

Acute Pulmonary Embolus

How Not to Miss
This Important Diagnosis
via Echo

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Acute Pulmonary Embolus

How Not to Miss
A Significant Pulmonary Embolus
via Echo

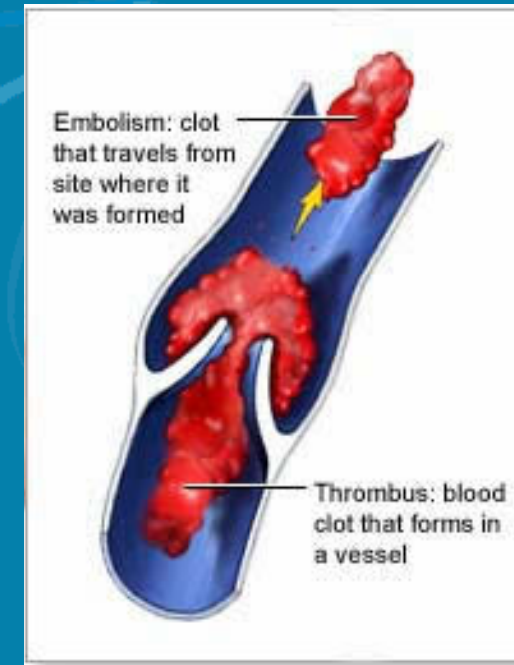
What causes a PE?

- Deep Vein Thrombosis

1. Local trauma to vessel wall
2. Hypercoagulability
3. Stasis

- Other

- Fat emboli
- Amniotic fluid
- Tumor tissue



Risk Factors

- Precipitating stress
 1. Surgery/trauma
 - immobilisation
 2. Cancer
 3. Other
 - Obesity
 - ↑age
 - Oral contraceptives/pregnancy/post-partum
 - Smoking
 - Stroke/spinal cord injury
 - Indwelling CV catheter
- Genetic predisposition (many)



Effect of PE on the R Heart

PA
obstruction

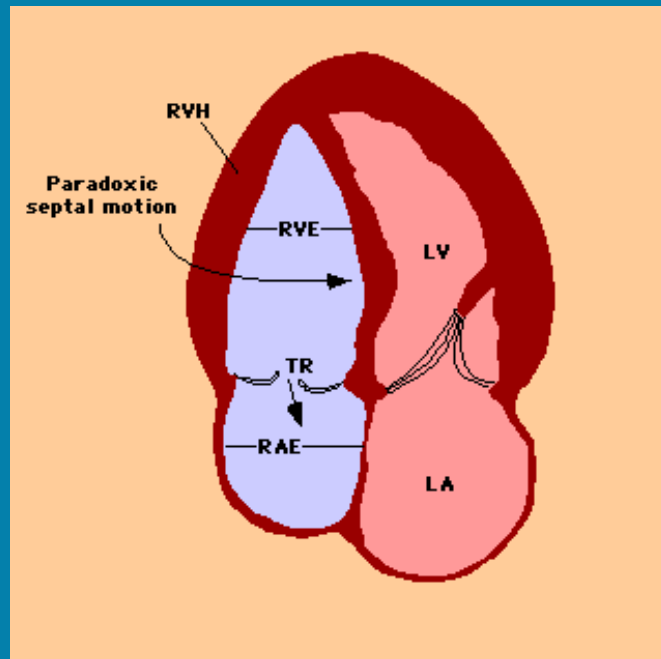
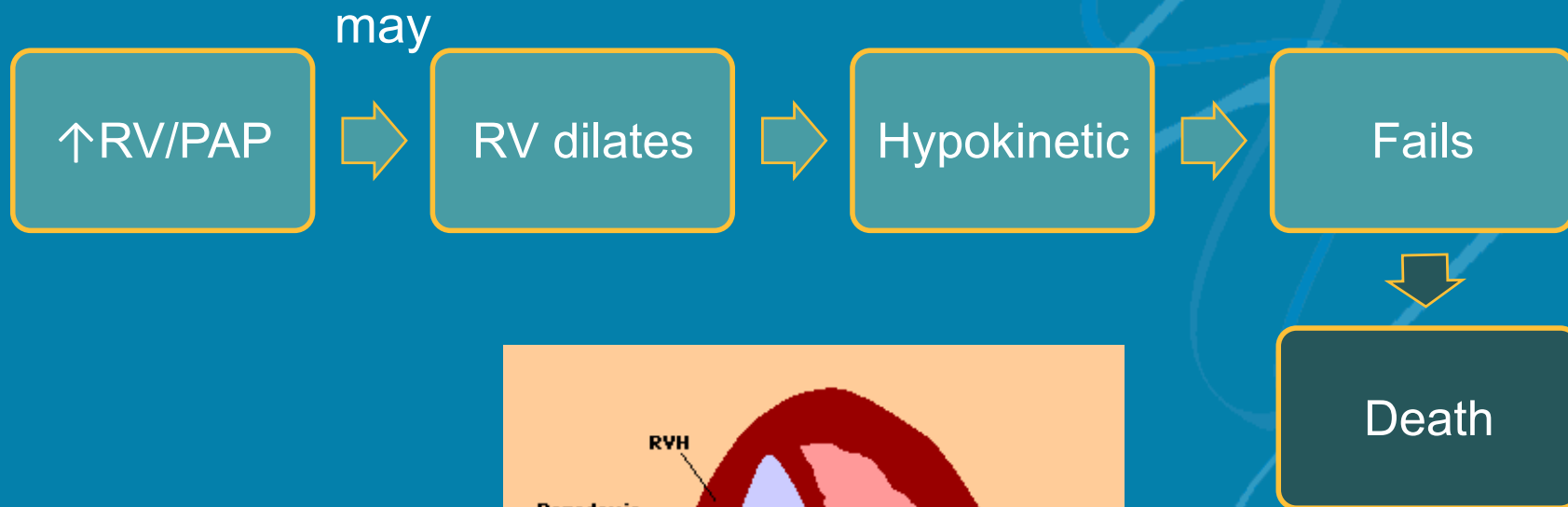


Circulating
neurohumoral
effects

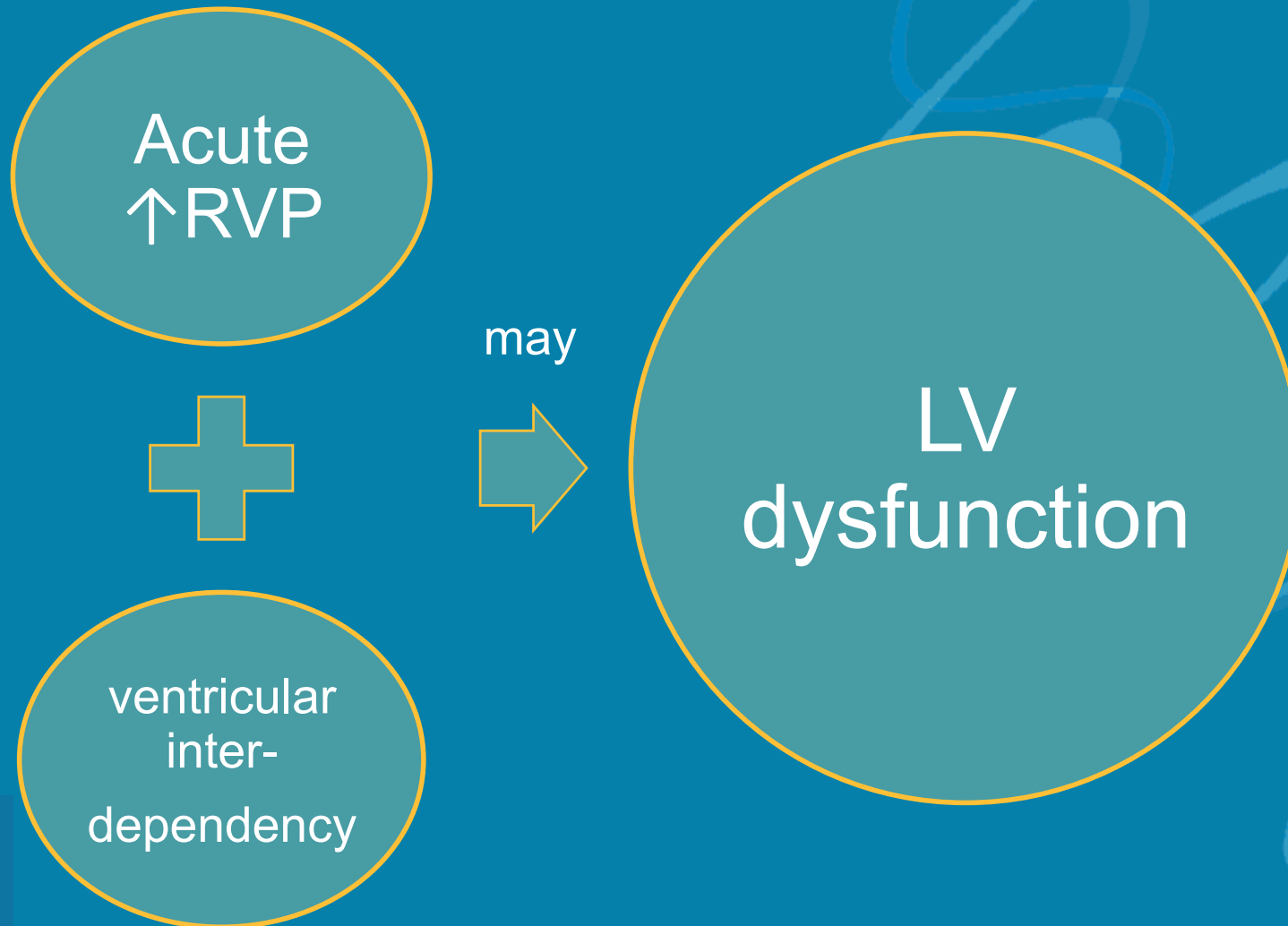


↑RV
afterload

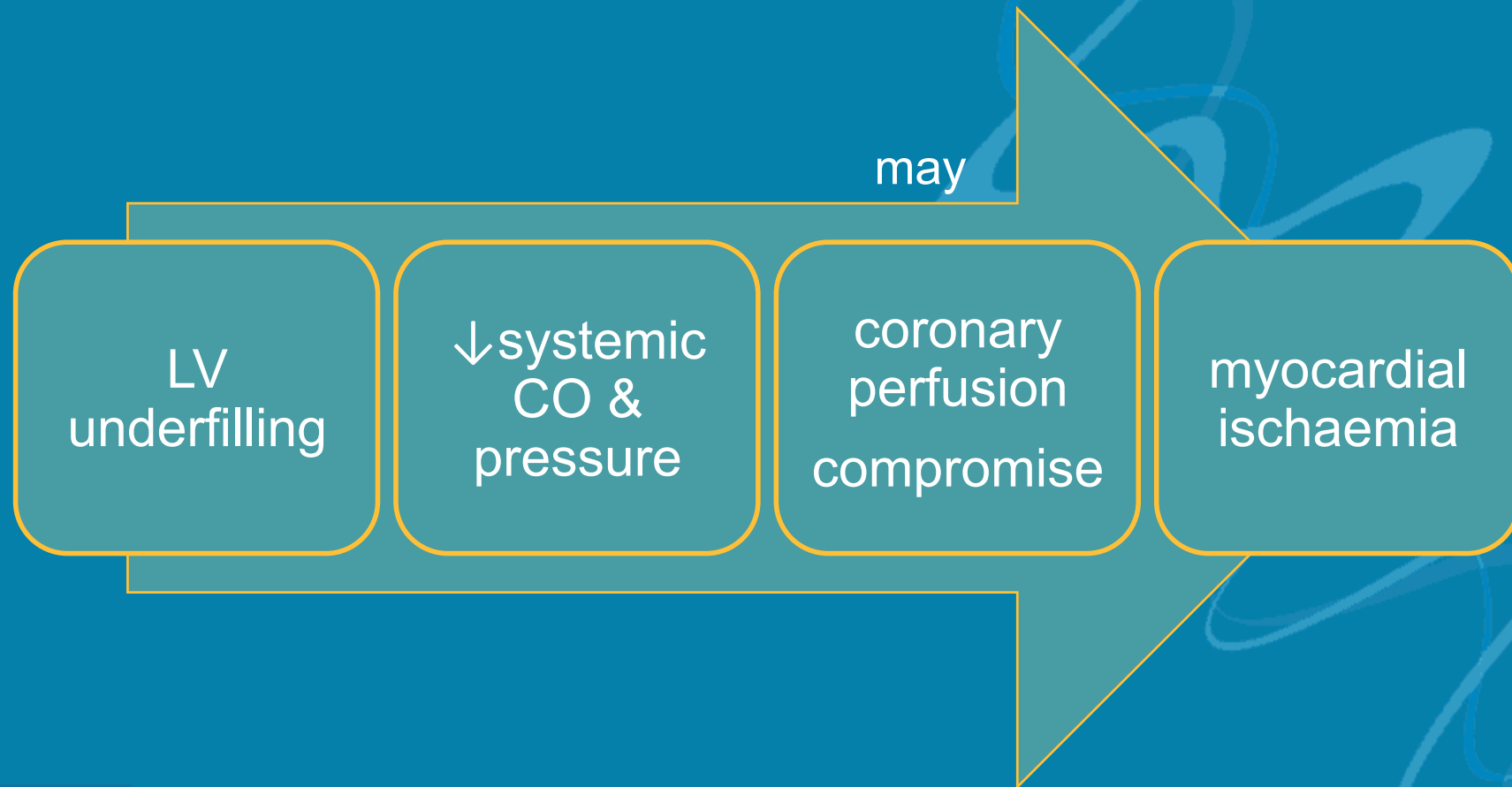
Effect of PE on the R Heart



Effect of PE on the L Heart



Effect of PE on the L Heart



Mortality/Treatment

Mortality (acute PE)

- 7-11%*

Treatment

1. Anti-coagulation
2. Thrombolysis
3. Embolectomy



Risk bleeding
↑Mortality

* Torbicki, A et al. EHJ 2008; 29: 2276

- Can be acutely unwell & deteriorate rapidly
⇒ Accurate & quick diagnosis most important
.....but challenging



Clinical Presentation

Symptoms

- Dyspnoea
- Acute chest pain
- Cough or haemoptysis (less common)

Signs

- Tc
- Tachypnoea
- Hypoxia
- RV dysfunction (less common)



Differential Diagnosis

- AMI
- Ao dissection
- Cardiac tamponade



Clinical Diagnosis

- No signs & symptoms are
 - unique to PE (spec)
 - or
 - necessarily present in PE pts (sens)
- Clinical diagnosis of PE difficult

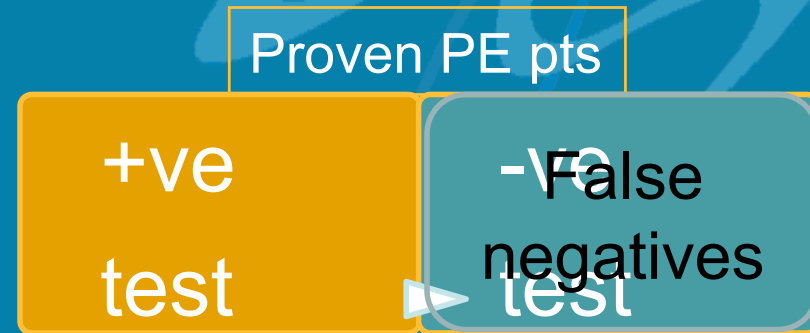
⇒ Tests



Definition of Terms

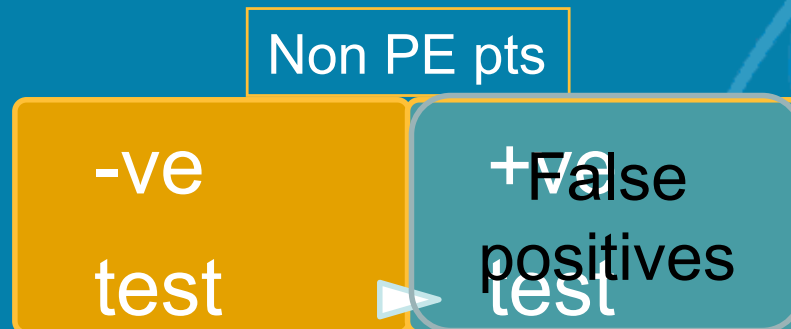
- Sensitivity

- Proportion of reference test positive (proven PE) patients who test positive with the screening test



- Specificity

- Proportion of reference test negative (non PE) patients who test negative with the screening test

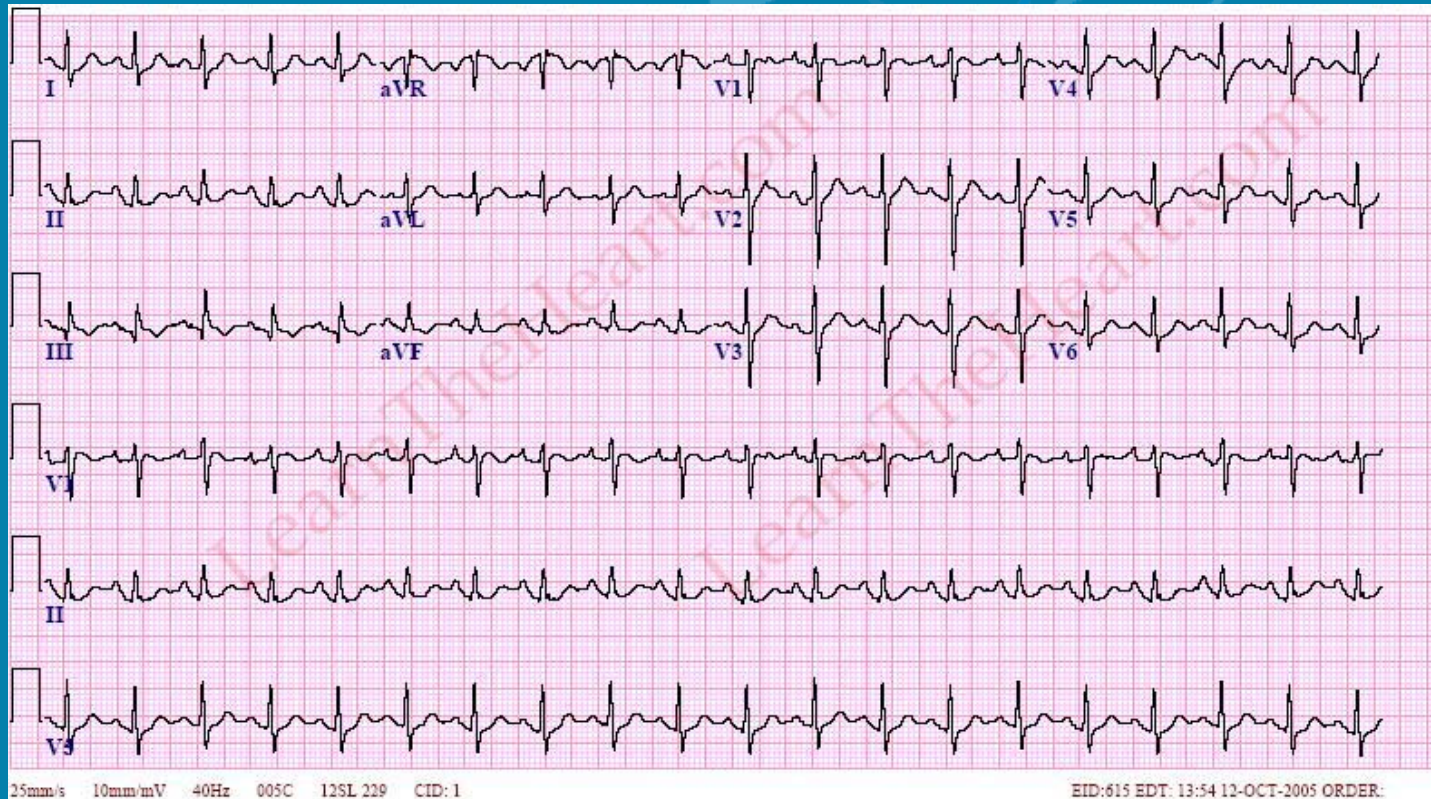


Tests

- ECG
- CXR
 - Rarely diagnostic
 - Needed with V/Q scan
- Troponin level
- Venous US
- Plasma D-dimer ELISA
- CTPA
- V/Q scan
- Pulmonary angiography
- Echo



ECG



- **STc**, $S_1Q_3T_3$ pattern of acute cor pulmonale
 - Large S wave in lead I
 - Q wave in lead III
 - Inverted T wave in lead III
- Only occurs in ~10% of people with PE

Troponin

- Measure of myocardial necrosis
- $N < 0.04$
- PE with RH strain/large: 1-2



Venous Ultrasound

- Can be helpful if DVT found
- Negative US doesn't rule out PE



Plasma D-Dimer ELISA

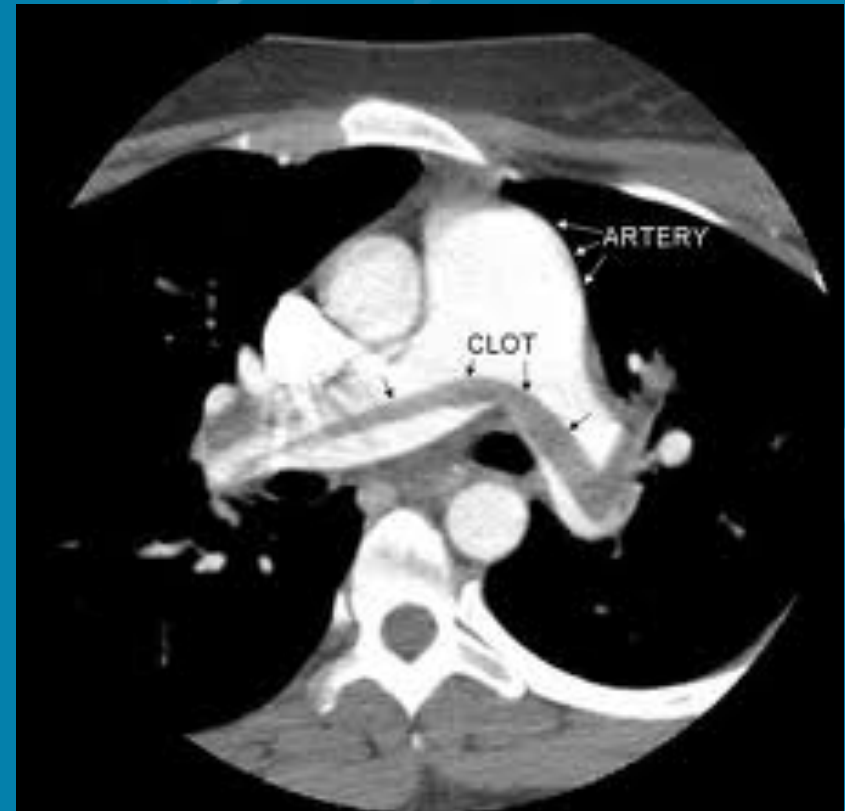
Enzyme Linked ImmunoSorbent Assay (ELISA)

- Blood test
 - Measures clotting activity
- Normal ELISA sensitive in excluding PE
- High sensitivity, moderate specificity
- Can be false +ve
 - Sx, trauma
- Unhelpful in pregnancy



Computed Tomographic Pulmonary Angiography (CTPA)

- May reveal PE
- >90% sensitivity & specificity
- Adv
 - Accurate for large PEs
 - Can detect other conditions eg ao dissection, lung tumour
- Disadv
 - Subsegments of PAs: sens & spec lower
 - Radiation (esp <30 yrs)
 - Dye (renal pts)

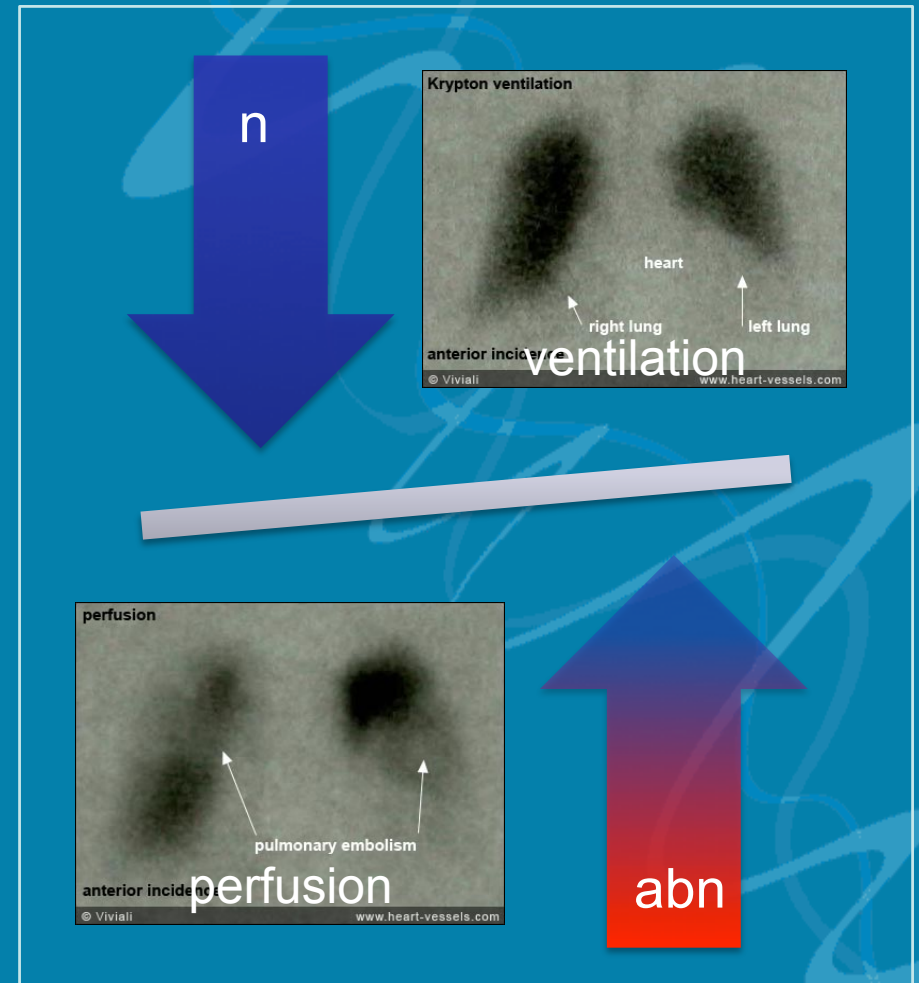


Lung (V/Q) Scan

- Perfusion/ventilation mismatch

- Low
- Mod
- High

Need to balance with clinical suspicion



Pulmonary Angiography

- Excludes PE
- Disadvantages
 - Expensive
 - Invasive
 - Not quickly or readily available



Complete obstruction of right posterior basal segmental artery

Role of Echo

1. Analyse haemodynamic effects of PE

PE
Diagnosis

?RV significantly
impaired

?Thrombolysis

2. Document response of thrombolysis

3. (Occasionally) diagnostic tool

Spectrum of Disease

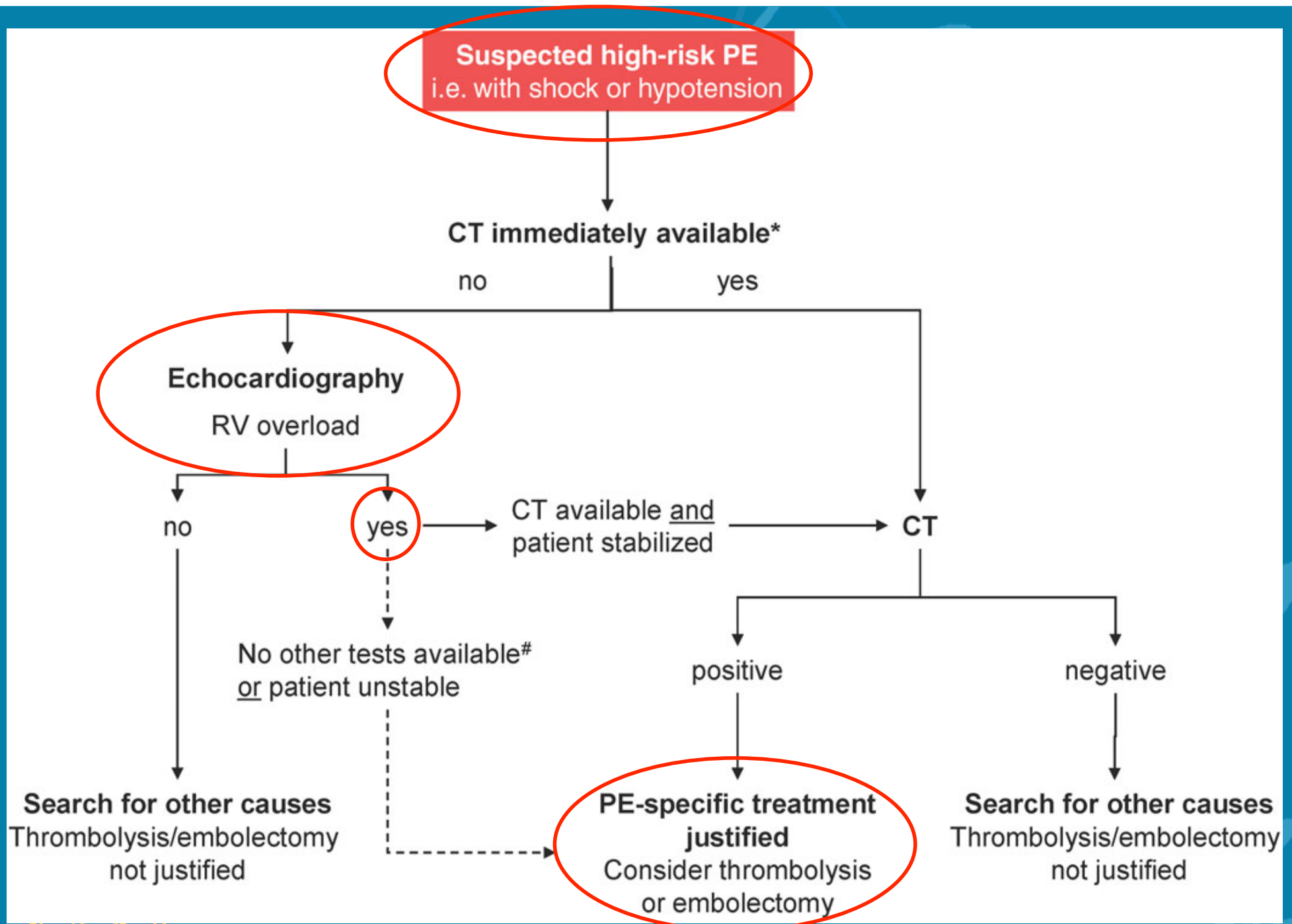
Minor

Massive
Low Risk

Echo Role

High Risk





Role of Echo

1. Analyse haemodynamic effects of PE
2. Document response of thrombolysis
3. (Occasionally) diagnostic tool



Advantages/Disadvantages of Echo

- Advantages

- Bedside
- Quick
- Non-invasive
- Low cost
- No side effects
- R/O other causes

- Disadvantages

- Image quality
- Poor sensitivity across full range PE severity



Echo Features

1. RV pressure overload (septum)
2. RV hypokinesis
3. TR Vmax >2.5 m/s
4. No RVH
5. Lack of inspiratory collapse of IVC
6. RA enlargement
7. PA dilatation

The 3 S's
Size
Systolic function
Septal Motion

Not seen in every pt with PE
Some seen in other clinical situations

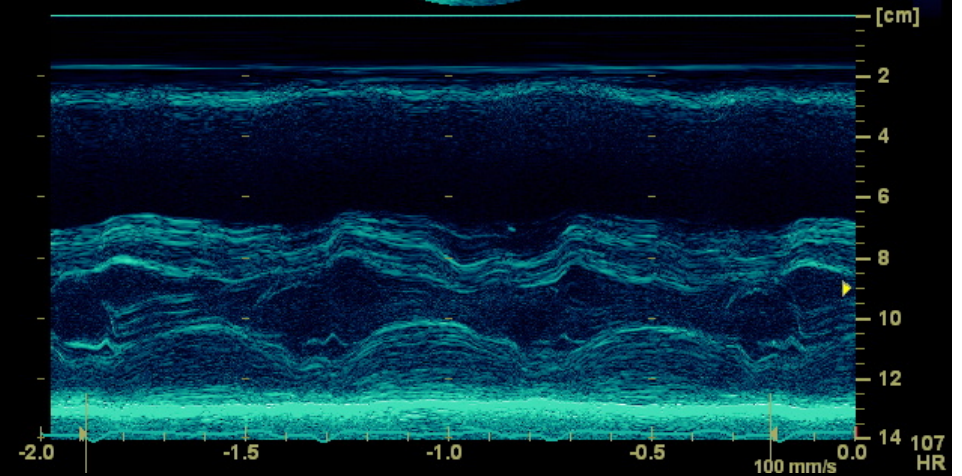
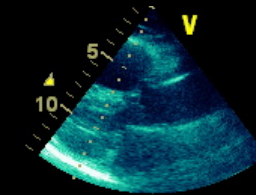
- RV Infarction
- Sarcoidosis
- CHD
- Pulm disease



1. RV Pressure Overload

- RV dilatation
 - $RV/LVEDD > 0.5 - 1.0$
- Abnormal septal motion

05/02/2004 14:18:46
FPS: 22.1



Par LAX M-mode

Par SAX View

2. RV Hypokinesia

A 4Ch View

NB "McConnell sign" (sparing of apex) (not shown here)
• Disputed

Assessment of RV Function: RVSa

v	0.09 m/s/MHz
p	0.03 mmHg/0.0
2 RVSa	0.09 m/s
1 RVSa	0.09 m/s

Gain: 3.0 dB

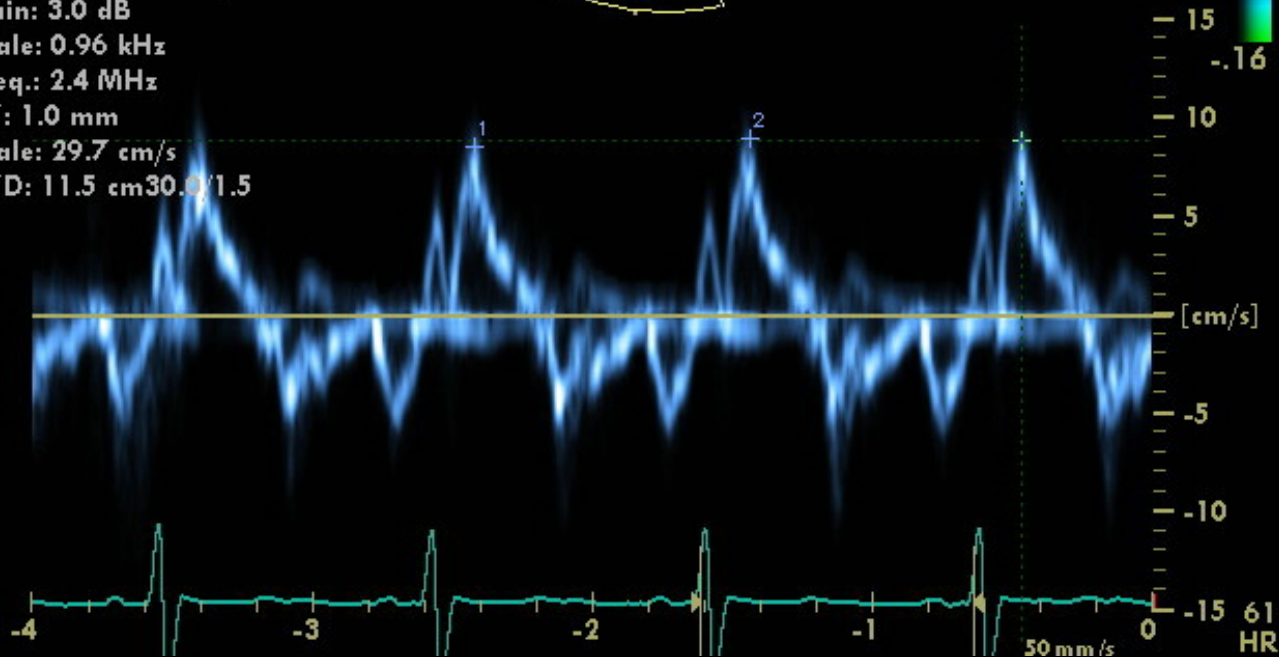
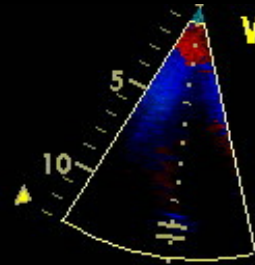
Scale: 0.96 kHz

Freq.: 2.4 MHz

SV: 1.0 mm

Scale: 29.7 cm/s

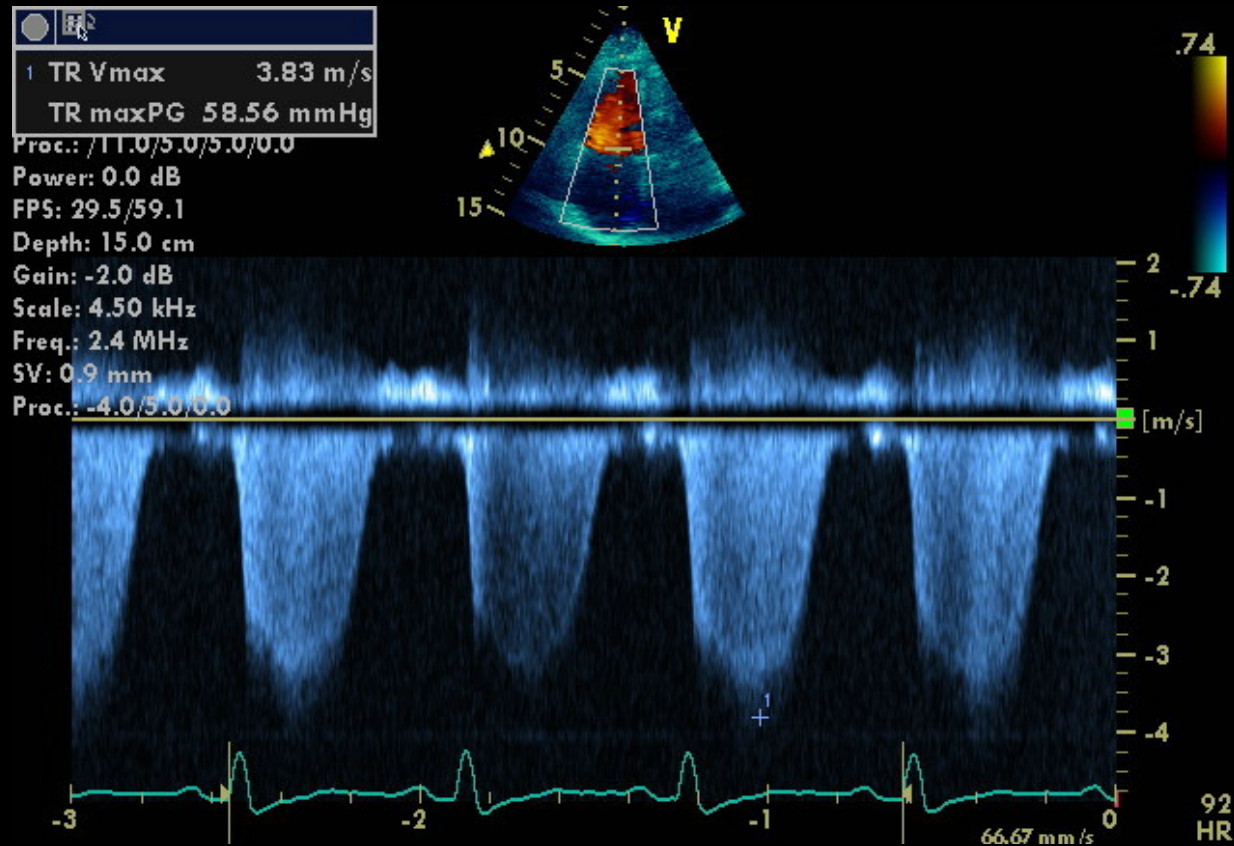
SVD: 11.5 cm/30.0/1.5



RVSa = 9 cm/s N>12 cm/s

3. TR Vmax > 2.5 m/s

Not always measurable



Vmax = 3.8 m/s, Peak Gradient = 58 mmHg
RVSP = 58 mmHg + RAP

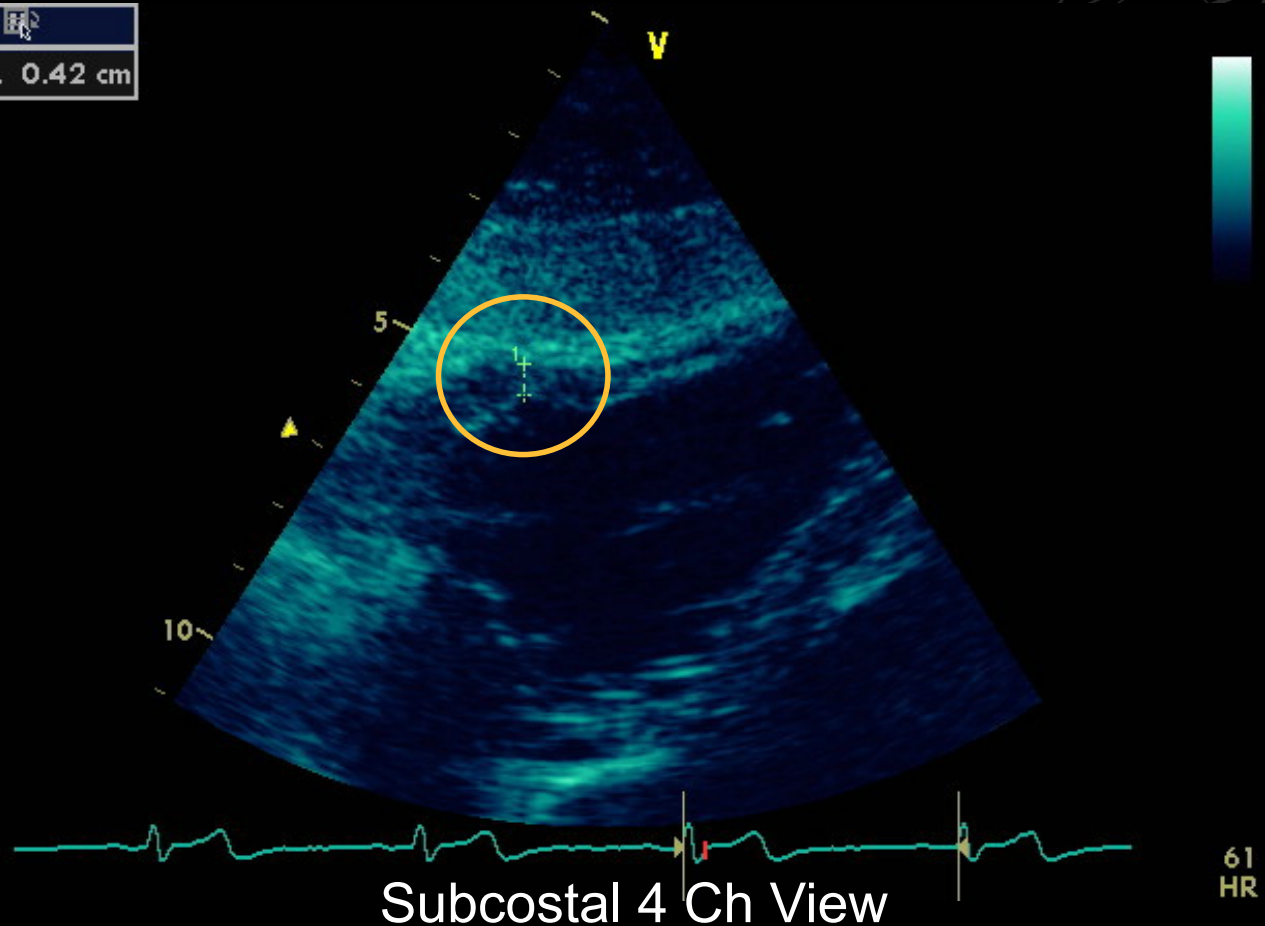
4. No RVH

1 L 0.42 cm

N<5mm

How to Measure

- Anterior TV leaflet tip
- Exclude pap muscle
- Beware of fat
- Reduce depth
- Focal zone to RV



Role of Echo

1. Analyse haemodynamic effects of PE
2. Document response of thrombolysis
3. (Occasionally) diagnostic tool
 - Visualisation of thrombus (rare)
 - Par, suprasternal SAX views
 - Easier to see on TOE



Cautionary Tale: Keeping an Open Mind

- 75 yo male presents with CP, dizziness, palpitations & sweating
- Med Hx: metastatic renal cell carcinoma
- O/E: STc 113, BP 95/60, ant TWI
- Urgent echo ordered for:
 - ?LV function



5 Days Later Following tPA

1. Left ventricle is of normal size with abnormal septal motion, otherwise normal systolic function. Normal wall thickness. $V_p \sim 46\text{cm/s}$, $E/E_a \sim 8$.

2. Normal left atrium. Mild right atrial enlargement. Right ventricle is normal in size and systolic function. Insufficient tricuspid regurgitation to measure right ventricular systolic pressure.

3. Aortic valve is trileaflet, normal.

4. Mitral valve leaflets are thickened with asymmetric leaflet apposition. Trivial mitral regurgitation.

5. Tricuspid valve is structurally normal.

6. Pulmonary valve is normal. No thrombus detected in the left pulmonary artery.

CONCLUSION: Right ventricular systolic pressure could not be measured, but right ventricular size and function have returned to normal.

Conclusion

1. Echo essential in thrombolysis decision making in acutely ill PE pt
2. Echo useful in assessing thrombolytic therapy
3. Echo *occasionally* can be diagnostic & show the clot

