DIAGNOSIS

Signs and Symptoms
- Courtney, AnnEM 10 – 7940 ED pts - 25 Signs/Sx’s
  - Signs and symptoms of PE in 7940 pts
  - Strongest predictors (OR > 2) were:
    - Hx of VTE, Unilateral Leg Swelling, O2 Sat < 95%, Estrogen Use, Surgery (GA) w/in 4 weeks
  - Weakest predictors (OR <1) were:
    - Inactive Ca, Sudden Onset, Pregnancy, Substernal CP, Smoker, Trauma w/in 4 weeks, Hemoptysis

Terminology in risk stratification
- Kline, JTH 08 - 8138 ED pts
  - 2/3 were clinically LOW SUSPICION (<15%) = 3% VTE rate
  - 27% were clinically MODERATE SUSPICION (15-40%) = 10% VTE rate
  - 7% were clinically HIGH SUSPICION (>40%) = 31% VTE rate

Risk Stratification - Gestalt vs prediction rule
- Runyon, Acad EM, 05
  - Gestalt yielded results that exactly mirrored those of a validated structured scoring system
  - Good interobserver reliability for gestalt (kappa > 0.60)

Prediction rules
- Wells, Ann IM, 98
- Wells, Thromb Haemost, 00
- Wicki, Arch IM, 01
- Kline, Ann EM, 02
- Miniati, AM J Med, 03

How well do we use them?
- Runyon et al., Acad EM, 2007
  - Half who are familiar with them use them > 50% of applicable cases.
  - Spontaneous recall of the specific elements was low to moderate.

The PERC rule
- Kline, JA et al JTH 08
  - 8138 ED pts, 5.9% had PE (6.9% any VTE) w/ 45 day f/u
  - Sens 97, spec 21 PERC Neg + Low Suspicion (20% of total) = 0.9% VTE
  1) Age < 50 years  5) SaO2= > 95%
  2) no unilateral leg swelling  6) hospitalization for trauma/surgery w/in 4 wks
  3) pulse < 100 bpm  7) No prior VTE
  4) no hemoptysis  8) no estrogen use.
D-dimers

- DiNisio JTH 07 meta-analysis
  - Sens=.97, Spec=.43
  - PLR = 1.7, NLR = 0.07
  "Cutoff value for D-Dimer by this method is 500ng/ml FEU (fibrinogen Equivalent Units). It has a high negative predictive value that a negative result rules out the diagnosis of DVT or PE. A positive result is not a definitive diagnosis but indicates further diagnostic testing may be warranted."

Table 5 Summary estimates of sensitivity and specificity of D-dimer methods

<table>
<thead>
<tr>
<th>Type of D-dimer</th>
<th>Deep vein thrombosis</th>
<th>Pulmonary embolism</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sensitivity (95% CI)</td>
<td>Specificity (95% CI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELISA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microplate</td>
<td>94 (86–97)</td>
<td>53 (38–68)</td>
</tr>
<tr>
<td>Membrane</td>
<td>89 (76–95)</td>
<td>53 (37–68)</td>
</tr>
<tr>
<td>ELFA</td>
<td>96 (89–98)</td>
<td>46 (31–61)</td>
</tr>
<tr>
<td>Latex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantitative</td>
<td>93 (89–95)</td>
<td>52 (46–61)</td>
</tr>
<tr>
<td>Semiquantitative</td>
<td>85 (68–93)</td>
<td>68 (53–81)</td>
</tr>
<tr>
<td>Qualitative</td>
<td>69 (27–93)</td>
<td>96 (94–100)</td>
</tr>
<tr>
<td>Whole-blood assay</td>
<td>83 (67–93)</td>
<td>71 (57–82)</td>
</tr>
</tbody>
</table>

Table 5 is derived from the bivariate multivariable model, adjusting for differences in study design. CI, confidence interval; ELFA, enzyme-linked fluorescent immunoassay; ELISA, enzyme-linked immunosorbent assay.

Post test probability

- 4% pretest + neg d-dimer => 0 post test
- 10% pretest + neg d-dimer => 1% post test
- 30% pretest + neg d-dimer => 3% post test

Radiation

Dose equivalents – sieverts and rems
Absorbed dose – grays and rads
Stein, Radiology, 2007

<table>
<thead>
<tr>
<th>Radiation Exposure</th>
<th>Effective Whole-Body Dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiography</td>
<td>0.87</td>
</tr>
<tr>
<td>Pancreatic scan</td>
<td>0.8</td>
</tr>
<tr>
<td>Venticulation-perfusion scan</td>
<td>1.2–2.0</td>
</tr>
<tr>
<td>CT angiography</td>
<td>1.8–3.3</td>
</tr>
<tr>
<td>CT venography</td>
<td>5.7</td>
</tr>
<tr>
<td>Pulmonary digital subtraction angiogram</td>
<td>3.2–30.1</td>
</tr>
<tr>
<td>Background radiation per year</td>
<td>2.5</td>
</tr>
</tbody>
</table>
• Background radiation/year = 3 milliSv
• PA and Lat CXR = 0.07 mSv
• CTPA = 5mSv (2-8)
• Abd/pelvis CT = 10 mSv

Actual Doses!!! – Smith-Bindman, Arch IM 09
• CTPA – 10 (7-14) mSv
• CT abdomen – 16 mSv

1 CT begets another - Kline AnnEM 09
• 73% had >=1 subsequent CT scans
• 5% had >= 5 repeat CTPAs.

Breast exposure (Matthews, Br J Rad, 06)
• V/Q – 280 microGy
• CTPA – 20,000-50,000 microGy
• Increased risk of Breast Ca begins > 200,000 microGy

Diagnosis in Pregnancy
D-dimer in pregnancy (Kline Clin Chem 05)
• Percentage of women with normal d-dimer (< 0.50 ng/L)
  • Preconception: 79%
  • 1st trimester: 50% (can use 0.50)
  • 2nd trimester: 22% (can use 0.75)
  • 3rd trimester: 0% (can use 1.0)
  • 4 weeks Postpartum: 69%

Fetal Radiation (Matthews, BrJRad 06)
• Background = 1000 microGy over 9 months
• 50,000 microGy (5 Rads) = teratogen
• 100 microGy = 1 in 300,000 cancer risk over next 15 years

V/Q Scan in Pregnancy
• Fetal radiation exposure
  • Ventilation = 40-200 microGy
  • Perfusion = 100-350 microGy
• Higher rate of diagnostic results (75% instead of 30%)
• Use half dose perfusion
• Place a foley

CTPA in Pregnancy
• 1st trimester = 3-20 microGy
• 2nd trimester = 8-80 microGy
• 3rd trimester = 50-130 microGy
TREATMENT

Enox vs fixed dose SQ UFH
- Kearon, et al. “Comparison of fixed-dose weight-adjusted UFH and LMWH for acute treatment of venous thromboembolism” Jama 06
  - No Difference!
- Vardi et al “SQ UFH vs (IV UFH or SQ LMWH) for VTE” Cochrane Library, 2009
  - 15 RCT’s, 3054 pts
  - No significant difference!
    - Recurrent DVT = O.R. 1.68 (.92 to 3.04)
    - Recurrent PE = O.R. 1.18 (.54 to 2.56)
    - Major Bleed = O.R. 0.9 (.6 to 1.36)
    - Death = O.R. 1.02
  - However, concluded SQ UFH was not non-inferior!
- ACCP Guidelines for Rx of VTE, CHEST 2008
  - DVT or PE: Fixed dose SQ UFH Grade 1A recommendation
    - 333/U/Kg initial dose then 250 units/Kg BID SQ
  - However, can’t get prefilled UFH syringes!

Fondaparinux vs IV UFH
- The MATISSE study, 2214 pts with PE
  - VTE at 3 mos. 3.8 vs 5.0 (NS)
  - Major Bleed 1.3 vs 1.1 (NS)
- Once daily dosing
- No HIT

HIT
(Morris, et al., Chest, 2007)
- 13 studies, 5,275 pts
- HAT 1.5% vs 1.2% (NS)
- HIT (2/1426 vs 3/1058)
- HITT (0/1000 vs 1/900)

Coumadin Dosing
- 5 to 10 mgs for 2 days and then adjust on 3rd day based on INR
- 10 mg for outpts

Thrombolysis
ACCP Guidelines for Rx of VTE, CHEST 2008
- For hemodynamic compromise – Grade 1B
- For Right Heart Strain AND Low Risk Bleeding – Grade 2B

IVC Filters - Use when anticoagulation contraindicated
- 400 pts with DVT compared Filter + Warfarin vs Warfarin alone – no difference!
Outpatient RX
ACCP guidelines 2008
- No published trials have randomized patients with acute PE to Rx in hospital or at home.
- Two randomized trials included patients with acute PE who were treated as outpatients.
  - (Wells, et al Arch Intern Med 2005) 90 of the pts had PE
  - (Kearon JAMA 06) = 52 pts with PE treated entirely as outpatients.
    - VTE (3.5%) and major bleeding (1.4%) among all 142 VTE pts
- Three observational studies of LMWH with 158 patients (35% of total) with PE were treated entirely at home.
  - Good results
- Prediction rules have been developed to aid with selection of patients with acute PE who are suitable for treatment out of hospital.

EurSC guidelines 2008
- Outpatient Rx is “conceivable”

CAREFUL! Risk of recurrent PE was 25 percent if the activated partial thromboplastin time (aPTT) was not therapeutic within the first 24 hours after initiation of heparin in pooled analysis of 3 trials (Hull et al. Arch IM 1997)

APPENDIX – Wells Criteria

3 points
- S/S of DVT (swelling and pain w/ vein palpation)
- Alternative diagnosis less likely than PE

1.5 points
- HR > 100
- Immobilization > 3 d OR surgery < 4 wks
- Prior PE or DVT

1.0 points
- Hemoptysis
- Malignancy (receiving Rx within 6 mos or palliative)

Van Belle Jama 06
4 or less (“PE Not Likely”)
- Safe for d-dimer testing
5 or more (“PE Likely”)
- Not safe for d-dimer testing
REFERENCES

**Risk Factors**


**Clinical Decision Rules**


**PERC Rule**

**D-Dimers**

**Radiation Exposure**

PULMONARY EMBOLISM – Diagnosis and Treatment
Jeffrey Tabas MD


**Evaluation in Pregnancy**


**Anticoagulation**


**Thrombolysis, IVC Filters, and Outpatient Treatment**


