Deep Venous Thrombosis/Pulmonary Embolism

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Objectives

- **Recognize common signs and symptoms of venous thromboembolism (VTE)**
- **Select appropriate diagnostic testing to identify VTE**
- **Appropriately assess risk for VTE**
- **Apply evidence based interventions in the treatment of VTE**

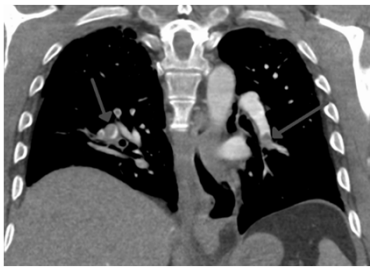
Background

Venous Thromboembolism (VTE) encompasses:

- **Deep Venous Thrombosis (DVT)**
- **Pulmonary Embolism (PE)**

Superficial Phlebitis is not included in this term

Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". *WikiJournal of Medicine* 1 (2).DOI:10.15347/wjm/2014.010. ISSN 2002-4436.



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Background

- **350,000 – 600,000 US cases annually**
- **Hospitalization is a major risk factor**
- **Among the leading causes of preventable hospital death**
- **10-15% Mortality**
- **Requires extended therapeutic anticoagulation**

Pathophysiology

Stasis	Hypercoagulability	Endothelial Damage
Immobility Polycythemia	Factor V Leiden Prothrombin G20210A Prothrombin C&S Deficiency Cancer/Chemotherapy Pregnancy HIT Obesity	Smoking Hypertension Surgery Catheterization Trauma

Clinical Pearls

96% of DVTs occur in the Lower Extremities

90% of Pulmonary Emboli originate from DVTs

50% of proximal LE DVT will result in PE

About 1/3 of DVTs result in post-thrombotic syndrome 5yrs post event

Recognizing VTE

Clinical Features of DVT

- **Asymmetric swelling/edema (greater than 3cm)**
- **Asymmetric pitting edema**
- **Local pain/erythema**
- **Palpable cord**
- **Homan's Sign**

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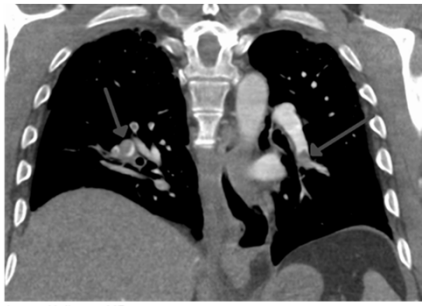
Recognizing VTE

Clinical Features Pulmonary Embolism Symptoms:

- **Chest Pain – Pleuritic**
- **Dyspnea**
- **Palpitation**
- **Cough**
- **Syncope**



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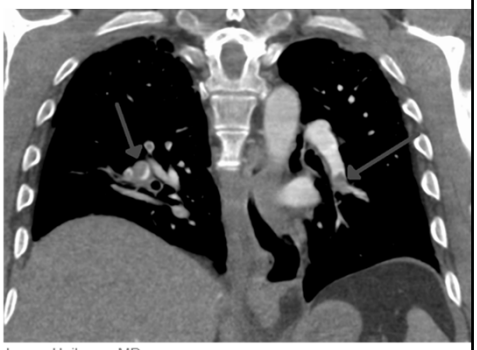
Recognizing VTE

Clinical Features Pulmonary Embolism
Diagnostic Findings:

- **Tachypnea**
- **Tachycardia**
- **Parasternal Heave**
- **Increased JVP**
- **Pleural Friction Rub**



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Diagnosing DVT/PE

Step 1	**Detailed History and Physical**	**Pretest Probability** **Low < 2** **Moderate = 2-6** **High > 6**
Step 2	**Apply a validated clinical prediction tool**	

Well's Criteria

Criteria	Points
Signs/Symptoms of DVT	3
No other more likely diagnosis	3
Tachycardia > 100 BPM	1.5
Immobilization > 3 days or Surgery past 4 weeks	1.5
Previous history of DVT/PE	1.5
Hemoptysis	1
Malignancy	1

Identifying - DVT/PE

Testing Modality Depends on Pretest Probability

D-Dimer	**Low**

Used to rule-out DVT in individuals with low pretest probability

Identifying - DVT/PE

Testing Modality Depends on Pretest Probability

Compression Ultrasound	**Intermediate /High**

Ultrasonography is both sensitive and specific for DVT

Identifying - DVT/PE

Testing Modality Depends on Pretest Probability

VQ Scan/CT Angiogram	High

CT Angiogram is the test of choice if no contraindications

VTE – A Common Case

A typical patient presentation or illness script for a patient presenting with VTE is as follows:

57 y/o male presents with 1 week of:
- **right thigh pain and swelling**
- **no history of recent surgery, trauma, hospitalization, long distance travel or immobilization**
- **On exam: erythema of the right thigh and a palpable cord is noted**

What is the appropriate test to order?

Treatment of DVT/PE

The goals of treatment for VTE are:

- **Anticoagulation to prevent further clot generation**
- **Thrombolysis if the thrombus is large enough to cause hemodynamic compromise.**

Treatment of DVT/PE

Agents for acute Anticoagulation to prevent further clot generation

- **Unfractionated heparin**
- **Low molecular weight heparin**
- **Fondaparinux**
- **Rivaroxaban, Apixaban**

Treatment of DVT/PE

The acute anticoagulants can be used for chronic anticoagulation, but they are less convenient due to their scheduling and mechanism of delivery (Injection)

Oral anticoagulants are the mainstay of therapy:

Coumadin (Warfarin)	**Vitamin K Antagonist**
Dabigatran	**Direct Thrombin Inhibitor**
Rivaroxaban	**Direct Xa Inhibitor**
Apixaban	
Edoxaban	

Treatment of DVT/PE

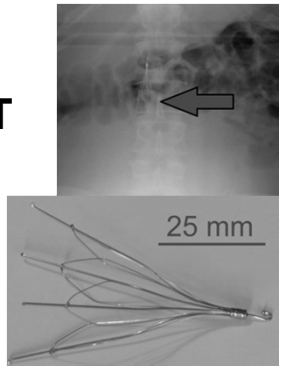
Duration of Chronic Anticoagulation Therapy:

- **Location – LE/UE/Distal/Proximal/PE**
- **Symptoms – Mild/Moderate/Severe**
- **Etiology – Provoked/Unprovoked**
- **History – Recurrent/Cancer-Associated**

Distal LE No/Mild Symptoms	N/A
Distal LE Mod/Severe Symptoms	3 mo
Proximal LE Provoked	3 mo
Proximal LE Unprovoked	Ext
Recurrent Provoked	3 mo
Cancer Associated	Ext

Special Considerations

Inferior Vena Cava Filter



Only indicated for patients with acute pelvic or proximal leg DVT who:

- **Cannot safely undergo anticoagulation due to bleeding risk**
- **Experiencing active bleeding.**

Special Considerations

Sub-Massive Pulmonary Embolism

Acute PE causing:

- **Observed Right Heart Strain/RV Dysfunction**
  - Or -
- **Myocardial Necrosis**
- **May be evident on echocardiogram, CT, ECG**

Special Considerations

Massive Pulmonary Embolism

Acute PE causing:

- **Sustained hypotension**
- **Greater than 15 minutes**
- **May require inotropic support**

Treatment of Submassive/Massive PE

If evidence of Shock, Respiratory Failure or Moderate to Severe RV Strain:

- **Lytic therapy (Fibrinolysis)**
- **Catheter Based Therapy**

Special Considerations

Hospitalized Patients

- **1% or more of admissions result in an HA-VTE**
- **Estimated to be among the most common preventable causes of hospital death**

Failure Modes

- **Inappropriate Risk Stratification**
- **Suboptimal PPx Ordering**
- **Failure to Administer Ordered PPx**
- **Incidental Identification**

Hospitalized Patients

How to Protect Our Patients:

<table>
<tr><th>LOW RISK</th><th colspan="2">HIGH RISK</th><th colspan="4">VERY HIGH RISK</th></tr>
<tr><td>Must meet <u>all</u> three:
• Ambulatory patient
• NO additional VTE risk factors (see page 4)
• Expected LOS < 48 hours
Also consider:
• Minor surgery in patient (same day surgery or OR time < 30 minutes)
• NO additional VTE risk factors
• On FULL anticoagulation</td><td colspan="2">• All other patients who are NOT in the LOW, or VERY HIGH groups or are NOT receiving FULL anticoagulation
• Most medical and surgical inpatients</td><td colspan="4">• Bariatric Surgery and BMI ≥ 40 kg/m^2
• Hip, pelvic, or severe lower extremity fractures
• Acute spinal cord injury (SCI)
• Multiple major trauma (e.g., multiple fractures due to a fall or motor vehicle accident)
• Abdominal or pelvic surgery for cancer
• Neurosurgery
• Stroke (within the last month)</td></tr>
<tr><td rowspan="2">PHARMACOLOGIC PROPHYLAXIS</td><td colspan="2">PHARMACOLOGIC PROPHYLAXIS</td><td colspan="4">PHARMACOLOGIC PROPHYLAXIS</td></tr>
<tr><td>BMI < 40 kg/m^2</td><td>BMI ≥ 40 kg/m^2</td><td colspan="2">CrCl ≥ 30 mL/min</td><td colspan="2">CrCl < 30 mL/min</td></tr>
<tr><td rowspan="2">• No pharmacologic prophylaxis</td><td rowspan="2">• Heparin 5,000 units SQ Q8H</td><td rowspan="2">• Heparin 7,500 units SQ Q8H</td><td>BMI < 40 kg/m^2</td><td>BMI ≥ 40 kg/m^2</td><td>BMI < 40 kg/m^2</td><td>BMI ≥ 40 kg/m^2</td></tr>
<tr><td>• Enoxaparin 40 mg SQ Q24H
○ Neurosurgery
○ Stroke
○ Abdominal /pelvic surgery for cancer
• Enoxaparin 30 mg SQ Q12H
○ Major trauma
○ Hip, pelvic, or severe lower extremity fractures
○ Acute spinal cord injury</td><td>• Enoxaparin 40 mg SQ Q12H</td><td>• Heparin 5,000 units SQ Q8H</td><td>• Heparin 7,500 units SQ Q8H</td></tr>
<tr><td>MECHANICAL PROPHYLAXIS</td><td colspan="2">MECHANICAL PROPHYLAXIS</td><td colspan="4">MECHANICAL PROPHYLAXIS</td></tr>
<tr><td>• Ambulation</td><td colspan="2">• Ambulation
• Use Sequential Compression Device (SCD) if drug therapy contraindication is documented</td><td colspan="4">• Ambulation when patient is able
• Use Sequential Compression Device (SCD) in <u>addition</u> to drug therapy or if drug therapy contraindication is documented</td></tr>
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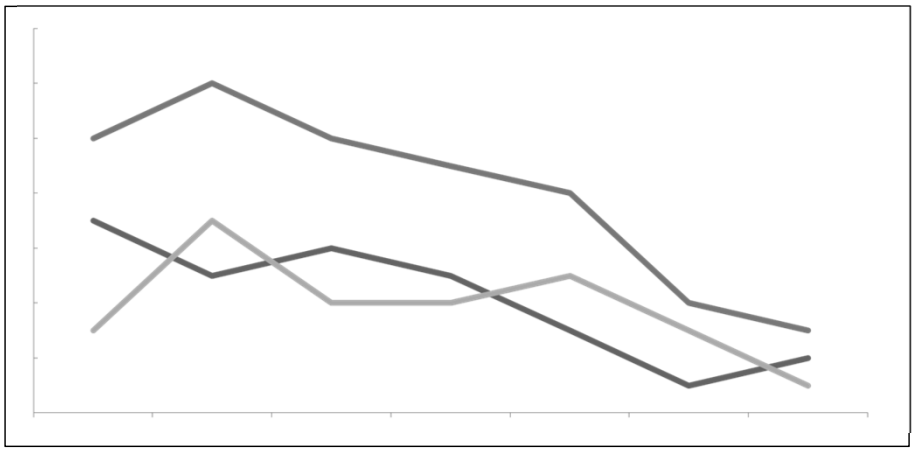
Hospitalized Patients

Inpatient Post-Operative VTE Rate:



Conclusions

- **Recognition of acute VTE requires careful history and physical exam**
- **Selection of appropriate diagnostic testing to identify VTE requires understanding and assessment of each patient's pretest probability**
- **VTE therapy is variable and is determined by specific features of the vTE event**
- **Hospitalized patients are at high risk for VTE and careful action must be taken to prevent avoidable harm**

Case #1

- 45 year old woman with symptomatic gallstones
- Past medical history: hypertension, obesity (BMI 34)
- Plan: laparoscopic cholecystectomy (estimated 60 minutes)

What DVT prophylaxis do you recommend?

Modified Caprini Score

1 Point	2 Points	3 Points	5 Points
Age 41-60	Age 61-74	Age > 75	Stroke < 1 month
Minor Surgery	Arthroscopic Surgery	History of DVT/PE	Arthroplasty
BMI > 25	Major Open Surgery > 45 Min.	Family History of DVT/PE	Hip, Pelvis, or Leg Fracture
Swollen Legs	Laparoscopic Surgery > 45 Min.	Factor V Leiden	Acute Spinal Cord Injury
Varicose Veins	Malignancy	Prothrombin Gene Mutation	
Pregnancy or Postpartum	Confined to Bed > 72 Hours	Lupus Anticoagulant	
History of Miscarriage	Immobilizing Plaster Cast	Anticardiolipin Antibody	
Oral Contraceptives/Hormones	Central Venous Access	Elevated Homocysteine	
Sepsis in Last Month		H.I.T	
Lung Disease in Last Month		Other Thrombophilia	
Abnormal PFTs			
Acute Myocardial Infarction			
Heart Failure			
Inflammatory Bowel Disease			
Bed Rest			

Case #1 General and Abdominal Surgery

- 1 point for age 45
- 1 point for BMI > 25
- 2 points for laparoscopic surgery > 45 minutes

4 points total

- Caprini score 0: no prophylaxis
- Caprini score 1-2: intermittent pneumatic compression
- Caprini score 3-4: LMWH, SQ heparin OR intermittent pneumatic compression
- Caprini score ≥ 5: LMWH or SQ heparin PLUS intermittent pneumatic compression

Case #2

- 63 year old man with back pain and spinal stenosis
- Past medical history: diabetes
- Plan: laminectomy

What DVT prophylaxis do you recommend?

Case #2: Spinal Surgery

- **Standard risk patients: intermittent pneumatic compression**
- **High risk patients: add pharmacologic prophylaxis once adequate hemostasis is achieved**

Case #3

- **59-year-old man with osteoarthritis of the left hip**
- **Past medical history: COPD**
- **Plan: left hip replacement**

What DVT prophylaxis do you recommend?

Case #3: Knee and Hip Arthroplasty

- Pharmacologic prophylaxis with LMWH preferred
  - Second line alternatives: fondaparinux, apixaban, dabigatran, rivaroxaban, or SQ heparin
  - Third line alternatives: low dose Coumadin, aspirin, or intermittent pneumatic compression
- Minimum of 10-14 days treatment
- If started pre-operatively, start LMWH ≥ 12 hours prior to surgery
- Routine screening duplex ultrasound of asymptomatic patients is NOT recommended

Case #4

- 75 year old man admitted with CHF exacerbation
- Past medical history: lung cancer (undergoing radiation therapy), Prior stroke, obesity (BMI 33)
- Past surgical history: Lobectomy 3 weeks ago

What DVT prophylaxis would you recommend?

DVT/PE Risk Factors in Hospitalized Patients

Risk Factor	Points
Active Cancer	3
Previous DVT/PE	3
Reduced mobility	3
Known Thrombophilia	3
Surgery in Last Month	2
Age > 70	1
Heart or Respiratory Failure	1
MI or Stroke	1
Infection or Rheumatologic Condition	1
BMI > 30	1
Hormonal Treatment	1

Case #4: Hospitalized Medical Patient

3 points for active cancer

2 points for recent surgery

1 point for age > 70

1 point for heart failure

1 point for obesity

Total = 8 points

- **High risk ≥ 4 points:**
  - **LMWH**
  - **SQ heparin**
  - **Fondaparinux**
- **High risk ≥ 4 points plus bleeding risk:**
  - **Intermittent pneumatic compression**
- **Low risk:**
  - **No prophylaxis**

Case #5

- 60 year old woman admitted to the ICU with respiratory failure due to influenza
- Past medical history: COPD

Should you do a routine screening duplex ultrasound?

What DVT prophylaxis would you recommend?

Case #5: Critically Ill Patient

- Screening ultrasounds NOT recommended
- LMWH or SQ heparin preferred
- Intermittent pneumatic compression in patients with bleeding risks

Case #6

- 48 year old woman with metastatic ovarian cancer undergoing chemotherapy

Should she have DVT prophylaxis as an outpatient?

If an indwelling central line is placed for chemotherapy, should she receive DVT prophylaxis?

Case #6: Outpatients With Cancer (solid tumors)

- Pharmacologic prophylaxis not recommended:
  - No additional risk factors for DVT/PE
- LMWH or SQ heparin recommended:
  - Previous thromboembolis
  - Immobilization
  - Hormonal therapy
  - Angiogenesis inhibitors
  - Thalidomide or lenalidomide
- Indwelling venous ports: prophylaxis not advised