Acute Pulmonary Embolism and Deep Vein Thrombosis

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Pulmonary Hypertension Center
Acute PE and DVT

- No disclosures.
Acute PE and DVT

• Learning objectives
  ◦ Understand the pathophysiology of clinical symptoms and signs of PE.
  ◦ Review the appropriate evaluation of a patient with suspected PE or DVT, in a variety of clinical circumstances.
  ◦ Discuss treatment recommendations for the clinically stable PE/DVT patient, including new guidelines from 10th edition ACCP report.
  ◦ Explore management options for massive and high risk submassive PE.
Acute PE and DVT

- Epidemiology and risk factors
- Pathophysiology and clinical consequences of pulmonary embolism
- Diagnostic workup
- Severity assessment
- Management
Epidemiology

- Annual incidence of VTE around 1 in 1000 US population.
- Estimates up to 100,000 VTE-related deaths/year in US.
- Incidence rates consistently underestimated using antemortem data alone.
- Significant morbidity and mortality:
  - Incident or recurrent events
  - Adverse events from anticoagulation/treatments
  - Post-thrombotic syndrome (DVT)
  - Chronic thromboembolic pulmonary hypertension

cdc.gov; Beckman et al, Am J Prev Med 2010
Risk factors

- Previous VTE event
- Malignancy
- Pregnancy
- OCPs/hormonal therapy
- Hospitalization or immobilization
- Surgery or major trauma
- Inherited thrombophilias (factor V Leiden, prothrombin gene mutation, protein C/S deficiency, antithrombin deficiency)
- Nephrotic syndrome
- Inflammatory bowel disease
Clinical consequences of pulmonary embolism

- **Infarction** (pain, hemoptysis, dyspnea)
- **Abnormal gas exchange** (dyspnea, hypoxemia)
- **Right ventricular compromise** (hypotension, tachycardia, dyspnea, hypoxemia)
Clinical consequences of pulmonary embolism

- Infarction
  - Small distal thrombi $\rightarrow$ ischemic necrosis
  - Increased perfusion by bronchial arteries $\rightarrow$ high pressure extravasation/hemorrhage
  - Pleural inflammation $\rightarrow$ pain
Clinical consequences of pulmonary embolism

- Abnormal gas exchange
  - Obstructed vascular flow $\rightarrow$ dead space
  - If ventilation fixed $\rightarrow$ hypercarbia
  - Usually stimulus to increase ventilation $\rightarrow$ low $\text{pCO}_2$

http://www.nature.com/gimo/contents/pt1/fig_tab/gimo73_F7.html
Clinical consequences of pulmonary embolism

- Abnormal gas exchange
  - Overall disruption of V/Q matching → hypoxemia
Clinical consequences of pulmonary embolism

- Right ventricular compromise
  - Acute increase in RV afterload
  - Pathologic RV spiral
  - Loss of RV stroke volume $\Rightarrow$ tachycardia
  - If compensatory mechanisms insufficient $\Rightarrow$ hypotension and shock
  - Poor cardiac output $\Rightarrow$ low mixed venous $O_2$ $\Rightarrow$ arterial hypoxemia
Diagnostic workup

- Pulmonary embolism, stable patients
- Pulmonary embolism, pregnant patients
- Pulmonary embolism, unstable patients
- Deep vein thrombosis
Diagnostic workup: PE, stable patients

- Wells criteria for pulmonary embolism

<table>
<thead>
<tr>
<th>Clinical signs/symptoms of DVT</th>
<th>3 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other diagnoses less likely than PE</td>
<td>3 points</td>
</tr>
<tr>
<td>Heart rate &gt;100</td>
<td>1.5 points</td>
</tr>
<tr>
<td>Immobilization (≥3 days) or surgery (4 weeks)</td>
<td>1.5 points</td>
</tr>
<tr>
<td>Previous DVT or PE</td>
<td>1.5 points</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>1 point</td>
</tr>
<tr>
<td>Malignancy</td>
<td>1 point</td>
</tr>
</tbody>
</table>

- Dichotomized
  - Low likelihood: score ≤ 4 points
  - High likelihood: score > 4 points
Diagnostic workup: PE, stable patients

- Low likelihood: PE unlikely
  - D-dimer testing
    - If <500 ng/mL → PE excluded
    - If ≥500 ng/mL → perform imaging
  - Age-adjusted D-dimer
    - D-dimer: low specificity (elevated in older patients, pregnancy, acute illness, etc)

28.2% of low probability patients had D-dimer <500 → 0.1% VTE risk
11.6% of low probability patients had D-dimer >500 but less than age adjusted → 0.3% VTE risk
Diagnostic workup: PE, stable patients

- Low likelihood: PE unlikely
  - D-dimer testing
  - PERC testing (Kline et al. J Thromb Haemost 2004 and 2008)
    - If all 8 fulfilled → PE excluded (~1% VTE incidence)
  - Age < 50
  - HR < 100
  - O2 sat ≥ 95%
  - No hemoptysis
  - No estrogen use
  - No prior DVT/PE
  - No unilateral leg swelling
  - No recent surgery or trauma (4 weeks)
Diagnostic workup: PE, stable patients

- High likelihood: PE likely (or unlikely with positive D-dimer)
  - D-dimer testing for high likelihood: no role
  - Most patients → CT pulmonary angiogram (CTPA): sensitivity >90%
  - Indeterminate findings → need for more imaging
Diagnostic workup: PE, stable patients

- Wells Score: clinical likelihood for PE
  - Low likelihood for PE
    - D-dimer
      - <500 ng/ml: PE excluded
      - ≥500 ng/ml: PE confirmed
  - High likelihood of PE
    - CT pulmonary angiogram
      - Negative: PE excluded
      - Positive: PE confirmed
Diagnostic workup: PE, stable patients

- High likelihood: PE likely (or unlikely with positive D-dimer)
  - Ventilation/perfusion (VQ) scan

<table>
<thead>
<tr>
<th></th>
<th>Clinical low probability</th>
<th>Clinical high probability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VQ normal</strong></td>
<td>PE excluded</td>
<td>PE excluded</td>
</tr>
<tr>
<td><strong>VQ low probability</strong></td>
<td>PE excluded</td>
<td>*</td>
</tr>
<tr>
<td><strong>VQ intermediate probability</strong></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td><strong>VQ high probability</strong></td>
<td>*</td>
<td>PE confirmed</td>
</tr>
</tbody>
</table>
Diagnostic workup: PE, pregnant patients

- Pregnant patients
  - Wells score: utility?
  - D-dimer: can be elevated in normal pregnancy; sensitivity only 73%
  - VQ scan: relatively low prevalence of indeterminate studies
    - Ensure CXR normal
  - CTPA: if CXR abnormal, or VQ indeterminate
  - Consider lower extremity ultrasound (if leg symptoms)
Diagnostic workup: PE, unstable patients

- Evidence based algorithms not applicable
- Balance of benefits of confirming the diagnosis versus risks of patient traveling from unit
  - PE not the only entity that causes shock/RV mediated shock
Diagnostic workup: DVT

- There is a Wells criteria for deep vein thrombosis to assign low, moderate, high probability of DVT, though use of this tool in practice is variable.
- Compression ultrasonography has good test performance characteristics, and is low risk and easily available.
Management

- Pulmonary embolism severity assessment
- Low/average risk PE or DVT
  - Anticoagulation
  - Outpatient management
- Massive PE
- High risk submassive PE
- IVC filters
Management: PE severity assessment

- PESI

Table 1: Original and simplified Pulmonary Embolism Severity Index (PESI).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Original PESI* Score</th>
<th>Simplified PESI† Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 80 years</td>
<td>Age in years</td>
<td>1</td>
</tr>
<tr>
<td>Male sex</td>
<td>+10</td>
<td>-</td>
</tr>
<tr>
<td>History of cancer</td>
<td>+30</td>
<td>1</td>
</tr>
<tr>
<td>History of heart failure</td>
<td>+10</td>
<td>1†</td>
</tr>
<tr>
<td>History of chronic lung disease</td>
<td>+10</td>
<td></td>
</tr>
<tr>
<td>Pulse ≥ 110 beats/minute</td>
<td>+20</td>
<td>1</td>
</tr>
<tr>
<td>Systolic blood pressure &lt; 100 mm Hg</td>
<td>+30</td>
<td>1</td>
</tr>
<tr>
<td>Respiratory rate ≥ 30 breaths/minute</td>
<td>+20</td>
<td>-</td>
</tr>
<tr>
<td>Temperature &lt; 36°C</td>
<td>+20</td>
<td>-</td>
</tr>
<tr>
<td>Altered mental status§</td>
<td>+60</td>
<td>-</td>
</tr>
<tr>
<td>Arterial oxygen saturation &lt; 90%</td>
<td>+20</td>
<td>1</td>
</tr>
</tbody>
</table>

* A total point score for a given patient is obtained by summing the patient's age in years and the points for each applicable prognostic variable. The five following risk classes are defined based on patients' total point score: class I (≤65 points), class II (66–85 points), class III (86–105 points), class IV (106–125 points), and class V (>125 points). Patients in risk classes I/II are considered low risk. + A total point score for a given patient is obtained by summing the points for each applicable prognostic variable. Patients with 0 points are considered low risk. § The variables were combined into a single category of chronic cardiopulmonary disease. § Altered mental status was defined as disorientation, lethargy, stupor, or coma. # Arterial oxygen saturation was defined with and without the administration of supplemental oxygen.

**TABLE 4. RISK CLASS–SPECIFIC MEDICAL OUTCOMES**

<table>
<thead>
<tr>
<th>Medical Outcomes</th>
<th>Derivation Sample, % (95% CI) (n = 10,354)</th>
<th>Internal Validation Sample, % (95% CI) (n = 5,177)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-day mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td>1.1 (0.7–1.7)</td>
<td>1.6 (0.9–2.6)</td>
</tr>
<tr>
<td>Class II</td>
<td>3.1 (2.5–4.0)</td>
<td>3.5 (2.5–4.7)</td>
</tr>
<tr>
<td>Class III</td>
<td>6.5 (5.5–7.6)</td>
<td>7.1 (5.7–8.7)</td>
</tr>
<tr>
<td>Class IV</td>
<td>10.4 (9.0–11.9)</td>
<td>11.4 (9.3–13.8)</td>
</tr>
<tr>
<td>Class V</td>
<td>24.5 (22.7–26.4)</td>
<td>23.9 (21.4–26.5)</td>
</tr>
</tbody>
</table>

Source: Thromb Haemost 2011; 106: 423–428
Management: PE severity assessment

- Massive PE (SBP <90 mmHg)
- High risk submassive
  - RV dysfunction (echo, CT scan)
  - Biomarkers (BNP, troponin)
  - Significant hypoxemia
  - Significant tachycardia without hypotension
  - Clot in transit
  - PFO
  - Impressive clot burden on imaging
- Low/average risk
Management: low/average risk PE/DVT

- Anticoagulation
- Disposition
Management

Antithrombotic Therapy for VTE Disease
CHEST Guideline and Expert Panel Report

Clive Kearon, MD, PhD; Elie A. Akl, MD, MPH, PhD; Joseph Omelas, PhD; Allen Blaivas, DO, FCCP; David Jimenez, MD, PhD, FCCP; Henri Bounnameaux, MD; Menno Huisman, MD, PhD; Christopher S. King, MD, FCCP; Timothy A. Morris, MD, FCCP; Namita Sood, MD, FCCP; Scott M. Stevens, MD; Janine R. E. Vintch, MD, FCCP; Philip Wells, MD; Scott C. Woller, MD; and COL Lisa Moores, MD, FCCP
Management: anticoagulation

• Major change in 10th edition of ACCP guidelines: for patients without cancer, direct oral anticoagulants (DOACs) suggested over warfarin
Management: anticoagulation

- Direct oral anticoagulants (DOACs)
  - Rivaroxaban (approved 11/2012)
    - EINSTEIN-PE
      - 4832 patients acute symptomatic PE
      - Non-inferiority, event driven design; rivaroxaban vs. enoxaparin → warfarin. Primary endpoint: recurrent VTE
      - Results: recurrent VTE in 2.1% rivaroxaban vs. 1.8% standard therapy (p=0.003 for non-inferiority)
      - Major hemorrhage reduced (HR 0.49, p=0.003)


Oral Rivaroxaban for the Treatment of Symptomatic Pulmonary Embolism

The EINSTEIN–PE Investigators*
Management: anticoagulation

- Direct oral anticoagulants (DOACs)
  - Apixaban (approved 8/2014)
    - AMPLIFY
      - 5395 patients acute VTE (34% PE +/- DVT)
      - Non-inferiority design, apixaban vs. enoxaparin → warfarin. Primary endpoint: recurrent VTE or VTE-related death
      - Results: 2.3% apixaban vs. 2.7% standard therapy (p<0.001 for non-inferiority)
      - Major hemorrhage reduced (RR 0.31, p<0.001)

Oral Apixaban for the Treatment of Acute Venous Thromboembolism

Giancarlo Agnelli, M.D., Harry R. Buller, M.D., Ph.D., Alexander Cohen, M.D., Madelyn Curto, D.V.M., Alexander S. Gallus, M.D., Margot Johnson, M.D., Urszula Masiukiewicz, M.D., Raphael Pak, Ph.D., John Thompson, Ph.D., Gary E. Raskob, Ph.D., and Jeffrey I. Weitz, M.D., for the AMPLIFY Investigator.
Management: anticoagulation

- Direct oral anticoagulants (DOACs)
  - Dabigatran (approved 4/2014)
    - RE-COVER
      - 2564 patients acute VTE, started on UFH/LMWH
      - Non-inferiority design, dabigatran vs. warfarin. Primary endpoint: recurrent VTE within 6 months
      - Results: 2.4% dabigatran vs. 2.1% warfarin (p<0.001 for non-inferiority)
      - Major hemorrhage (RR 0.82, p=NS)

Dabigatran versus Warfarin in the Treatment of Acute Venous Thromboembolism

Sam Schulman, M.D., Clive Kearon, M.D., Ajay K. Kakkar, M.D., Patrick Mismetti, M.D., Sebastian Schellong, M.D., Henry Eriksson, M.D., David Baanstra, M.Sc., Janet Schnee, M.D., and Samuel Z. Goldhaber, M.D., for the RE-COVER Study Group*
Management: anticoagulation

- Direct oral anticoagulants (DOACs)
  - Edoxaban (approved 1/2015)
    - Hokusai-VTE
      - 8240 patients with acute VTE (40% with PE), started on LMWH or UFH
      - Non-inferiority, event driven design, edoxaban vs. warfarin. Primary endpoint: recurrent VTE
      - Results: 3.2% edoxaban vs. 3.5% warfarin (p<0.001 for non-inferiority)
      - Major hemorrhage reduced (RR 0.81, p=0.004)
Management: anticoagulation

- Direct oral anticoagulants: summary
  - 3 Xa-inhibitors (rivaroxaban, apixaban, edoxaban) and direct thrombin inhibitor dabigatran
  - Rivaroxaban/apixaban can be used at diagnosis, edoxaban/dabigatran following UFH/LMWH (“after 5-10 days of parenteral anticoagulation”)
  - All non-inferior to standard therapy; improvements in bleeding outcomes, though concern for irreversibility
  - Massive PE/high risk for bleeding excluded
  - All tested in patients with GFR >30 (or 25)
Management: anticoagulation

- If up front parenteral therapy is planned (DOACs contraindicated or undesirable, or dabigatran or edoxaban being used), guidelines suggest LMWH over UFH.
- UFH may be preferred in:
  - Renal failure, extreme obesity, anasarca
  - High bleeding risk; ?fibrinolysis candidates
- If warfarin used, start early (day 1), continue parenteral ≥5 days and until INR 2.0 for 24 hours.
- If dabigatran/edoxaban used, recommended after 5-10 days of parenteral therapy.
Management: anticoagulation

- Duration of anticoagulation
  - Provoked (surgical or transient nonsurgical risk factors): 3 months
  - Unprovoked, initial event: at least 3 months, with evaluation of risk-benefit thereafter
  - Unprovoked, second event: extended course
  - Malignancy: extended course (LMWH>VKA)
Management: anticoagulation

- Anticoagulation in pregnancy
  - LMWH recommended
  - Warfarin avoidance especially in first trimester and late pregnancy
  - DOACs avoided during pregnancy, lactation
  - Continue anticoagulation at least 6 weeks postpartum and 3 months therapy
Management: subsegmental PE

- Uncertainty regarding clinical implications of isolated subsegmental PE, as well as likelihood of false positives.
- 10th edition ACCP guidelines:
  “In patients with subsegmental PE and no proximal DVT in the legs who have a low risk for recurrent VTE, we suggest clinical surveillance over anticoagulation”
Management: outpatient

- Simple DVT often managed outpatient
- 10th edition ACCP guidelines:
  - “In patients with low-risk PE and whose home circumstances are adequate, we suggest treatment at home or early discharge over standard discharge”
  - Clinically stable with good cardiopulmonary reserve
  - Not high risk of bleeding (recent bleeding, renal or liver failure, thrombocytopenia)
  - Expected to be compliant with therapy
  - Feels well enough to be treated at home
Management: massive PE

- 2392 PE patients from ICOPER, 1995-96
- 108 patients with massive PE (SBP <90 mmHg)
Management: massive PE

- Massive PE with no contraindication → systemic thrombolysis
  - tPA 100 mg
- If lysis contraindicated or failed
  - Depending on available options
  - VA ECMO/CPB/surgical embolectomy
  - Percutaneous mechanical embolectomy
    - Rheolytic (saline jet), rotational, suction
    - Evidence: case series based
Management: high-risk submassive PE

- High risk submassive: controversial
  - Anticoagulation alone
  - Systemic thrombolysis (tPA 100 or 50 mg over 2 hrs)
  - Catheter-directed, ultrasound-accelerated thrombolysis (tPA ~20 mg over ~24 hrs)
  - Percutaneous mechanical embolectomy
Management: high-risk submassive PE

- PEITHO study
  - 1005 patients, acute PE with RV dysfunction (CT, echo) and positive troponin
  - Weight-based tenecteplase+UFH vs. placebo+UFH
  - Primary endpoint: death or hemodynamic collapse at 7 days

Fibrinolysis for Patients with Intermediate-Risk Pulmonary Embolism

Guy Meyer, M.D., Eric Vicaut, M.D., Thierry Danays, M.D., Giancarlo Agnelli, M.D., Cecilia Becattini, M.D., Jan Beyer-Westendorf, M.D., Erich Bluhmki, M.D., Ph.D., Helene Bouvaist, M.D., Benjamin Brenner, M.D., Francis Couturaud, M.D., Ph.D., Claudia Dellas, M.D., Klaus Empen, M.D., Ana Franca, M.D., Nazzareno Galiè, M.D., Annette Geibel, M.D., Samuel Z. Goldhaber, M.D., David Jimenez, M.D., Ph.D., Matija Kozak, M.D., Christian Kupatt, M.D., Nils Kucher, M.D., Irene M. Lang, M.D., Mareike Lankeit, M.D., Nicolas Meneveau, M.D., Ph.D., Gerard Pacouret, M.D., Massimiliano Palazzini, M.D., Antoniu Petris, M.D., Ph.D., Piotr Pruszczyk, M.D., Matteo Rugolotto, M.D., Aldo Salvi, M.D., Sebastian Schellong, M.D., Mustapha Sebbane, M.D., Bozena Sobkowicz, M.D., Branislav S. Stefanovic, M.D., Ph.D., Holger Thiele, M.D., Adam Torbicki, M.D., Franck Verschuren, M.D., Ph.D., and Stavros V. Konstantinides, M.D., for the PEITHO Investigators*
Management: high-risk submassive PE

- PEITHO study

Table 3. Efficacy Outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Tenecteplase (N = 506)</th>
<th>Placebo (N = 499)</th>
<th>Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome — no. (%)</td>
<td>13 (2.6)</td>
<td>28 (5.6)</td>
<td>0.44 (0.23–0.87)</td>
<td>0.02</td>
</tr>
<tr>
<td>Death from any cause</td>
<td>6 (1.2)</td>
<td>9 (1.8)</td>
<td>0.65 (0.23–1.85)</td>
<td>0.42</td>
</tr>
<tr>
<td>Hemodynamic decompensation</td>
<td>8 (1.6)</td>
<td>25 (5.0)</td>
<td>0.30 (0.14–0.68)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Table 4. Safety Outcomes in the Intention-to-Treat Population.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Tenecteplase (N = 506)</th>
<th>Placebo (N = 499)</th>
<th>Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding between randomization and day 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major extracranial bleeding</td>
<td>32 (6.3)</td>
<td>6 (1.2)</td>
<td>5.55 (2.3–13.39)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Minor bleeding</td>
<td>165 (32.6)</td>
<td>43 (8.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major bleeding†</td>
<td>58 (11.5)</td>
<td>12 (2.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke between randomization and day 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ischemic stroke</td>
<td>2 (0.4)</td>
<td>0</td>
<td>12.10 (1.57–93.39)</td>
<td>0.003</td>
</tr>
<tr>
<td>Hemorrhagic stroke‡</td>
<td>10 (2.0)</td>
<td>1 (0.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serious adverse events between</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>randomization and day 30</td>
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</tbody>
</table>
Management: high-risk submassive PE

- **MOPETT study**
  - Single center, 121 patients, moderate clot burden
  - Anticoagulation (LMWH>UFH) plus tPA 50 mg (over 2 hours) vs. anticoagulation alone
  - Primary outcome: echo evidence of pulmonary hypertension at followup (mean 28 months)
Management: high-risk submassive PE

- **ULTIMA study**
  - 59 patients, acute PE with RV/LV ratio > 1
  - UFH plus catheter-directed, ultrasound accelerated thrombolysis (≤20 mg/15 hrs) vs. UFH alone
  - Primary outcome: difference in ratio at 24 hours
  - Catheter-directed lytic group with significantly improved RV/LV ratio at 24 hours, no major bleeding


Nils Kucher, MD; Peter Boekstegers, MD; Oliver J. Müller, MD; Christian Kupatt, MD; Jan Beyer-Westendorf, MD; Thomas Heitzer, MD; Ulrich Tebbe, MD; Jan Horstkotte, MD; Ralf Müller, MD; Erwin Blessing, MD; Martin Greif, MD; Philipp Lange, MD; Ralf-Thorsten Hoffmann, MD; Sebastian Werth, MD; Achim Barmeyer, MD; Dirk Härtel, MD; Henriette Grünwald, MD; Klaus Empen, MD; Iris Baumgartner, MD
Management: IVC filters

- Classic teaching: recurrent PE reduced, DVT increased, neutral on total VTE and mortality
- PRECIP2 (JAMA 2015): no significant improvement in recurrent PE (3.0% filter group, 1.5% in no filter group at 3 months)
- Recommend against IVC filters for most
  - Place if contraindication to anticoagulation
  - Massive PE (or near-massive) with DVT (“next PE lethal)? can be controversial
Management: overall goals

- Prevent immediate/in-hospital mortality related to PE
- Minimize risks and complications of therapy (anticoagulation, fibrinolysis, interventional procedures)
- Minimize risk of recurrent PE/DVT
- Reduce morbidity due to chronic thromboembolic pulmonary hypertension and post thrombotic syndrome
- Individualize therapeutic choices based on risks/benefit profile of each patient
- New: Multidisciplinary PE response teams
Summary: Acute PE and DVT

- Venous thromboembolic disease is common; pulmonary embolism, in particular, can be very high risk. PE must be part of the differential diagnosis in appropriate patients with dyspnea, chest pain, syncope, or shock.
- Pathophysiology impacts gas exchange and cardiovascular mechanics, with a great range of severity.
- Diagnostic algorithms employ multimodality data, with results of Wells score, D-dimer testing, CT pulmonary angiogram, and compression ultrasonography highly relevant in most patients.
Summary: Acute PE and DVT

- Direct oral anticoagulants are now recommended as preferred treatment in non-cancer patients; some DOACs require up front parenteral therapy.
- Warfarin and LMWH will continue to be the appropriate choice anticoagulant for many.
- Patients presenting with hypotension and/or shock represent a very high mortality subgroup and require aggressive medical/procedural intervention.
- Optimal treatment of the stable but high-risk "submassive" PE patient is still unclear and must be individualized.
Questions?