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Student's scientific community

3 November 2023

Scientific discussion

Pulmonary thromboembolism, diagnostic tests.

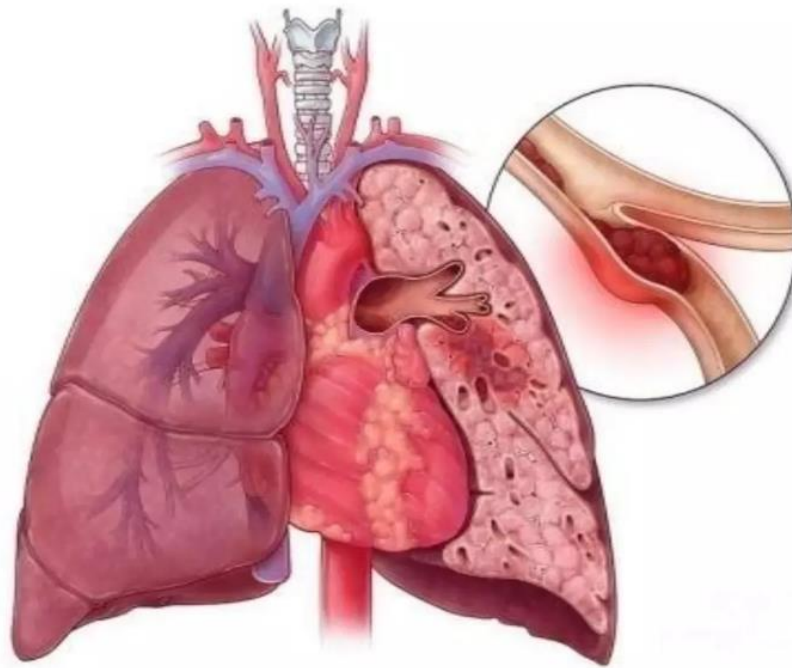


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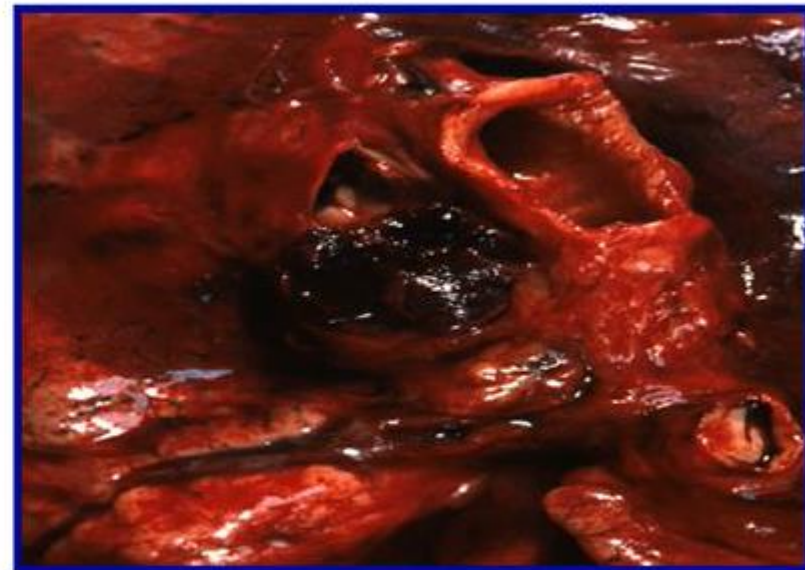
- ▶ **Pulmonary Embolism (PE)**

- ▶ A blokage in an artery in lungs. It usually happens when a blood clot in another part of the body breaks loos and travel to the lungs. DVT clot are a commen couses of PE.



Why care?

- PE is the most common preventable cause of death in hospitalized patients
- ~600,000 deaths/year
- 80% of pulmonary emboli occur without prior warning signs or symptoms
- 2/3 of deaths due to pulmonary emboli occur within 30 minutes of embolization
- Death due to massive PE is often immediate
- Diagnosis can be difficult
- Early treatment is highly effective
- YOU WILL TAKE CARE OF PATIENTS WITH PE!



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

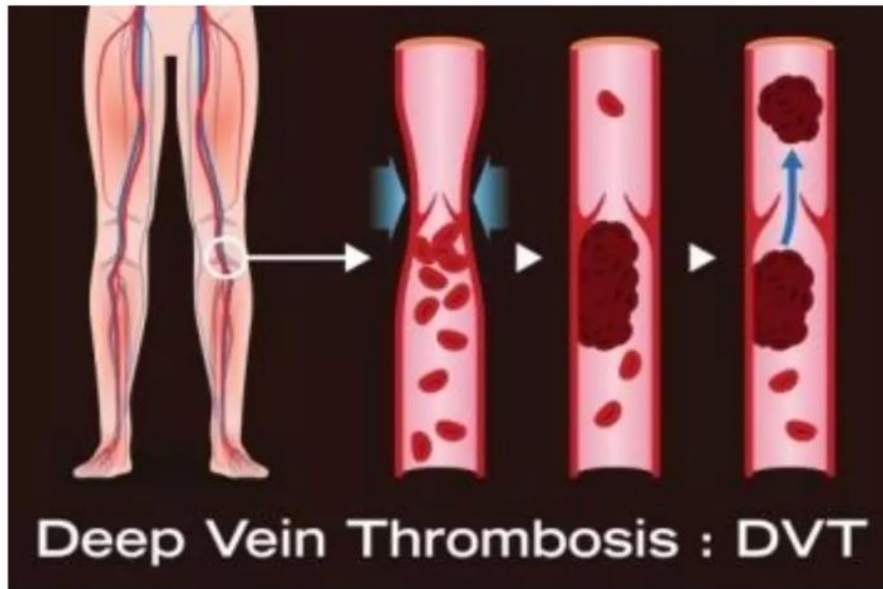
PE

- **Epidemiology**

- 90-95% of pulmonary emboli originate in the deep venous system of the lower extremities
- Other rare locations include
 - Uterine and prostatic veins
 - Upper extremities
 - Renal veins
 - Right side of the heart

DEEP VAIN THRODEEPMBOSIS (DVT)

- ▶ A blood clot that's deep inside a vein. These clots usually affect the lower legs, But they can also happen in other pars of the body.



Risk Factors

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

Risk Factors

- immobilization
- surgery
- malignancy
- previous thrombophlebitis
- lower extremity trauma
- estrogen use
- Stroke
- 3 months post-partum.

Virchow's Triad

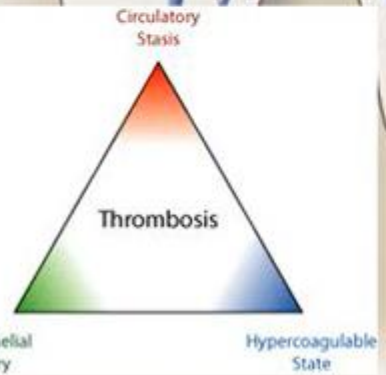
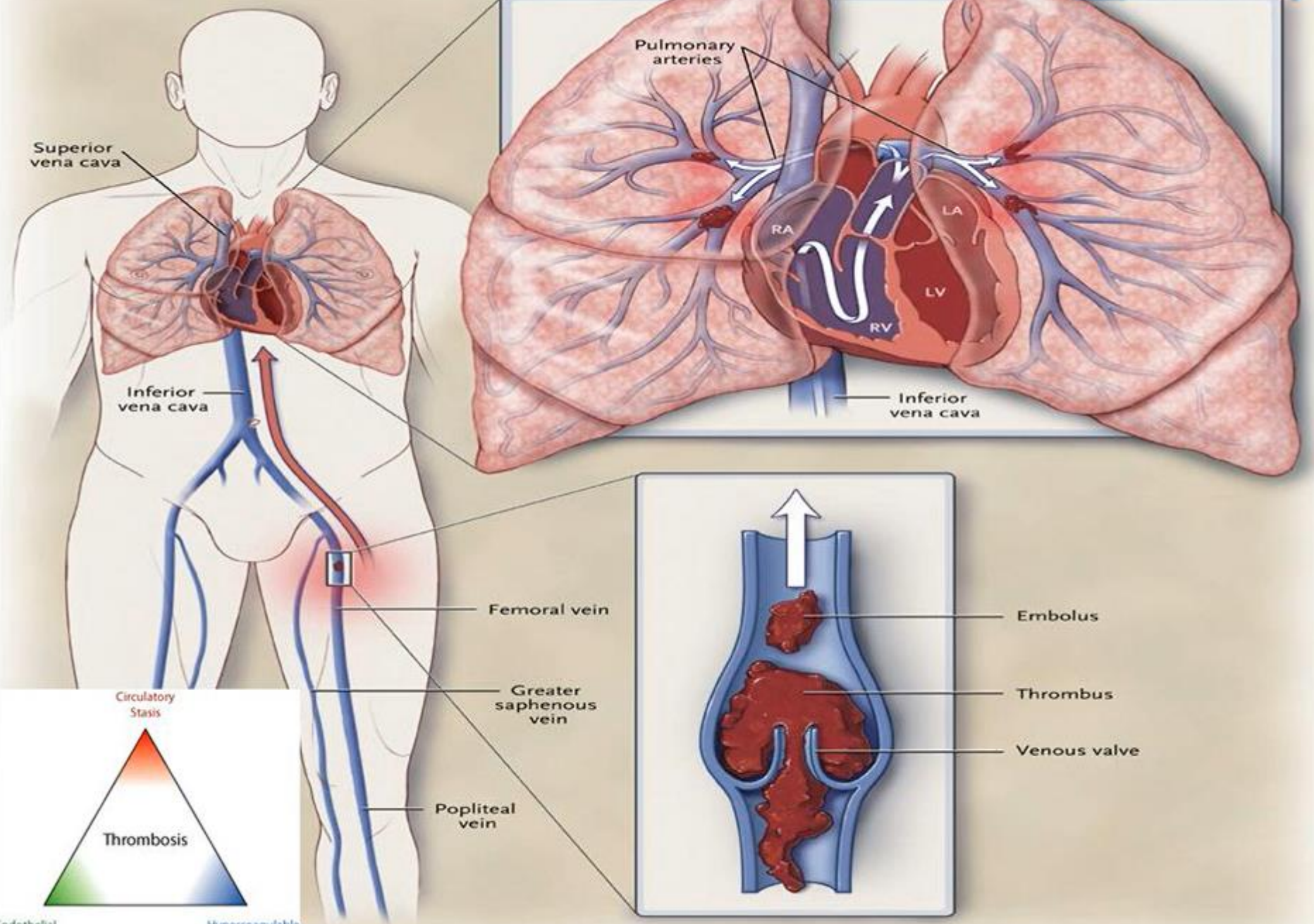
- Rudolf Virchow postulated more than a century ago that a triad of factors predisposed to venous thrombosis
 - Local trauma to the vessel wall
 - Hypercoagulability
 - Stasis of blood flow
- It is now felt that pts who suffer a PE have an underlying predisposition that remains silent until a acquired stressor occurs

PE

- When venous emboli become dislodged from their site of origin, they embolize to the pulmonary arterial circulation or, paradoxically to the arterial circulation through a patent foramen ovale
 - About 50% of pts with pelvic or proximal leg deep venous thrombosis have PE
 - Isolated calf or upper extremity venous thrombosis pose a lower risk for PE

Pathophysiology

- Increased pulmonary vascular resistance
- Impaired gas exchange
- Alveolar hyperventilation
- 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 perpetuates further right ventricle dilation and dysfunction
- Interventricular septum bulges into and compresses the normal left ventricle

OPHYSIOLOGY

gas exchange

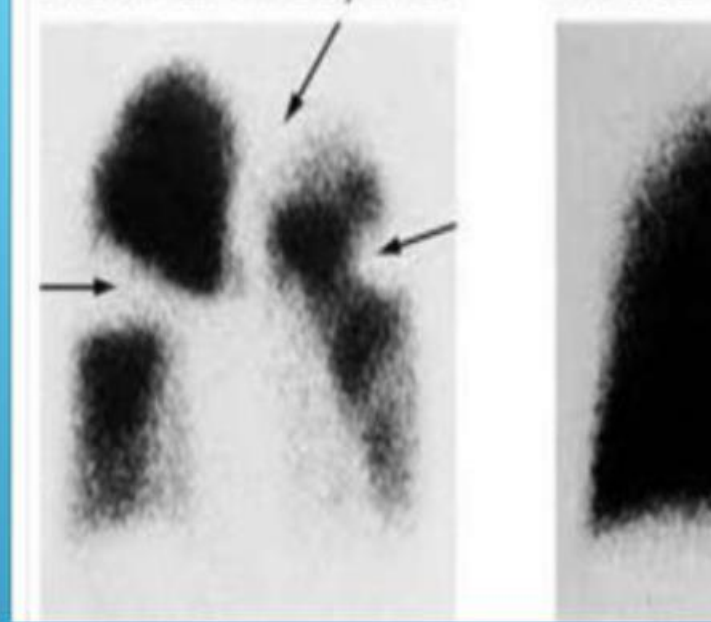
mechanical and functional obstruction of the vascular
altering the ventilation to perfusion ratio (V/Q Mismatch)

vascular compromise

ension due to diminished stroke volume and cardiac

ed pulmonary vascular resistance due to physical
tion and hypoxic vasoconstriction

ion → Decreased LV preload → Decreased CO



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

Diagnosis

- **Clinical Syndromes**

- Pulmonary Infarction usually indicates a small PE, but is very painful, because it lodges near the innervation of the pleural nerves
- Nonthrombotic Pulmonary Embolism
 - Fat Embolism
 - Amniotic Fluid Embolism
 - IVDA (Talc, cotton, etc)

Diagnosis

- **H&P**
- 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 CP, cough, or hemoptysis

Symptom list

- 73% Dyspnea
- 66% Pleuritic Pain
- 43% Cough
- 33% Leg Swelling
- 30% Leg Pain
- 15% Hemoptysis
- 12% Palpitations
- 10% Wheezing
- 5% Angina-Like pain

Symptoms in those without a PE

- Dyspnea 72%
- Pleuritic Pain 59%
- Cough 36%
- Leg Swelling 22%
- Leg Pain 24%
- Hemoptysis 8%
- Palpitations 18%
- Wheezing 11%
- Angina-Like pain 6%

Pulmonary Embolism Symptoms



Pain in calf or thigh



Coughing up blood



Wheezing



Dull chest pain



Coughing



Loss of consciousness



Sudden shortness of breath

Differential Diagnosis

- PE is known as “the great masquerader”
- USA, MI
- Pneumonia, bronchitis
- CHF
- Asthma
- Costochondritis, Rib Fx,
- Pneumothorax
- **PE can coexist with other illnesses!!**

Physical Signs & Symptoms

- Dyspnea 73%
- Pleuritic Pain 66%
- Cough 43%
- Leg Swelling 33%
- Leg Pain 30%
- Hemoptysis 15%
- Palpitations 12%
- Wheezing 10%
- Angina-Like pain 5%

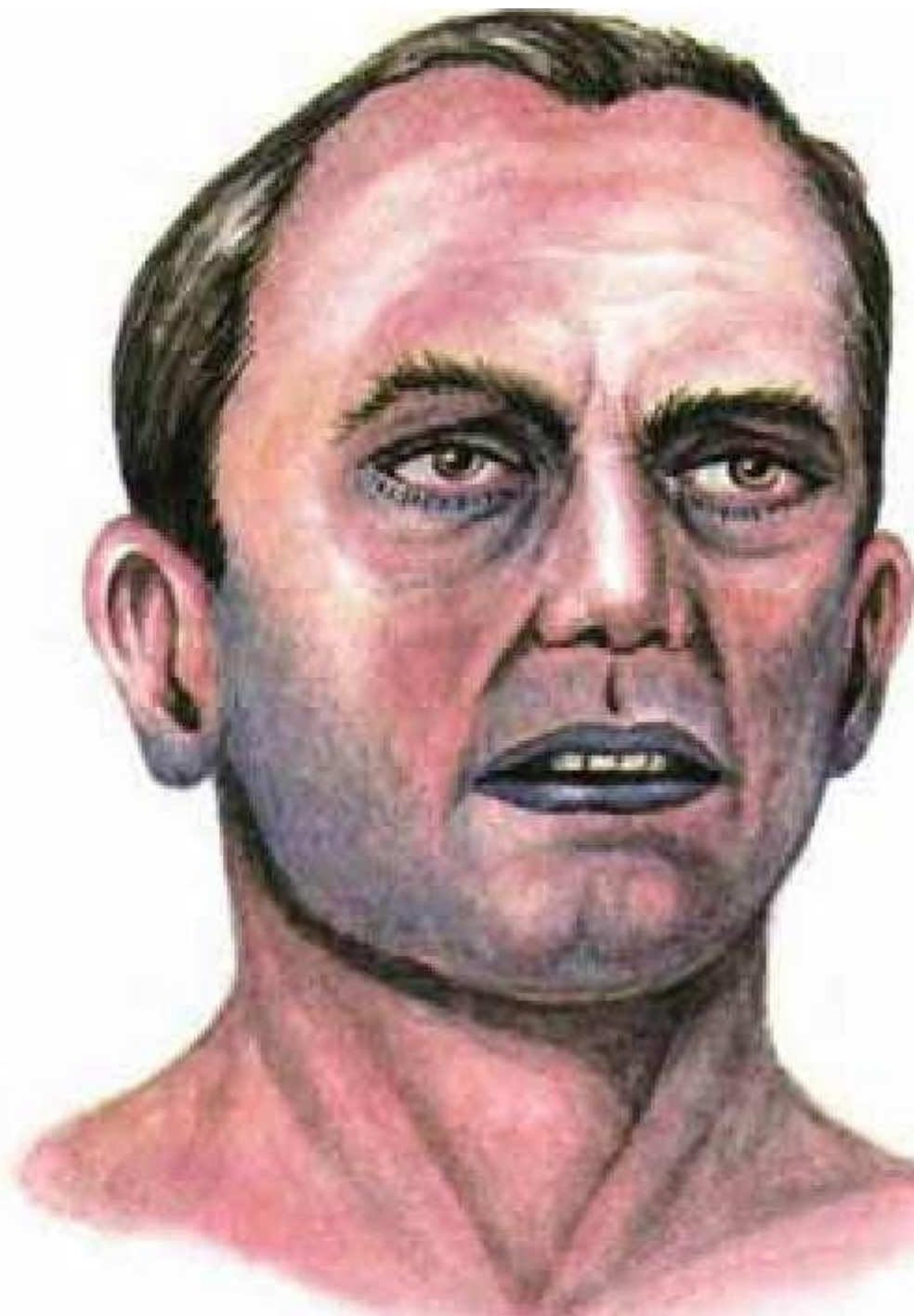


Рис. 4. Цианоз.









Symptoms and signs of acute pulmonary embolism

	Frequency
Symptom	
Dyspnea	int
Pleuritic chest pain	int
Cough	int
Hemoptysis	int
Sign	
Tachypnea	int
Rales	int
Tachycardia	int
Fourth heart sound	int
Accentuated pulmonic component of second heart sound	int
Circulatory collapse	it

Prepared with data from:

1. Stein PD, Terrin ML, Haies CA, et al. Clinical, laboratory, roentgenographic, and electrocardiographic findings in patients with acute pulmonary embolism and coronary disease. *Chest* 1991; 100:598.
2. Stein PD, Saltzman HA, Weg JG. Clinical characteristics of patients with acute pulmonary embolism. *Am J Cardiol* 1991; 68:1723.

- Tachycardia (rapid heart beat)
- Tachypnea (rapid breathing)
- Hypotension (low blood pressure)
- Decreased breath sounds over a portion of a lung, indicating that air is not flowing to that area
- Rales (crackles over the lungs), indicating fluid in the air sacs
- Elevated pressure in the neck veins, suggesting an obstruction in the pulmonary artery
- Swelling or tenderness over the thigh or calf, indicating a DVT

Wells' Score

Typical symptoms of DVT (swelling, pain with palpation)	3.0
Alternative diagnosis less likely than pulmonary embolism	3.0
Heart rate >100	1.5
Immobilization (≥3 days) or surgery in the previous four weeks	1.5
Previous DVT/PE	1.5
Hemoptysis	1.0
Pregnancy	1.0

Traditional clinical probability assessment (Wells criteria)

High	>6.0
Moderate	2.0 to 6.0
Low	<2.0

Simplified clinical probability assessment (Modified Wells criteria)

PE likely	>4.0
PE unlikely	≤4.0

Активация V
Чтобы активировать
"Параметры".

Wells criteria and modified Wells criteria: clinical assessment for pulmonary embolism

Clinical symptoms of DVT (leg swelling, pain with palpation)	3.0
Other diagnosis less likely than pulmonary embolism	3.0
Heart rate >100	1.5
Immobilization (≥3 days) or surgery in the previous four weeks	1.5
Previous DVT/PE	1.5
Hemoptysis	1.0
Malignancy	1.0
Probability	Score
Traditional clinical probability assessment (Wells criteria)	
High	>6.0
Moderate	2.0 to 6.0
Low	<2.0
Simplified clinical probability assessment (Modified Wells criteria)	
PE likely	>4.0
PE unlikely	≤4.0

DVT: deep vein thrombosis; PE: pulmonary embolism.

Data from van Belle A, Buller HR, Huisman MV, et al. Effectiveness of managing suspected pulmonary embolism using an algorithm combining clinical probability, D-dimer testing, and computed tomography. *JAMA* 2006; 295:172.

Objectifies risk of PE, like Wells' score.

When to Use ▾	Pearls/Pitfalls ▾	Why Use ▾	
Age > 65	No 0	Yes +1	
Previous DVT or PE	No 0	Yes +3	
Surgery (under general anesthesia) or lower limb fracture in past month	No 0	Yes +2	
Active malignant condition Solid or hematologic malignant condition, currently active or considered cured < 1 year	No 0	Yes +2	
Unilateral lower limb pain	No 0	Yes +3	
Hemoptysis	No 0	Yes +2	
Heart rate	< 75 0	75-94 +3	≥ 95 +5
Pain on limb palpation	No 0	Yes +4	

Активация V
Чтобы активировать
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Simplified Geneva Score

Variable	Score
Age >65	1
Previous DVT or PE	1
Surgery or fracture within 1 month	1
Active malignancy	1
Unilateral lower limb pain	1
Hemoptysis	1
Pain on deep vein palpation of lower limb and unilateral edema	1
Heart rate 75 to 94 bpm	1
Heart rate greater than 94 bpm	+1

Score of less than 2 is low probability for PE, score of less than 2 plus a negative D-dimer results in a likelihood of PE of 3%

KUP

emia (74%)

atory alkalosis and hypocapnia (41%)

diagnostic utility

rognostically for risk stratification (and nomenclature)

utility as BNP

Активация V

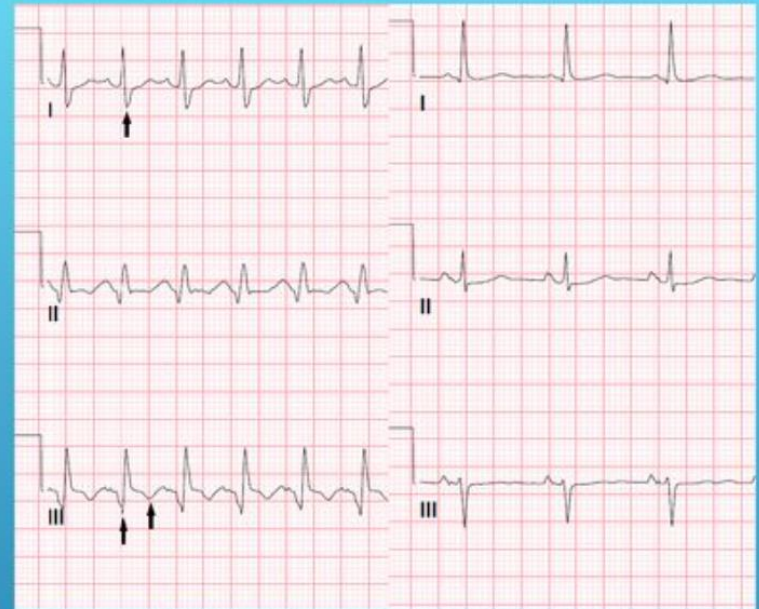
Чтобы активиров

"Параметры".

WORKUP

EKG

- Most common findings? (70%)
- S1Q3T3, RV strain, new incomplete RBBB uncommon (< 10%)



EKG in Pulmonary Embolism

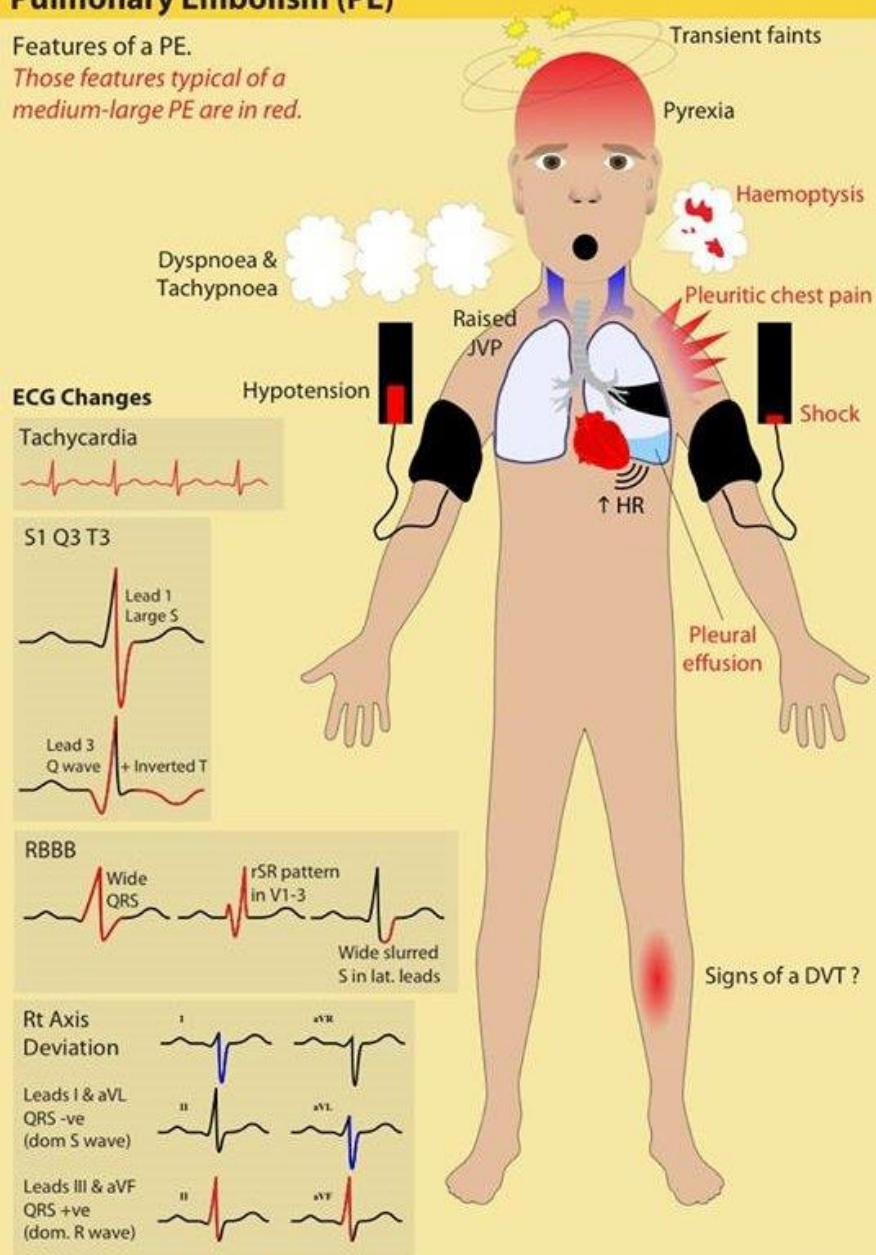
- Most commonly sinus tachycardia, with possible nonspecific ST/T wave changes
- Only 10% of patients can have the S1Q3T3 so not reliable
- Other EKG abnormalities including atrial arrhythmias, right bundle branch block, inferior Q-waves, and precordial T-wave inversion and ST-segment changes, are associated with a poor prognosis.



Pulmonary Embolism (PE)

Features of a PE.

Those features typical of a medium-large PE are in red.



D – Dimer Blood Test

▶ D-Dimer Test

- ▶ A D-dimer test looks for D-dimer in blood. D-dimer is a protein fragment (small piece) that's made when a blood clot dissolves in your body.
- ▶ Blood clotting is an important process that prevents you from losing too much blood when you are injured. Normally, your body will dissolve the clot once your injury has healed. With a blood clotting disorder, clots can form when you don't have an obvious injury or don't dissolve when they should. These conditions can be very serious and even life-threatening. A D-dimer test can show if you have one of these conditions.
- ▶ Other names: fragment D-dimer, fibrin degradation fragment
- ▶ USED FOR
- ▶ A D.DIMER test is most often used to find out whether you have blood clot disorder. These disorders include



D-dimer (or **D dimer**) is a [fibrin degradation product](#) (or FDP), a small protein fragment present in the blood after a [blood clot](#) is degraded by [fibrinolysis](#). It is so named because it contains [two](#) D fragments of the [fibrin](#) protein joined by a [cross-link](#).

D-dimer concentration may be determined by a [blood test](#) to help diagnose [thrombosis](#).^[2] Since its introduction in the 1990s, it has become an important test performed in people with suspected thrombotic disorders, such as [venous thromboembolism](#)

D-dimer Assays

- Five major types available:
 - Enzyme-linked immunosorbent assay (ELISA)
 - Rapid ELISA
 - Latex agglutination assay
 - Whole blood assay
 - Turbidimetric assay
 - Immunofiltration assay

ELISA Assay

- Positive if $> 500\text{ng/ml}$
- In the diagnosis of PE:
 - Sensitivity= 94-97%
 - Specificity= 44%
 - Negative LR = 0.07
- Drawback: 2-4h to perform
- Rapid ELISA
 - $< 2\text{h}$
 - Similar sensitivity and negative LR

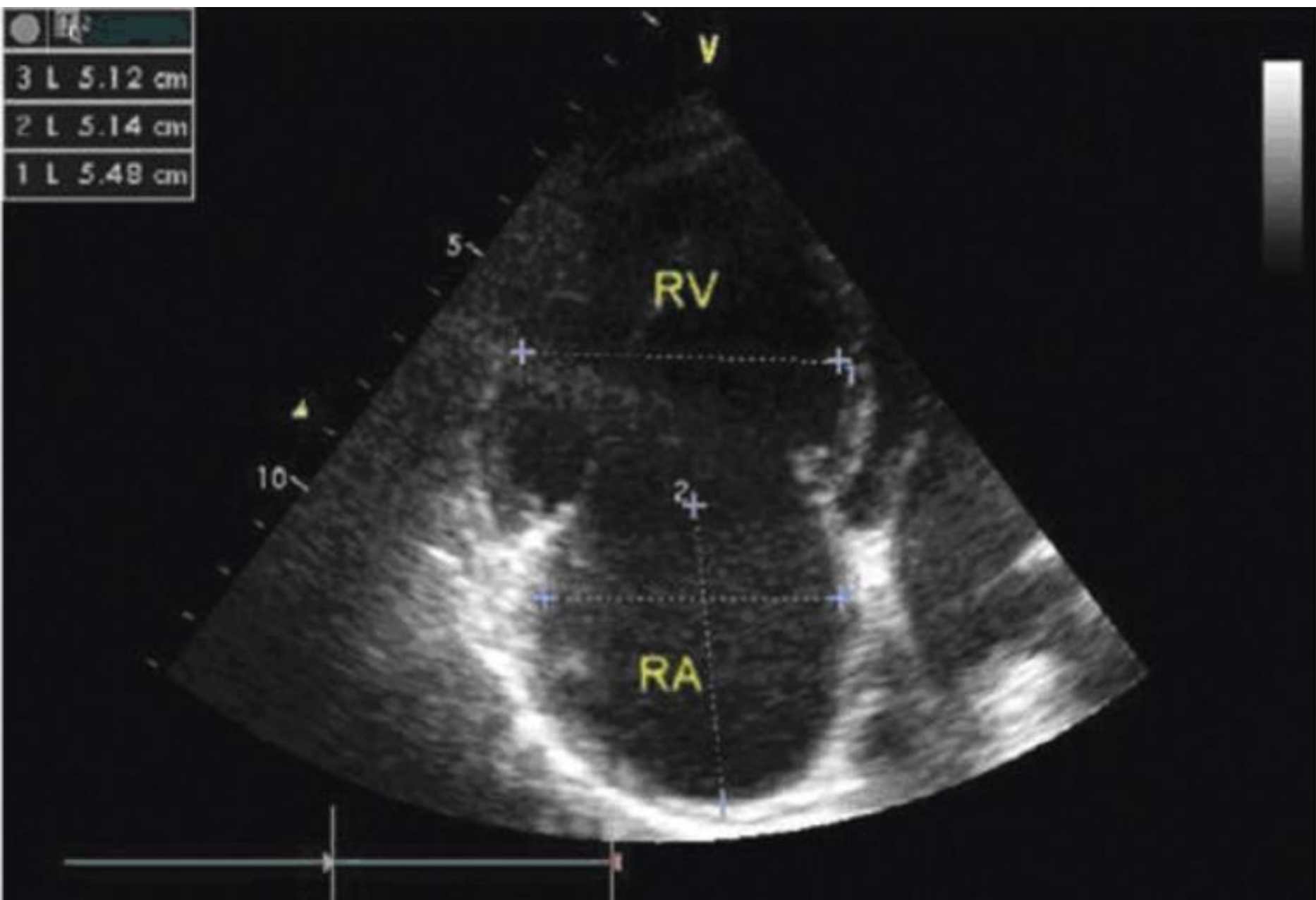


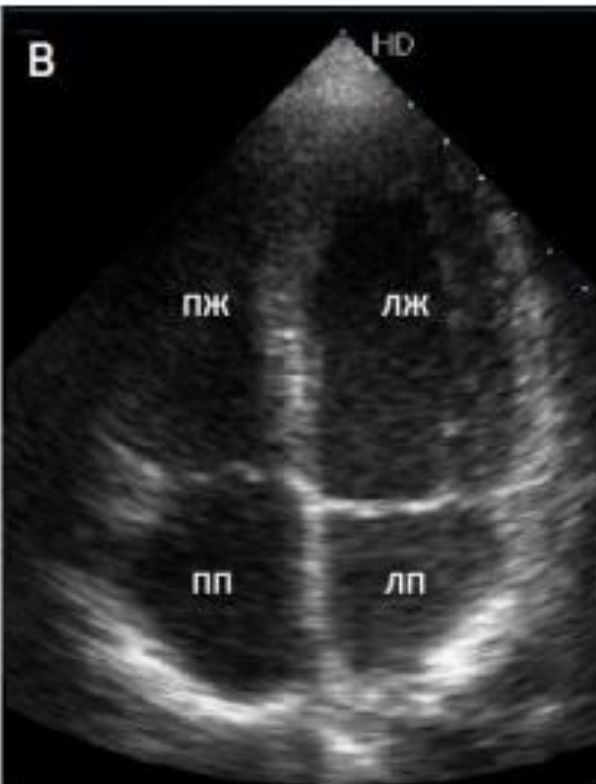
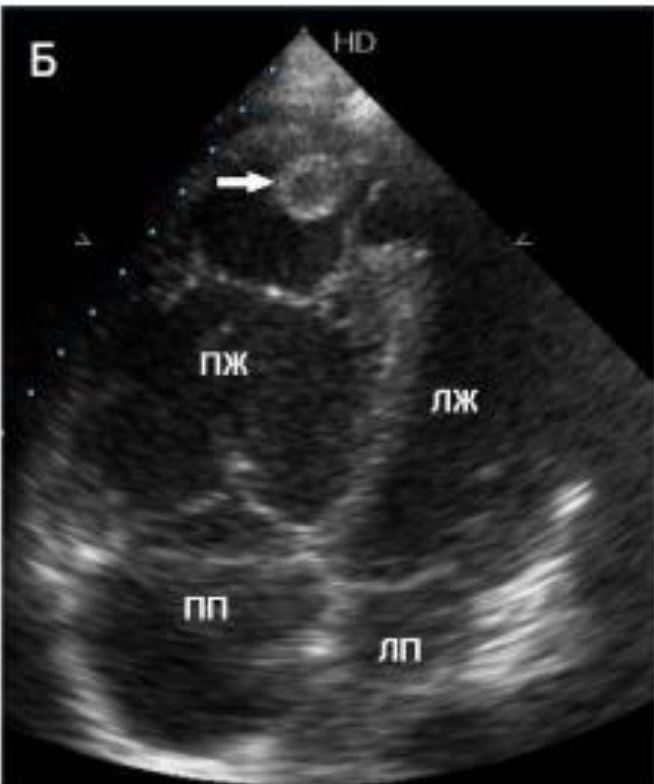
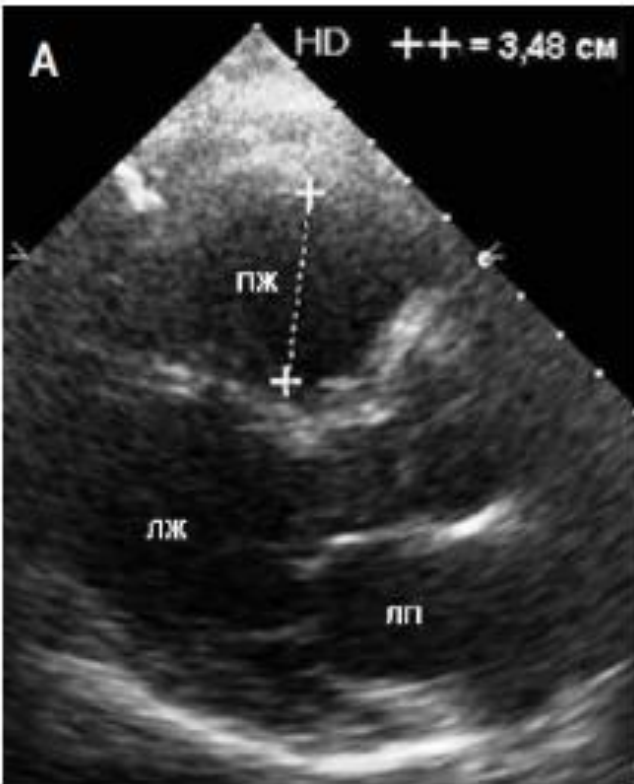
WORKUP

Echocardiogram

- Useful for prognostic purposes in patients with CONFIRMED PE
- New RV strain and RV thrombus are poor prognostic indicators
- https://youtu.be/f_QgPo4c6XU

●	16
3 L	5.12 cm
2 L	5.14 cm
1 L	5.48 cm

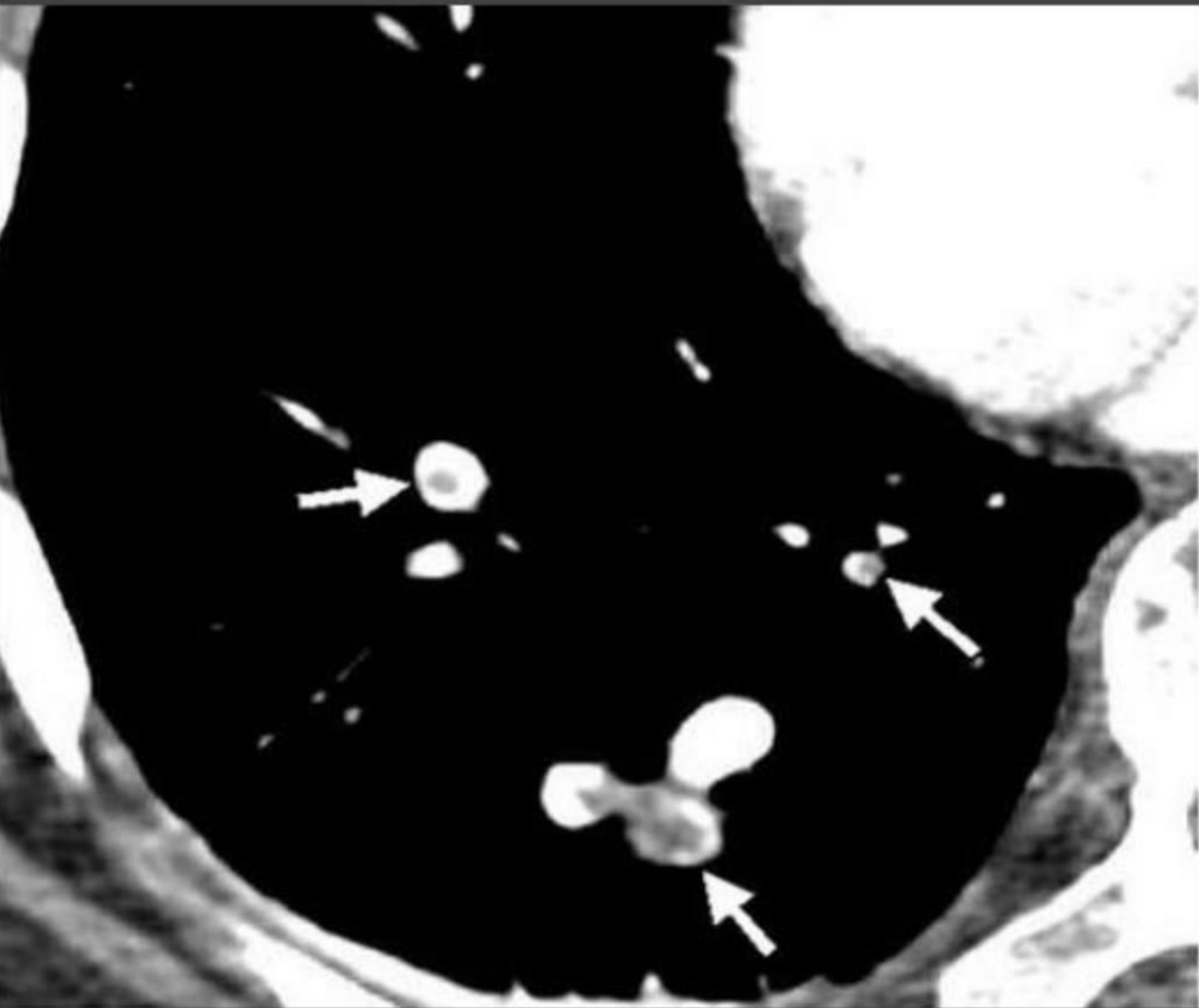




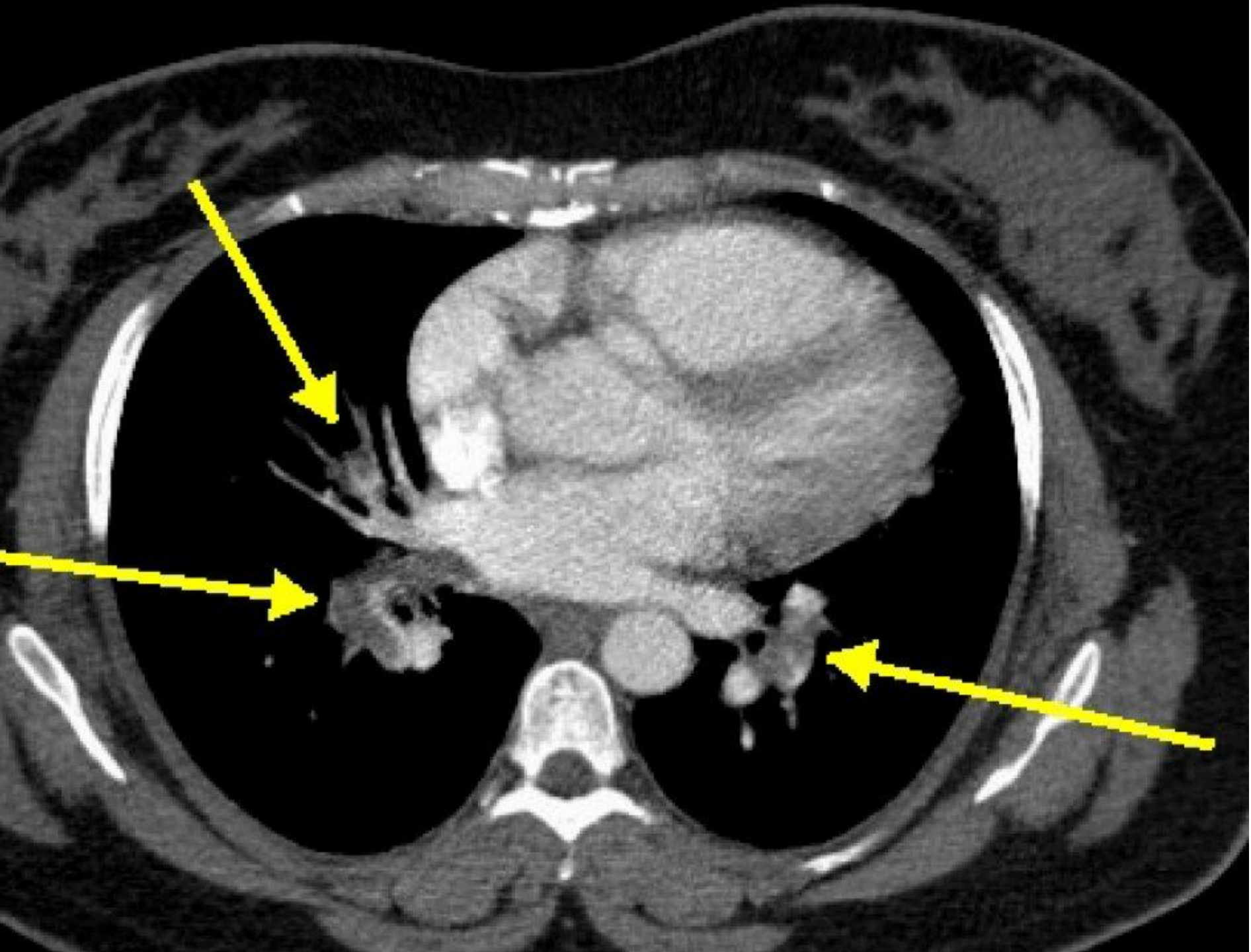
CT Angiography

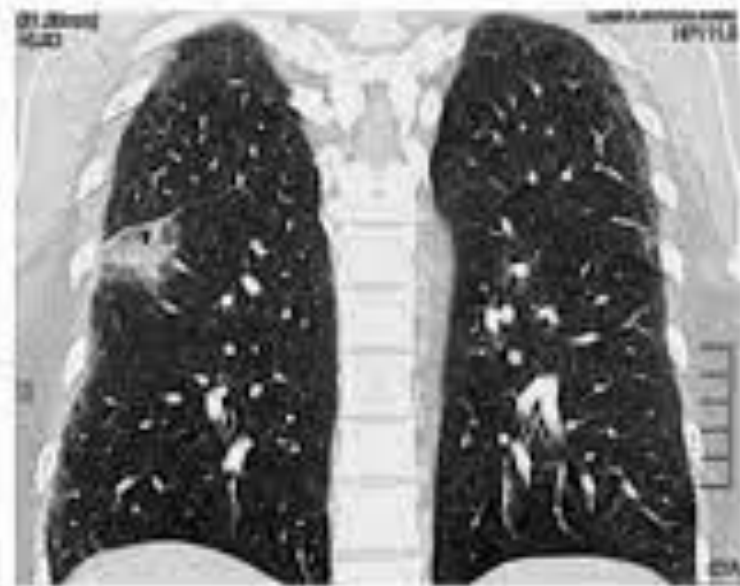
- Studies have shown sensitivity of close to 95% with an experienced observer
- One of the most commonly cited benefits of CTA is its ability to detect alternative pulmonary abnormalities that may explain the patient's symptoms and signs
- In 67% of patients without PE, CT provided additional information for alternate diagnosis
- May predispose patients to further unnecessary testing

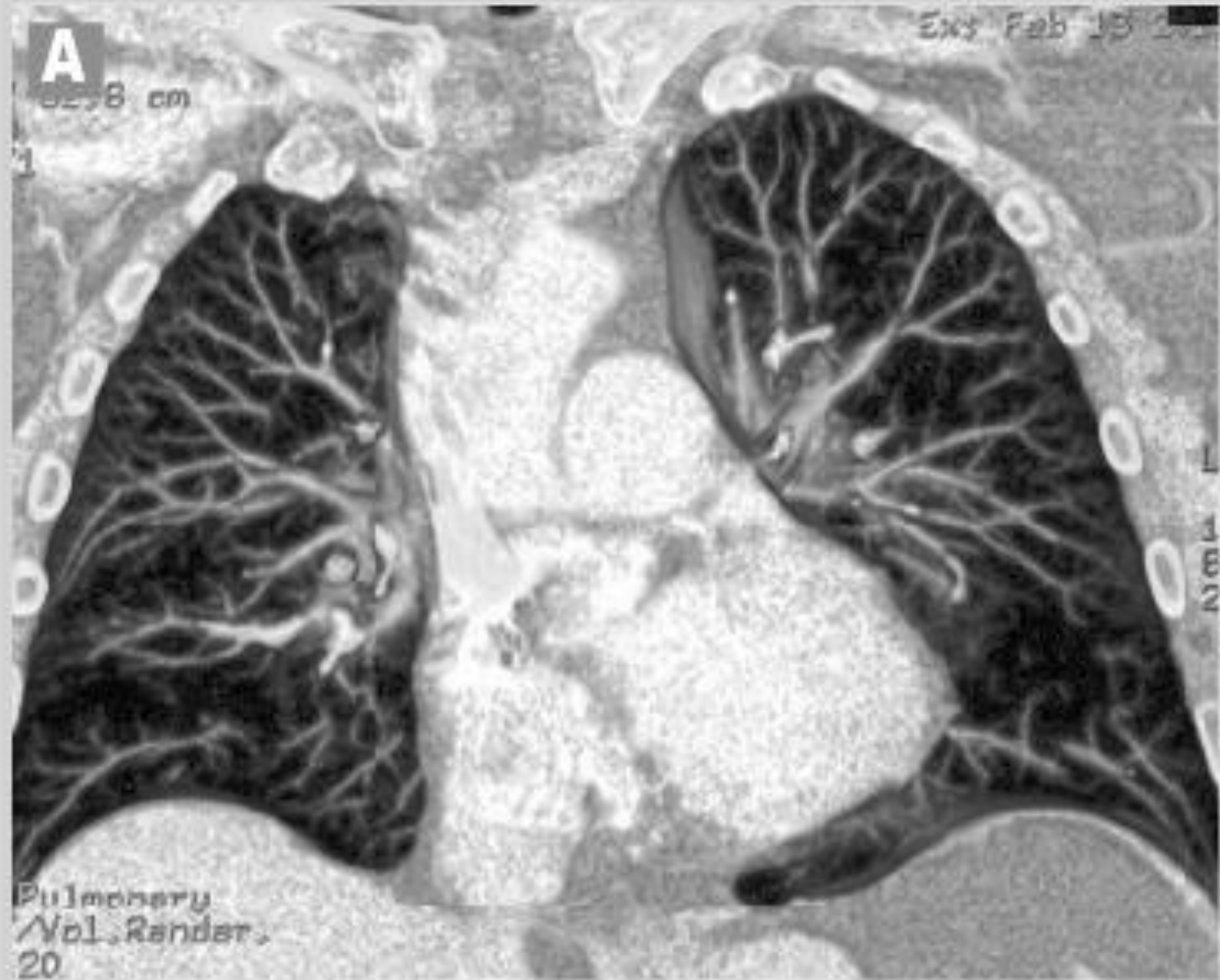
С1 Аудиология

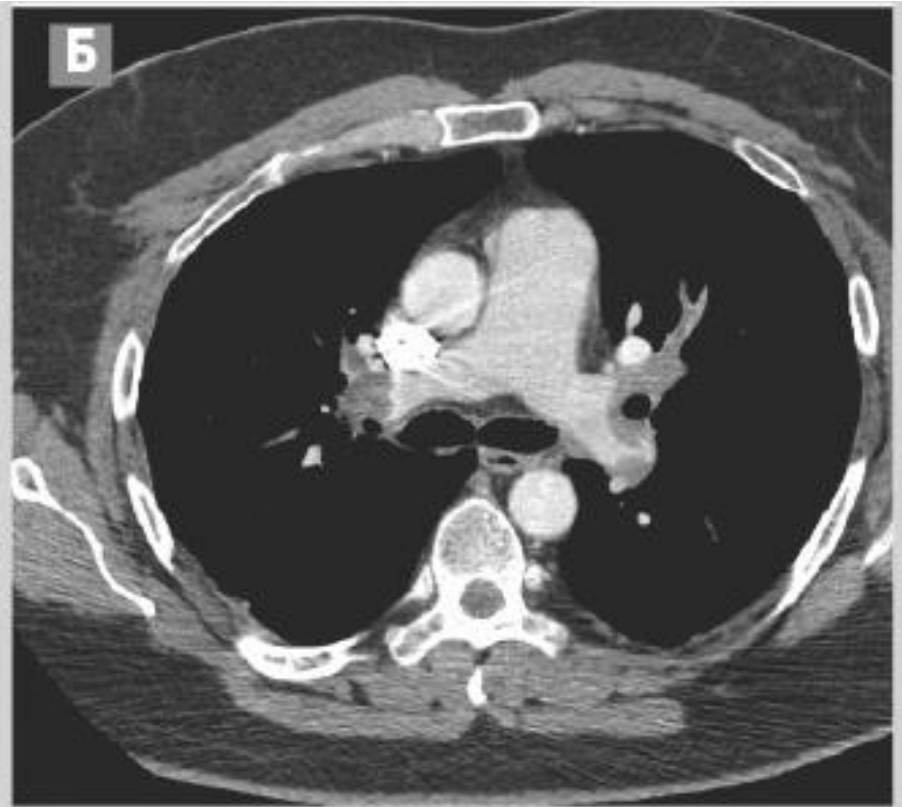
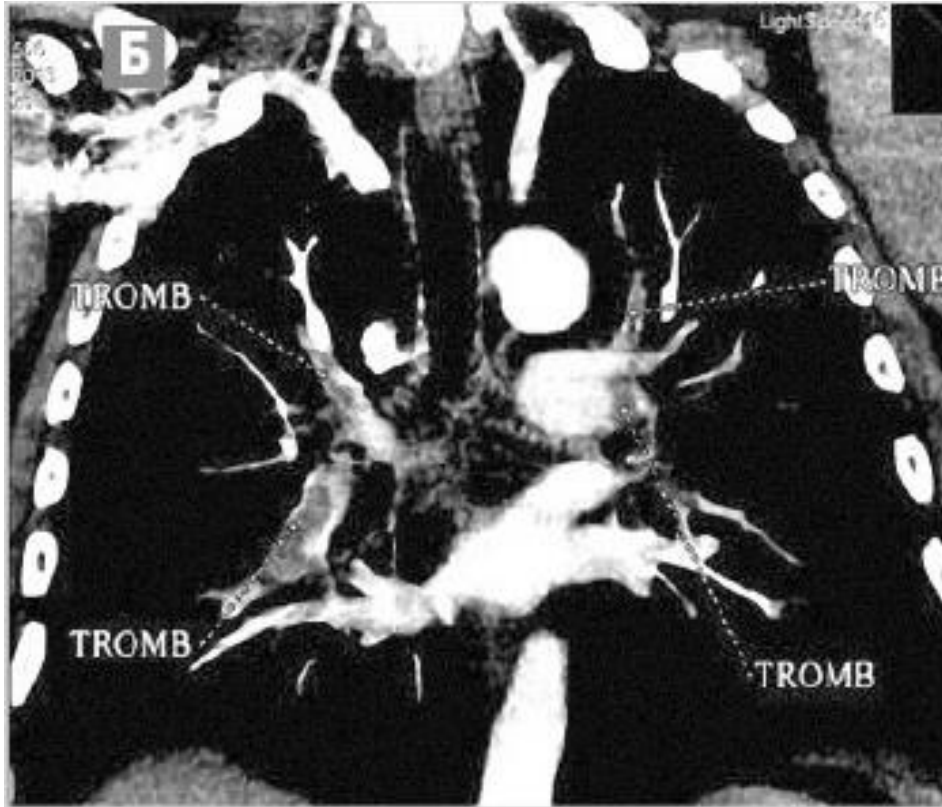


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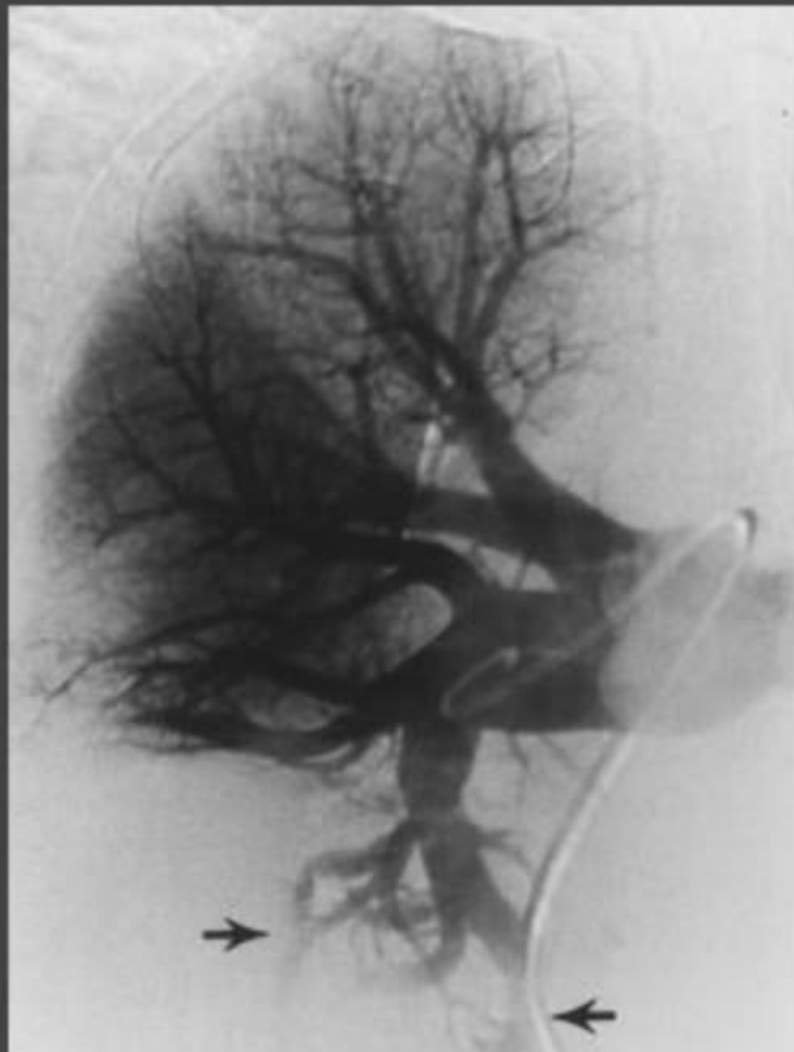
Pulmonary Angiography in PE

The “gold standard”

A negative pulmonary angiogram excludes clinically relevant PE.

The risk of embolization in patients with a negative angiogram is extremely low

Pulmonary Angiography



Активация V
Чтобы активировать
"Параметры".

Pulmonary angiography

