

Απεικόνιση στην πνευμονική εμβολή

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ΠΑΓΝΗ



ΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΓΕΝΙΚΟ
ΝΟΣΟΚΟΜΕΙΟ ΗΡΑΚΛΕΙΟΥ

SIMA 23

Σε-μα Ιατρική (Λατρός) Μινωτική Κρήτη

1ο ΠΟΛΥΘΕΜΑΤΙΚΟ ΣΥΝΕΔΡΙΟ
ΙΑΤΡΙΚΟΥ ΣΥΛΛΟΓΟΥ ΗΡΑΚΛΕΙΟΥ



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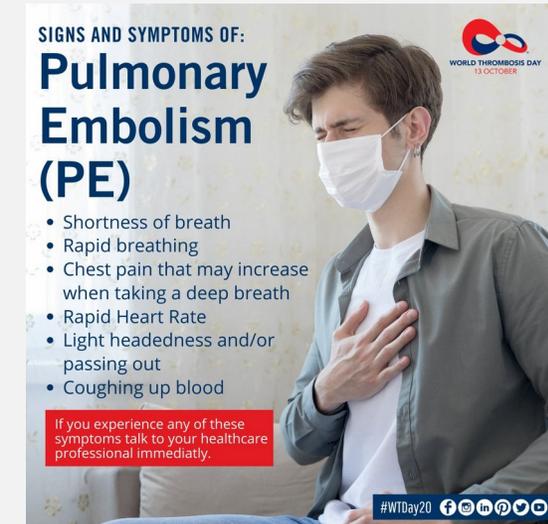


ΕΡΕΥΝΗΤΙΚΟ
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Pulmonary Embolism- Clinical presentation

- Acute PE is a common and often fatal complication of venous thromboembolic disease (VTE)
- Common clinical presentations include chest pain, tachycardia, hypotension, dyspnea, cough, and hemoptysis, while up to 2/3 of patients may be asymptomatic
- Recurrence is seen in up to a third of patients with VTE within 10 years



Pulmonary Embolism - Clinical and lab assessment

- The clinical risk of PE is stratified based on the Wells score or the Geneva score
- A two-tier model (≤ 4 PE unlikely; > 4 PE likely) approach recommends performing a **D-dimer test on “PE unlikely” patients and a CT angiography (CTA) for “PE likely” patients.**
- D-dimer has a high sensitivity and negative predictive value in diagnosis of VTE. **A negative D-dimer test (< 500 ng/mL) in a low or intermediate pre-test likelihood patient excludes acute PE, and no further testing is required.** If the D-dimer test is positive, then patients should undergo CTA for further evaluation
- Caution should be exercised in patients with **sepsis, malignancy, pregnancy, myocardial infarction, or recent surgery** as these conditions may result in **false positive D-dimer**

Table 1 Wells score

Malignancy (1.0 point)

Hemoptysis (1.0 point)

History of pulmonary embolism or deep vein thrombosis (1.5 points)

Tachycardia (> 100) (1.5 points)

Immobilization (≥ 3 days) or recent surgery (within 4 weeks) (1.5 points)

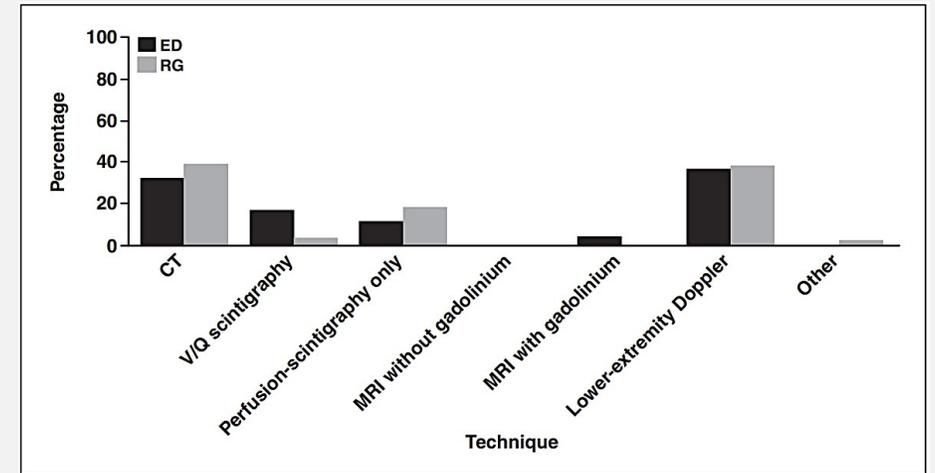
Most likely diagnosis is pulmonary embolism; no alternative diagnosis better explains the illness (3.0 points)

Clinical signs and symptoms of deep vein thrombosis (3.0 points)

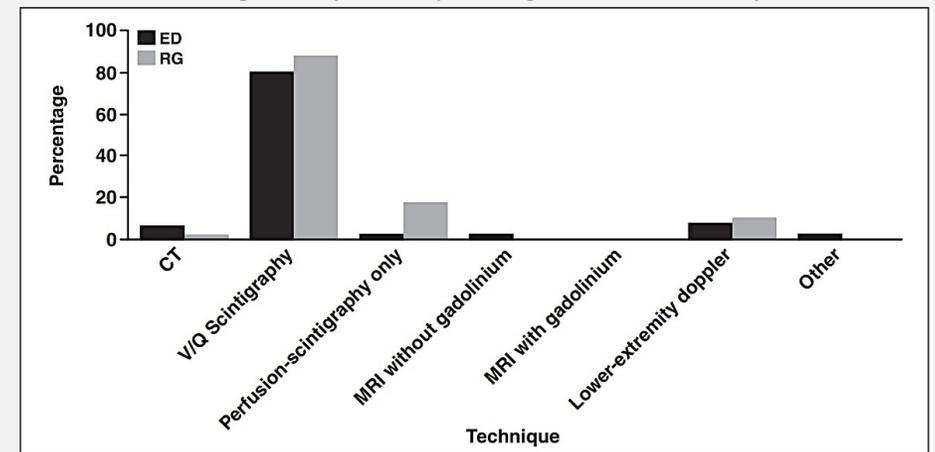
Pulmonary Embolism-Imaging approach

Multiple imaging modalities, including:

- Chest radiographs
- CTPA
- Nuclear medicine ventilation/ perfusion scan
- Magnetic resonance pulmonary angiography (MRPA)
- Venous ultrasound
- Echocardiography, and
- Catheter pulmonary angiography



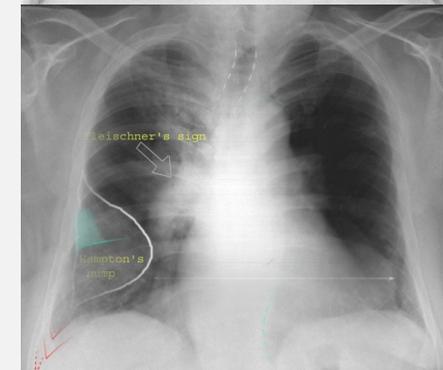
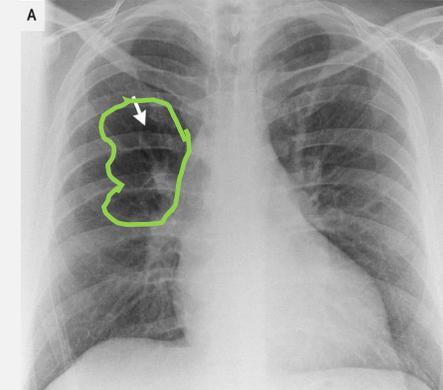
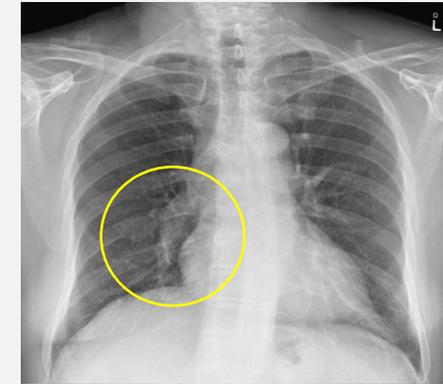
Pregnancy and young women ≤ 40 yrs



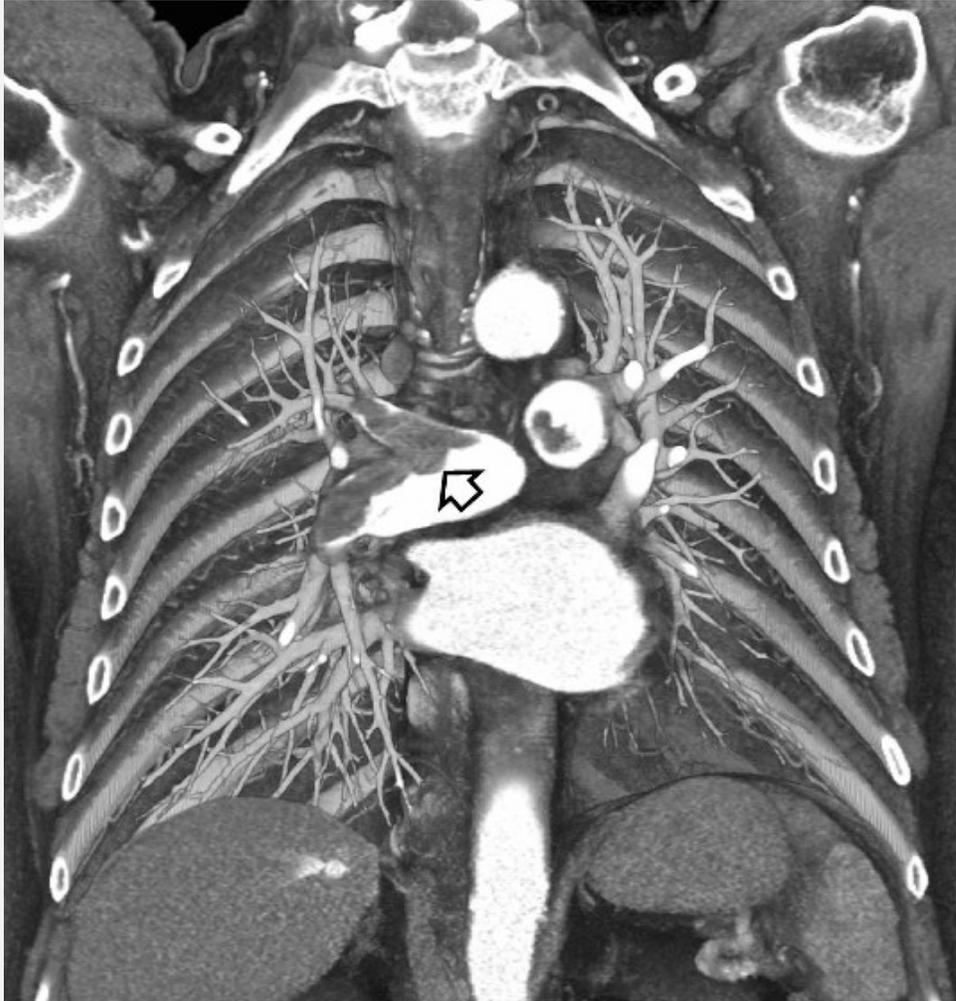
Renal failure or allergic reaction to iodinated contrast

Pulmonary Embolism - Chest Radiograph

- **Chest X-ray:** not useful in the diagnosis of PE, per se, but useful in excluding other causes of acute chest pain such as pneumonia, pulmonary edema, or pneumothorax
- **Fleischner sign:** An enlarged pulmonary artery is secondary to pulmonary hypertension or distension of the vessel by pulmonary embolus
- **Westermark sign:** Regional oligemia from PE, and this has 14% sensitivity, 92% specificity, 38% PPV, 76% NPV in diagnosis of PE
- **Hampton hump:** a peripherally located wedge shaped opacity may be seen corresponding to pulmonary infarct (sensitivity 22%, specificity 82%, PPV 28%, NPV 76%)
- Non-specific findings: **pleural effusion** (sensitivity 36%, specificity 70%, PPV 28%, NPV 76%), **elevated diaphragm** (sensitivity 20%, specificity 85%, PPV 30%, NPV 76%) and **vascular redistribution** (sensitivity 10%, specificity 87%, PPV 21%, NPV 74%)



CT PULMONARY ANGIOGRAPHY (CTPA)

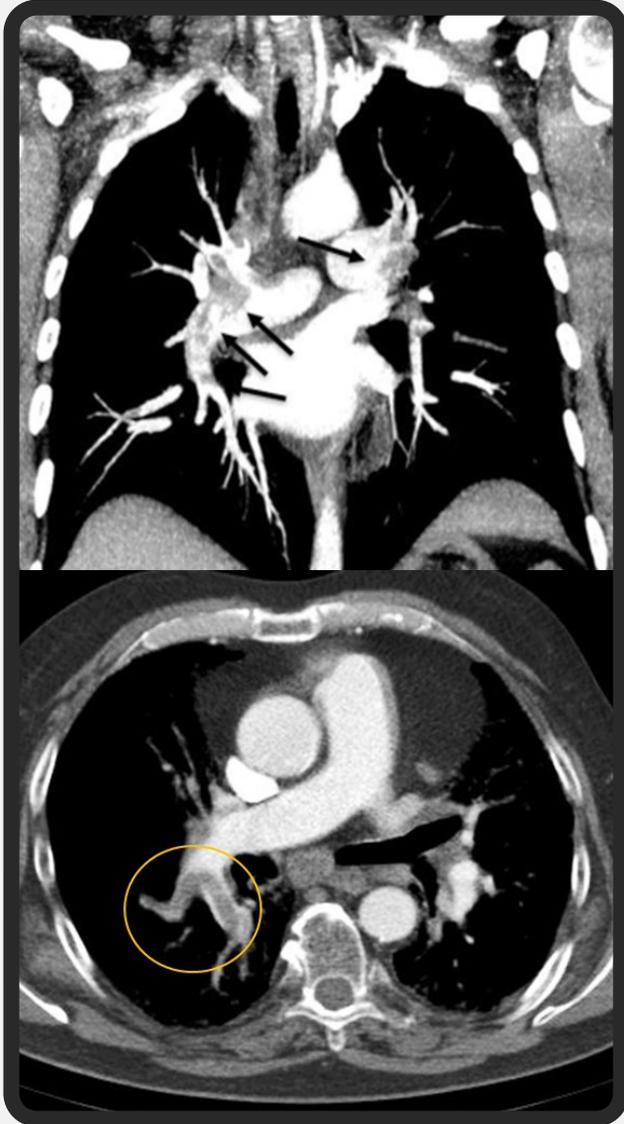


Imaging modality of choice for the workup of patients with suspected acute PE, is readily available, minimally invasive, and fast with scan duration in modern scanners of less than one second

CTPA has high sensitivity (83%) and specificity (96) (PIOPED II trial). Combined with clinical probability, the positive predictive value rose to as high as 96%

CTPA can reveal other etiologies of chest pain and shortness of breath such as **musculoskeletal injuries, pericardial abnormalities, pneumonia, vascular pathologies, and even coronary artery disease** in dedicated protocols

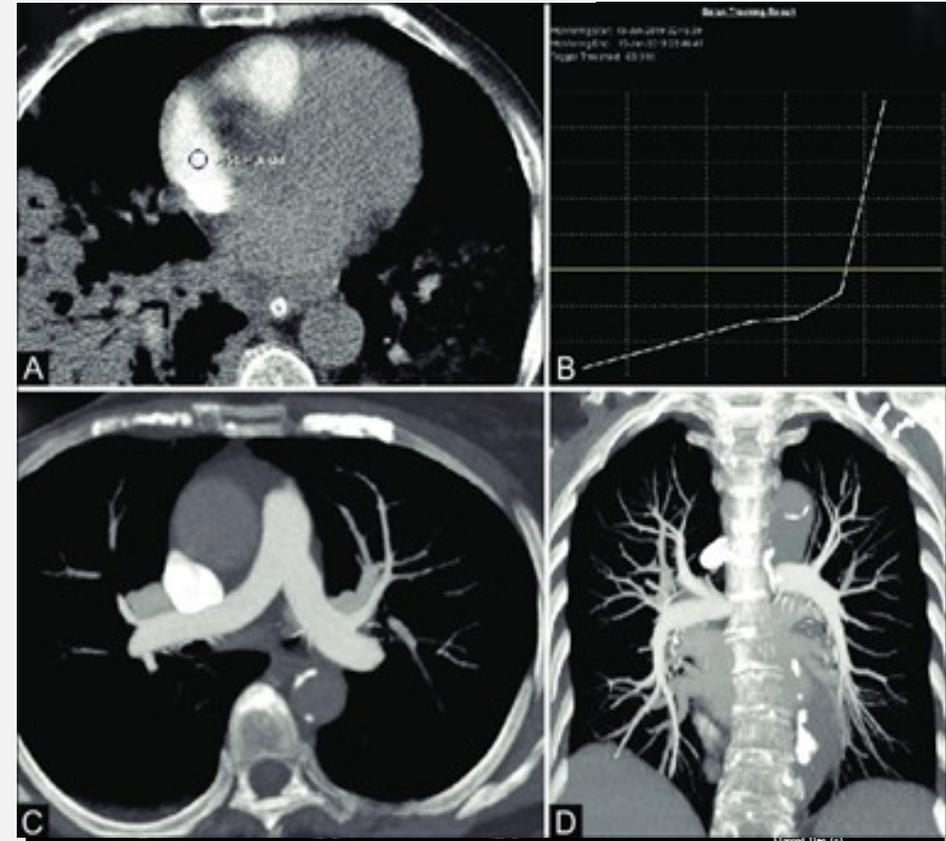
CT PULMONARY ANGIOGRAPHY (CTPA)



- CTPA is performed with intravenous contrast material
Assessment of contraindications (i.e low GFR, adverse events, including anaphylactoid reactions related to i.v iodinated contrast, etc ...)
- The American College of Radiology (ACR) recommends a **20-gauge or larger intravenous (IV) catheter** in the antecubital fossa or forearm for CTPA
- Typically, 60 to 150 mL of intravenous contrast is administered at a rate near 5 mL/s, followed by a saline chaser to allow washout of contrast from the superior vena cava (SVC), thus minimizing streak artifact 
- CTPA study protocol is largely dependent on available hardware but also on **patient size, patient motion and cardiac function**

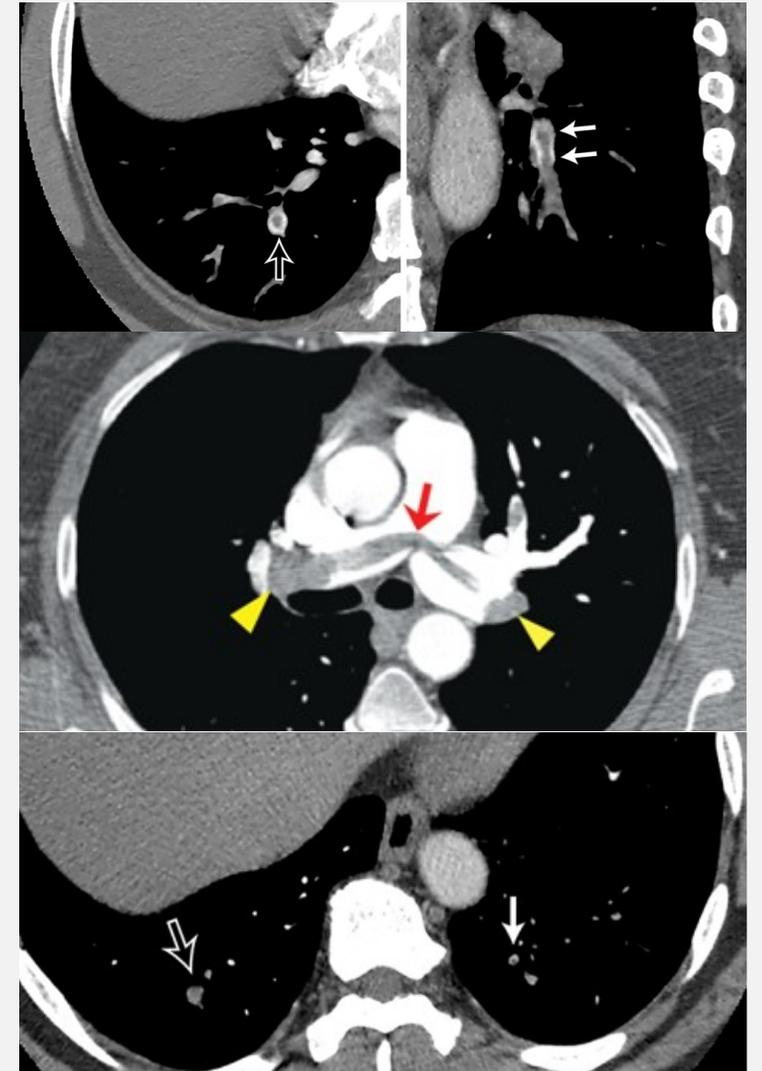
CT PULMONARY ANGIOGRAPHY (CTPA) - PROTOCOL

- Optimal timing of contrast material bolus
 1. **bolus-tracking** and
 2. **timing bolus**
- In the bolus-tracking method, a region of interest (ROI) is placed over the main pulmonary artery in the axial image and multiple dynamic images are obtained in the same position after injection of contrast material
- In the timing bolus technique, a small bolus of contrast material (10 mL) is injected at the desired rate, followed by a dynamic scan with a ROI over the pulmonary artery. A time attenuation curve is generated, the time-to-peak opacification is determined and the scan delay time
- In case of tachycardia



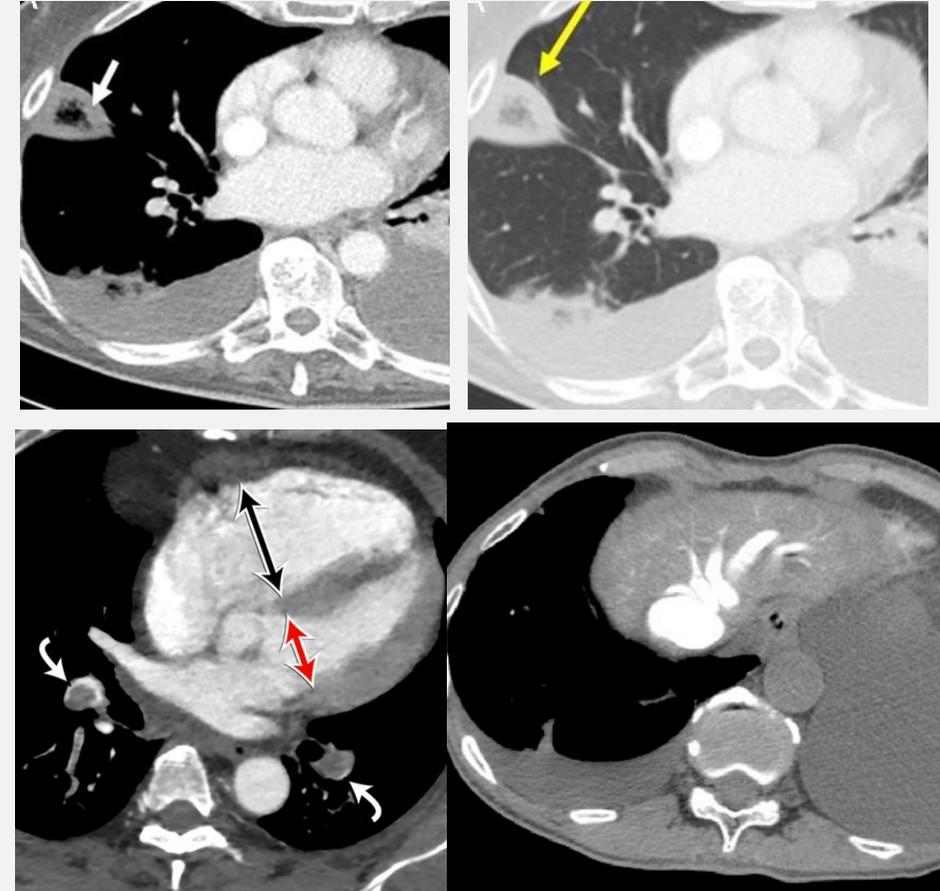
CT PULMONARY ANGIOGRAPHY (CTPA) - DIAGNOSIS

- Direct findings of acute PE in CT include a central filling defect within a vessel surrounded by contrast material when orthogonal to the long axis of the vessel or a “railway sign” when observed parallel to the vessel long axis
- When particularly large and draped over the pulmonary trunk bifurcation, the embolus may be referred to as a “saddle embolus”
- CTPA can detect very small sub-segmental pulmonary emboli which can be sub millimeter thanks to slice thickness $\leq 1\text{mm}$.



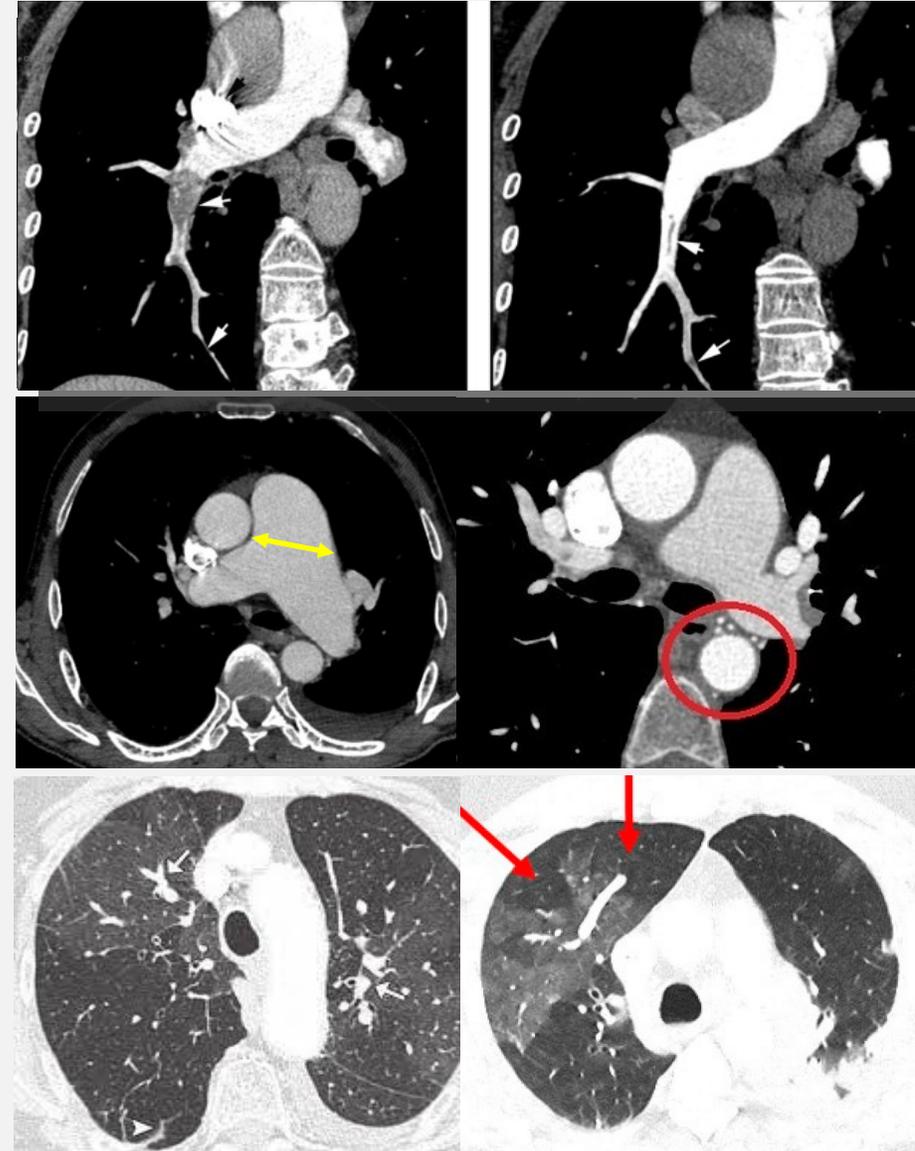
CT PULMONARY ANGIOGRAPHY (CTPA) - DIAGNOSIS

- Pulmonary infarct is a notable consequence of acute PE: wedge-shaped, peripheral opacity consisting of central ground glass and a rim of consolidation. Pleural effusions can also be seen with acute PE
- Estimating the severity of PE and risk-stratification, such as right heart strain. Features of right heart strain include **increased right ventricle (RV)/left ventricular (LV) ratio (>1 in axial plane)**, **flattening of interventricular septum** and **reflux of contrast material into the IVC and hepatic veins**



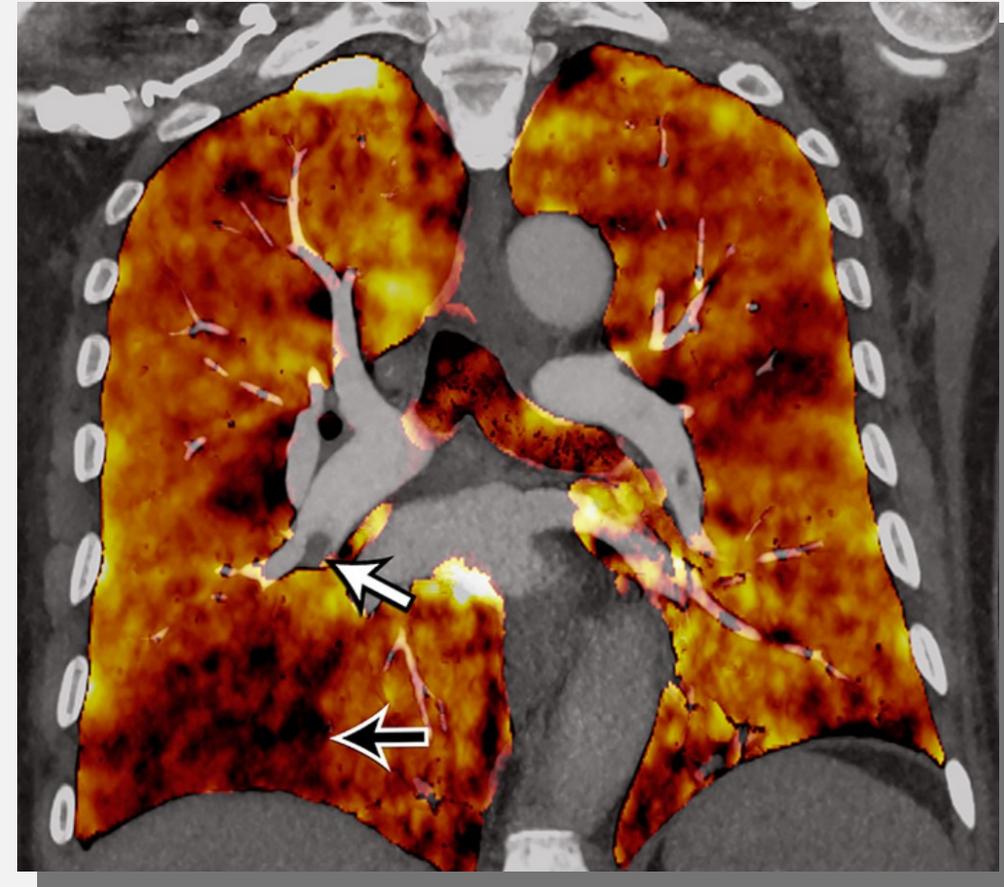
Chronic PE: The role of CTPE

- Follow-up of PE
- Peripheral thrombus
- Complete or partial obstruction
- Calcified thrombus
- Pulmonary arterial bands/pulmonary arterial webs
- Enlargement of main pulmonary arteries
- Collateral pulmonary vessels
- Pulmonary arterial calcification
- Mosaic attenuation
- Right ventricular enlargement/hypertrophy



Dual Energy Computed Tomography (DECT)

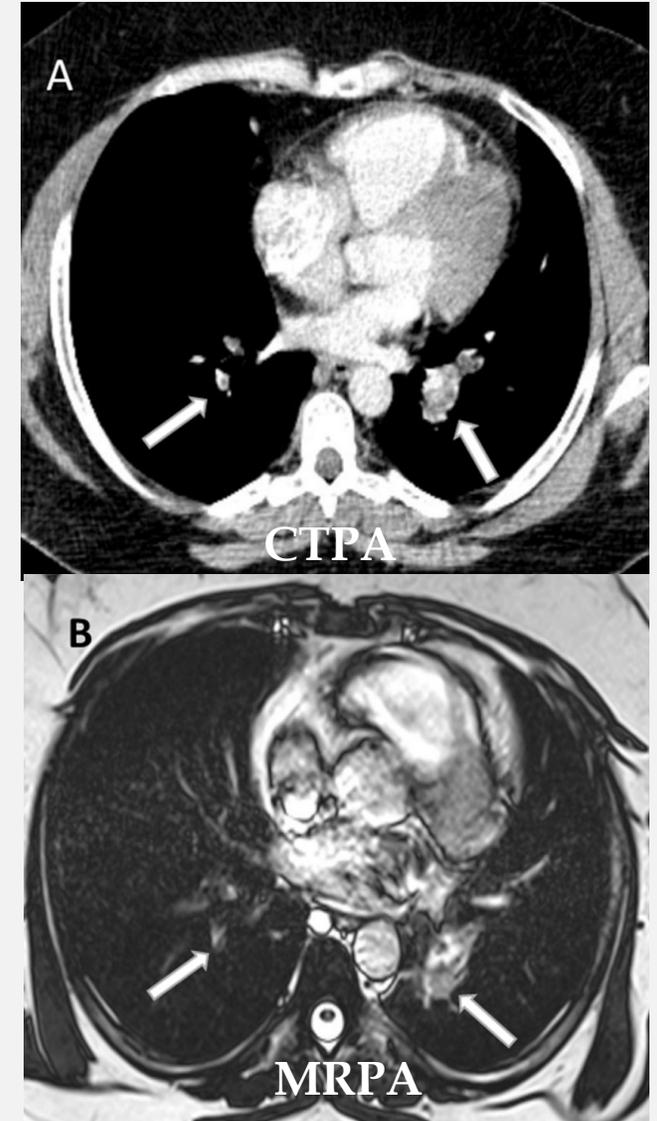
- Uses two energy levels to create data sets from two distinct X-ray spectra, which can be used to distinguish materials based on their unique interactions with the differing X-ray energy spectra, **using lower keV and less contrast media amount**
- Data sets derived from DECT can be used to generate iodine maps that, in turn, allow **visualization of the distribution of iodine within the lung** after intravenous contrast material administration
- Using post-processing software, **perfusion maps can be generated to overlay traditional CT images**



CTPA fused with a generated iodine map

Role of MRI in diagnosis of pulmonary embolism

- MRPA : a potential alternative diagnostic technique to CTPA in the assessment of the pulmonary vascular tree and diagnosis of PE. Can be performed **with or without i.v** administration of gadolinium (contraindicated in pregnancy and renal failure)
- Protocol : **White blood (WB)** and **Black blood (BB)** sequences with ECG and respiratory gating
- **Sensitivity, specificity and accuracy:** for central and lobar arteries, they were 100% for each parameter, for segmental vessels 88%, 100%, and 94% and for sub segmental vessels 34.6%, 100%, and 66% were noticed respectively
- False negative results may occur due to low MRPA resolution due to thick image acquisition, breathing motion artifacts due to long examination time



In Conclusion...

- CTPA → First-line diagnostic method for PE
- May identify thrombi in up to sub segmental arteries
- Follow up of PE / Distinguish between Acute and Chronic PE
- Evaluation of extrapulmonary structures : i.e Heart, thoracic cage, great vessels...
- Alternatively → V/Q lung scintigraphy, MRPA, with or without GD and DECT



Σας ευχαριστώ