

### Pulmonary Embolism

Pathophysiology

- A thrombus in another area of the body **embolizes to the pulmonary vasculature via the RV and PA.**
- Blood flow distal to the embolus is obstructed, causing **increased PVR, PA pressure, and RV pressure.** If severe, acute **cor pulmonale** can occur.
- Blood flow decreases in some areas, **dead space** is created where there is **ventilation but no perfusion.**
- **Hypoxemia and hypercarbia** occur and drive **tachypnea.**

If dead space is large, signs are more overt (SOB). PE and DVT are on a continuum.

### Pulmonary Embolism (cont)

Source

- Most PE arise from **thromboses of deep veins** of lower extremities above the knee (iliofemoral DVT).
- Can also arise from deep veins of pelvis.
- Calf vein thrombi have a low incidence of embolizing to the lungs, but they can progress into the proximal veins and increase the risk of PE.
- Upper extremity DVT is rare (seen in IVDU).
- **Fat emboli** from long bone fractures, amniotic fluid emboli during or after delivery, air emboli (trauma, lines), septic emboli (IVDU), schistosomiasis.

Symptoms

- Not a reliable indicator of the presence of PE.
- **Dyspnea (73%), cough (37%), pleuritic chest pain (65%), hemoptysis (13%).**
- Only 1/3 of patients will have signs and symptoms of a DVT.
- Syncope seen in large PE.

### Pulmonary Embolism (cont)

Signs

- **Tachypnea** (70%), rales (51%), **tachycardia** (30%), S4 (24%), increased P2 (23%).
- Shock with rapid circulatory collapse in massive PE.
- Others include low-grade fever, decreased breath sounds, and dullness on percussion.

Risk Factors for DVT and PE.

- Age >60, **malignancy**, prior history, hereditary, **hypercoagulable states**, prolonged immobilization, cardiac disease (esp. CHF), obesity, **nephrotic syndrome**, major surgery (esp. pelvic or orthopedic), major trauma, pregnancy, and estrogen use.



### Pulmonary Embolism (cont)

- Prognosis
- PE is usually clinically silent.
  - Recurrences are common, which can lead to **chronic pulmonary HTN and chronic cor pulmonale**.
  - When undiagnosed, mortality approaches 30%.
  - When PE is diagnosed, mortality is 10% in first 60 minutes. Of those who survive initial event, 30% will die of recurrent PE if untreated.
  - Most are recurrent in the first few hours.
  - Treatment with **anticoagulation** decreases mortality to 2-8%.

- Diagnosis
- If suspected PE, stabilize with **IVF and O2**. If PE is likely, **start anticoagulation before diagnostic tests**.
  - If PE is unlikely, get testing first.
  - If the patient has contraindications to anticoagulation, get testing first and then **consider IVC filter**.

### Testing

- D-Dimer
- **Specific fibrin degradation product** whose levels can be elevated in PE or DVT.
  - Sensitive (90-98%).
  - If results are normal and clinical suspicion is low, PE is very unlikely.
  - **Specificity is low**, as it can be **elevated in MI, CHF, pneumonia, and postop**.
  - Any cause of clot or increased bleeding can elevate D-Dimer.

### Testing (cont)

- Venous Duplex Ultrasound
- If positive, **treat with IV heparin**.
  - False positives will lead to anticoagulation in patients without PE.
  - If negative, the test is of very little value and the patient may still have a PE (up to 50% of patients with PE).

- Echocardiogram
- **Acute massive PE** is accompanied by **RV dilation and failure due to RV outflow obstruction and increased PVR**.
  - The **dilated RV pushes the septum towards the LV**, causing further **decrease in LV preload and CO**.
  - This shows up as **dilated RV cavity and hypokinesis of the RV free wall** with sparing of the apex (**McConnell's sign**).

- Helical CT
- **>90% sensitivity and good specificity**.
  - Can visualize very small clots (>2mm). Can miss clots in small sub segmental vessels.
  - **Test of choice**.
  - If negative and high clinical probability of PE, there is a 5% incidence of PE.
  - Contraindicated in patients with renal insufficiency because of **IV contrast**.

### Testing (cont)

- CXR
- Usually normal. **Atelectasis or pleural effusion** may be present.
  - Mainly useful to exclude competing diagnoses.
  - Hampton's hump or Westermark's sign are rarely present

- V/Q Scan
- Important when there is a contraindication to helical CT.
  - Results can either be normal, low-probability, intermediate-probability, or high-probability.
  - A normal V/Q scan rules out PE and no further testing is needed.
  - A high probability scan is **very sensitive for PE** and indicates treatment with heparin.
  - If low or intermediate probability, clinical suspicion determines next step.
  - If high, pulmonary angiography is indicated.

- Arterial Blood Gas
- Not diagnostic.
  - **PaO2 and PaCO2 are low** (latter due to hyperventilation) and **pH is high**.
  - **Typically respiratory alkalosis**.
  - **The A-a gradient is usually elevated**. A normal A-a gradient makes PE less likely but does not exclude it.

### Testing (cont)

Pulmonary Angiography

- **Gold standard.** Definitively diagnoses or excludes PE.
- But the test is invasive. **Contrast is injected into the PE branch after percutaneous catheterization of the femoral vein.**
- Consider when noninvasive testing is equivocal and risk of anticoagulation is high, or if the patient is unstable and embolectomy may be required. Rarely performed due to 0.5% mortality.

Rules Out PE

Normal or low-probability V/Q scan or helical scan and low clinical suspicion, negative pulmonary angiogram (definite), and negative D-Dimer with low suspicion

Wells Criteria

Symptoms and signs of DVT (3 points), alternative diagnosis less likely than PE (3 points), HR > 100 (1.5 points), immobilization > 3 days or surgery in last 4wks (1.5 points), previous DVT or PE (1.5 points), hemoptysis (1 point) and malignancy (1 point). If > 4, PE is likely.

### Testing (cont)

Indications for Treatment

intraluminal defects in central, segmental or lobular PAs on helical CT (or high probability with a scan) and clinical suspicion, DVT diagnosed with clinical suspicion, and positive pulmonary angiogram (definitively proves PE).

### Treatment

Oxygen Therapy

- To correct **hypoxemia.**
- Severe hypoxemia or respiratory failure requires intubation and mechanical ventilation.

Heparin

- Either unfractionated or LMWH (enoxaparin) to prevent recurrence.
- Prevents further clot formation but **does not lyse existing emboli or diminish thrombus size.**
- Start immediately based clinical suspicion. Do not wait for studies if high.
- Give one bolus, followed by infusion for 5-10days.
- Goal aPTT of 1.5-2.5x normal.
- Acts by **promoting antithrombin III.**
- Contraindications include active bleeding, uncontrolled HTN, recent stroke, and HIT.
- LMWH has less complications but NOT used in ESRD.

### Treatment (cont)

Warfarin

- For long-term treatment. **Can start with heparin on day 1.**
- Goal INR is 2-3. Continue for 3-6 months depending on risk factors.
- Some patients with significant risk for recurrence (malignancy, hypercoagulable state) should receive lifelong therapy.

Thrombolytic Therapy

- Streptokinase, TPA.
- **Speed up lysis of clots.**
- Does not improve mortality rates.
- Should be considered for use in patients with **massive PE** who are **unstable**, and patients with **evidence of RHF.**

IVC Filter

- Have not been proven to reduce mortality.
- Patients are at a higher risk of recurrent DVT but lower risk of recurrent PE.
- Complications include filter migration or misplacement, filter erosion and perforation of IVC, and IVC obstruction due to filter thrombosis.
- Indicated for patients with contraindications to anticoagulation, complication of current anticoagulation, failure of adequate anticoagulation evidence by recurrence, and low pulmonary reserve (high risk of death due to PE).

### Treatment (cont)

NOACs Fondaparinux is an injectable factor Xa inhibitor. Rivaroxaban is an oral factor Xa inhibitor. Neither can be used in severe CKD (GFR<30). Elixiban is approved for use in CKD.



By [xkissmekatex \(kissmekate\)](#)  
[cheatography.com/kissmekate/](http://cheatography.com/kissmekate/)

Published 14th January, 2017.  
Last updated 16th January, 2017.  
Page 4 of 4.

Sponsored by [CrosswordCheats.com](http://CrosswordCheats.com)  
Learn to solve cryptic crosswords!  
<http://crosswordcheats.com>