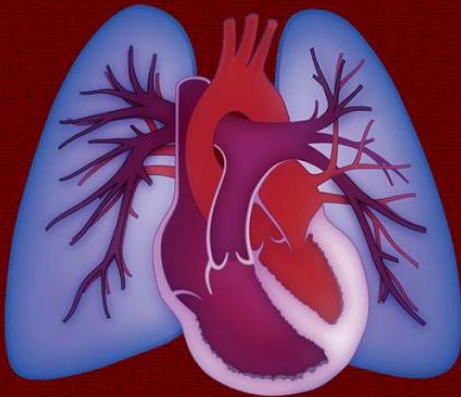




ΕΛΛΗΝΙΚΗ ΕΤΑΙΡΕΙΑ ΜΕΛΕΤΗΣ ΤΗΣ ΠΝΕΥΜΟΝΙΚΗΣ ΥΠΕΡΤΑΣΗΣ

2^ο ΠΑΝΕΛΛΗΝΙΟ ΣΥΝΕΔΡΙΟ ΠΝΕΥΜΟΝΙΚΗΣ ΥΠΕΡΤΑΣΗΣ



Αθήνα, 15-17 Ιουνίου 2018

Αμφιθέατρο Cotsen Hall
(Γεννάδειος Βιβλιοθήκη)

"Χορηγούνται Μόρια Συνεχιζόμενης
Ιατρικής Εκπαίδευσης από τον Π.Ι.Σ."



Πνευμονική Υπέρταση 'Απεικόνιση Ι Αξονική Τομογραφία

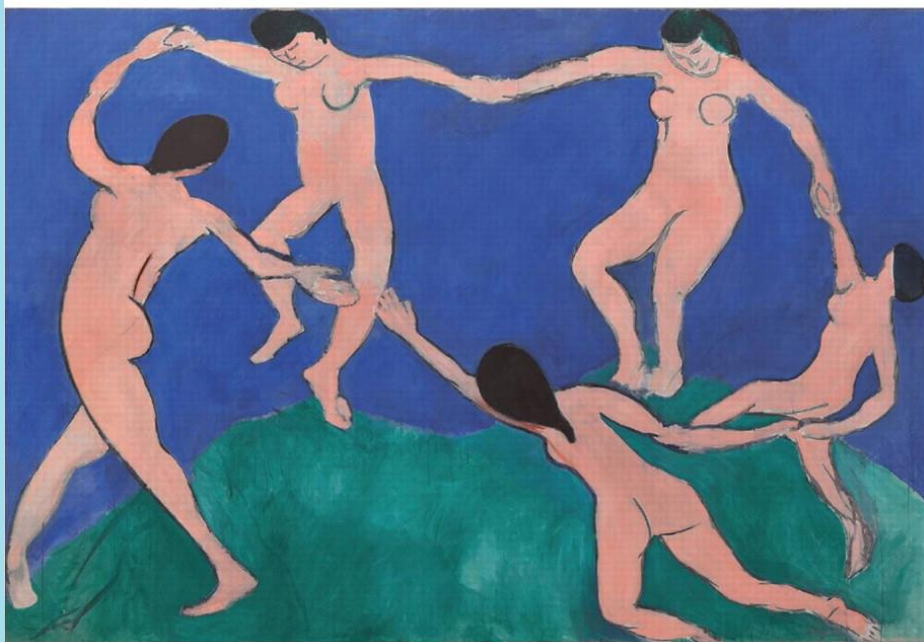


ΑΡΓΕΝΤΟΣ Ι. ΣΤΥΛΙΑΝΟΣ ΔΙΕΥΘΥΝΤΗΣ ΕΣΥ
Β' ΕΡΓΑΣΤΗΡΙΟ ΑΚΤΙΝΟΛΟΓΙΑΣ ΠΑΝ/ΜΙΟΥ ΑΘΗΝΩΝ
ΑΤΤΙΚΟ ΠΑΝ/ΚΟ ΝΟΣΟΚΟΜΕΙΟ

TH



WORLD SYMPOSIUM ON PULMONARY HYPERTENSION



NICE ACROPOLIS, Nice

February 27-28 / March 1, 2013



European Heart Journal
doi:10.1093/eurheartj/ehv317

ESC/ERS GUIDELINES



2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension

The Joint Task Force for the Diagnosis and Treatment of Pulmonary Hypertension of the European Society of Cardiology (ESC) and the European Respiratory Society (ERS)

Endorsed by: Association for European Paediatric and Congenital Cardiology (AEPC), International Society for Heart and Lung Transplantation (ISHLT)

Authors/Task Force Members: Nazzareno Galiè* (ESC Chairperson) (Italy), Marc Humbert^{†a} (ERS Chairperson) (France), Jean-Luc Vachiery^c (Belgium), Simon Gibbs (UK), Irene Lang (Austria), Adam Torbicki (Poland), Gérard Simonneau^a (France), Andrew Peacock^a (UK), Anton Vonk Noordegraaf^h (The Netherlands), Maurice Beghetti^b (Switzerland), Ardeschir Ghofrani^a (Germany), Miguel Angel Gomez Sanchez (Spain), Georg Hansmann^b (Germany), Walter Klepetko^c (Austria), Patrizio Lancellotti (Belgium), Marco Matucci^d (Italy), Theresa McDonagh (UK), Luc A. Pierard (Belgium), Pedro T. Trindade (Switzerland), Maurizio Zompatori^e (Italy) and Marius Hooper^a (Germany)

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Marc Humbert, Service de Pneumologie, Hôpital Bicêtre, Université Paris-Sud, Assistance Publique Hôpitaux de Paris, 78 rue du Général Leclerc, 94270 Le Kremlin-Bicêtre, France, Tel: +33 145217972, Fax: +33 145217971, Email: marc.humbert@aphp.fr

ESC Committee for Practice Guidelines (CPG) and National Cardiac Societies document reviewers: listed in Appendix

^aRepresenting the European Respiratory Society; ^bRepresenting the Association for European Paediatric and Congenital Cardiology; ^cRepresenting the International Society for Heart and Lung Transplantation; ^dRepresenting the European League Against Rheumatism; and ^eRepresenting the European Society of Radiology.

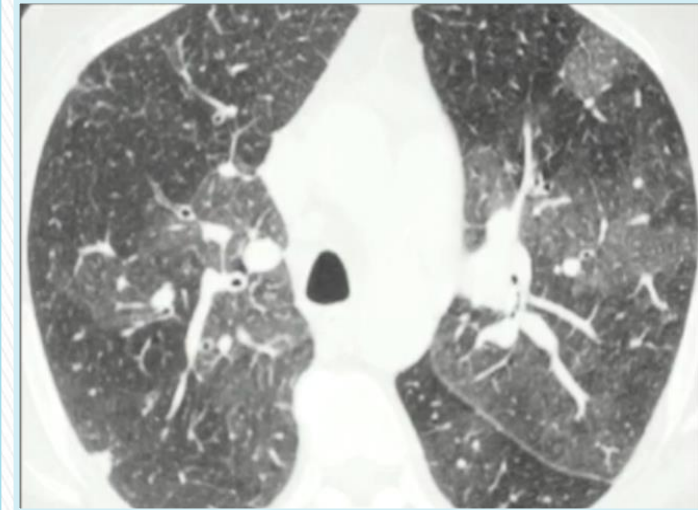
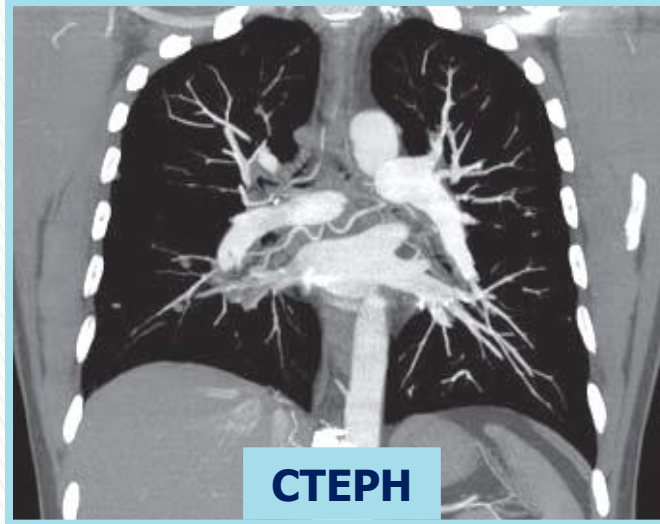
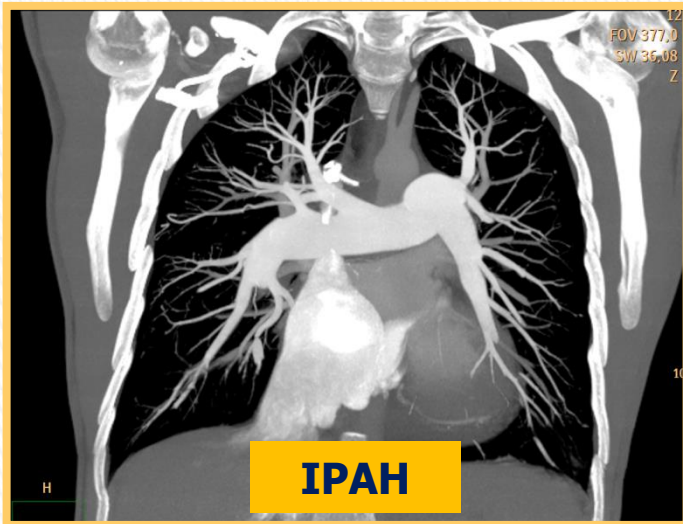
ESC entities having participated in the development of this document:

ESC Associations: Acute Cardiovascular Care Association (ACCA), European Association for Cardiovascular Prevention & Rehabilitation (EACPR), European Association of Cardiovascular Imaging (EACVI), European Association of Percutaneous Cardiovascular Interventions (EAPCI), European Heart Rhythm Association (EHRA), Heart Failure Association (HFA).

ESC Councils: Council for Cardiac Practice (CCP), Council on Cardiovascular Nursing and Allied Professions (CCNAP), Council on Cardiovascular Primary Care (CCPC).

Pulmonary Hypertension CT Protocol

- ✓ **High Resolution CT : Inspiratory Expiratory**
- ✓ **Computed Tomography Pulmonary Angiography (CTPA)**



- ✓ Γρήγορες σαρώσεις (4-12 sec) μετά IV έγχυση ιωδιούχου σκιαγραφικού
- ✓ Τροποποίηση του πρωτοκόλλου έγχυσης για ταυτόχρονη σκιαγράφιση πνευμονικού και συστηματικού αρτηριακού δικτύου (μεγαλύτερη διάρκεια έγχυσης, ↑ threshold, ↑ delay)
- ✓ Λεπτές τομές submm (0,7mm). Μετεπεξεργασία σε πολλαπλά επίπεδα (MPR, VR, MIP)

Multi Detector CT ADVANCES

ECG Gated MDCT



Assessment of RV functional parameters when the patient is unable to undergo MRI



Increased radiation dose

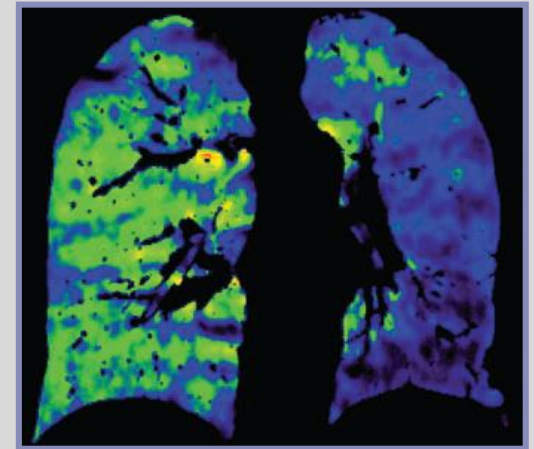


No blood flow or pressure data

Iterative Reconstruction Algorithms

Dose reduction up to 50%

Dual Energy CTPA - Pulmonary Perfusion



Υποψία

Πρόγνωση

Ανίχνευση
Διάγνωση

Ανταπόκριση
στη θεραπεία

Ταξινόμηση

Αξιολόγηση
βαρύτητας

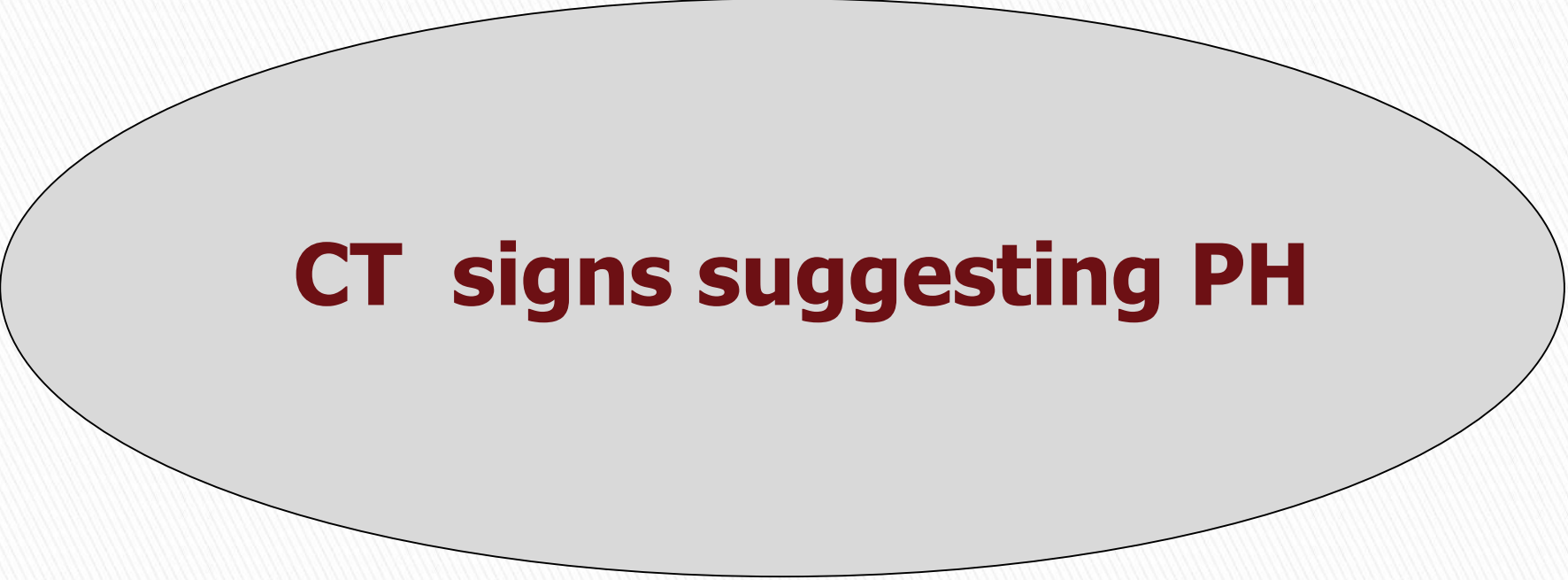
RadioGraphics 2012; 32:9–32

Role of CT in Pulmonary Hypertension

- ✓ **Identify imaging features suggesting PH**
 - In suspected PH**
 - In routine practice**
- ✓ **Identify cause of PH**

CT signs suggesting PH

CT signs suggesting the cause of PH



CT signs suggesting PH

CT signs suggesting PH

1. Vascular Signs (Pulmonary Arteries)

Dilatation, loss of distensibility

2. Cardiac Signs (Right Ventricle)

Hypertrophy, dilatation

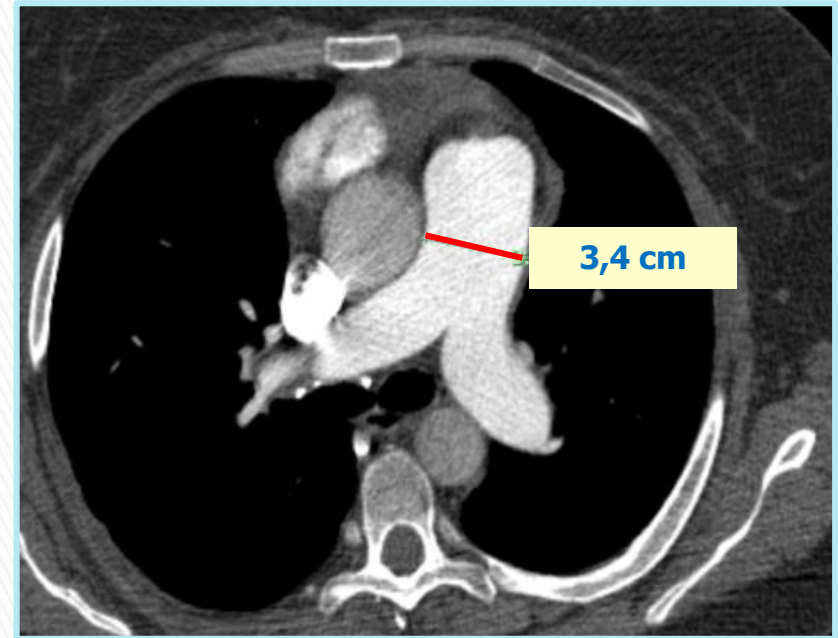
1. Vascular Signs: PA dilatation

1. Diameter of main pulmonary artery ≥ 29 mm : Sens 79%, spec 83%
2. Diameter of main pulmonary artery ≥ 28 mm : Sens 88%, spec 78%

mPAD: > 29 mm in men, > 27 mm in women

Truong QA, Massaro JM, Rogers IS, et al. Reference values for normal pulmonary artery dimensions by noncontrast cardiac computed tomography: the Framingham Heart Study.

Circ Cardiovasc Imaging 2012;5(1):147–154.

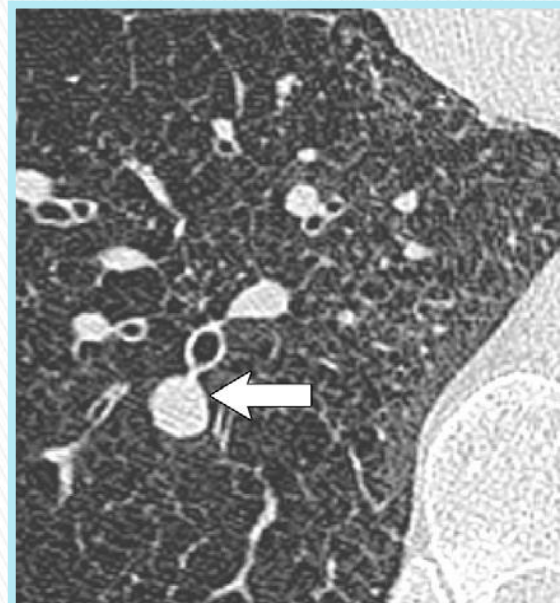
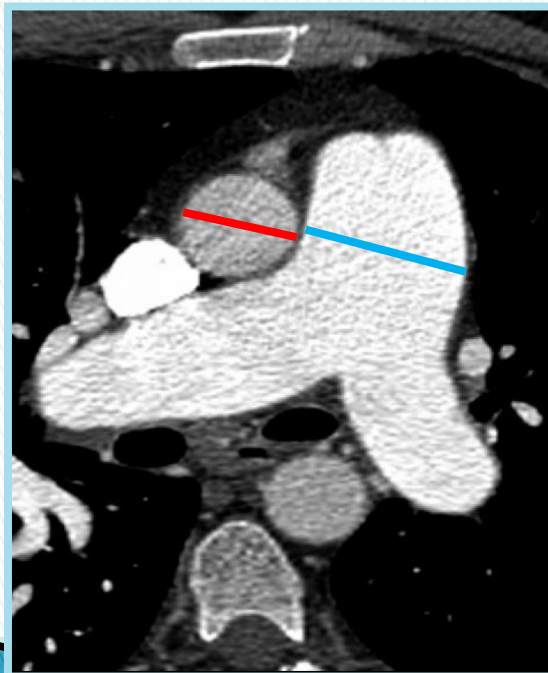


1. Vascular Signs: PA dilatation

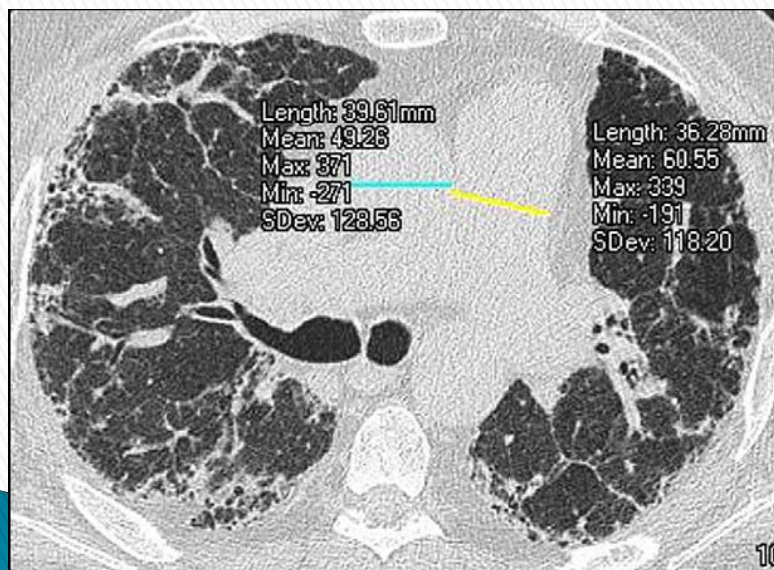
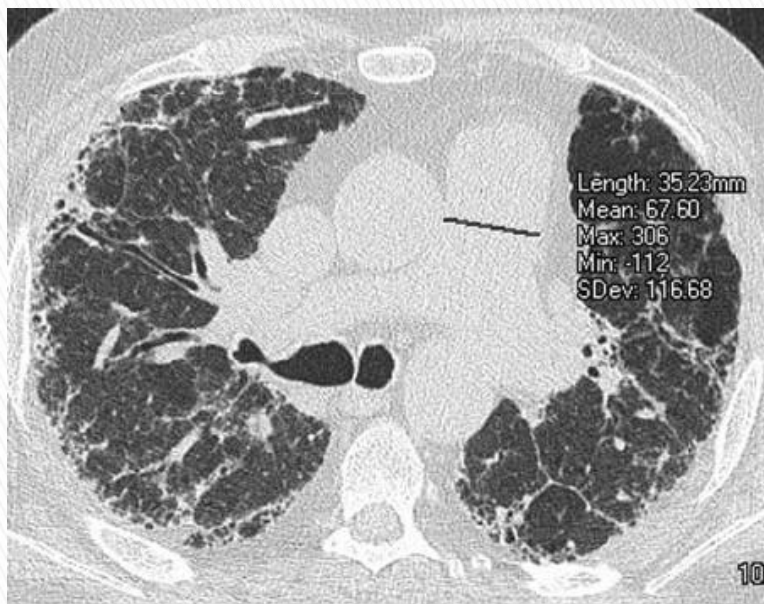
1. Main PA diameter/ ascending aorta diameter ratio ≥ 1 : sens 92%, sp 72%

Boerrigter 2010 Ιδιαίτερα σε άτομα < 50 ετών

**1. Segmental artery-to-bronchus diameter ratio ≥ 1 in at least three lobes:
Sens 87%, spec 68% Devaraj Radiology 2010**



Segmental artery D/ bronchus
D Ratio > 1



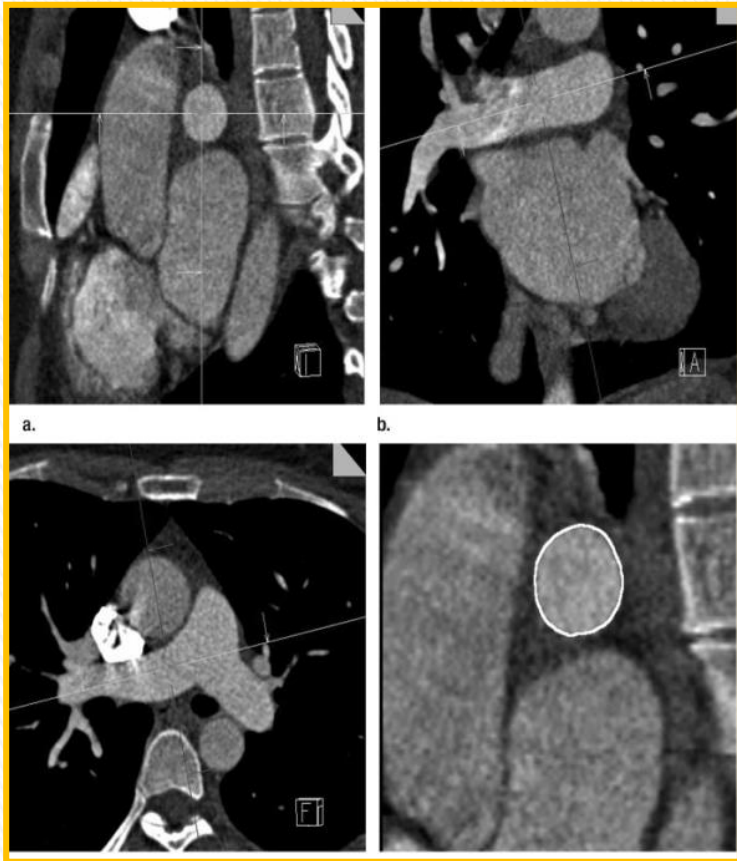
Εξαίρεση

Η διάμετρος της κύριας πνευμονικής αρτηρίας δεν έχει καλή συσχέτιση με την πίεση της πνευμονικής αρτηρίας (mPAP) σε ασθενείς με πνευμονική ίνωση. Σε αυτή την περίπτωση, πιο αξιόπιστος δείκτης είναι ο λόγος διαμέτρων ΠΑ/ ΑΑ

Zisman DA, Karlamangla AS, Ross DJ, et al. High resolution chest CT findings do not predict the presence of pulmonary hypertension in advanced idiopathic pulmonary fibrosis. *Chest* 2007;132:773-9

Devaraj A, Wells AU, Meister MG, et al. The effect of diffuse pulmonary fibrosis on the reliability of CT signs of pulmonary hypertension. *Radiology* 2008;249:1042-9.

1. Vascular signs: Decrease in RPA distensibility



Revel MP et al. Pulmonary hypertension: ECG-gated 64-section CT angiographic evaluation of new functional parameters as diagnostic criteria. *Radiology* 2009;250(2):558–566

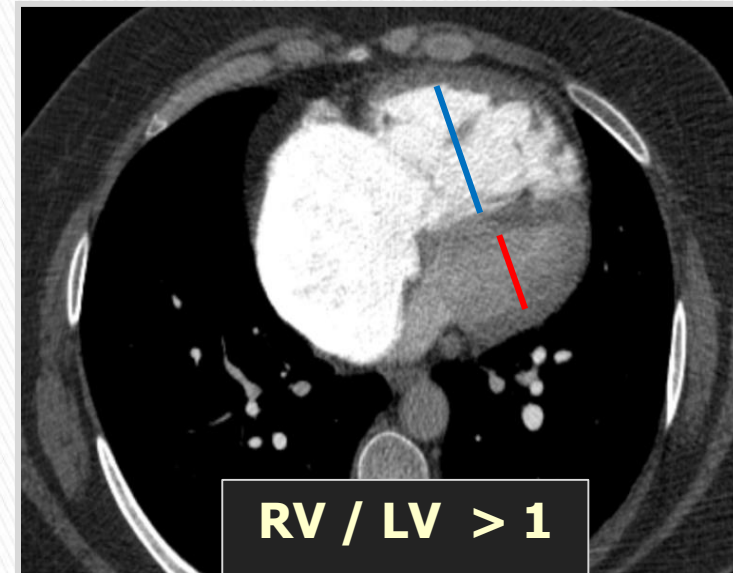
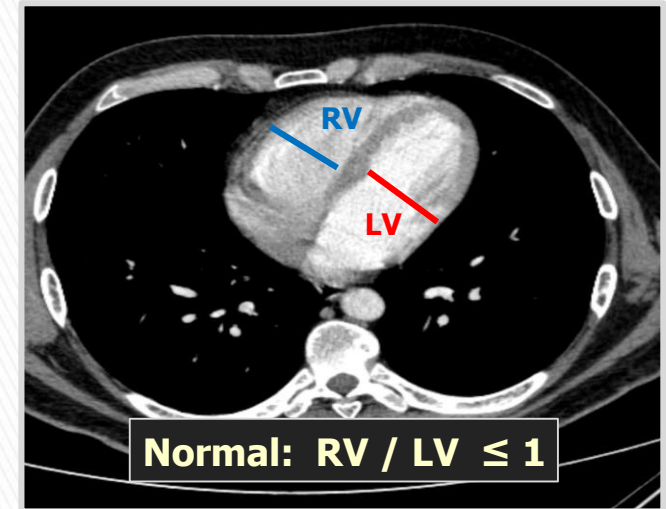
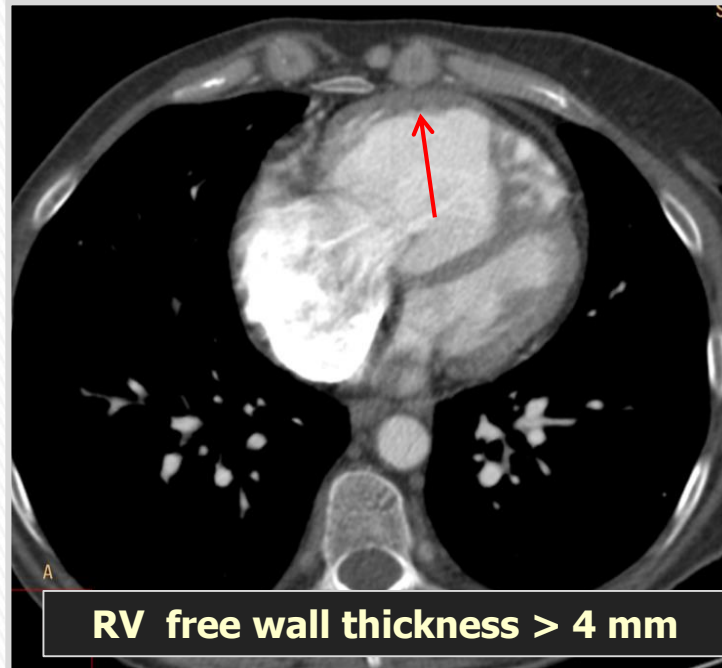


Decrease in right pulmonary artery distensibility

The best pulmonary artery distensibility cutoff for distinguishing between patients with pulmonary hypertension and those without it was 16.5% when a standard method of measurement was used and 13% when a simplified method was used

2. Cardiac Signs

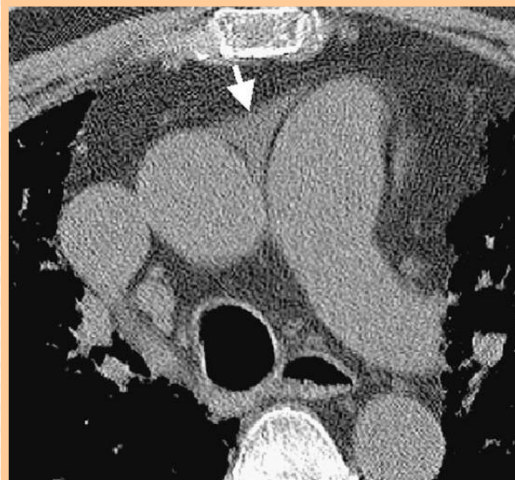
1. **Right Ventricular Hypertrophy**
RV myocardium more than 4 mm thick
2. **RV dilatation**
RV/LV diameter ratio ≥ 1
3. **Straightening or leftward bowing of the interventricular septum**



straightening of the IVS, D-shaped LV

... and

1. Pericardial effusion
2. Reflux of contrast material into IVC and hepatic veins
3. Reopening of foramen ovale

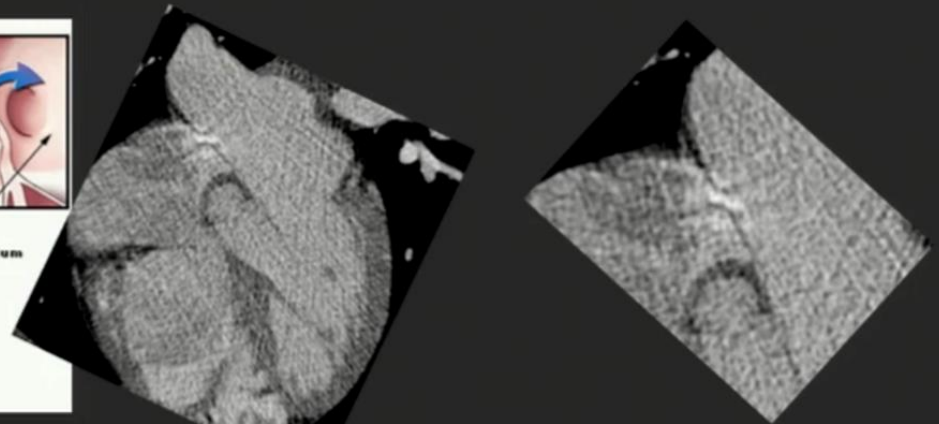
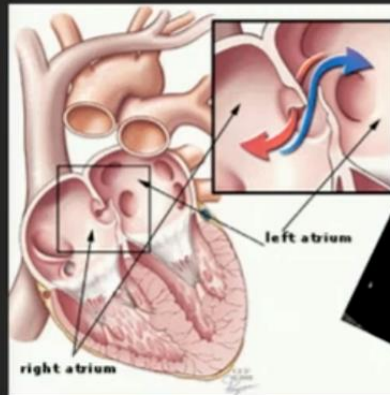


Pericardial effusion
POOR prognostic sign



Reflux of CM to IVC and hepatic veins

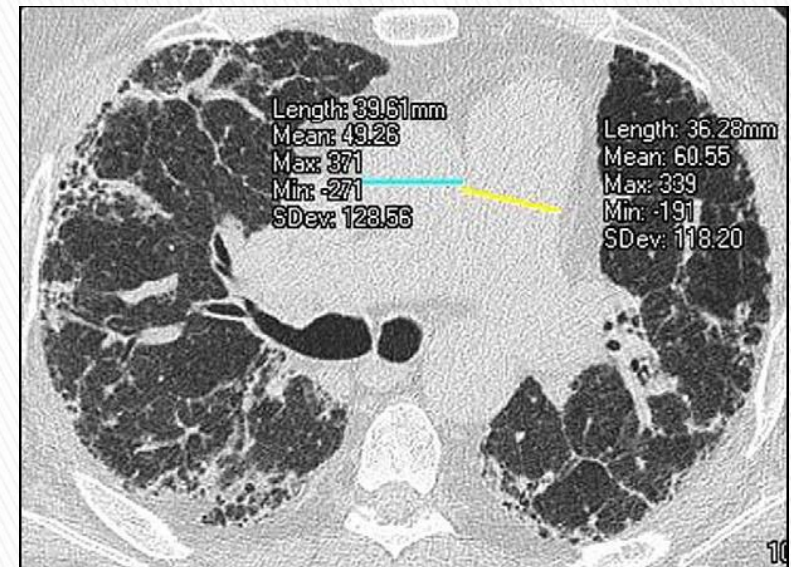
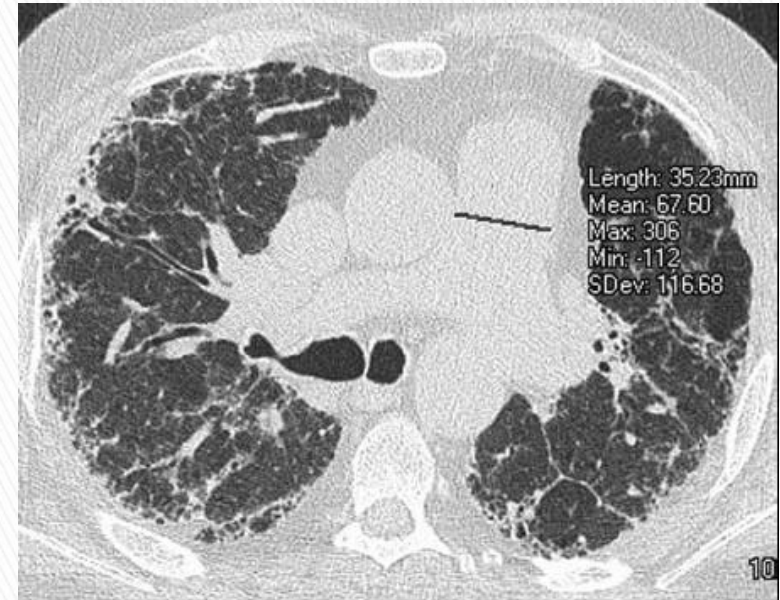
■ Re-opening of Foramen ovale



CT Limitations

- ✓ **CT does not provide pulmonary pressure and resistances (severity of PH cannot be precisely estimated by CT)**
- ✓ **A normal appearance of the pulmonary arteries does not eliminate the possibility of mild pulmonary hypertension**
- ✓ **Ascending aorta diameter may change with body size and/or age**
- ✓ **PA dilatation may also occur without PH in patients with chronic diffuse pulmonary fibrosis**

Devaraj A et al. Radiology 2008;249:1042-9



Devaraj et al. A Radiology 2008;249:1042-9

**CT signs suggesting the
cause of PH**

GROUP 1' Pulmonary Veno-Occlusive Disease (PVOD) Pulmonary Capillary Haemangiomas (PCH)

- ✓ Rare conditions. Pathological, clinical and radiological overlap
- ✓ Many cases are still misclassified as IPAH. The prognosis appears to be worse
- ✓ PAWP is almost invariably normal
- ✓ Hazardous lung biopsy (the gold standard to confirm a histological diagnosis of PVOD/ PCH), is no longer recommended in most cases
- ✓ The only curative therapy for PVOD/PCH is lung transplantation

GROUP 1' : PVOD/PCH

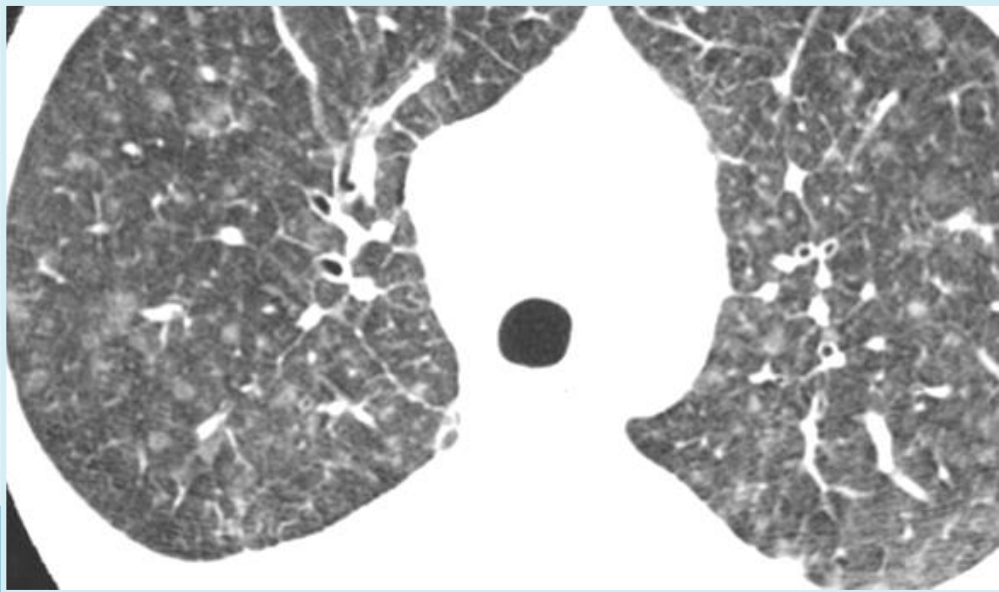
***High-resolution CT of the chest is the investigation of choice.
V/Q lung scanning is not useful in discriminating PVOD/PCH from IPAH***

Specific CT signs

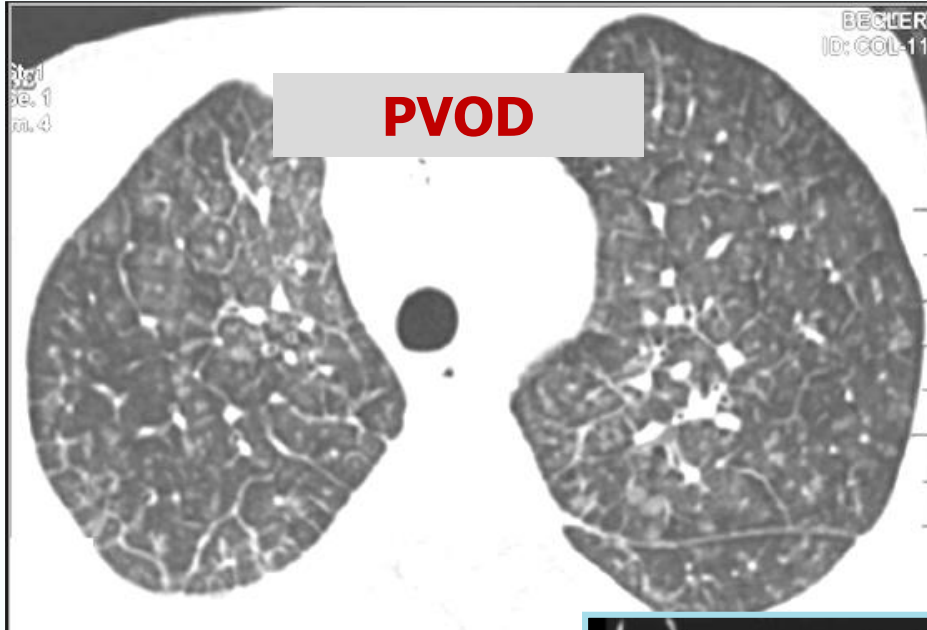


- 1. Smoothly thickened interlobular septa**
- 2. Poorly defined centrilobular ground glass opacities**
- 3. Lymphadenopathy**

Sens 66% Spec 100% Resten et al. AJR 2004;183:65-70



GROUP 1' : PVOD/PCH



In PVOD



... small central pulmonary veins

**... and normal PAWP
(< 15 mmHg)**

GROUP 1' : PVOD/PCH

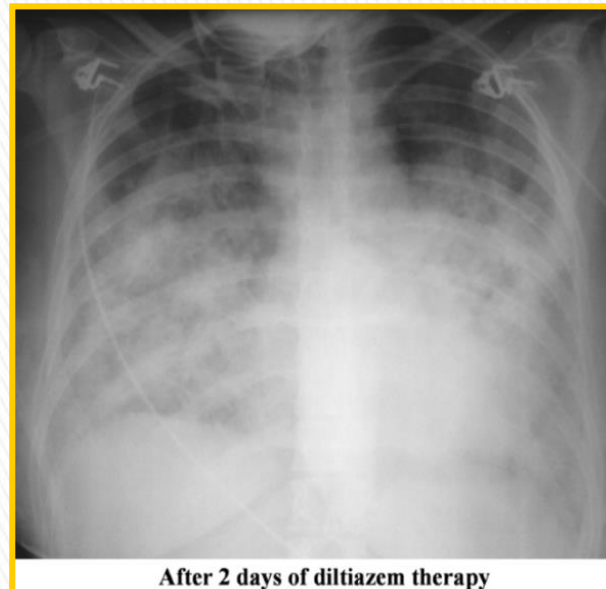
Rare, difficult to diagnose

But, no room for error

Vasodilators and, in particular, i.v. epoprostenol must be used with great caution because of the high risk of severe drug-induced pulmonary oedema

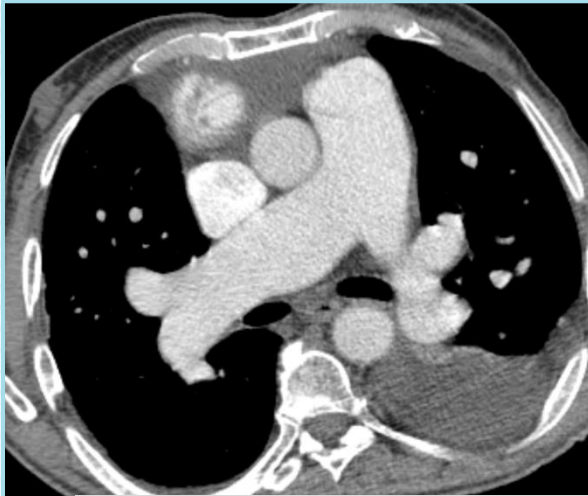


Prior to diltiazem therapy

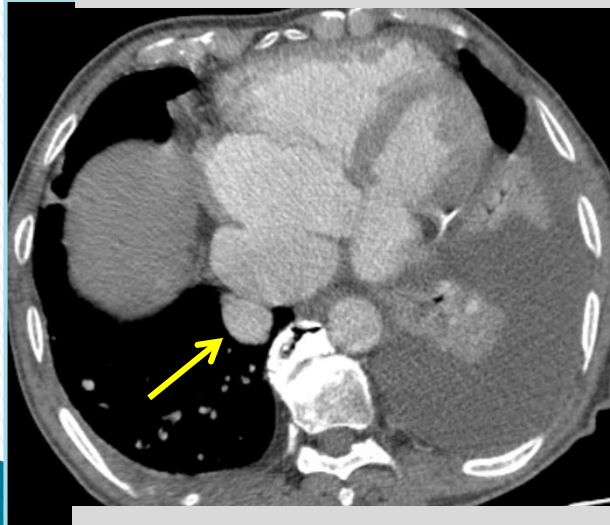
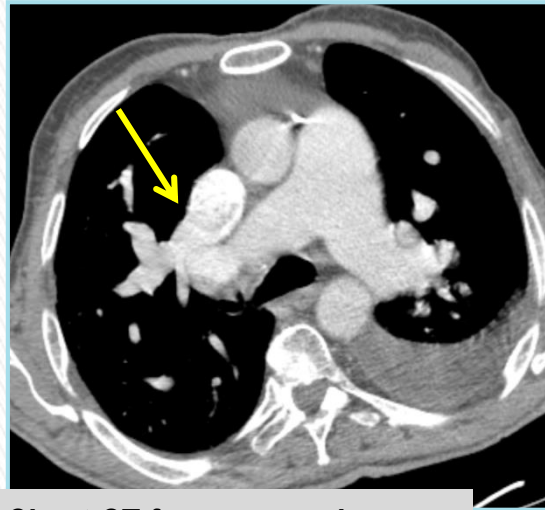


After 2 days of diltiazem therapy

GROUP 1: PAH associated with Congenital Heart Disease (CHD)



72 yo man diagnosed as IPAH. Chest CT for pneumonia

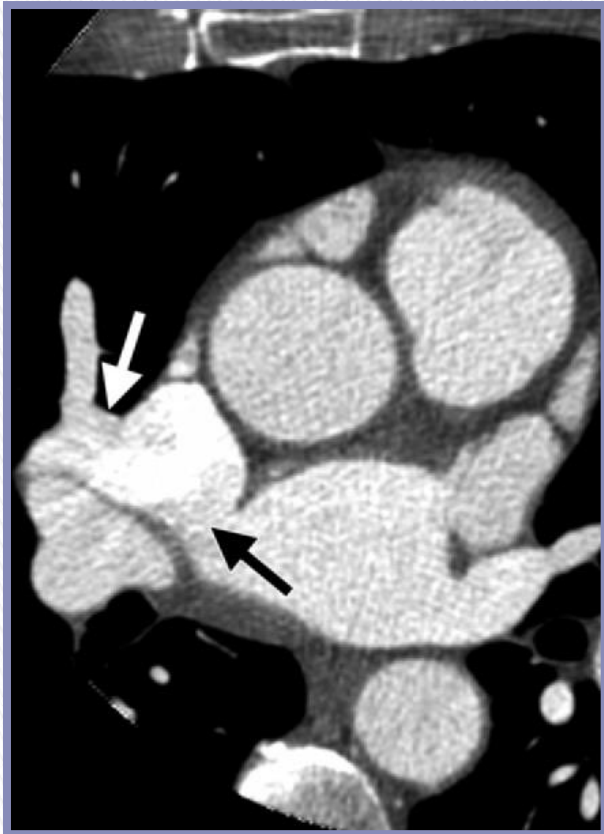


Partial Anomalous Pulmonary Venous Return

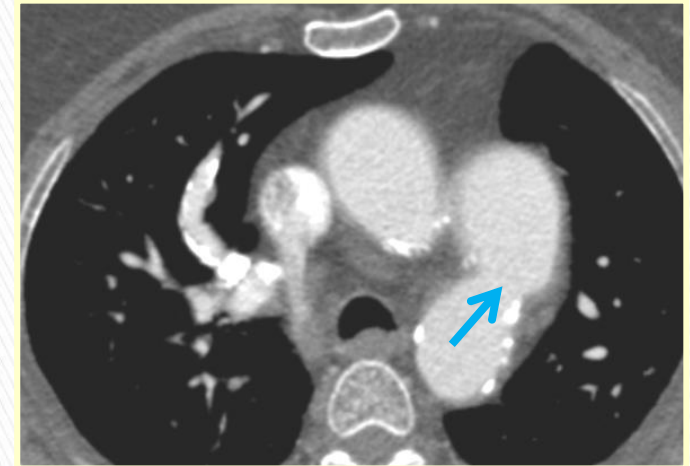
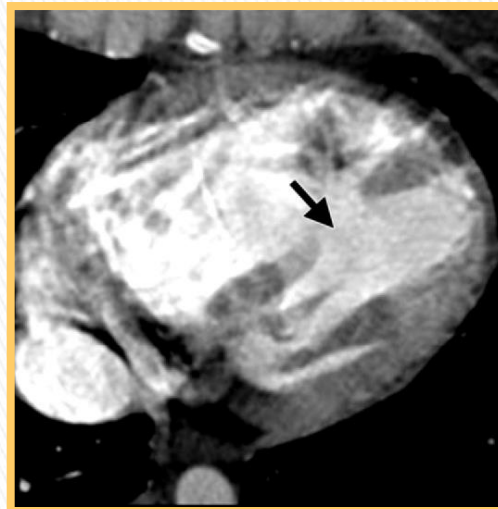
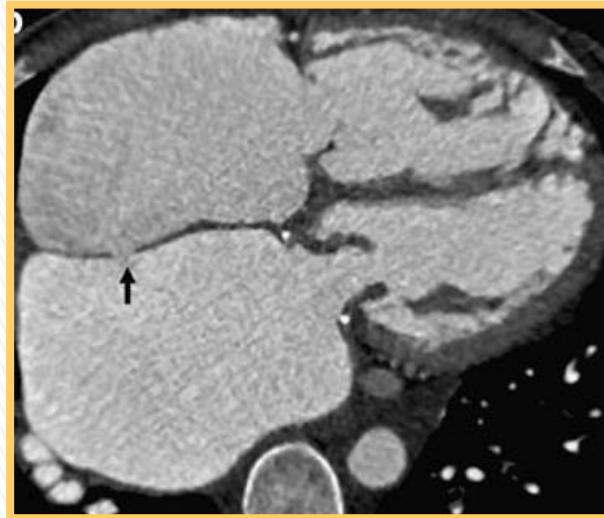
Some malformations, such as *patent ductus arteriosus*, *sinus venosus atrial septal defect* or *partial anomalous pulmonary venous return*, are often concealed and patients are misclassified as suffering from IPAH. Hence, these congenital anomalies should be specifically sought

2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension

Άλλα ευρήματα που δεν πρέπει να διαφύγουν



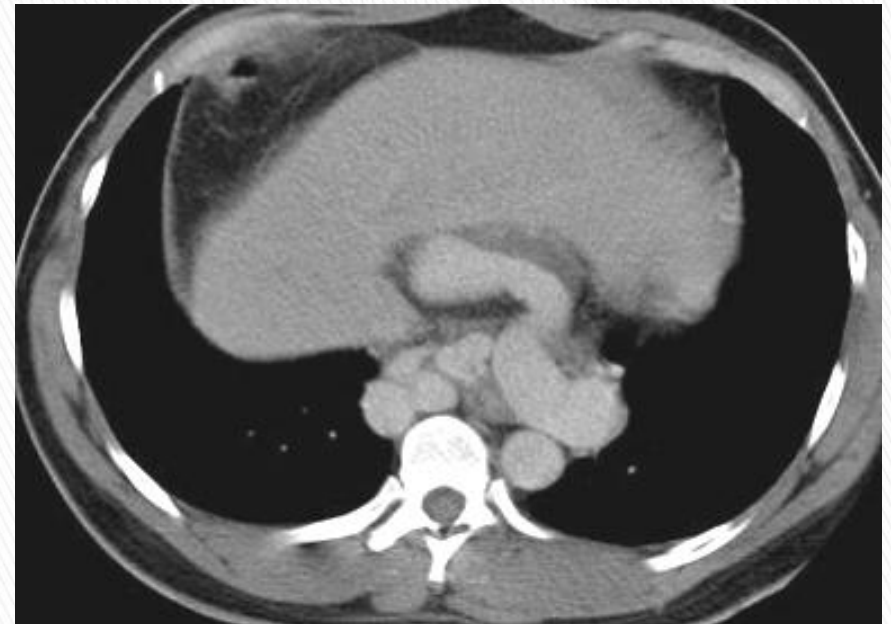
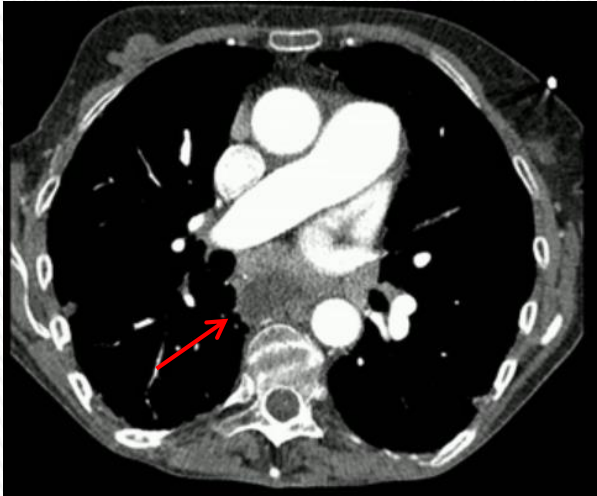
Γυναίκα 26 ετών
Sinus Venosus



Γυναίκα 44 ετών
Patent Ductus Arteriosus

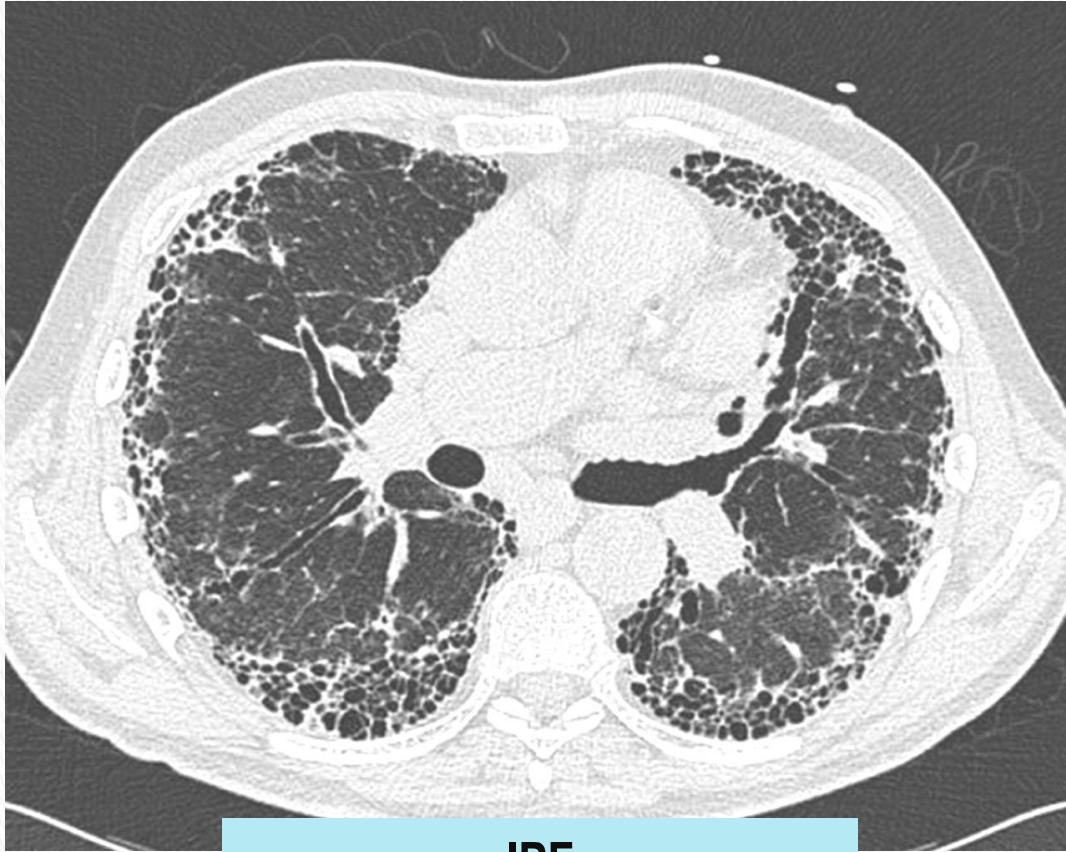
GROUP 1: Associated with CTD (mainly SSc, SLE , mixed CTD)

GROUP 1: Associated with portal hypertension

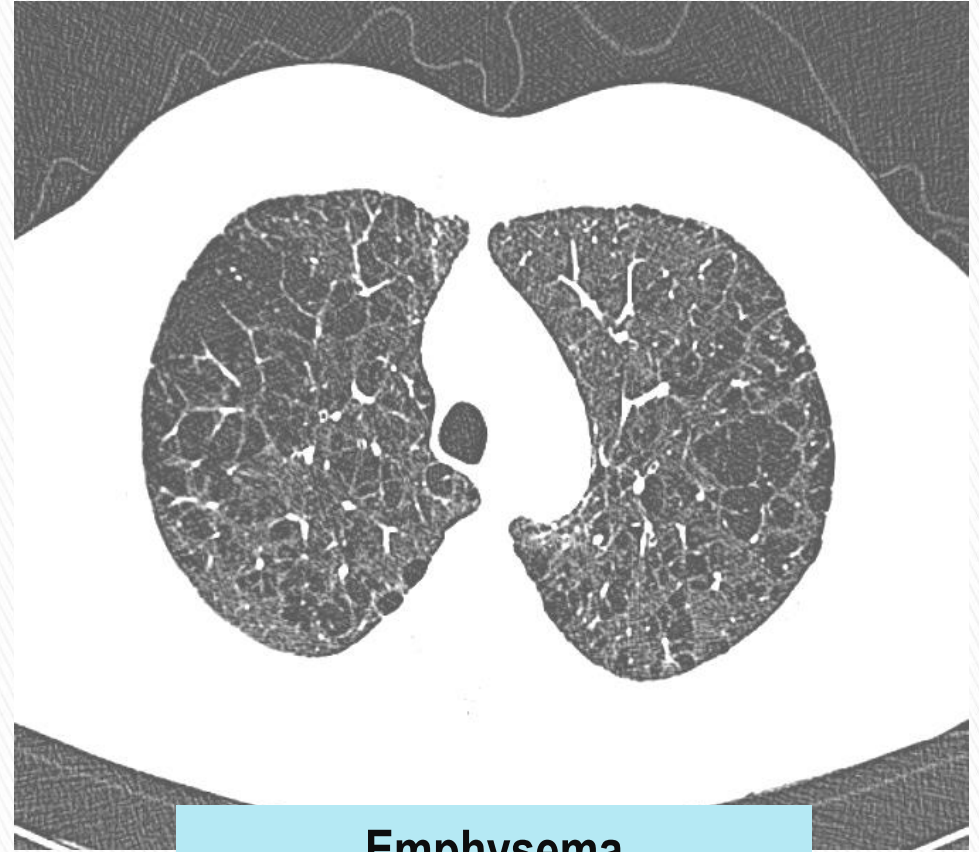


Άνδρας 62 ετών, CREST

GROUP 3: PH due to lung diseases



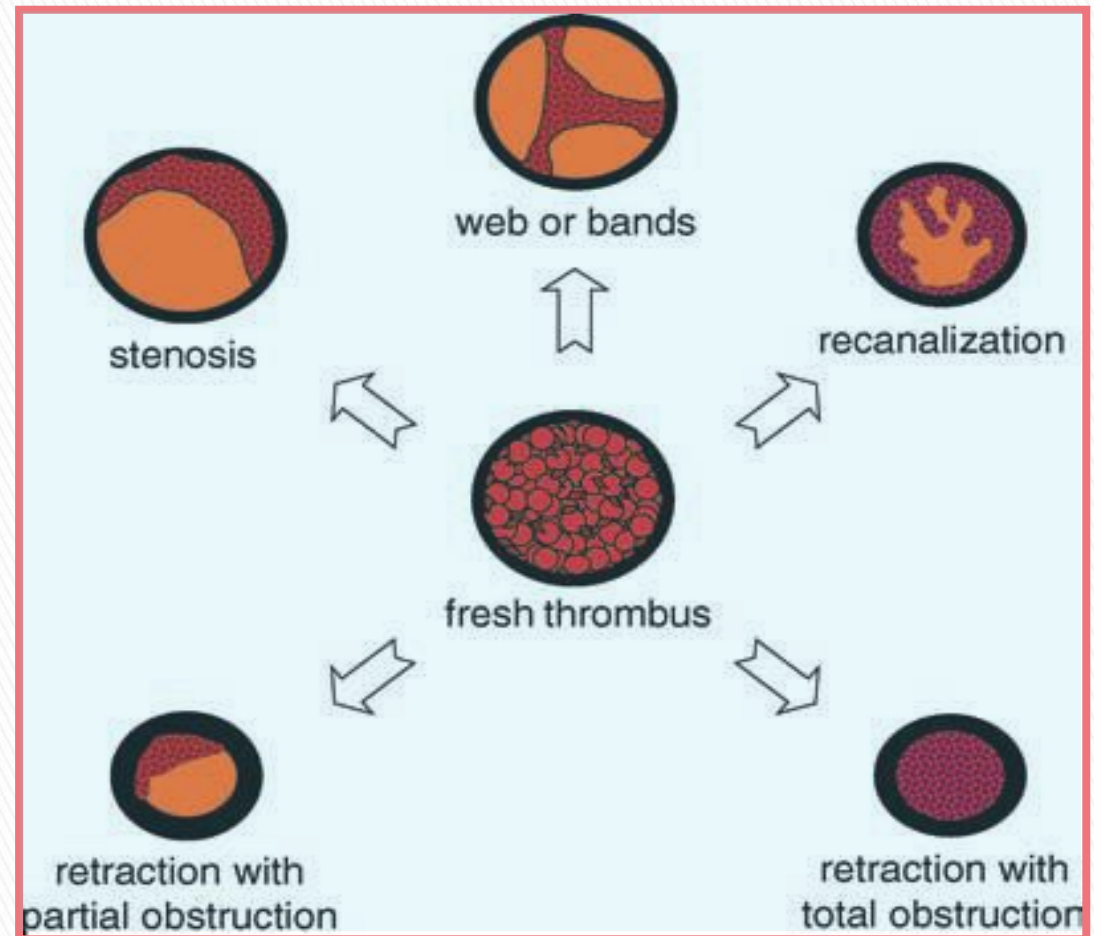
IPF



Emphysema

GROUP 4 : Chronic Thrombo Embolic Pulmonary Hypertension (CTEPH)

- ✓ Complicates up to 3,8 % of acute PE
- ✓ Routine screening for CTEPH after PE is not supported by current evidence
- ✓ It is of the utmost importance to diagnose CTEPH early and, further, to recognize patients eligible for PEA.

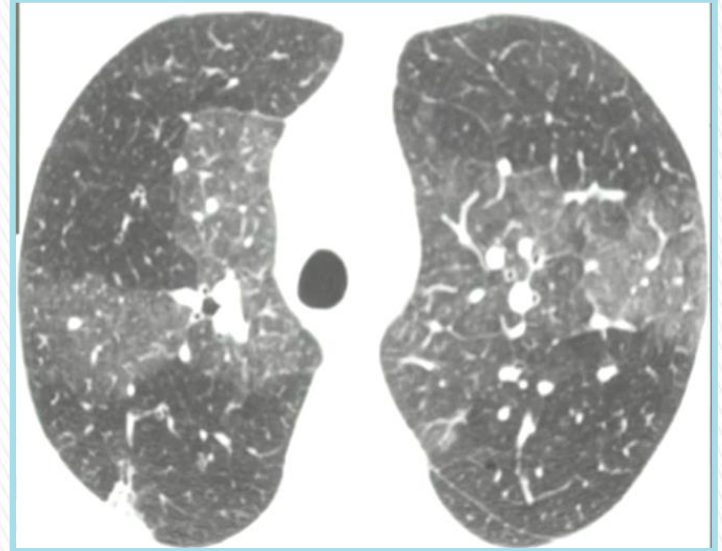
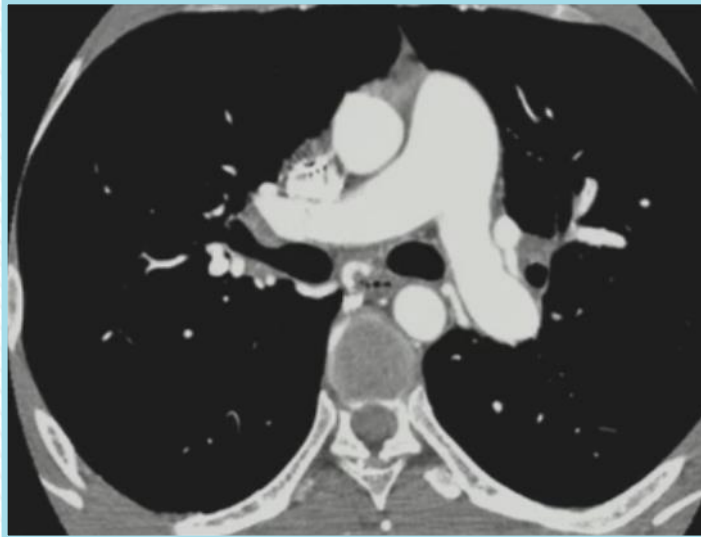
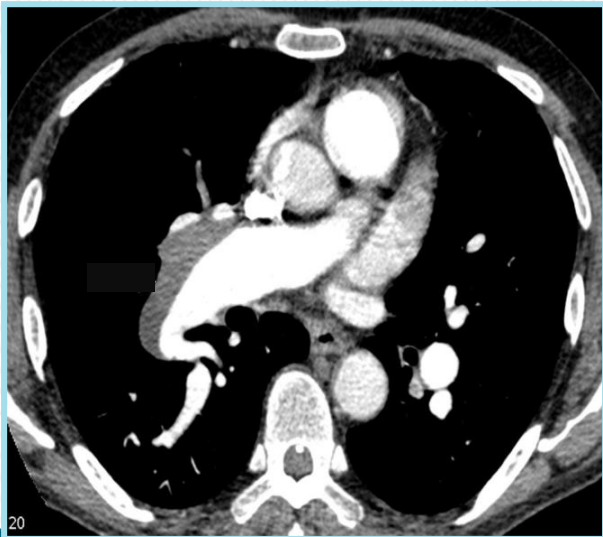


GROUP 4: CTEPH

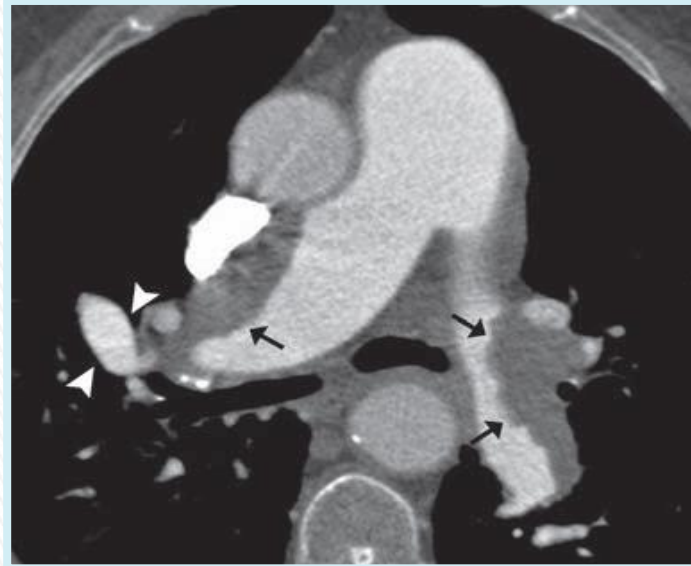
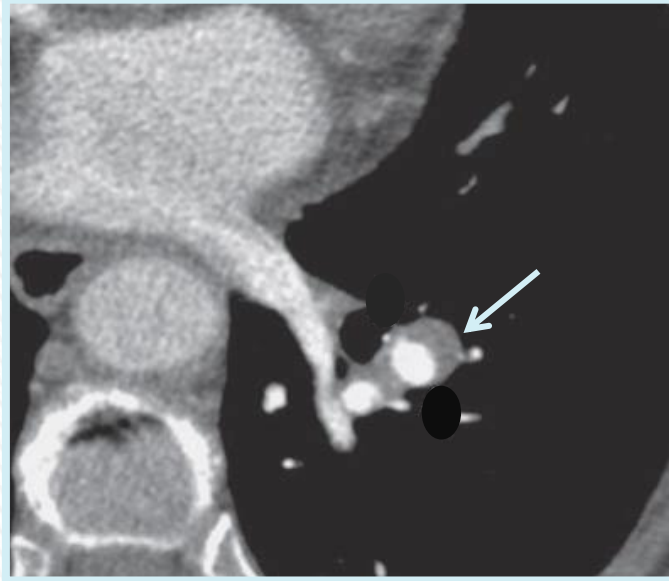
Specific CT signs



1. Signs of chronic PE
2. Enlarged systemic arteries
3. Mosaic perfusion



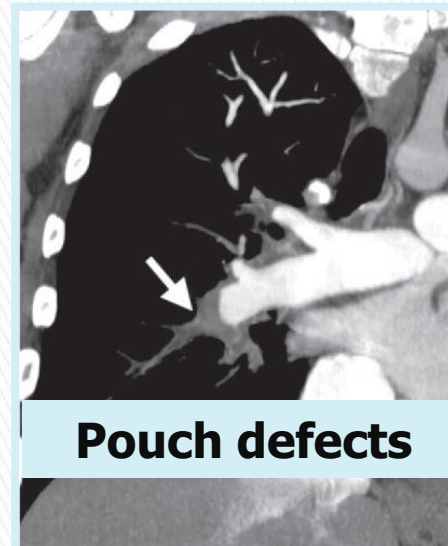
GROUP 4: CTEPH



Eccentric thrombi Obtuse angle between thrombus and vessel wall



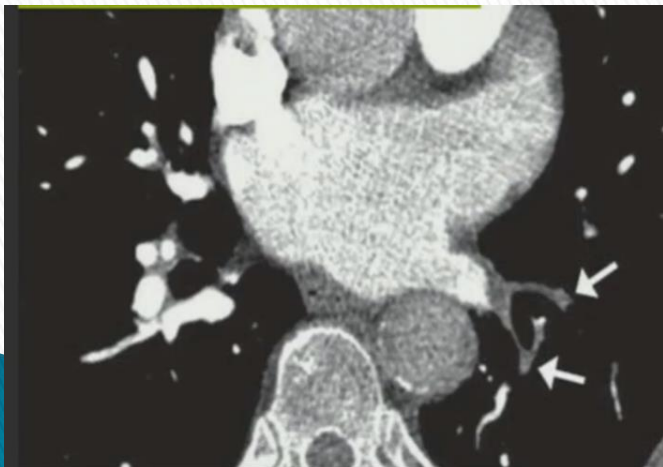
Webs and bands



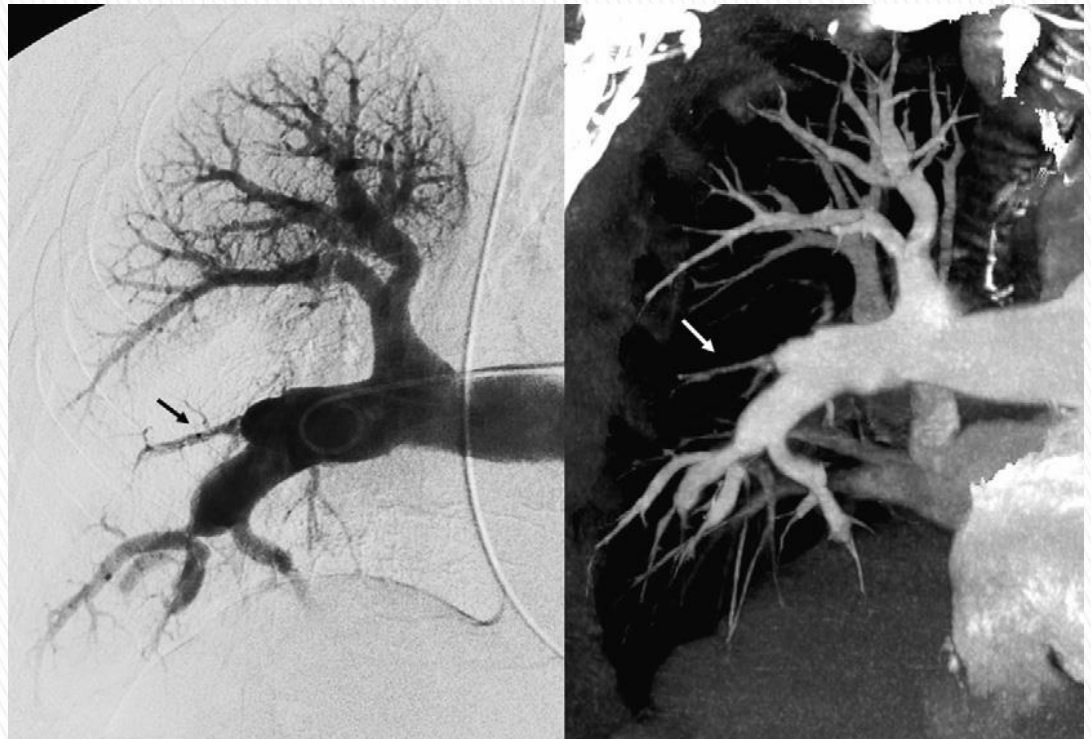
Pouch defects

GROUP 4: CTEPH

Small size occluded vessels



Post-stenotic dilatation, abrupt narrowing



European Journal of Radiology 71 (2009) 49–54

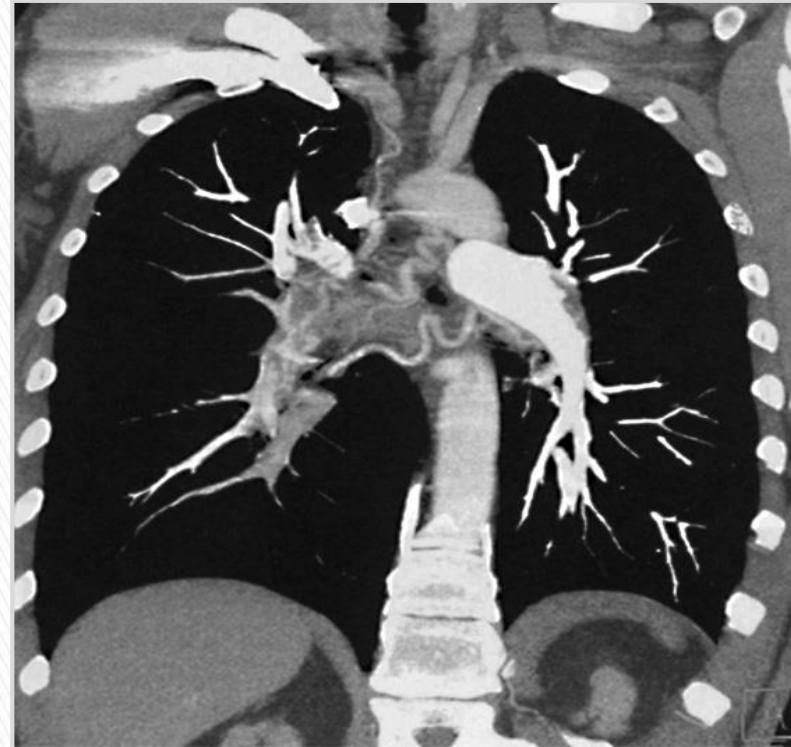
GROUP 4: CTEPH

Vascular Remodelling in CTEPH

- Laminated thrombus
- Webs / Bands
- Post-stenotic dilatation
- Pouch
- Occlusion
- Abrupt narrowing
- Intimal irregularity

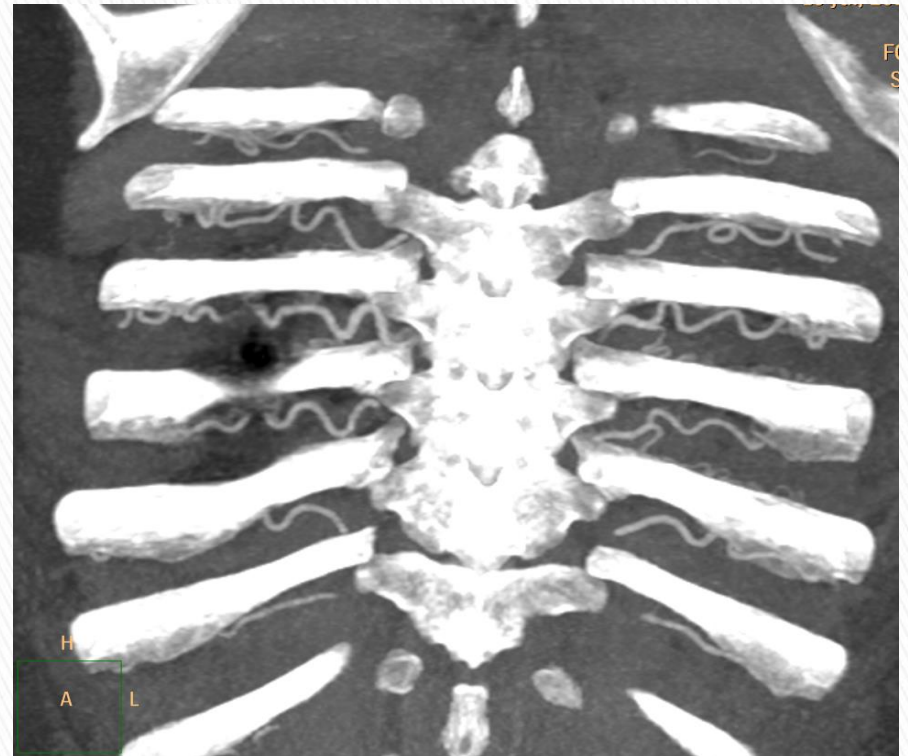
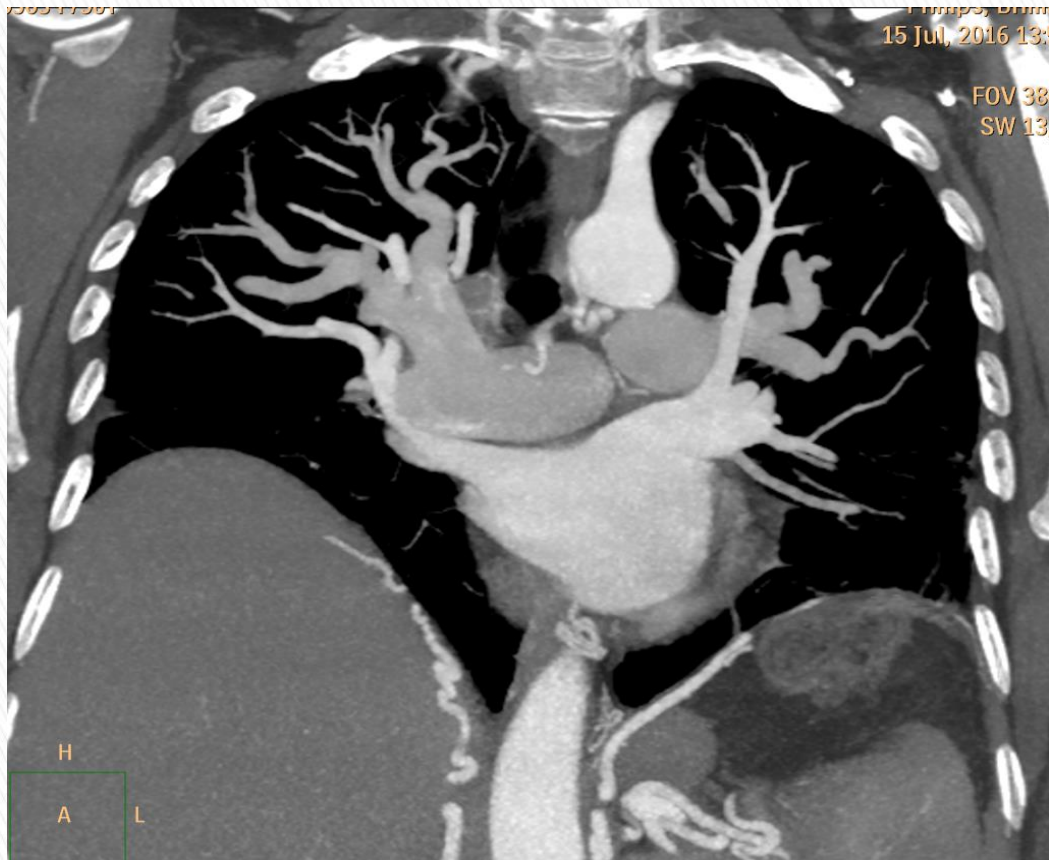
N. Screaton ECR 2018

GROUP 4: CTEPH



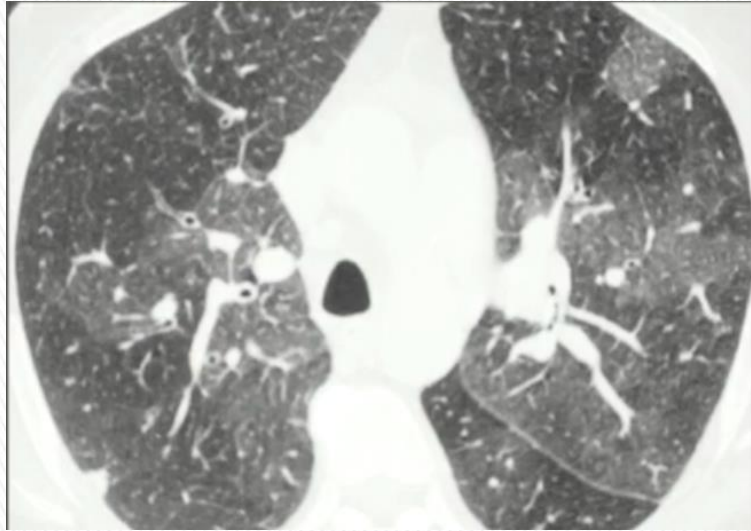
Enlarged bronchial arteries

GROUP 4: CTEPH



Systemic collaterals

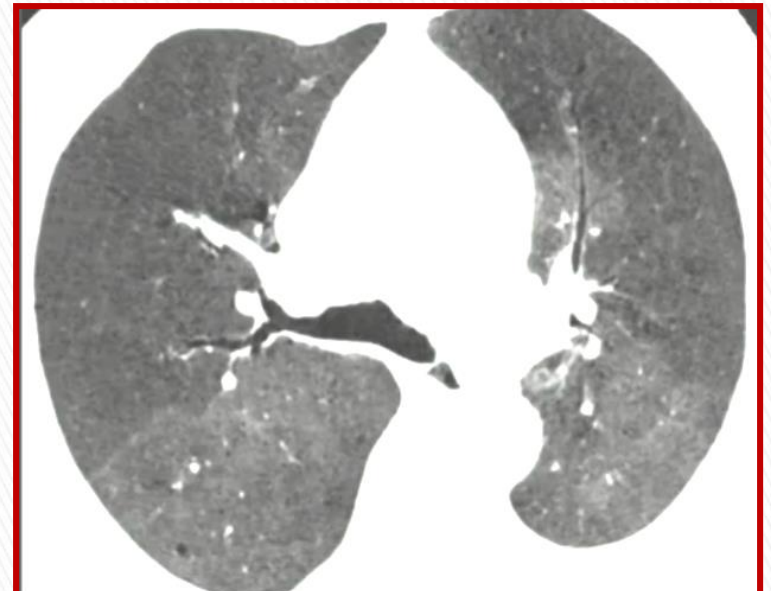
GROUP 4: CTEPH



Mosaic Perfusion



Mosaic perfusion can be subtle

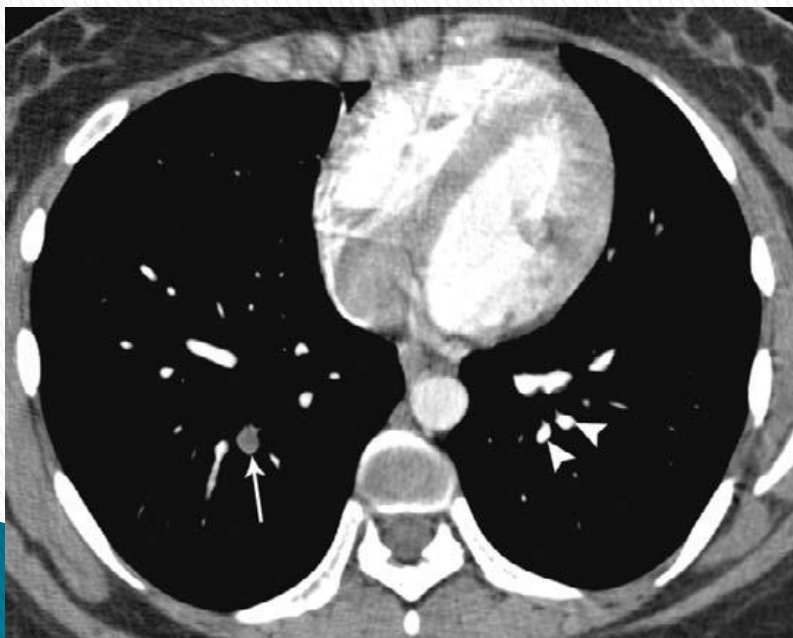


Minimum Intensity Projection (MinIP)

Οξεία vs Χρόνια

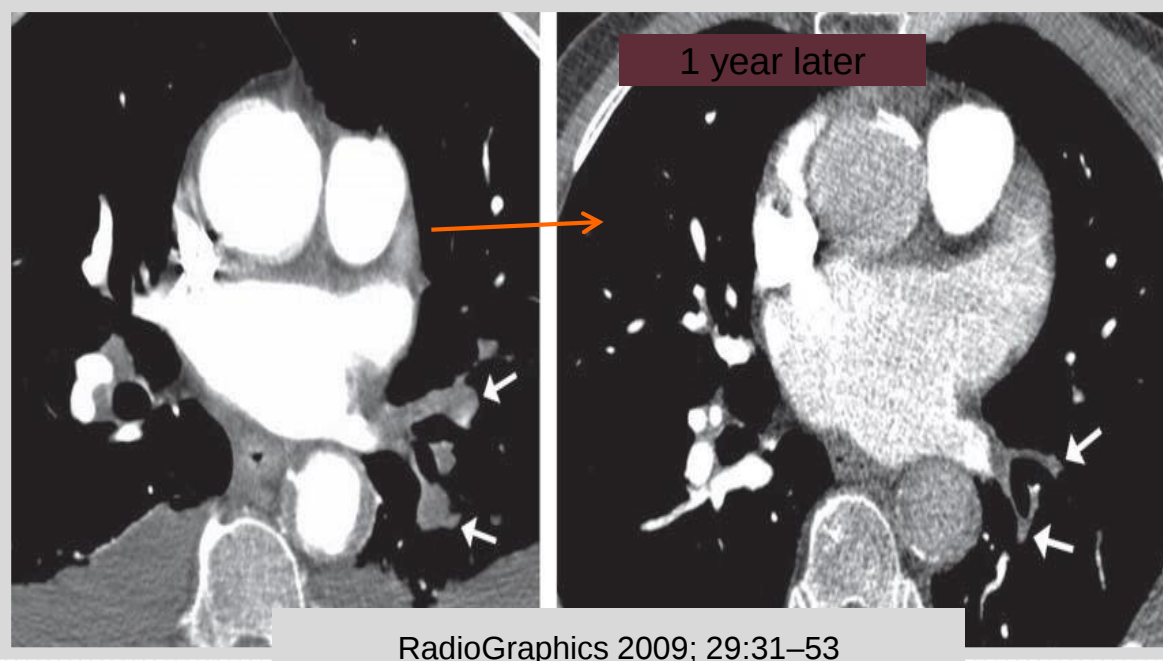
ΟΞΕΙΑ ΠΕ

Αύξηση της διαμέτρου των αγγείων



ΧΡΟΝΙΑ ΠΕ

Ελάττωση της διαμέτρου των αγγείων

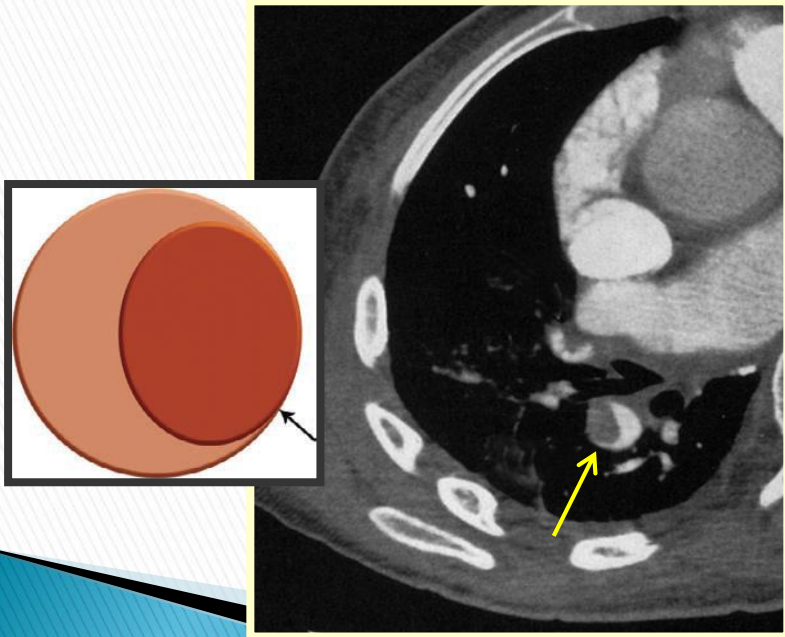


RadioGraphics 2009; 29:31–53

Οξεία vs Χρόνια

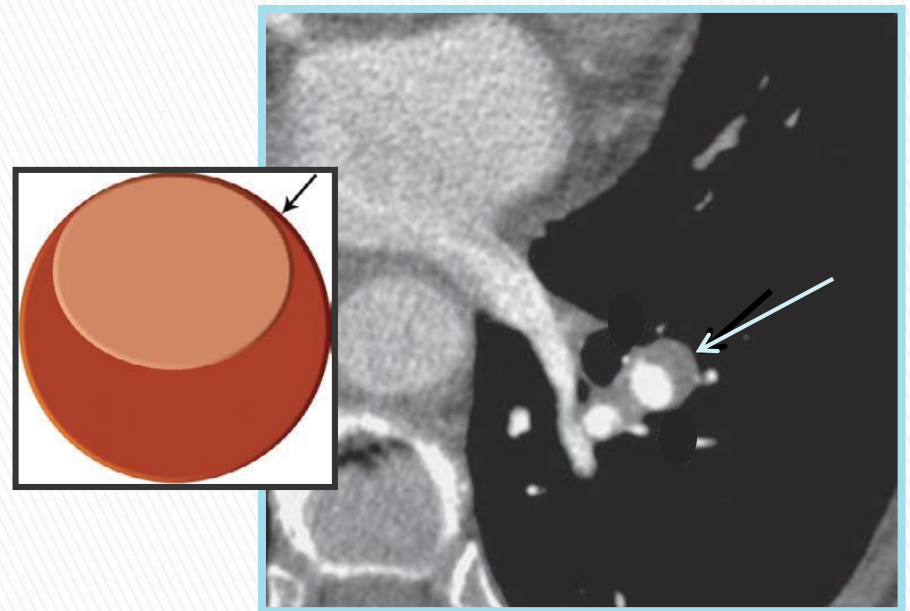
ΟΞΕΙΑ ΠΕ

Οξεία γωνία του θρόμβου με το τοίχωμα του αγγείου

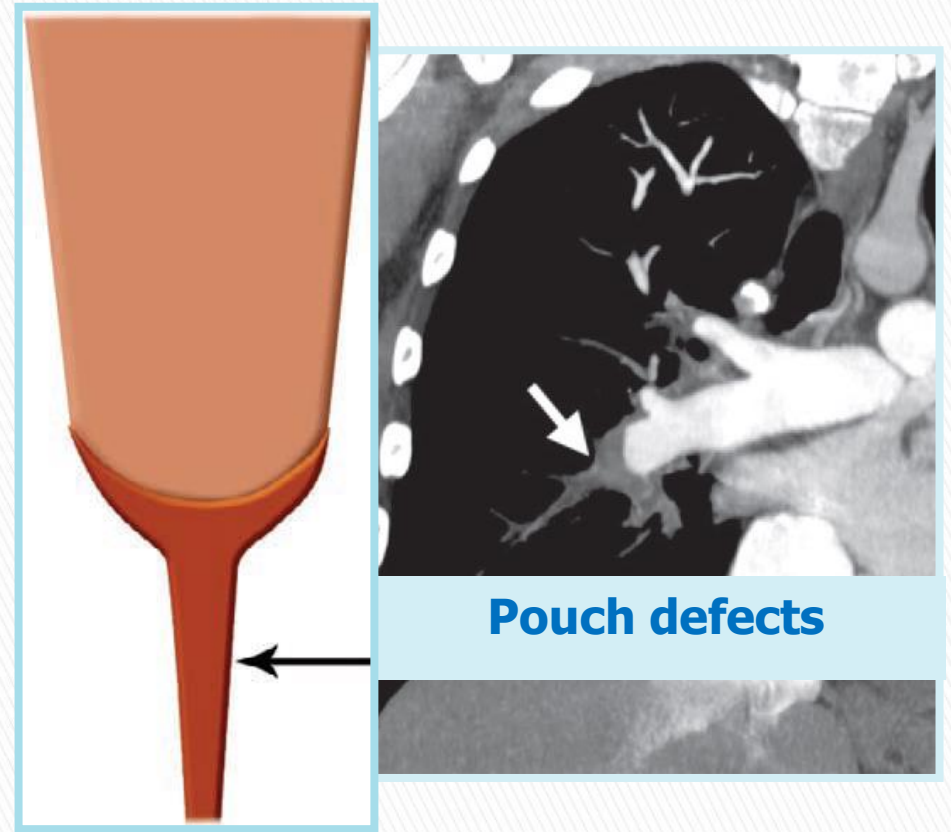
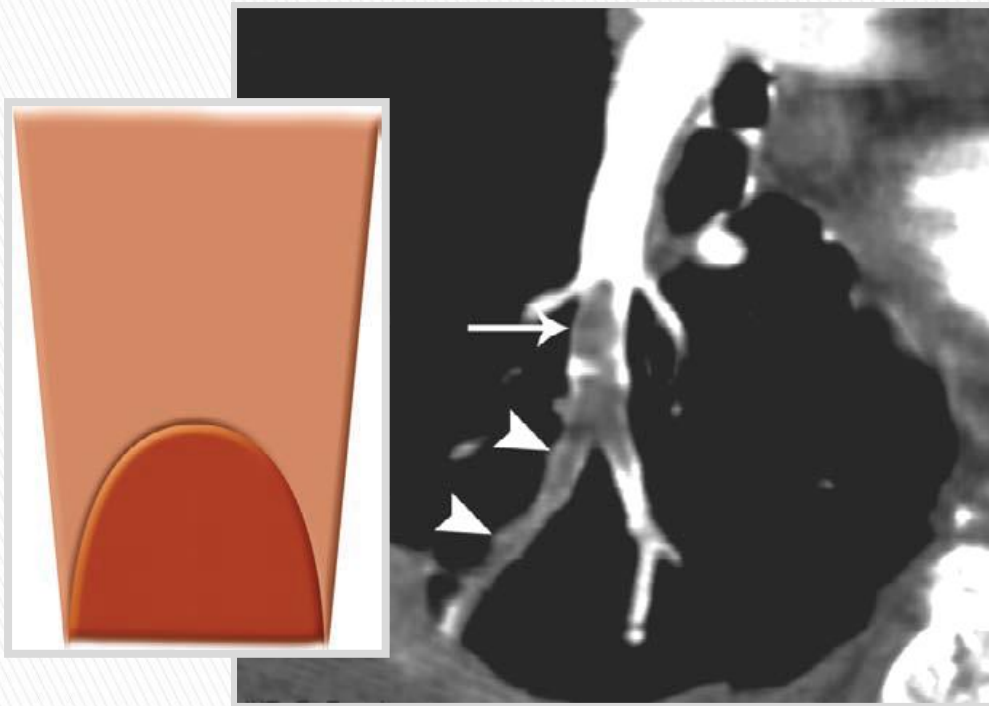


ΧΡΟΝΙΑ ΠΕ

Αμβλεία γωνία του θρόμβου με το τοίχωμα του αγγείου



Οξεία vs Χρόνια

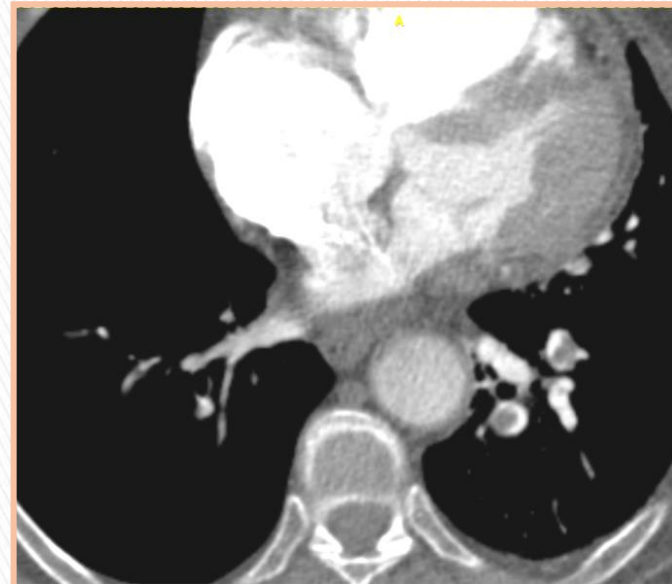


Οξεία vs Χρόνια

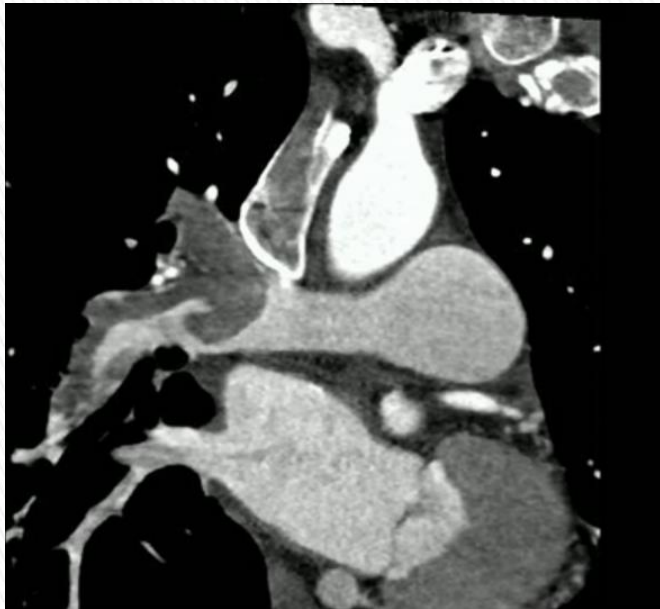
ΟΞΕΙΑ ΠΕ	ΧΡΟΝΙΑ ΠΕ
Διάταση (όχι υπερτροφία) της δεξιάς κοιλίας	Διάταση και υπερτροφία της δεξιάς κοιλίας
Ασυνήθης η διάταση των βρογχικών αρτηριών	Συνήθης η διάταση των βρογχικών αρτηριών

Οξεία vs Χρόνια

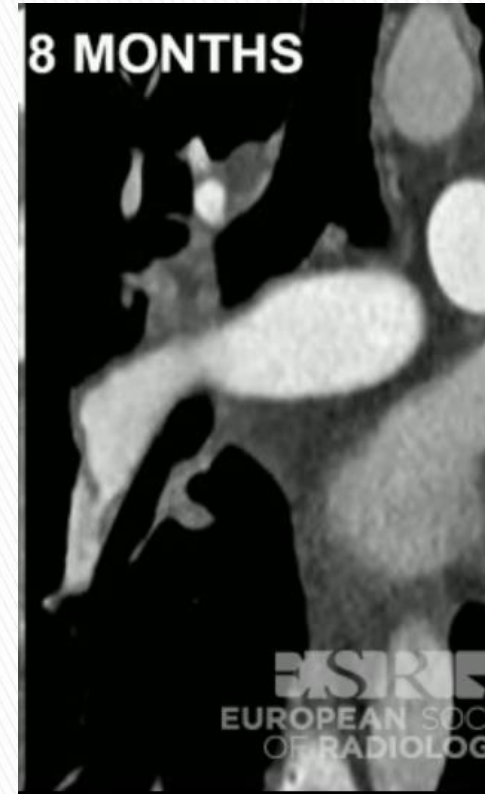
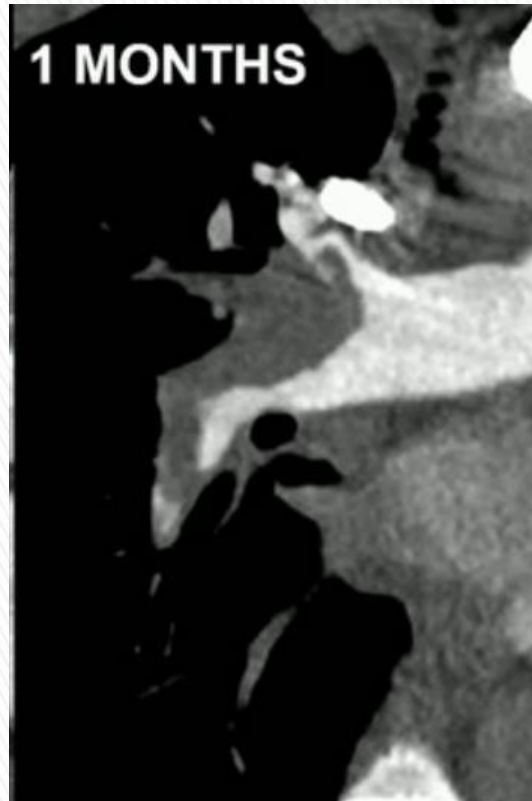
- Δεν είναι σπάνιο να συνυπάρχουν σημεία οξείας και χρόνιας εμβολής (Υποτροπιάζουσα πνευμονική εμβολή)
- Η χρόνια πνευμονική εμβολή πολλές φορές αναδεικνύεται σε CTPA που γίνονται για τον αποκλεισμό οξείας πνευμονικής εμβολής
- Η παρουσία διατεταμένων βρογχικών αρτηριών ή υπερτροφίας της δεξιάς κοιλίας είναι ευρήματα που υποστηρίζουν διάγνωση υποτροπιάζουσας ή χρόνιας πνευμονικής εμβολής



Οξεία vs Χρόνια



Acute PE

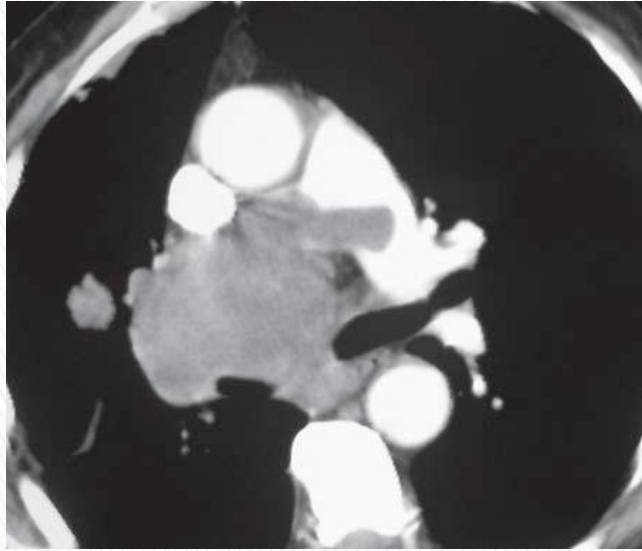


Chronic PE



N. Screatton ECR 2018

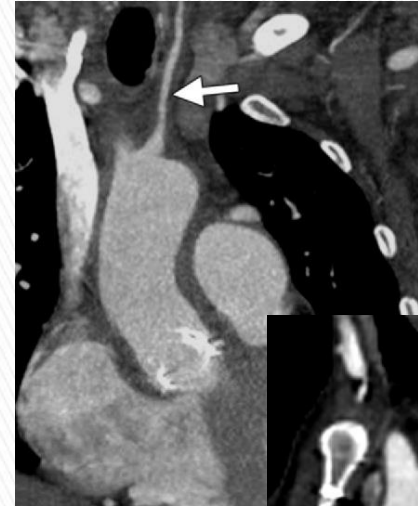
Mimics of CTEPH



**Pulm. Artery
sarcoma**

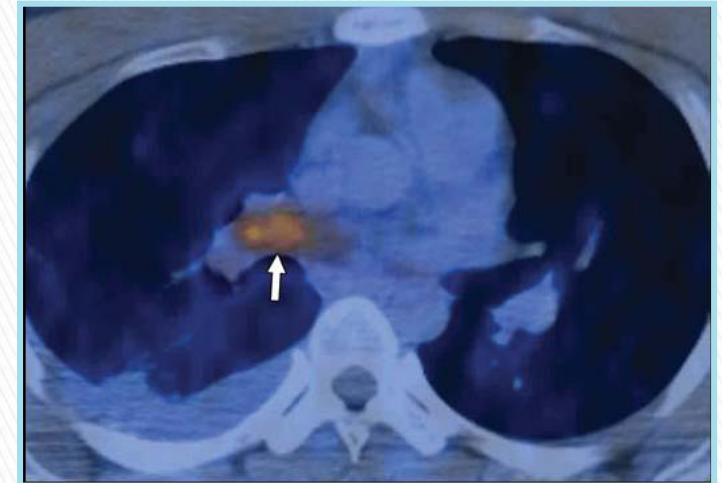
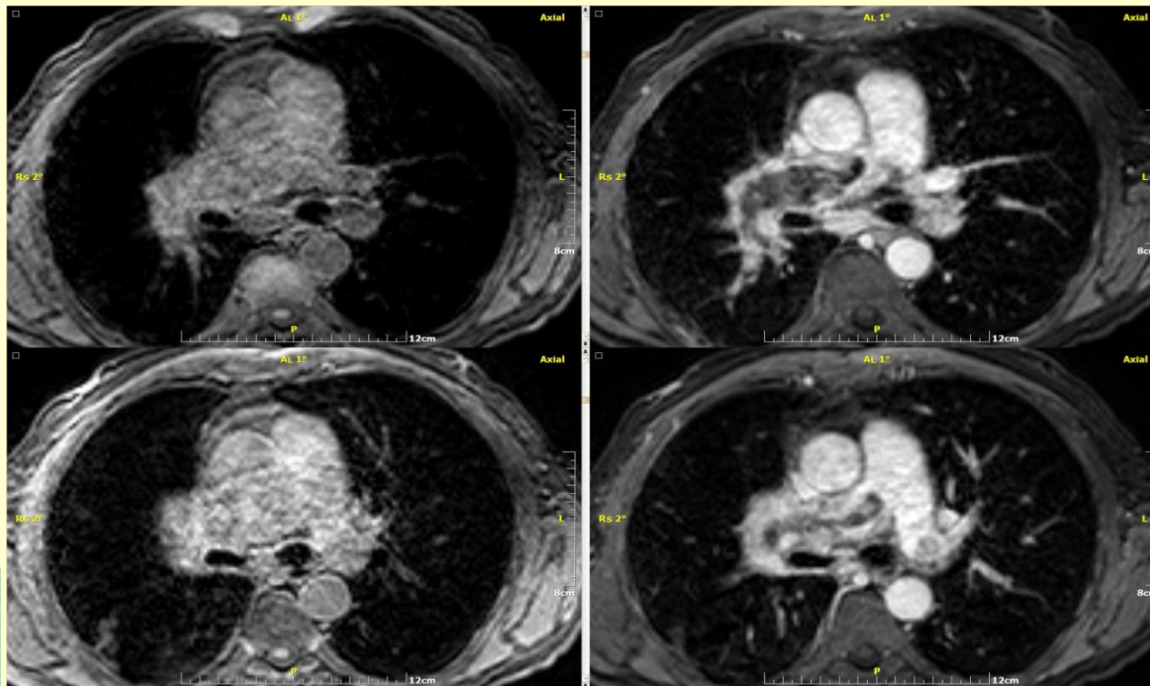
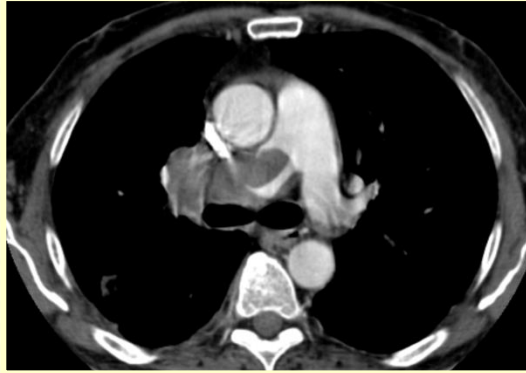


**Fibrosing
mediastinitis**



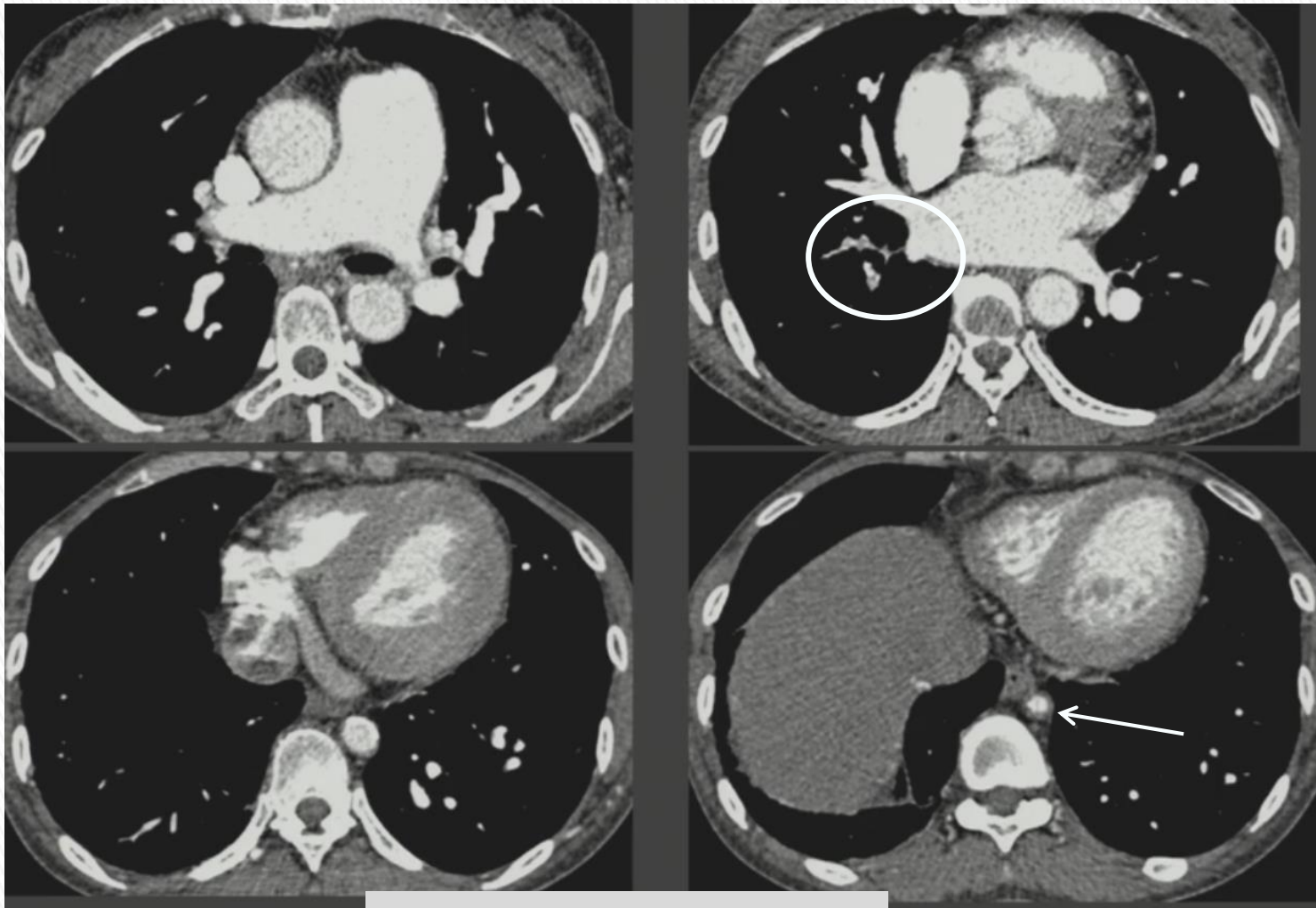
Takayasu

Pulm. Artery sarcoma



AJR 2007; 188:1691–1693

40 yo woman, severe PH, ASD repair in childhood

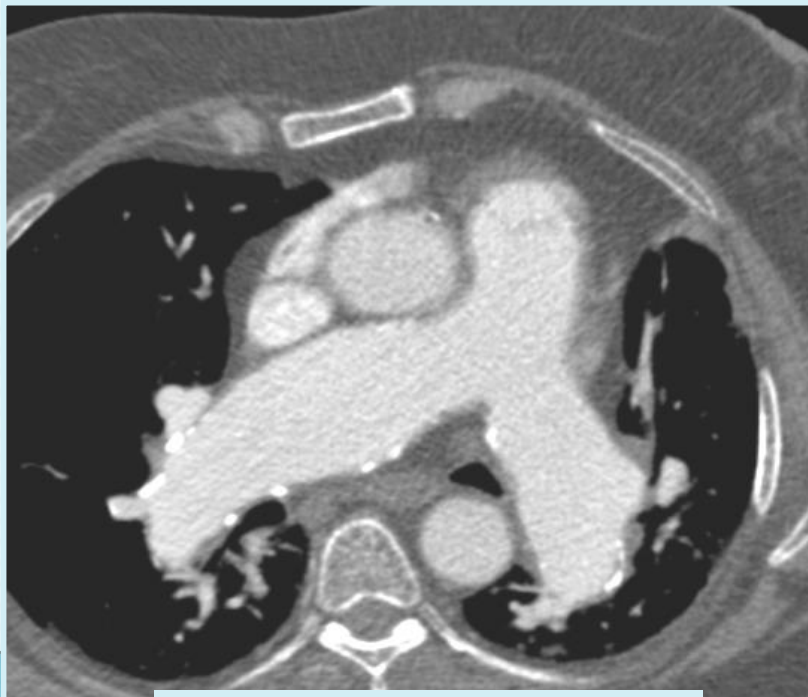


Takayasu

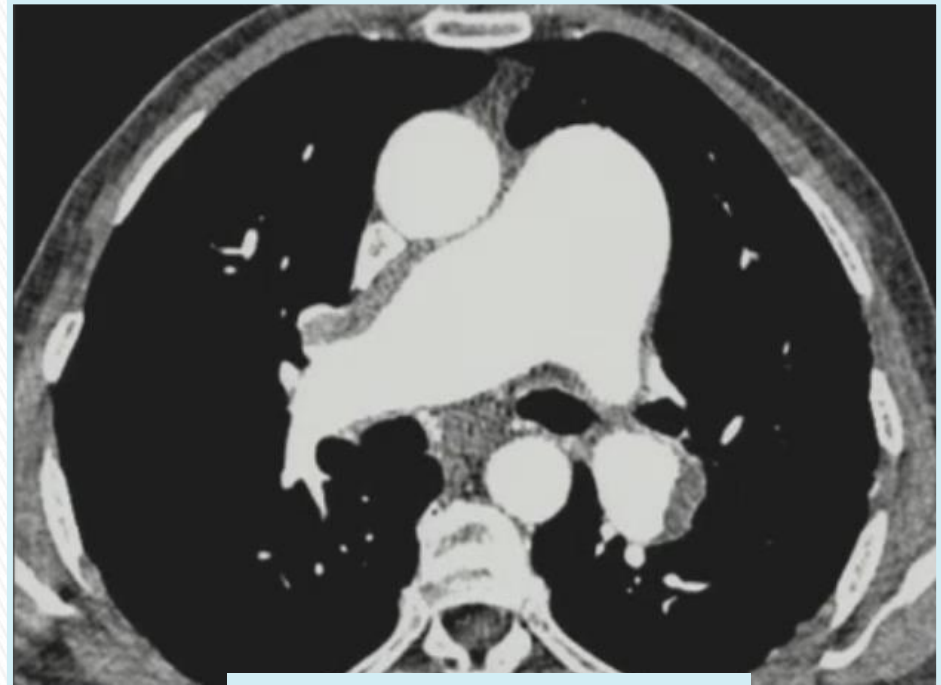
Marie- Pierre REVEL ECR 2015

Mimics of CTEPH

Eisenmenger's syndrome and PH due to portal hypertension can be associated with aneurysmal dilatation of the central pulmonary arteries, in situ thrombosis (long standing PH) and mural calcifications. Confusion with eccentric thrombi in CTEPH must be avoided



Eisenmenger



Portal Hypertension

CTPA vs MRA

- **ECG-gated MD-CTPA vs. ce-MRA**

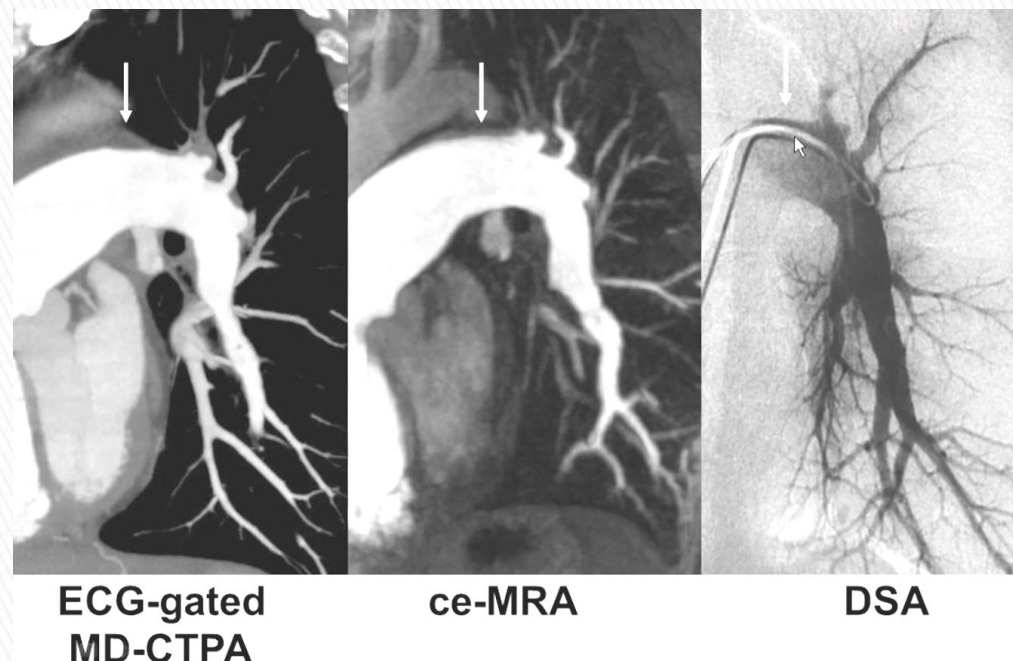
- **Diagnostic work-up of CTEPH:**
 - ✓ Diagnosis and differential diagnosis.
 - ✓ Technical operability.
- **ECG-gated MD-CTPA performs better than ce-MRA (and even DSA?).**
- **Aim: a negative MD-CTPA scan precludes a surgically assessible form of CTEPH.**

Rajaram S et al, Eur Radiol 2012; 22: 310-317

Ley S et al, Eur Radiol 2012; 22: 607-616

Sugiura T et al, Chest 2013; 143: 1074-1077

Sugiyama M et al. Jpn J Radiol 2014; 32: 375-382



Karl-Friedrich Kreitner ESCR 2017

Χρόνια Θρομβοεμβολική Πνευμονική Υπέρταση (CTEPH)

Tunariu N, Gibbs SJ, Win Z, et al. Ventilation-perfusion scintigraphy is more sensitive than multidetector CTPA in detecting chronic thromboembolic pulmonary disease as a treatable cause of pulmonary hypertension. *J Nucl Med* 2007;48:680–4

They reported a sensitivity rate of detecting chronic thromboembolic disease of just 51% with CTPA versus >96% with a VQ scan.

It is important to note that while CTPA has been proven to be noninferior to V'/Q' in diagnosing CTEPH, a negative CTPA does not exclude CTEPH, as subsegmental disease can be missed if reliance is placed only on CT.

Eur Respir Rev 2017; 26: 160108

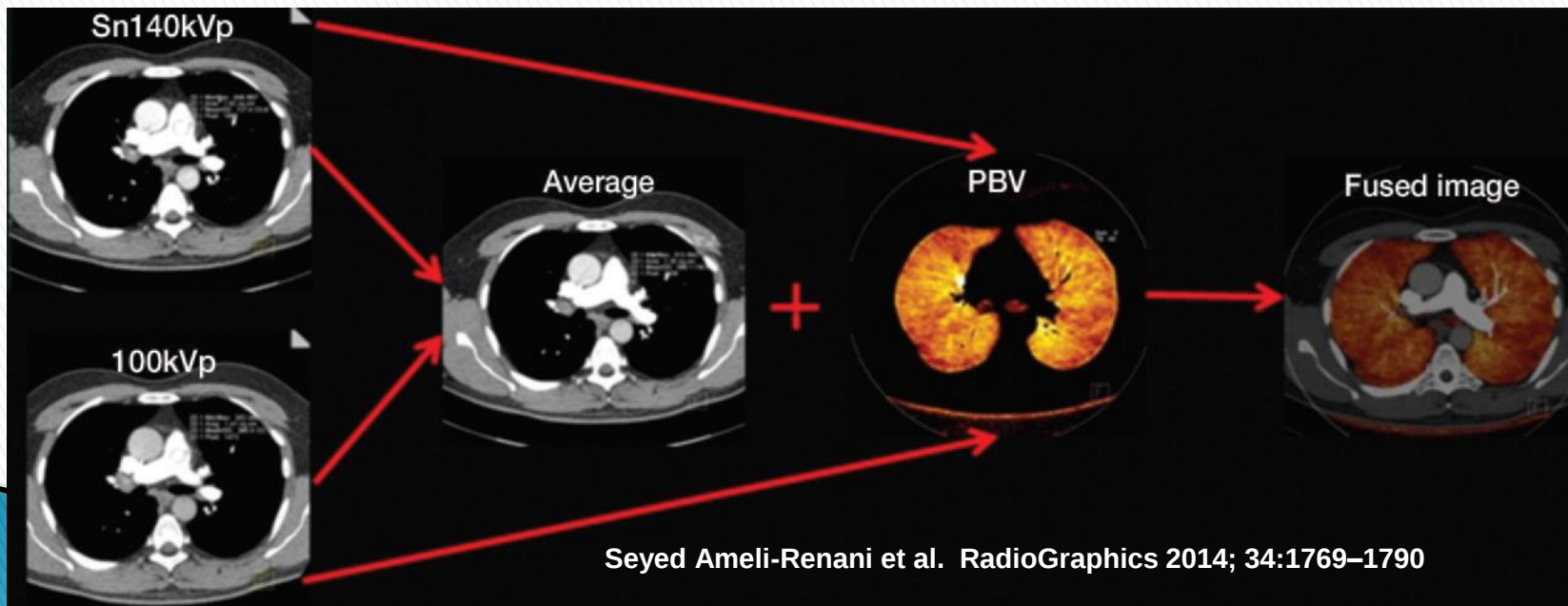
Multidetector CT pulmonary angiography has become an established imaging modality for confirming CTEPH, however, this investigation alone cannot exclude the disease

**2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension
European Heart Journal (2016) 37, 67–119**

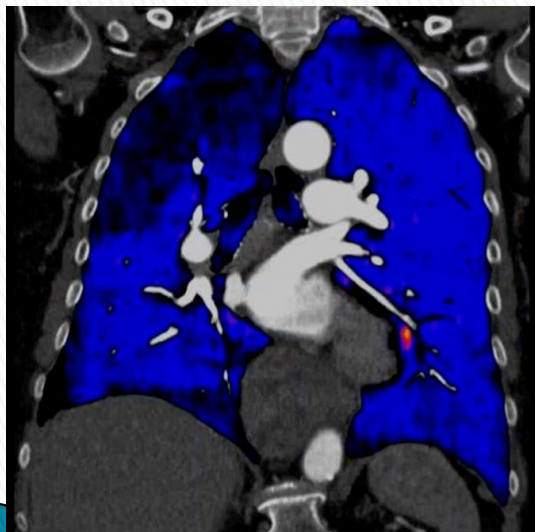
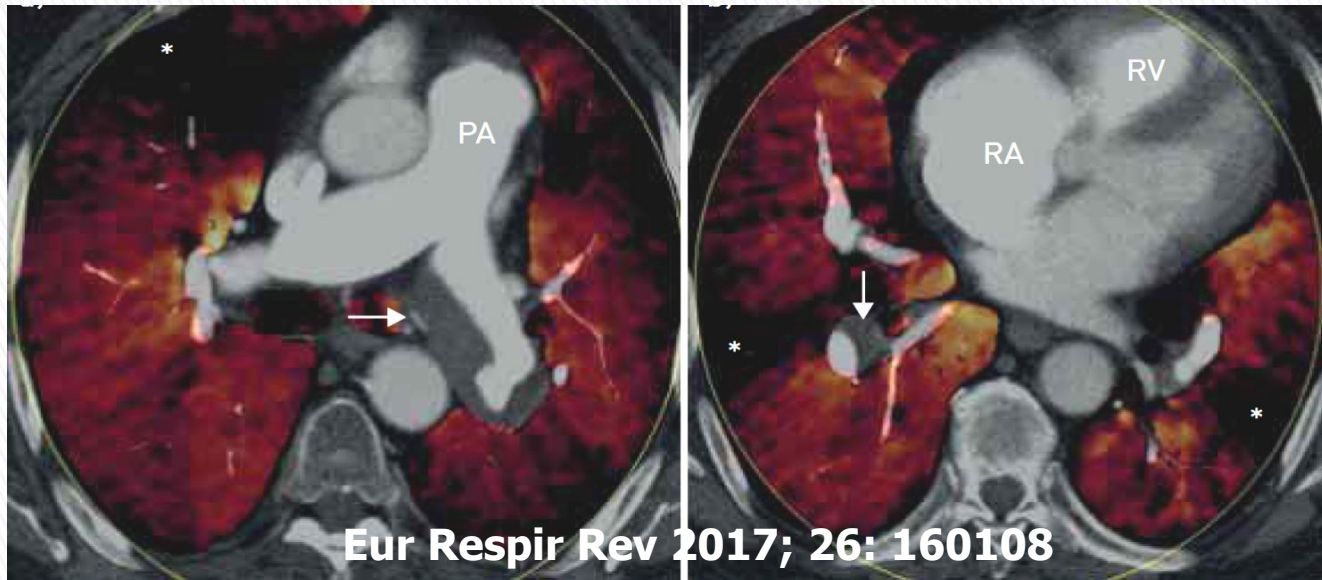
Dual Energy CT- Lung Perfusion

- Dual-energy CT pulmonary angiography allows the generation blood volume (PBV) maps that represent the relative iodine concentration in the lung parenchyma, which is a surrogate marker of perfusion
- ***Perfusion defects on PBV maps may also result from lung parenchymal disease so careful attention must be paid to avoid a false positive result***
- Recent developments of dual-energy CT suggest improved detection of peripheral thromboembolic disease in the future.

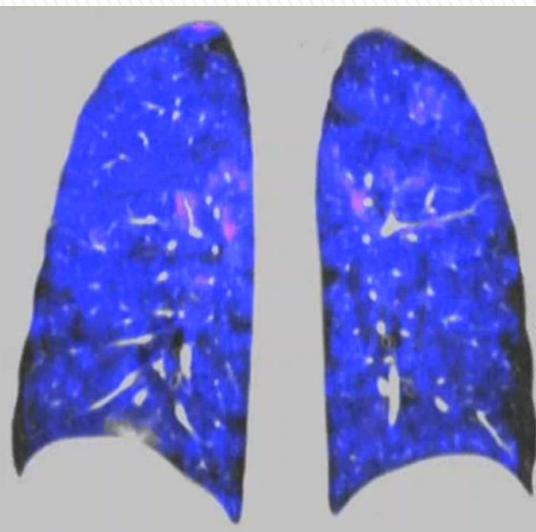
C. E.E. van der Bruggen et al. ERS Monogr 2015; 70: 60–79, 158–170



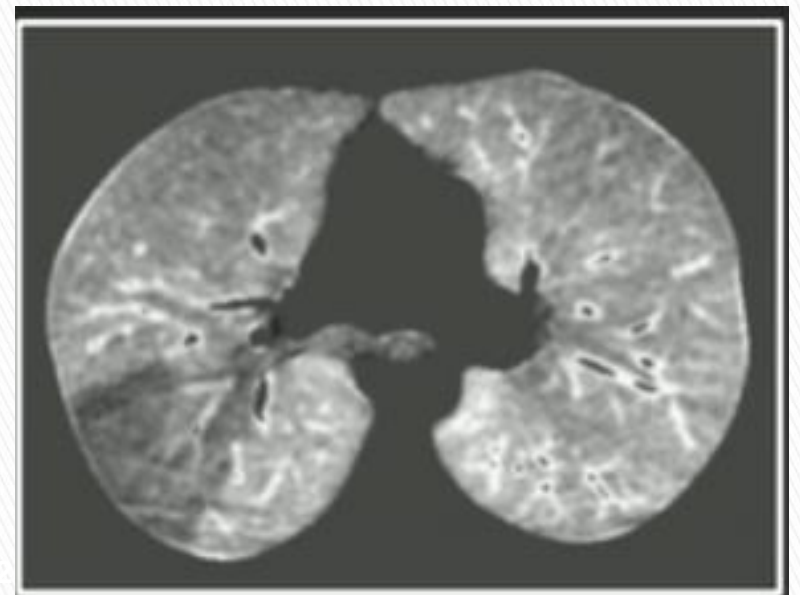
Dual Energy CT- Lung Perfusion



CTEPH



IPAH



Χρόνια θρομβοεμβολική πνευμονική υπέρταση

Επιλογή ασθενών για θρομβοενδαρτηρεκτομή

Κριτήρια επιτυχούς θρομβοενδαρτηρεκτομής

- ✓ **Έκταση προσβολής- εντόπιση. Τουλάχιστον μέχρι τους κεντρικούς τμηματικούς κλάδους**
 - ✓ **Διάταση βρογχικών αρτηριών**

Heinrich M et al. Chest 2005;127: 1606–1613

Αξονική Τομογραφία

- 👍 Ευρέως διαθέσιμη, όχι ακριβή
- 👍 Ταχεία, μη επεμβατική
- 👍 Εξαιρετική διακριτική ικανότητα
- 👍 Εκτεταμένη, λεπτομερής αξιολόγηση πνευμονικού παρεγχύματος, αγγειακών δομών, καρδιάς
- 👍 Δυνατότητα σχετικά χαμηλής δόσης ($< 5 \text{ mSv}$)
- 👎 Όχι πληροφορίες ροών, πιέσεων

**CT signs
suggesting the
cause**

```
graph LR; A[CT signs suggesting the cause] --> B[Extra cardiac shunts (Group 1)]; A --> C[PVOD/PCH (Group 1')]; A --> D[Lung Diseases (Group 3)]; A --> E[CTEPH (Group 4)]; A --> F[Sarcoidosis, Histiocytosis X etc (Group 5)];
```

The diagram features a central pink box on the left with the text 'CT signs suggesting the cause'. Five red arrows originate from the right side of this box and point to five separate grey boxes on the right. The boxes are arranged vertically and contain the following text: 'Extra cardiac shunts (Group 1)', 'PVOD/PCH (Group 1')', 'Lung Diseases (Group 3)', 'CTEPH (Group 4)', and 'Sarcoidosis, Histiocytosis X etc (Group 5)'. The text 'Group 1' in the second box is highlighted in blue. The bottom left corner of the image has a decorative blue and black gradient.

**Extra cardiac shunts
(Group 1)**

PVOD/PCH (Group 1')

Lung Diseases (Group 3)

CTEPH (Group 4)

**Sarcoidosis, Histiocytosis X
etc (Group 5)**

- **Value of MD-CT and MRT in PH imaging**

	ECG-gated MD-CT	MR-Imaging
Presence of PH	+ + +	+ + (+)
Assessment of lung parenchyma	+ + +	+ +
Assessment of macro- and microcirculation	+ + +	+ +(+)
Right heart impairment Pulmonary hemodynamics	+ +/ +	+ + +
Monitoring of therapy	+	+ + +
Prognostic significance	-	+ + +

PH Diagnostic algorithm

1st step

Symptoms, signs, history suggestive of PH

Echocardiographic probability of PH (Table 8)

High or intermediate

Low

Table 8A Echocardiographic probability of pulmonary hypertension in symptomatic patients with a suspicion of pulmonary hypertension

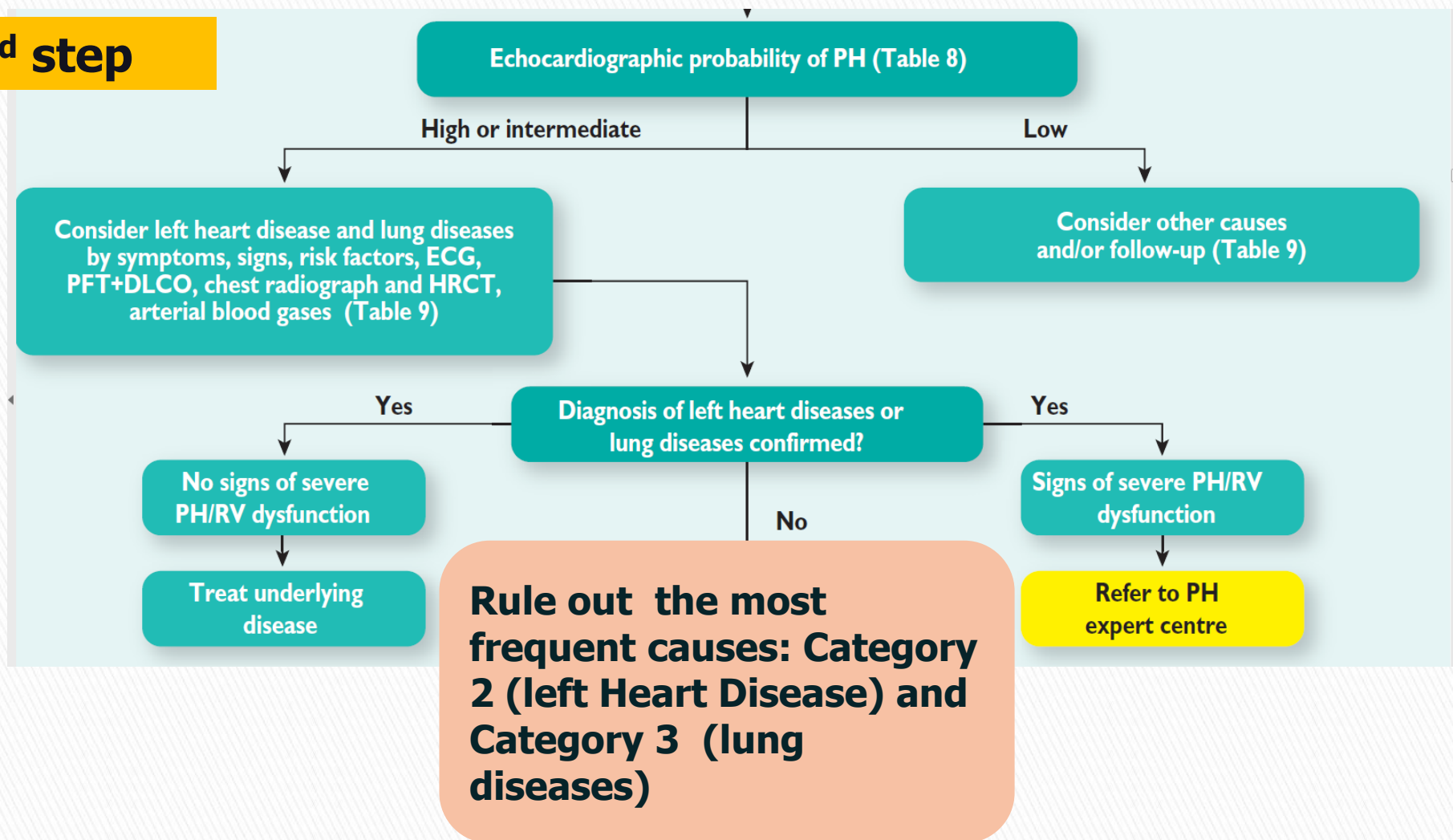
Peak tricuspid regurgitation velocity (m/s)	Presence of other echo 'PH signs' ^a	Echocardiographic probability of pulmonary hypertension
≤2.8 or not measurable	No	Low
≤2.8 or not measurable	Yes	Intermediate
2.9–3.4	No	
2.9–3.4	Yes	High
>3.4	Not required	

A: The ventricles ^a	B: Pulmonary artery ^a	C: Inferior vena cava and right atrium ^a
Right ventricle/left ventricle basal diameter ratio >1.0	Right ventricular outflow Doppler acceleration time <105 msec and/or midsystolic notching	Inferior cava diameter >21 mm with decreased inspiratory collapse (<50 % with a sniff or <20 % with quiet inspiration)
Flattening of the interventricular septum (left ventricular eccentricity index >1.1 in systole and/or diastole)	Early diastolic pulmonary regurgitation velocity >2.2 m/sec	Right atrial area (end-systole) >18 cm ²
	PA diameter >25 mm.	

Echocardiography : ALSO rule out cardiac cause, rule out intracardiac shunt, assess RV function

PH Diagnostic algorithm

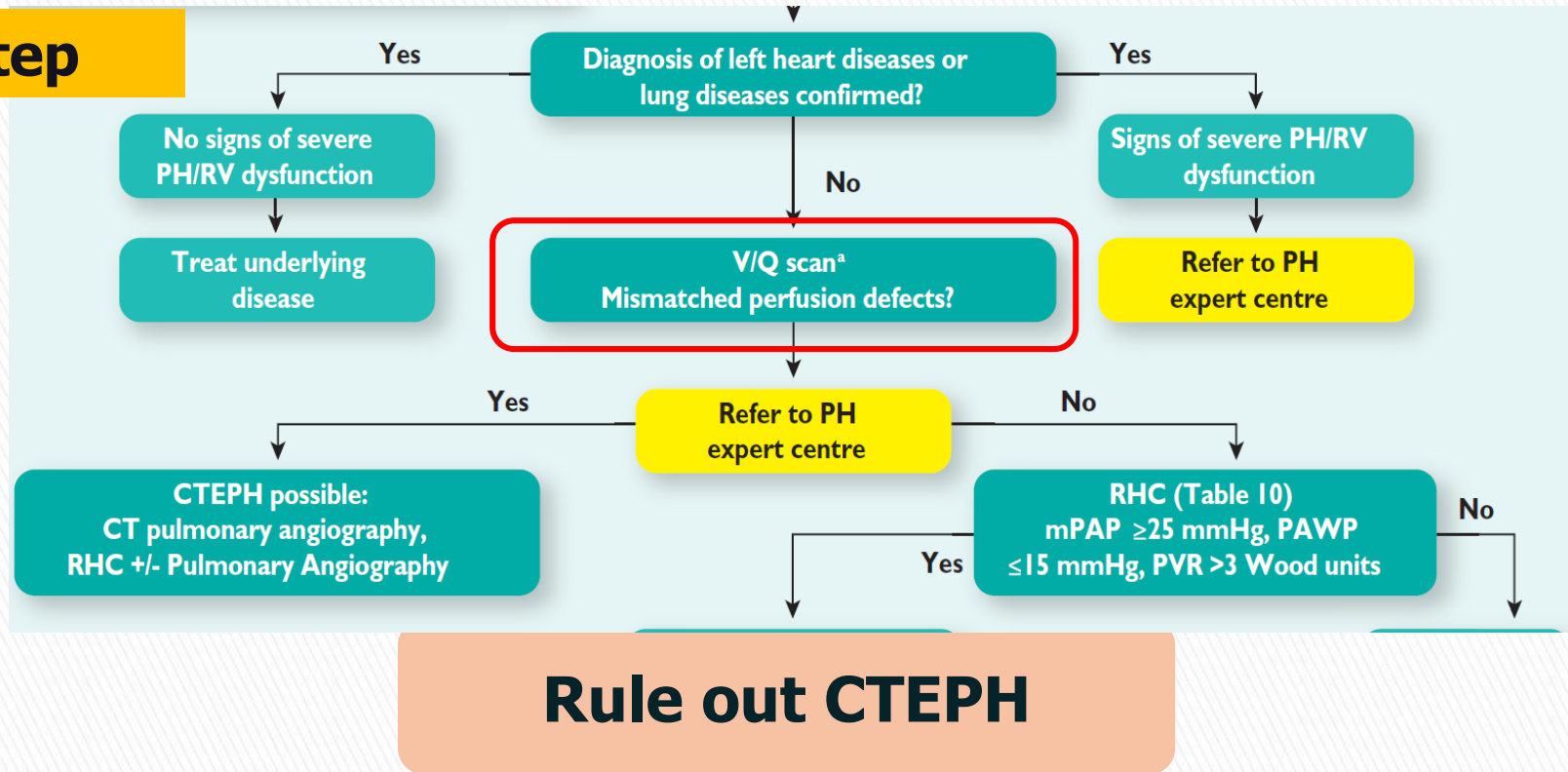
2nd step



High Resolution CT (HRCT) of the pulmonary parenchyma
practically in all patients with high or intermediate probability of PH

PH Diagnostic algorithm

3rd step

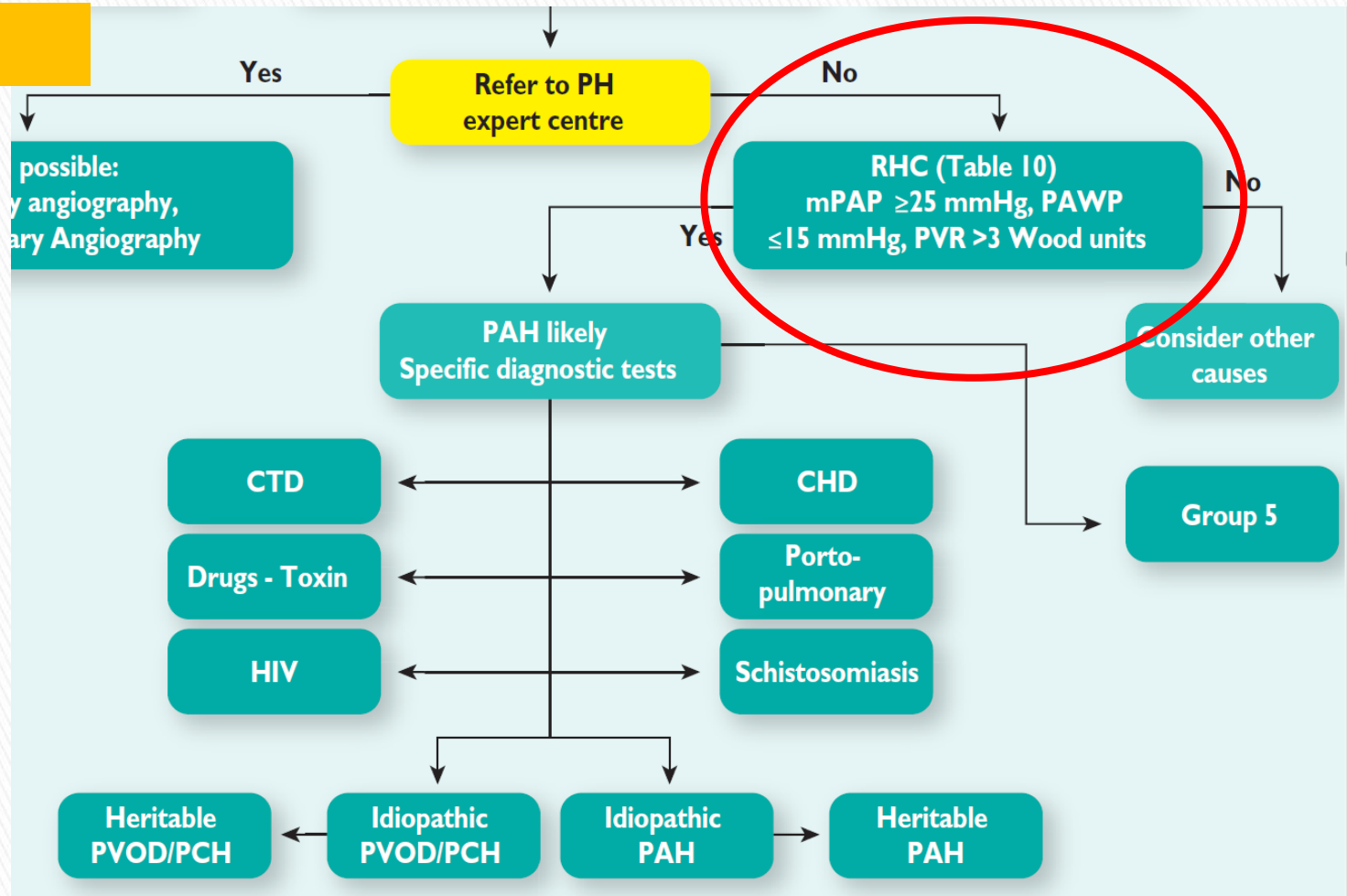


V/Q scan: high sensitivity, high NPV, lower dose than CT

But false positives (PVOD, IPAH), underestimation of vascular obstruction and no dd is possible between acute and chronic embolism

PH Diagnostic algorithm

4th step



Take Home Messages

- ✓ Κομβικός ο ρόλος της μη επεμβατικής απεικόνισης
- ✓ Απαραίτητη η γνώση των σημείων που θέτουν υπόνοια πνευμονικής υπέρτασης
- ✓ CTPA, ECG-gated MDCTPA: Στην εκτίμηση της CTEPH
- ✓ DECT: Lung Perfusion
- ✓ PVOD/PCH: HRCT → Υποψία της νόσου
- ✓ Make sure there is not extracardiac shunt
- ✓ CT: Η καλύτερη μέθοδος στην αναζήτηση της αιτίας
- ✓ Όχι πληροφορίες ροών, πιέσεων