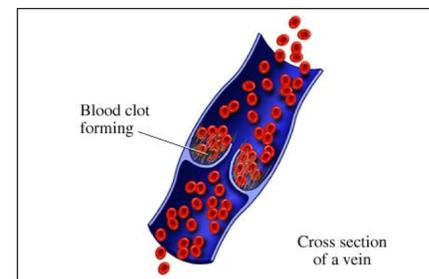
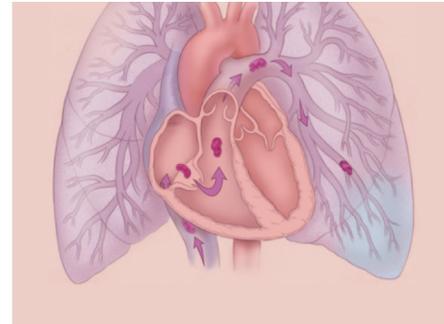
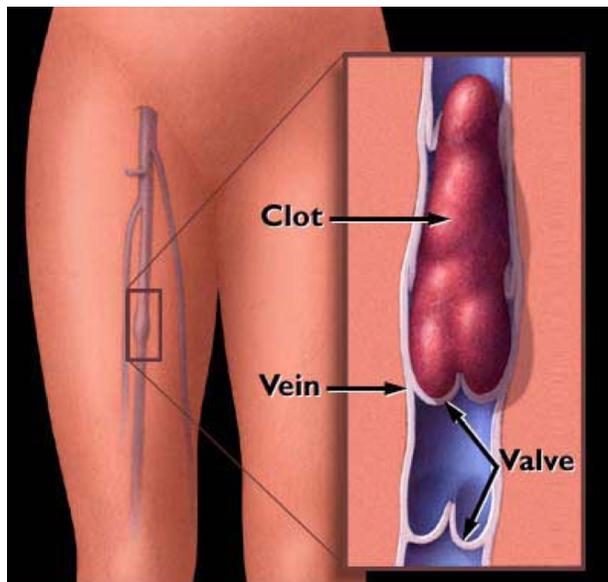


Pulmonary emboli

usually arise from thrombi that originate in the **deep venous system of the lower extremities**; however, they rarely also originate in the **pelvic, renal, upper extremity veins, or the right heart chambers**.

After traveling to the lung, large thrombi can lodge at the bifurcation of the main pulmonary artery or the lobar branches and cause hemodynamic compromise.



The pathophysiology of pulmonary embolism

Although pulmonary embolism can arise from anywhere in the body, most commonly it arises from the **calf veins**. The venous thrombi predominately originate in venous valve pockets and at other sites of presumed venous stasis. To reach the lungs, thrombo emboli travel through the right side of the heart. RA, right atrium; RV, right ventricle; LA, left atrium; LV, left ventricle.

Pulmonary thromboembolism is not a disease in and of itself. Rather, it is a complication of underlying venous thrombosis.

Under normal conditions, microthrombi (tiny aggregates of red cells, platelets, and fibrin) are formed and lysed continually within the venous circulatory system.

Typical signs and symptoms

- abrupt onset of pleuritic chest pain
- shortness of breath
- hypoxia
- sudden catastrophic hemodynamic collapse
- gradually progressive dyspnea
- Accentuated second heart sound (pulmonic valve)
- Tachycardia (heart rate >100/min)
- Fever (temperature >37.8°C [100.04°F])
- Diaphoresis
- S₃ or S₄ gallop

The diagnosis of pulmonary embolism should be suspected in patients with respiratory symptoms unexplained by an alternative diagnosis.

Atypical signs and symptoms:

- Seizures
- Syncope
- Abdominal pain
- Fever
- Productive cough
- Wheezing
- Decreasing level of consciousness
- New onset of atrial fibrillation
- Hemoptysis
- Flank pain
- Delirium (in elderly patients)

PERC Rules:

- Age ≥ 50
- HR ≥ 100
- O₂ Sat on room air < 95%
- Prior history of DVT/PE
- Recent trauma or surgery
- Hemoptysis
- Exogenous estrogen
- Unilateral leg swelling

Labs to order:

D-dimer testing very sensitive test not specific

- White blood cell count
- Arterial blood gases:
- Serum troponin levels
- Brain natriuretic peptide

Hypercoagulation workup

should be performed if no obvious cause for embolic disease is apparent, including screening for conditions such as the following:

- Antithrombin III deficiency
- Protein C or protein S deficiency

Factor V Leiden (Most common)

- Lupus anticoagulant
- Homocystinuria
- Occult neoplasm
- Connective tissue disorders (SLE, nephrotic syndrome)

Imaging:

Gold standard: Computed tomography angiography (CTA)

Multidetector-row CTA (MDCTA) is the standard for diagnosing pulmonary embolism

Pulmonary angiography:

Standard for diagnosing pulmonary embolism when CTA is not available

V/Q scanning:

When CT scanning is not available or is contraindicated GFR<50

EKG:

Most common abnormalities tachycardia and nonspecific ST-T wave abnormalities
right ventricular strain 9th inning

MRI:

Using standard or gated spin-echo techniques, pulmonary emboli demonstrate increased signal intensity within the pulmonary artery

Echocardiography:

Transesophageal echocardiography may identify central pulmonary embolism

Duplex ultrasonography: Noninvasive diagnosis of pulmonary embolism by demonstrating the presence of a DVT at any site most commonly calf

Treatment

Anticoagulation and thrombolysis

Immediate full anticoagulation is mandatory for all patients suspected of having DVT or pulmonary embolism

IV Heparin

Long-term anticoagulation is critical to the prevention of recurrence of DVT or pulmonary embolism, because even in patients who are fully anticoagulated, DVT and pulmonary embolism can and often do recur.

Anticoagulation medications include the following:

- **Unfractionated heparin**
- **Low-molecular-weight heparin**
- **Factor Xa inhibitors**
- **Warfarin**

Thrombolytic agents used in managing pulmonary embolism include the following:

- **Alteplase (Tpa)**
- **Reteplase**

Surgical options

- Catheter embolectomy and fragmentation or surgical embolectomy
- **Placement of vena cava filters**

