



Department of Anesthesia Techniques



Pulmonary embolism

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Venous thromboembolism (VTE) consist of:

1. Deep Venous Thrombosis (DVT)
2. Pulmonary Embolism (PE), is one of the three major cardiovascular causes of death, along with myocardial infarction and stroke.

VTE can cause death from PE , chronic thromboembolic pulmonary hypertension

- PE is the most common **preventable cause of death among hospitalized patients**

The long-term effects of nonfatal VTE lower the quality of life. Chronic thromboembolic pulmonary hypertension is often disabling and causes breathlessness.

Pulmonary embolism PE

- **Epidemiology**

- Five million cases of venous thrombosis each year
- 10% of these will have a PE
- 10% will die
- Correct diagnosis is made in only 10-30% of cases
- Up to 60% of autopsies will show some evidence of past PE

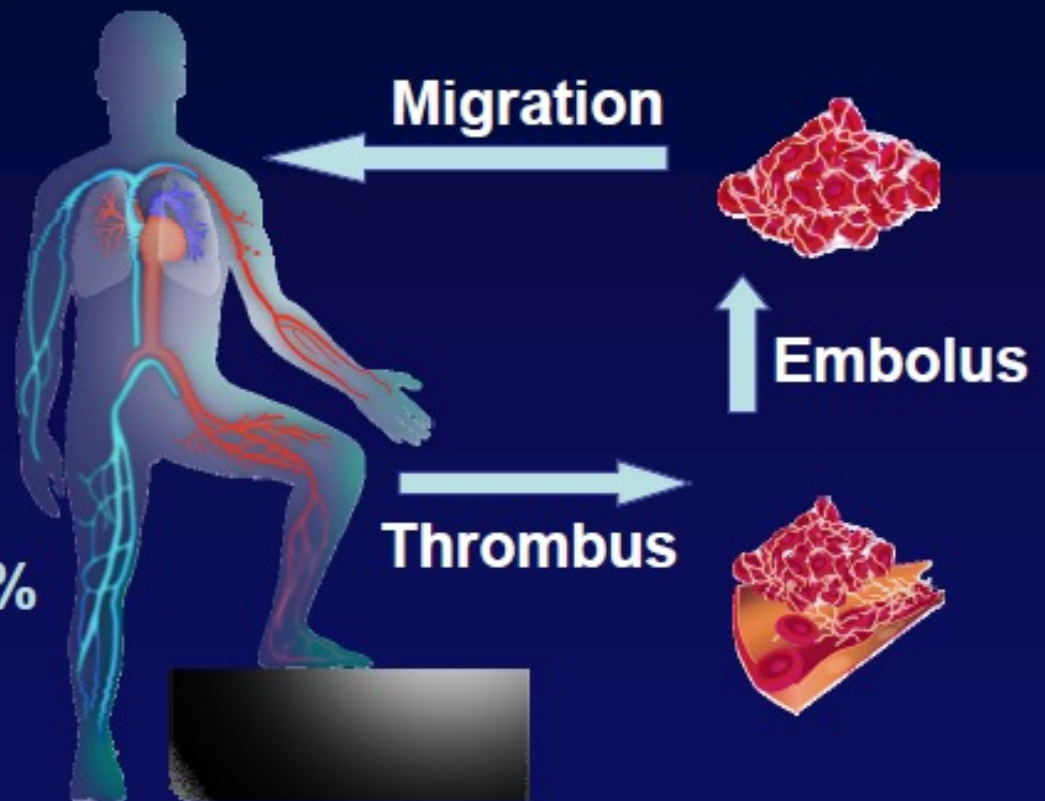
- **factors predisposed to venous thrombosis**

- Local trauma to the vessel wall
- Hypercoagulability
- Stasis of blood flow

VTE: A strong relationship between DVT and PE

About 50% of patients with proximal DVT of the leg have asymptomatic PE¹

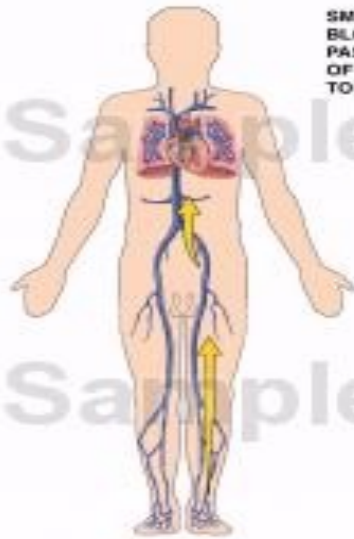
DVT (mainly asymptomatic) is found in around 80% of patients with PE²



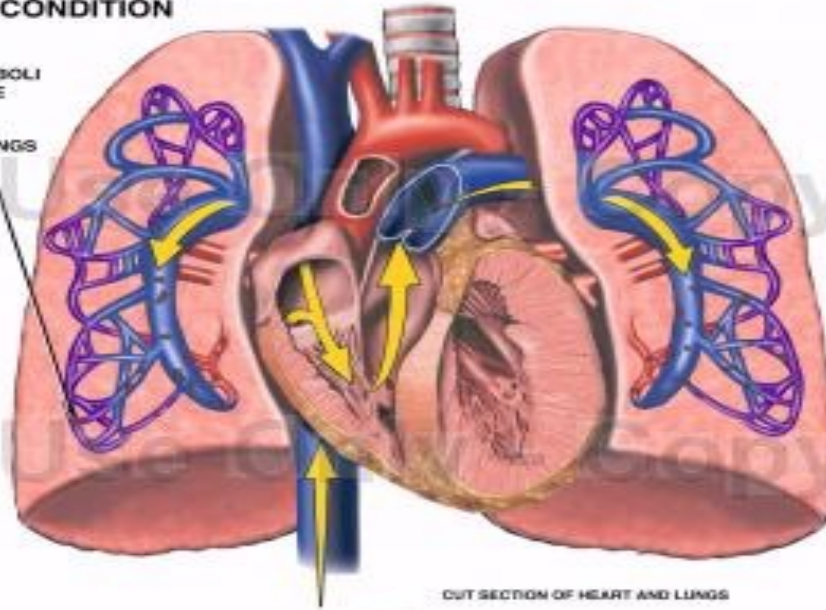
Pulmonary Embolism

Sample Use Only - Copy

INITIAL CONDITION



SMALL EMBOLI
BLOCK THE
PASSAGE
OF BLOOD
TO THE LUNGS



CUT SECTION OF HEART AND LUNGS

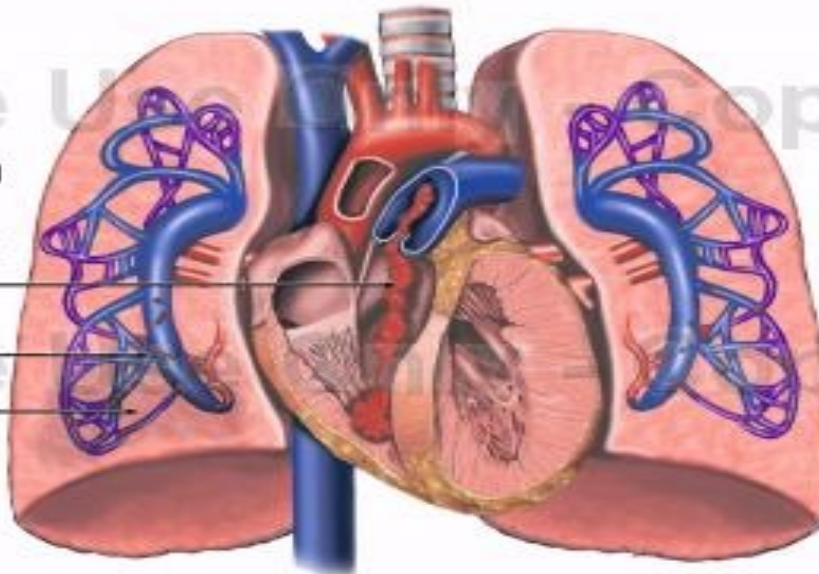
ARROWS INDICATE THE PATHWAY
OF THE EMBOLI FROM THE LOWER
LEFT LEG UP TO THE THORAX.

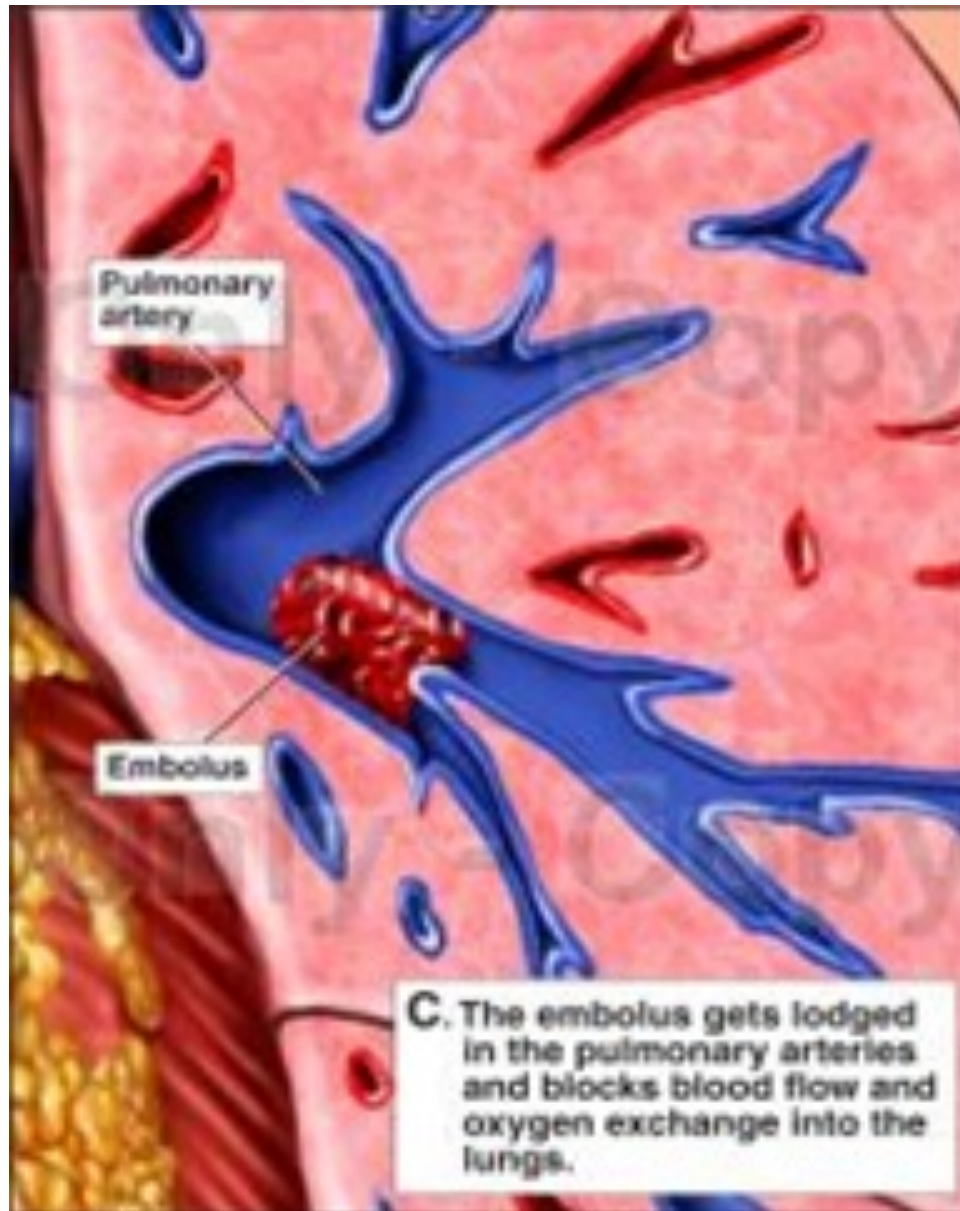
ULTIMATE CONDITION

EMBOLUS MEASURING 39 x 1.8 cm
BLOCKS THE RIGHT VENTRICLE
AND THE PULMONARY TRUNK

SMALL EMBOLI
(AT LEAST 48 HOURS OLD)

INFARCTION
OF THE LOWER LOBE
OF THE RIGHT LUNG





Risk Factors

- CHF
- Malignancy
- Obesity
- Estrogen/OCP
- Pregnancy (esp post partum)
- Lower extremity injury
- Coagulopathy
- Venous Stasis
- Prior DVT
- Age > 70
- Prolonged Bed Rest
- Surgery requiring > 30 minutes general anesthesia
- Orthopedic Surgery

PE

- When venous emboli become dislodged from their site of origin, they embolize to the pulmonary arterial circulation
- **Pathophysiology**
- Increased pulmonary vascular resistance(PVR)
- Impaired gas exchange(increased alveolar dead space from)
- Alveolar hyperventilation reflex stimulation of irritant receptors.
- Increased airway resistance
- Decreased pulmonary compliance

Right Ventricular Dysfunction

- Progressive right heart failure is the usual immediate cause of death from PE
- As pulmonary vascular resistance increases, right ventricular wall tension rises and further right ventricle dilation and dysfunction
- Interventricular septum bulges into and compresses the normal left ventricle

Clinical Syndromes

- **Pts with massive PE** present with systemic arterial hypotension and evidence of peripheral thrombosis
- **Pts with moderate PE** will have right ventricular hypokinesis on echocardiogram but normal systemic arterial pressure
- **Pts with small to moderate PE** have both normal right heart function and normal systemic arterial pressure

Physical Signs & Symptoms

- Dyspnea
- Pleuritic Pain
- Cough
- Leg Swelling
- Leg Pain
- Hemoptysis
- Palpitations
- Wheezing
- Angina-Like pain

Diagnosis

- Always ask about prior DVT, or PE
 - Family History of thromboembolism
 - **Dyspnea** is the most frequent symptom of PE
 - **Tachypnea** is the most frequent physical finding
 - Dyspnea, syncope, hypotension, or cyanosis suggest a massive PE
 - Pleuritic Chest Pain, cough, or hemoptysis

Diagnosis

- **Serum Studies**

- **D-dimer**

- Elevated in more than 90% of pts with PE
 - Reflects breakdown of plasmin and endogenous thrombolysis
 - Not specific: Can also be elevated in MI, sepsis, or almost any systemic illness

- **CXR**

- A normal or nearly normal chest x-ray often occurs in PE

- **CT Scan**

- Identifies proximal PE (which are the ones usually hemodynamically important)

- Not as accurate with peripheral PE

- **Venous Ultrasonography**

- **V/Q Scan**

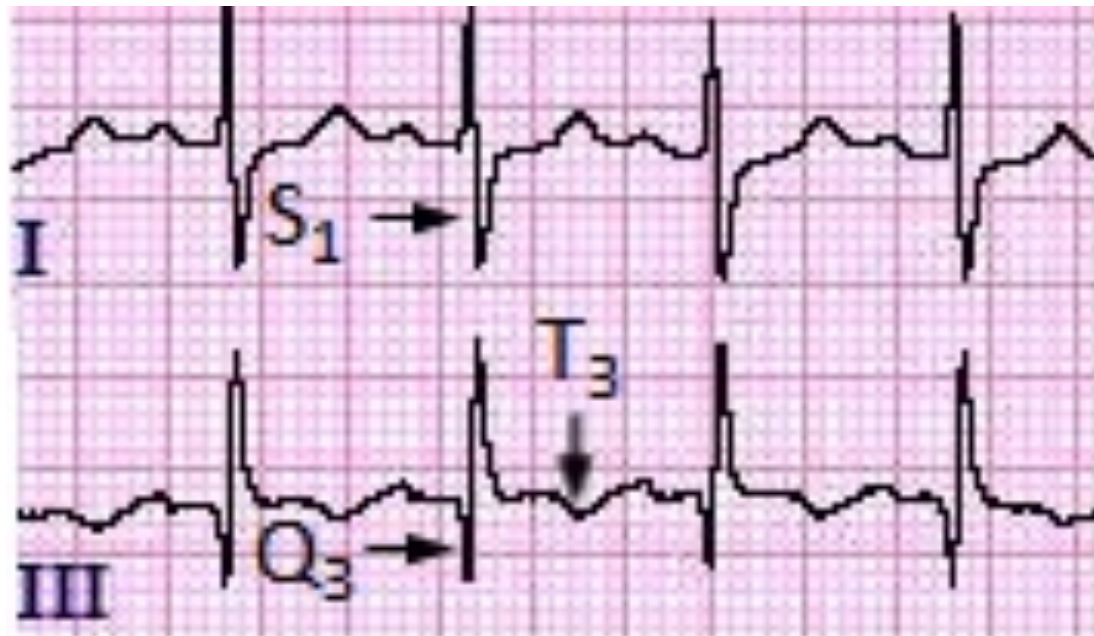
- **Pulmonary Angiogram**

- **Echocardiogram**

ECG

The most common ECG finding in the setting of a pulmonary embolism is sinus tachycardia. However, the “S₁Q₃T₃” pattern of acute cor pulmonale is classic.

A large S wave in lead I, a Q wave in lead III and an inverted T wave in lead III together indicate acute right heart strain.



The S₁Q₃T₃ pattern

High risk of an adverse clinical outcome

- Hemodynamic instability,
- RV dysfunction on echocardiography,
- RV enlargement on chest CT,
- Elevation of the troponin level due to RV microinfarction outcome

Primary therapy

- Fibrinolysis
- Pharmacomechanical catheter-directed therapy
- surgical embolectomy
- pulmonary thromboendarterectomy]
- **Prevention**
- Anticoagulant
- Inferior vena cava filter
- graduated compression stocking
- Intermittent pneumatic compression devices

Treatment

- **Begin treatment with either unfractionated heparin or LMWH, then switch to warfarin** Does NOT directly dissolve thrombus that already exists)
- **Warfarin for at least 3 months, INR 2-3**

IVC filter indication

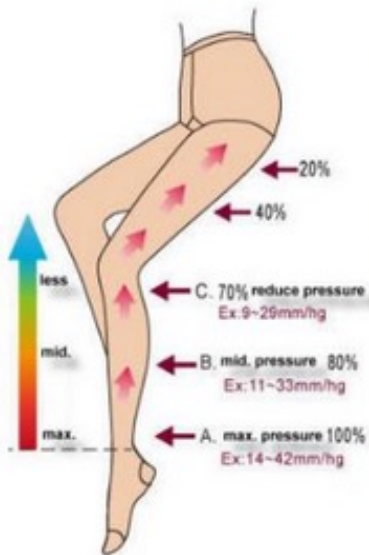
- 1-active bleeding that precludes anticoagulation
- 2-recurrent venous thrombosis despite intensive anticoagulation.
- 3- Prevention of recurrent PE in patients with right heart failure who are not candidates for fibrinolysis
- 4- prophylaxis of extremely high-risk patients

IVC filter



graduated compression stocking

Basic Terms of Standard Compression Stockings



- (1) Has gradually decreased pressure.
- (2) Has tridimensional heels knit.
(ensure smooth circulation without a pain in the bow of forefoot.)
- (3) Pass International Standard Approval.
(ex. FDA, CE, TGA, etc.)
- (4) Show pressure value on the product & pack.
- (5) Show size on the product & pack.

KoolFree® professional compression stockings have pass FDA510(k), CE, TGA approval and stably exported to North U.S.A., Europe, Australia, China, etc.



Intermittent pneumatic compression devices

