2011

- **Admitting Service:**
- **Attending Physician:**
- **Ordering Physician:** 130:0802

**Admitting Dx:**

**Admitting Condition:**

**Bed Type:**

- **Admission Orders:**
  - Admit - Place in Observation
  - Admit - Full (Inpatient)

**Protocols/Education:**
- Activate Vaccination Protocol
- Smoking Cessation / Education

**Admission Orders Note:**

Please note, placing a patient in observation is based on medical necessity and not the length of time the patient is expected to be in a hospital bed. Open order to see criteria for observation status.

---

**Click here for VTE Assessment Info ---**

### VTE (DVT/PE) Prophylaxis

<table>
<thead>
<tr>
<th>Order</th>
<th>Patient Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Therapeutic Anticoagulation Prescribed</td>
<td>Heparin dip started.</td>
</tr>
<tr>
<td>No chemical VTE Prophylaxis</td>
<td></td>
</tr>
<tr>
<td>Low Risk for VTE</td>
<td>Mobile medical, minor surgery, or admits &lt; 48 hours</td>
</tr>
<tr>
<td>Moderate Risk for VTE</td>
<td>General surgery/medically ill patients or patients with limited mobility — one Risk Factor</td>
</tr>
<tr>
<td><strong>HIGH RISK for VTE</strong></td>
<td>Major trauma, hip fracture, hip/knee arthroplasty or spinal cord injury.</td>
</tr>
</tbody>
</table>

### Therapy Choices - 7 Item(s)

- **No additional recommendations**
- **Mobility Orders**
- **Sequential Compression Device**
- **Antithrombotic Stockings**
- **Heparin Inf.** 5000 units every 8 hours
- **Enoxaparin Inf. (PREG/PHARM/01S)** 30 mg every 12 hours
- **Enoxaparin Inf. (PREG/PHARM/01S)** 40 mg every 24 hours
Treatment

• Recurrent thrombosis if untreated
  – 29-47%

• Recurrent thrombosis if treated
  – 4.7-7.1%

• Untreated DVT resulting in PE
  – 26-67%
Treatment

• Anticoagulation
  – Short term (until INR $\geq 2.0$ for 24 hours)
    • SC LMWH
    • IV UFH
    • Monitored SC UFH
  – Long term
    • Warfarin (start on first treatment day)

### Treatment

<table>
<thead>
<tr>
<th>Patient group</th>
<th>Duration of anticoagulation</th>
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</thead>
<tbody>
<tr>
<td>DVT/PE due to reversible factor</td>
<td>3 months</td>
</tr>
<tr>
<td>1(^{st}) episode of unprovoked DVT/PE</td>
<td>3-6 months vs.. long-term(2yrs)*</td>
</tr>
<tr>
<td>2(^{nd}) episode of unprovoked DVT/PE</td>
<td>lifetime</td>
</tr>
<tr>
<td>Cancer pts. with DVT/PE</td>
<td>3-6 months minimum (until CA cleared)</td>
</tr>
</tbody>
</table>

* After 3 months pts. should be assessed for risk-benefit of long-term therapy

*From the ACCP guidelines, chest 2008*
Heparin

• 4,221 DVT pts.
  – Fatal PE during therapy 0.4%
  – Fatal PE after therapy 0.3%
• 1,302 PE pts.
  – Fatal PE during therapy 1.5%
  – Fatal PE after therapy 0%
• Thrombus regression in 20-30%
• 3 months of treatment

Heparin

• Trivia
  – How much is 1 unit of heparin?
Heparin

• Trivia
  – How much is 1 unit of heparin?
    • One Howell Unit (William Henry Howell)
Heparin

• Trivia
  – How much is 1 unit of heparin?
    • One Howell Unit (William Henry Howell)
    • 0.002mg of pure heparin
Heparin

• Trivia

  – How much is 1 unit of heparin?
    • One Howell Unit (William Henry Howell)
    • 0.002mg of pure heparin
    • Quantity required to keep 1 ml of Cat’s blood liquid at 0 degrees Celsius for 24 hours
Low-Molecular Weight Heparin

- Half life is not dose dependent
- Less antiplatelet activity
- More constant factor Xa inhibition
- Less protein C antigen decrease
- Less complement activation
- Less inhibition of platelet aggregation
- Subcutaneous administration
- No monitoring necessary
  - Renal failure, pregnancy, obesity
2192 LMWH vs.. 2259 Heparin

- Proximal (AK) thrombosis
- Thrombotic complications
  - 3.6 % vs.. 6.3%
- Major hemorrhage
  - 1% vs.. 2.1%
- Mortality
  - 3.3% vs.. 5.3%

van Dongen, CJ et al. Fixed dose subcutaneous low molecular weight heparins versus adjusted dose unfractionated heparin for venous thromboembolism. Cochrane Database of Systematic Reviews, 4:2004
Warfarin

• In the early 1920s a group of cows died after minor procedures
  – 21/22 died after dehorning
  – 12/25 bulls died after castration
  – Bled to death
Warfarin

- Ingestion of moldy sweet clover
  - Coumarin in the clover was converted to dicoumarol by fungus
- 1933-1941 Karl Link
  - Pivotal work on isolating compound
  - Called it Warfarin (WARF – Wisconsin Alumni Research Foundation)
  - Colorless and tasteless
Warfarin

• 1948 Used as a pesticide for rats and mice
• 1951 US Army inductee unsuccessfully attempted suicide with multiple doses of warfarin rodenticide
  – Treated with vitamin K
  – Studies began of warfarin as a therapeutic anticoagulant
• Famous early recipient was Dwight Eisenhower in 1955 after a heart attack
• Some claim Joseph Stalin was poisoned with warfarin
Treatment

• Catheter directed thrombolysis
  – If ilio-femoral DVT
  – symptoms <14 days
  – low risk of bleeding
  – Should have good functional status
  – Reduce acute symptoms
  – Reduce post thrombotic morbidity

• Post thrombolysis, balloon/stent any obstructing lesion

• Pharmaco-mechanical thrombolysis may shorten treatment time

• After thrombolysis, anticoagulate
Treatment

Mechanical thrombolysis

- Trellis
- Angiojet
- Ekos
Treatment

- Systemic thrombolytics can be considered if catheter directed therapy unavailable
  - Also shown to reduce post thrombotic morbidity and acute symptoms
  - Preferred method for use in PE with hemodynamic compromise
Treatment

• Operative venous thrombectomy
  – Symptoms < 7 days
  – Good functional status
  – Reduce acute symptoms and post thrombotic morbidity
  – Use in patients with contraindication to thrombolysis
Treatment

• Early ambulation
  – In the past bed rest recommended – fear of clot dislodging
• Leg elevation
• Compression stockings (30-40 mmHg)
  – Symptomatic proximal DVT
  – Start as soon as possible
  – Continue for 2 years, longer if PTS symptoms
Treatment

• Vena Cava Filters
  – Patient cannot tolerate even a small pulmonary embolus
  – Anticoagulation contraindicated (head bleed)
  – Anticoagulation fails to prevent embolization or extension of thrombus
  – Patient suffers a major bleeding episode while undergoing anticoagulation therapy

• After risk of bleeding resolves, pts. should receive full course of anticoagulation
That's gonna be a hard pill to swallow.

Psst... it's a suppository.
Upper Extremity DVT

• Most are asymptomatic

• Symptoms
  — Pain
  — edema

• Incidence increasing
  — Increase in indwelling catheters (TLC and PICC)

• Duplex scanning
  — Sensitivity 78-100%
  — Specificity 82-100%
Upper Extremity DVT

• Internal Jugular and Subclavian veins most common sites
• 10% of all venous thrombosis involve upper extremity
Upper Extremity DVT

• **Primary (30%)**
  – Paget-Schroetter syndrome (effort thrombosis)
  – Idiopathic

• **Secondary (70%)**
  – Venous catheter
  – Pacemaker wires
  – Extrinsic compression
  – Malignancy
  – Traumatic injury
  – Thrombophilia
Upper Extremity DVT

• Catheter associated thrombi
  – Catheter adherent fibrin sleeve
    • Most common type
    • Starts at entry point and extends to catheter tip
    • Length proportional to duration of catheterization
    • Most asymptomatic but fragments may detach and embolize
  – Non-occlusive mural thrombosis
  – Occlusive thrombus
Upper Extremity DVT
Upper Extremity DVT

• Catheter associated thrombi
  – Increased likelihood of DVT
    • Number of punctures used during insertion
    • Number of catheters inserted/changed
    • Location of catheter tip
    • Duration of catheterization
    • Types of catheters used
    • Infusion fluid
    • Catheter related infection
    • Hyper coagulable states
    • Presence of CHF
Peripherally Inserted Central Catheters and Upper Extremity Deep Vein Thrombosis

- 317 UE duplex scans
- 115 (32%) positive for UE DVT
- Main risk factors:
  - Central line
  - Malignancy
  - Administration of chemotherapy
- PICC most common (2.6% symptomatic thrombosis rate)
- Symptomatic 7% PICC lines for chemo compared to 1% PICC lines for other
- 10% of chemo pts. through PICC had thrombosis
- Post thrombotic syndrome infrequent

Risk Factors UE DVT Associated with use Central Vein Catheter in Cancer Patients

- 16.1% (50/310) CVC-related thrombosis
- Independent risk factors
  - CVC tip in upper half of superior vena cava
  - Left sided CVC insertion
  - Chest radiotherapy
  - Distant metastases

Upper Extremity DVT

• PE
  – 2-36% (20% fatal)
  – Less frequent than LE DVT (3 vs.. 16%)

• Unexplained or recurrent UE DVT
  – Need to r/o hyper coagulable state or malignancy

• Central vein stenosis in 7% of these patients
  – Longer catheter dwell time increases risk

• Mortality 10-50% (associated disease)
Upper Extremity DVT

• Treatment
  – Limb elevation
  – Graduated compression arm sleeve
  – Anticoagulation
  – Catheter directed thrombolysis
  – Suction thrombectomy
  – Angioplasty
  – Vein stenting
  – Surgical thrombectomy
  – Thoracic outlet decompression
Upper extremity Deep Vein Thrombosis: Clinical and Treatment Characteristics

<table>
<thead>
<tr>
<th>Response</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant relief in symptoms 7 days</td>
<td>32</td>
<td>88.8</td>
</tr>
<tr>
<td>Significant lysis* on day 10</td>
<td>16</td>
<td>44.4</td>
</tr>
<tr>
<td>Moderate lysis** on day 10</td>
<td>17</td>
<td>47.3</td>
</tr>
<tr>
<td>Persistence on day 10</td>
<td>3</td>
<td>8.3</td>
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</tbody>
</table>

Response to LMWH by 36 patients with upper extremity DVT
* decrease in thrombus size ≥ 35%
** decrease in thrombus size < 35%

Literature Review of UE DVT Treatment

<table>
<thead>
<tr>
<th></th>
<th>Anticoagulation</th>
<th>Thrombolysis</th>
<th>Decompression</th>
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<tbody>
<tr>
<td>Patients</td>
<td>379</td>
<td>262</td>
<td>43</td>
</tr>
<tr>
<td>Residual Symptoms</td>
<td>111 (29%)</td>
<td>62 (23%)</td>
<td>30 (69.8%)</td>
</tr>
<tr>
<td>Improvement</td>
<td>268 (71%)</td>
<td>200 (77%)</td>
<td>22 (51.2%)</td>
</tr>
<tr>
<td>Re-thrombosis</td>
<td>21 (6%)</td>
<td>18 (7%)</td>
<td>2 (4.7%)</td>
</tr>
</tbody>
</table>

Upper Extremity DVT

• All patients with UE DVT regardless of etiology should receive anticoagulation if no contraindication to it
• If contraindication consider SVC filter
• Treat underlying pathology
• Catheter related UE DVT
  – Remove catheter and anticoagulant therapy for 3 months
  – If catheter still needed may try thrombolysis via existing catheter followed by anticoagulation for as long as catheter remains in place
Upper Extremity DVT

- SVC filter
  - Patient cannot tolerate even a small pulmonary embolus
  - Anticoagulation contraindicated (head bleed)
  - Anticoagulation fails to prevent embolization or extension of thrombus
  - Patient suffers a major bleeding episode while undergoing anticoagulation therapy
Pregnancy

Mom, we felt the baby kick!
Pregnancy

• PE is the leading cause of maternal mortality in the US
  – Proximal VTE increases risk of silent PE 50%
  – 50% occur post partum
• 5-10 fold increase in VTE in pregnancy
• Absolute risk 0.5-3 / 1000 pregnant women
  – <1 / 1000 non-pregnant women
Pregnancy

• 33% of pregnant women will develop varicose veins during pregnancy
• 12% will persist after childbirth
Pregnancy

• Common risk factors
  – Increased age (greater than 35)
  – Operative delivery
  – Obesity
  – Thrombophilia
  – Family or personal history of thrombosis
Pregnancy

- Virchow’s triad
  - Hyper coagulable state
    - Fibrinogen levels double in pregnancy
    - Factors II, VII, VIII, IX, X and XII increase
    - Fibrinolytic activity decreases
    - 40% decrease in free Protein S
  - Venous stasis
    - Venous outflow obstruction by gravid uterus
  - Vessel wall injury
    - delivery
## Pregnancy

<table>
<thead>
<tr>
<th>Time period</th>
<th>% of DVTs</th>
</tr>
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<tbody>
<tr>
<td>1(^{st}) trimester</td>
<td>22%</td>
</tr>
<tr>
<td>2(^{nd}) trimester</td>
<td>34%</td>
</tr>
<tr>
<td>3(^{rd}) trimester</td>
<td>44%</td>
</tr>
<tr>
<td>Antepartum</td>
<td>66%</td>
</tr>
<tr>
<td>Postpartum</td>
<td>34%</td>
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</table>

Left sided or bilateral 82% of the time

Left sided or bilateral 82% of the time
**Table II**  Odds ratios and 95% CIs for deep vein thrombosis among the idiopathic group with and without adjustment for age, center, calendar time, and family history of venous thrombosis

<table>
<thead>
<tr>
<th>Number of participants</th>
<th>Odds ratios</th>
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<tbody>
<tr>
<td></td>
<td>Cases</td>
<td>Control subjects</td>
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<tr>
<td>No risk factor</td>
<td>36</td>
<td>244</td>
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<td>Pregnancy</td>
<td>22</td>
<td>31</td>
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<td></td>
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<td>Puerperium</td>
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<tr>
<td>Cesarean delivery</td>
<td>6</td>
<td>12</td>
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<tr>
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<tr>
<td>Total</td>
<td>76</td>
<td>317</td>
</tr>
</tbody>
</table>

Pregnancy

• Diagnose DVT
  – duplex ultrasound

• Diagnose PE
  – VQ scan vs. CT PE protocol
    • Higher dose of radiation/childhood cancers with VQ scan
  – No data on MRI
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Estimated fetal radiation exposure (mGy)</th>
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<tbody>
<tr>
<td>Bilateral venography</td>
<td>6.28</td>
</tr>
<tr>
<td>without abdominal shield</td>
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</tr>
<tr>
<td>Unilateral venography</td>
<td>3.14</td>
</tr>
<tr>
<td>without abdominal shield</td>
<td></td>
</tr>
<tr>
<td>Limited venography</td>
<td>≤0.50</td>
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<tr>
<td>with abdominal shield</td>
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<tr>
<td>Pulmonary angiography</td>
<td>4.05</td>
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<tr>
<td>via femoral route</td>
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<tr>
<td>Pulmonary angiography</td>
<td>≤0.50</td>
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<tr>
<td>via brachial route</td>
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<tr>
<td>Perfusion lung scan</td>
<td>0.18</td>
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<tr>
<td>with $^{99m}$TcMAA</td>
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</tr>
<tr>
<td>3 mCi</td>
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<tr>
<td>1–2 mCi</td>
<td>0.06–0.12</td>
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<tr>
<td>Ventilation lung scan</td>
<td>0.04–0.19</td>
</tr>
<tr>
<td>$^{133}$Xe</td>
<td></td>
</tr>
<tr>
<td>$^{99m}$TcDTPA</td>
<td>0.07–0.35</td>
</tr>
<tr>
<td>$^{99m}$TcSC</td>
<td>0.01–0.05</td>
</tr>
<tr>
<td>CT scan of the chest</td>
<td>0.16</td>
</tr>
<tr>
<td>CT scan of abdomen</td>
<td>30</td>
</tr>
<tr>
<td>Chest radiography</td>
<td>≤0.01</td>
</tr>
</tbody>
</table>

* Data from Refs. [46,57].

Pregnancy

Pregnancy

• Treatment
  – No Warfarin!!
    • Warfarin embryopathy in first trimester
    • Intracranial bleeding late
    • Fetal hemorrhage late
    • Schizencephaly late
  – LMWH (Q12 hour injections)
    • Monitor monthly 1st and 2nd trimester
    • Monitor every 2 weeks in 3rd trimester
  – Switch to SQ UFH later (reversible)
    • Must monitor frequently though
Pregnancy

• At delivery
  – Hold heparin 12-24 hours prior to delivery
  – Avoid spinal/epidural
• After delivery treat for 6 months
  – Coumadin safe, even if breast feeding
• Make sure good prophylaxis during and after subsequent pregnancies
Pregnancy

• Occlusive ilio-femoral DVT
  – No thrombolytics due to risk of placental, fetal and maternal bleeding
  – Mechanical thrombectomy
    • Trellis
    • Angiojet
    • Ekos
  – Open thrombectomy
Pregnancy

Trellis

Angiojet

Ekos
Pregnancy

• Filter?
  – Suprarenal placement to avoid contact with gravid uterus
Conclusions

• VTE is a largely preventable cause of in-hospital mortality

• Hospital wide policy and order forms have been shown to decrease the incidence of VTE

• While UE DVT has a lower rate of PE and PTS, if left untreated can still cause significant morbidity and mortality

• VTE treatment in the pregnant population must be adjusted to minimize the risks to both mother and fetus
Question #1

• For an acute proximal femoral deep venous thrombosis in the first 24-48 hours, all of the following are recommended except:
  – LMW Heparin
  – Bed rest
  – Leg elevation
  – Compression stockings
  – Ambulation
  – Rat poison
Question #1

• For an acute proximal femoral deep venous thrombosis in the first 24-48 hours, all of the following are recommended except:
  – LMW Heparin
  – **Bed rest**
  – Leg elevation
  – Compression stockings
  – Ambulation
  – Rat poison (Coumadin)
Question #2

• Most Common Form of Upper Extremity DVT?
  – Effort vein thrombosis
  – Secondary thrombosis
  – Paget-von Schroetter syndrome
  – Thoracic outlet syndrome
Question #2

• Most Common Form of Upper Extremity DVT?
  – Effort vein thrombosis
  – Secondary thrombosis (catheter related)
  – Paget-von Schröetter syndrome
  – Thoracic outlet syndrome
Question #3

• Most common type of thrombi associated with central venous catheter?
  – Catheter adherent fibrin sleeve
  – Non-occlusive
  – Completely occlusive deep vein thrombosis
  – Phlegmasia cerulea dolens
Question #3

• Most common type of thrombi associated with central venous catheter?

  – Catheter adherent fibrin sleeve
  – Non-occlusive
  – Completely occlusive deep vein thrombosis
  – Phlegmasia cerulea dolens
Question #4

• DVT is more common on which side in pregnant women?
  – Right
  – Left
  – Neither, pregnant women do not get DVTs
Question #4

- DVT is more common on which side in pregnant women?
  - Right
  - Left
  - Neither, pregnant women do not get DVTs
Question #5

• May-Thurner syndrome is
  – Compression of the LCIV by the overlying RCIA
  – Compression of the RCIV by the overlying LCIA
  – Compression of the LCIA by the overlying RCIV
  – Compression of the RCIA by the overlying LCIV
Question #5

• May-Thurner syndrome is
  – Compression of the LCIV by the overlying RCIA
  – Compression of the RCIV by the overlying LCIA
  – Compression of the LCIA by the overlying RCIV
  – Compression of the RCIA by the overlying LCIV
May-Thurner Syndrome

- Compression of the left common iliac vein by the overlying right common iliac artery
• Lupus anticoagulant
• Protein C deficiency
• Protein S deficiency
• Homocystinemia
• Factor V Leiden
• Antiphospholipid antibody
• Factor VIII excess
• Antithrombin III deficiency
<table>
<thead>
<tr>
<th>Type of DVT</th>
<th>Recommended Length of Anticoagulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf DVT</td>
<td>6 weeks (reversible risk factor) to 12 weeks (no risk factors)</td>
</tr>
<tr>
<td>Proximal DVT from reversible risk factor</td>
<td>3 to 6 mo</td>
</tr>
<tr>
<td>Second event</td>
<td>6 mo to 2 years</td>
</tr>
<tr>
<td>Third event</td>
<td>Lifetime</td>
</tr>
<tr>
<td>Idiopathic</td>
<td>Minimum 3-6 mo</td>
</tr>
<tr>
<td>Heterozygous FV Leiden or PT20210A deficiency</td>
<td>No increase (no current guideline)</td>
</tr>
<tr>
<td>Protein C or S, antithrombin deficiency with family history of VTE or presence of antiphospholipid antibodies</td>
<td>Lifetime (no current guideline)</td>
</tr>
<tr>
<td>Cancer</td>
<td>LMWH for first 3-6 mo continue anticoagulation until cancer resolved</td>
</tr>
<tr>
<td>Elevated d-dimer</td>
<td>Prolonged (awaiting further studies)</td>
</tr>
<tr>
<td>Nonrecanalization of veins</td>
<td>Prolonged (awaiting further studies)</td>
</tr>
</tbody>
</table>

Abbreviations: DVT, deep venous thrombosis; LMWH, low molecular weight heparin.
Studies on treatment with anticoagulation

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Residual Symptoms</th>
<th>Improvement</th>
<th>Rethrombosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Del Arco et al</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Sabeti et al</td>
<td>62</td>
<td>13</td>
<td>49</td>
<td>5</td>
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<tr>
<td>Martinelli et al</td>
<td>98</td>
<td>33</td>
<td>65</td>
<td>12</td>
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<tr>
<td>Savage et al</td>
<td>46</td>
<td>1</td>
<td>45</td>
<td>1</td>
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<tr>
<td>Karabay et al</td>
<td>36</td>
<td>4</td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>Burihan et al</td>
<td>52</td>
<td>18</td>
<td>34</td>
<td>3</td>
</tr>
<tr>
<td>Ameli et al</td>
<td>15</td>
<td>4</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Abu-Rahma et al</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>0</td>
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<tr>
<td>Heron et al</td>
<td>54</td>
<td>36</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>379</td>
<td>111 (29%)</td>
<td>268 (71%)</td>
<td>21 (6%)</td>
</tr>
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</table>

# Studies on treatment with thrombolysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Residual Symptoms</th>
<th>Improvement</th>
<th>Rethrombosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sabeti et al</td>
<td>33</td>
<td>4</td>
<td>29</td>
<td>2</td>
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<tr>
<td>Beygui et al</td>
<td>31</td>
<td>8</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>Grassi et al</td>
<td>12</td>
<td>2</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Urschel and Razzuk</td>
<td>36</td>
<td>6</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Molina</td>
<td>28</td>
<td>6</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>Machedler</td>
<td>36</td>
<td>6</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Sheeran et al</td>
<td>12</td>
<td>7</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Lee et al</td>
<td>11</td>
<td>2</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Lee et al</td>
<td>22</td>
<td>11</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Angle et al</td>
<td>18</td>
<td>4</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Kreienberg et al</td>
<td>23</td>
<td>6</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>262</strong></td>
<td><strong>62 (23%)</strong></td>
<td><strong>200 (77%)</strong></td>
<td><strong>18 (7%)</strong></td>
</tr>
</tbody>
</table>

# Treatment with Surgical Decompression

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Surgery</th>
<th>Residual symptoms</th>
<th>Improvement</th>
<th>Rethrombosis</th>
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</thead>
<tbody>
<tr>
<td>Urschel and Razzuk</td>
<td>35</td>
<td>35</td>
<td>25</td>
<td>21/25</td>
<td>1</td>
</tr>
<tr>
<td>Pittam and Darke</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>1/5</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43</strong></td>
<td><strong>43</strong></td>
<td><strong>30 (69.8%)</strong></td>
<td><strong>22 (51.2%)</strong></td>
<td><strong>2 (4.7%)</strong></td>
</tr>
</tbody>
</table>

Upper Extremity DVT

• Recurrent thrombosis, look for cancer or thrombophilia
  – Antiphospholipid antibodies most common
    • 31% lupus anticoagulant
    • 12.9% anticardiolipin antibodies
  – Factor V Leiden 12.9%
  – Prothrombin 20210A gene mutation 20%