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Pulmonary Embolism

★ Objectives:

1. To know etiology & risk factors for pulmonary embolism.
2. How to diagnose pulmonary embolism & its major clinical presentations.
3. Lines of treatment of pulmonary embolism.

★ Resources Used in This lecture:

-Doctor's comments

Step up to medicine,Lecture ,Master the board

-Important

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Introduction

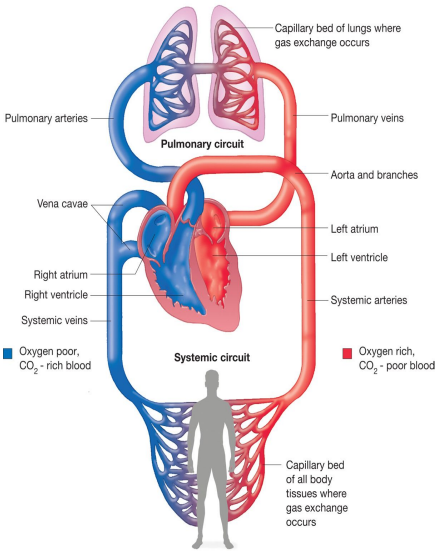
Blood circulation

Pulmonary Circulation:

Pulmonary circulation is the movement of blood from the heart to the lungs for oxygenation, then back to the heart again .

Arteries: From the right ventricle, Deoxygenated blood is pumped through the pulmonary semilunar valve into the left and right pulmonary arteries (one for each lung) and travels through the lungs.

Veins: Take the oxygenated blood and leaves the lungs through pulmonary veins, which return it to the left atrium, completing the pulmonary cycle.



Embolism:

An embolism is the lodging of an embolism, a blockage-causing piece of material, inside a blood vessel (pulmonary vessel). The embolus might be a blood clot (thrombus), a fat globule, a bubble of air or other gas (gas embolism), or a foreign material.

- **Pulmonary embolism is almost always caused by DVT, thus there is other states that can cause PE.**

1- Pregnancy

- Present with DVT, PR or Fetal loss or stillbirth.

2-Thrombophilia

- It needs an insult to trigger PE as smoking or being pregnant.
- Factor V leiden most commonly
- Other forms: deficiency of protein C, S or antithrombin III.

3- Fat embolism

- After 3-4 days of long bone fracture/ trauma.
- Rarely after CPR
- Present with triad: 1-SOB 2-Petechia on neck or axilla 3- Confusion
- Tx: supportive no anticoagulant is given

Definition

- **Pulmonary embolism** occurs when a thrombus in another region of the body embolizes to the pulmonary vascular tree via the RV and pulmonary artery. Blood flow distal to the embolus is obstructed.
- **Massive pulmonary embolism** results from an acute right ventricular failure and death, usually undiscovered until autopsy, typically leads to death within 2 hrs.

Sources of emboli:

- ❑ **Deep venous thrombosis (>95%)**

- Lower extremity DVT (most common) such as : iliofemoral DVT , (most common) , pelvic DVT or calf DVT.
- Upper extremity DVT very rare. (can be seen in IV drug abusers)
  - ❑ **Other veins such as** Superficial Femoral vein, Renal , Uterine , Right cardiac chamber.

Other sources of emboli :

- Fat embolism (due long-bone fractures.), Amniotic fluid embolism (during delivery), Air embolism (due to trauma to thorax), or Septic embolism (IV drug use).
- In lupus anticoagulant PE can be caused from an artery.

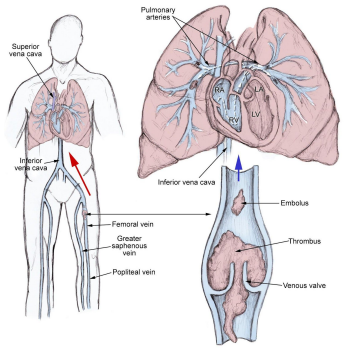
Risk factors :

- Age > 60 , Obesity
- History of DVT or PE
- Malignancy
- Major Trauma or Major surgery (esp. pelvic surgery), general anesthesia
- Cardiac disease (Esp. CHF)
- Nephrotic syndrome (due to loss of Antithrombin III)
- Hypercoagulability state hereditary (vactor V leiden, protein s and c deficiency)
- Pregnancy,postpartum or estrogen use (oral contraceptive pills)
- Immobilization or traveling long distance or long time sleep.(stasis)

Pathophysiology

Blocking a portion of pulmonary vasculature **leading to :**

- **Increased** pulmonary vascular resistance and pulmonary artery pressure (PAP) → increase in Right ventricular pressure
- Decrease filing of left ventricular → Decrease CO → hypoxemia stimulate vasoconstriction→ increase in PAP
- Decreased blood flow in some areas of lung → **hyperventilation →** dead space created in the lung (low perfusion & high ventilation).



- Recurrences are common, which can lead to development of chronic pulmonary HTN and chronic cor pulmonale.
- Severe (large PE) **acute cor pulmonale** can result.

Clinical Presentation

Symptoms:

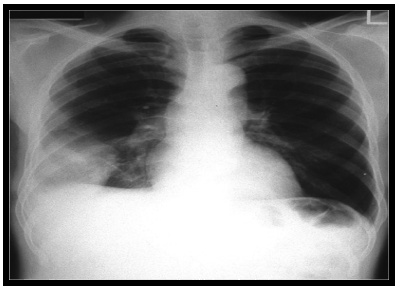
- Most often, PE is clinically silent.
- Sudden onset of SOB.
- Pleuritic chest pain
- Cough
- Hemoptysis
- Syncope in large PE
- Unilateral leg pain from DVT. (calf swelling)

Signs :

Tachypnea , Tachycardia , Rales , added sound S4 , dullness on percussion

- **Other signs include: low grade fever, decreased breathing sounds dullness on percussion.**
- **Most sensitive symptoms are tachypnea and tachycardia**

Diagnosis



- ❑ **History and Physical examination**
- ❑ **Initial tests**

1- CXR (chest x-ray) : usually normal , use to exclude alternative diagnosis. The abnormality can be seen Atelectasis[1] (most common abnormality) or pleural effusion and less likely humpton hum & westermark sign

2- ABG : low PaO_2 (due to Hypoxia)and $PaCO_2$ (due to hyperventilation) , respiratory alkalosis. (A-a gradient) is usually elevated

3- ECG (electrocardiogram) : shows sinus tachycardia , anterior T-wave inversion , ST-segment and T- wave changes, rarely right bundle branch block

Note : Best initial test of PE : CXR and ABG
-effusion of chest x-ray can be transudate or exudate
-ABG in healthy young adults can be normal.

- ❑ **Confirm test → Divided into two:**

A. High Clinical suspicion

1. **CT angiogram (spiral CT) :**

- Visualize Pulmonary vessels allow us to see small clots
- May miss clots in the periphery
- if the clots present → confirm PE and .
- Contradiction in Renal Insufficiency

[1] partial or complete collapse of the lung.

2. **Ventilation perfusion Lung scan (V/Q)**

Used when CT angiogram contraindicated or the result inclusive .

The test shows either:	
Normal V/Q →	Exclude the PE
High Probability	Confirm PE
Low or intermediate Probability (patient might have underlying chronic lung disease only)	Do Lower extremities duplex ultrasound

3. **Lower Extremity doppler ultrasound :** used when the V/Q shows Low or intermediate Probability . IF the result is positive so we don't need to do further test because the treatment of PE = DVT
4. **Pulmonary Angiography** : Used when all above are equivocal

It is the gold standard (can show the periphery)

B. Low clinical suspicion

- **D-dimer assay** : specific fibrin degradation product

Positive → start the steps of High clinical suspicion.

Negative → exclude the PE.

- D-dimer will be elevated in MI, Pneumonia and CHF .
- The Spiral CT is the test of choice if negative, might be periphery PE especially if high painent.
- Pulmonary Angiography Most accurate test but it's invasive

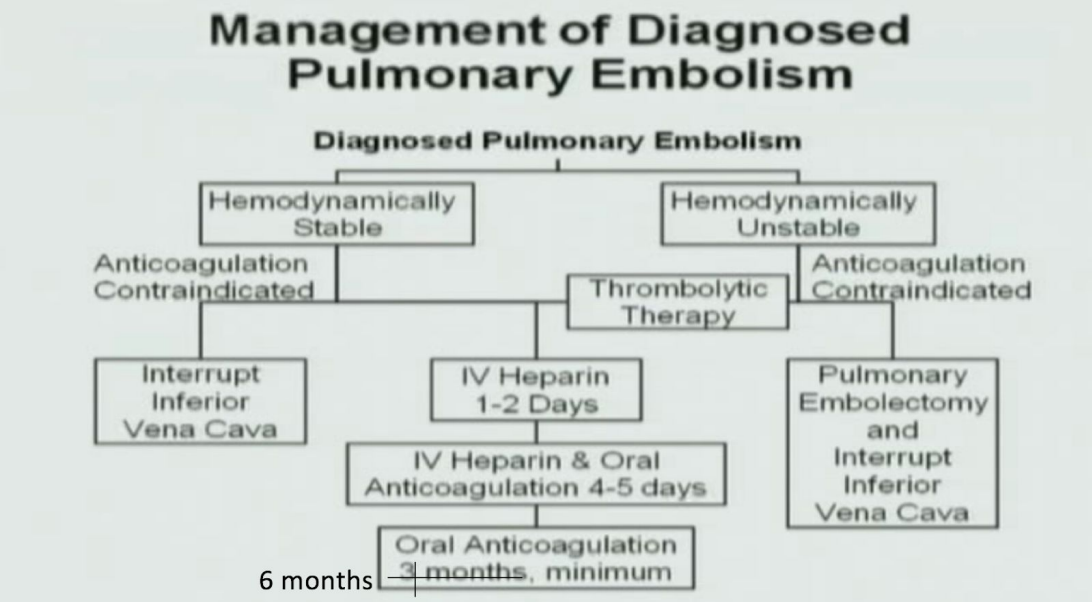
Treatment

- ❑ **Oxygen** : used to correct hypoxemia
- ❑ **heparin** :give it to the patient immediately . it Prevent further clots formation. We can use Either Low molecular weight Heparin or unfractionated heparin.

- If diagnosis is positive continue on heparin till 5-7 days.
- Heparin is Best initial therapy .
- LMWH More effective and less complication compared to UFH.

- ❑ **Oral anticoagulant**: Strated at the same time with the heparin such as :
- **Warfarin**: needs to monitor INR between 2 and 3
- **Rivaroxaban or dabigatran**: No needs to to monitor INR and reach the therapeutic effect in several Hours
- ❑ **Thrombolytics** (streptokinase ,Urokinase,Recombinant tissue-plasminogen activator) lysis the clots, used only in ;
- Hemodynamically unstable patient (hypotension and tachycardia)
- Right sided Heart failure
- ❑ **IVC Filte**r: used only in
- Patient contraindicated to Anticoagulant (Bleeding condition or recent surgery)
- Recurrent DVT or PE despite use of Anticoagulant
- Right sided Heart failure
- ❑ Thrombectomy

- IVC filter : don't reduce the mortality + don't reduced the Risk of DVT (only lower the risk oF PE)
- Pregnant woman are contraindicated to warfarin so they complete on heparin(LMWH) only.
- Lifelong anticoagulant if there is recurrent DVT or PE.
- Patient with Heparin induced thrombocytopenia : Replace the heparin by either :
  - ★ **Direct acting thrombin inhibitors (Lepirudin , argatroban)**
  - ★ **Fondaparinux**



Summary

1. Pulmonary embolism is a medical emergency
2. Diagnosis of DVT or PE is an indication for treatment
3. Lower extremities are the main source of emboli.
4. In severe cases acute cor pulmonale may result
5. Clinical symptoms become more overt as the size of dead space in lung increases.
6. Symptoms of PE are not specific.
7. Most often PE is silent.
8. Dyspnea, pleuritic chest pain , tachypnea are the most common manifestations.
9. Recurrences are common.
10. Spiral CT is the test of choice in diagnosing PE.
11. DVT is diagnosed by ultrasound and clinical suspicion.
12. V/Q scan plays an important role in diagnosing PE if spiral CT is contraindicated.
13. Pulmonary angiography can make a definite diagnosis but, it is invasive.
14. Start therapeutic heparin as initial treatment. Also start warfarin at the same time.

MCQ's

1) A 65-year-old woman who recently underwent hip replacement comes to the emergency department with the acute onset of shortness of breath and tachycardia. The chest x-ray is normal, with hypoxia on ABG, an increased A-a gradient, and an EKG with sinus tachycardia. What is the most appropriate next step in management?

a. Intravenous unfractionated heparin

b. Thrombolytics

C. Spiral CT scan

D. Ventilation/perfusion (V/Q) scan

E. D-dimer

When the history and initial labs are suggestive of PE, it is far more important to start therapy than to wait for the results of confirmatory testing such as the spiral CT or V/Q scan. D-dimer is a poor choice when the presentation is clear because its specificity is poor. Embolectomy is

rarely done and is performed only if heparin is ineffective and there is persistent hypotension, hypoxia, and tachycardia.

2) What is the commonest place and vein of DVT in PE?

A- Lower extremities-saphenous vein

B- Lower extremities-iliofemoral vein

C- IVC

D- Upper extremities-Cephalic vein

Answer: A,B

Case

A 39-year-old female is brought to the ED by her husband with the chief complaint of acute SOB and anxiety that started suddenly 2 to 3 hours ago while she was working around the house. She denies chest pain. Her PMH is unremarkable. She takes oral contraceptives but no other medications. Vital signs are: Temperature=99.1, RR=34, BP=148/90, pulse=100. Oxygen saturation is 94% on room air. On examination, the patient appears healthy although in moderate respiratory distress. Her examination is otherwise unremarkable. Laboratory tests reveal: WBC=7.1, Hgb=12.2, Hct=37.3, Na+=138, K+=4.7, Cl−=109, HCO_3−=25, BUN=14, Cr=0.9, glucose=106. ABGs are obtained and reveal: pH=7.52, HCO_3−=20, $PaCO_2$=26, PaO_2=70. CXR and ECG are normal. What is the acid–base disorder? What is the appropriate management of this patient?

Answer: This patient has respiratory alkalosis. Her hyperventilation may result from pulmonary embolism, or from a number of other conditions, including panic attacks. Given the high clinical suspicion for pulmonary embolism (sudden onset of dyspnea, oral contraceptive use, and hypoxemia), start the patient on heparin and obtain a V/Q scan or a spiral CT scan.