Use of echocardiography in diagnosis of pulmonary embolism

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Objectives

- Introduction and epidemiology of PE.
- Definition and classification.
- Diagnostic tools for thromboemboli .
- Role of Echo.
- Prognosis.

INTRODUCTION

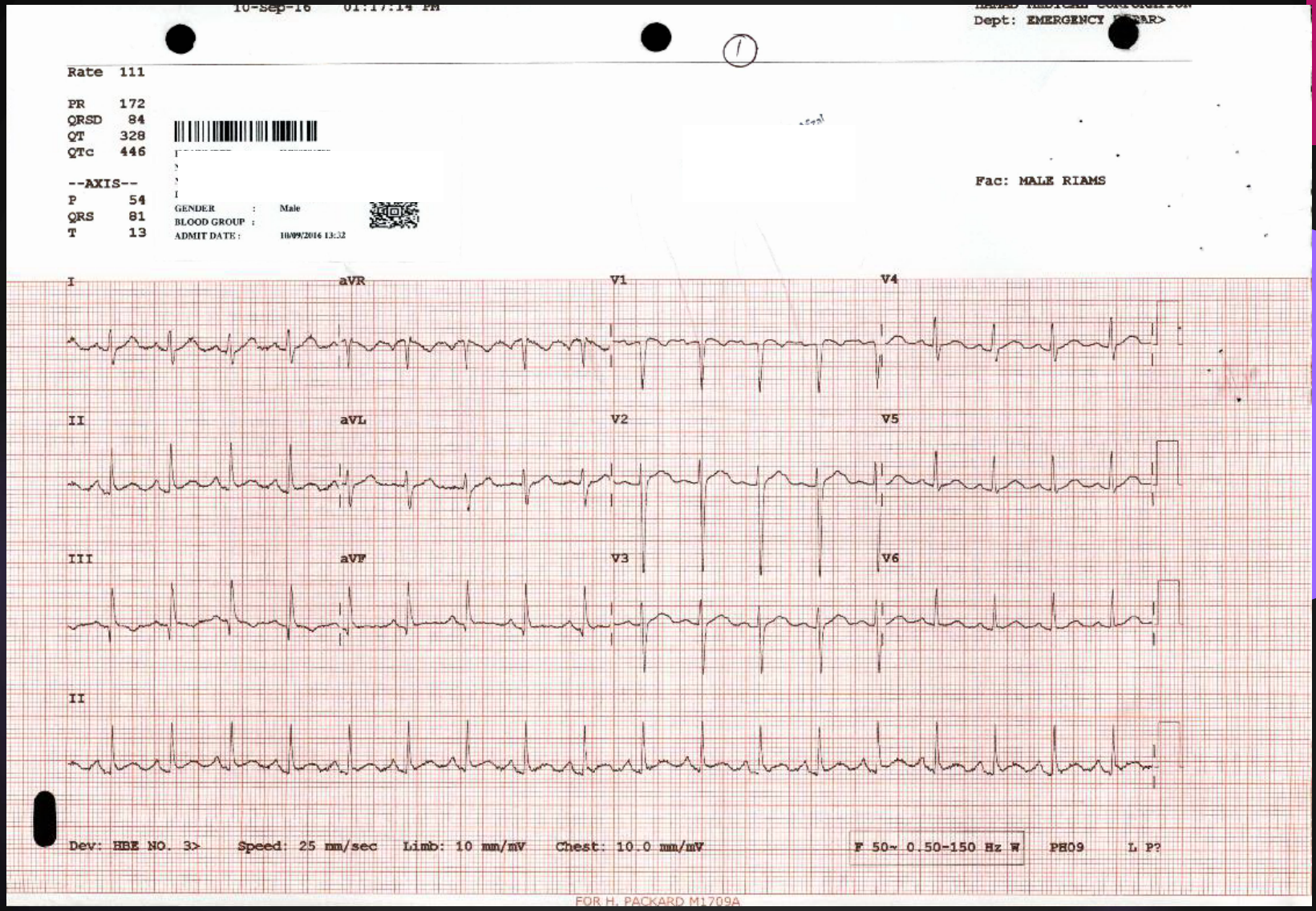
- Common and sometimes fatal.
- Variable clinical presentation.
- The evaluation of patients should be efficient so that patients can be diagnosed and therapy administered quickly to reduce the associated morbidity and mortality.
- The overall incidence of PE is approximately 112 cases per 100,000.
- Males > females and incidence increases with age.
- Deaths from PE account for approximately 100,000 deaths per year in the United States

DEFINITION AND NOMENCLATURE

- Pulmonary embolus (PE) refers to obstruction of the pulmonary artery or one of its branches by material (eg, thrombus, tumor, air, or fat) that originated elsewhere in the body.
- PE can be classified according to :
  - The presence or absence of hemodynamic stability (hemodynamically unstable or stable).
  - The temporal pattern of presentation (acute, subacute, or chronic).
  - The anatomic location (saddle, lobar, segmental, subsegmental).
  - The presence or absence of symptoms (symptomatic or asymptomatic).

DIAGNOSIS

- CXR: Classic focal oligemia is seldom seen.
- ECG : abnormal in 80%, but not specific and no diagnostic .
- Traditional Pulmonary angiography has been the gold standered and it is invasive and expensive.
- V/Q scans it is safe and available , unfortunately 35% of cases are considered non diagnostic.
- CTPA: the most common , available , rapid , cost effective and highly accurate.
- Transthoracic echocardiography: ???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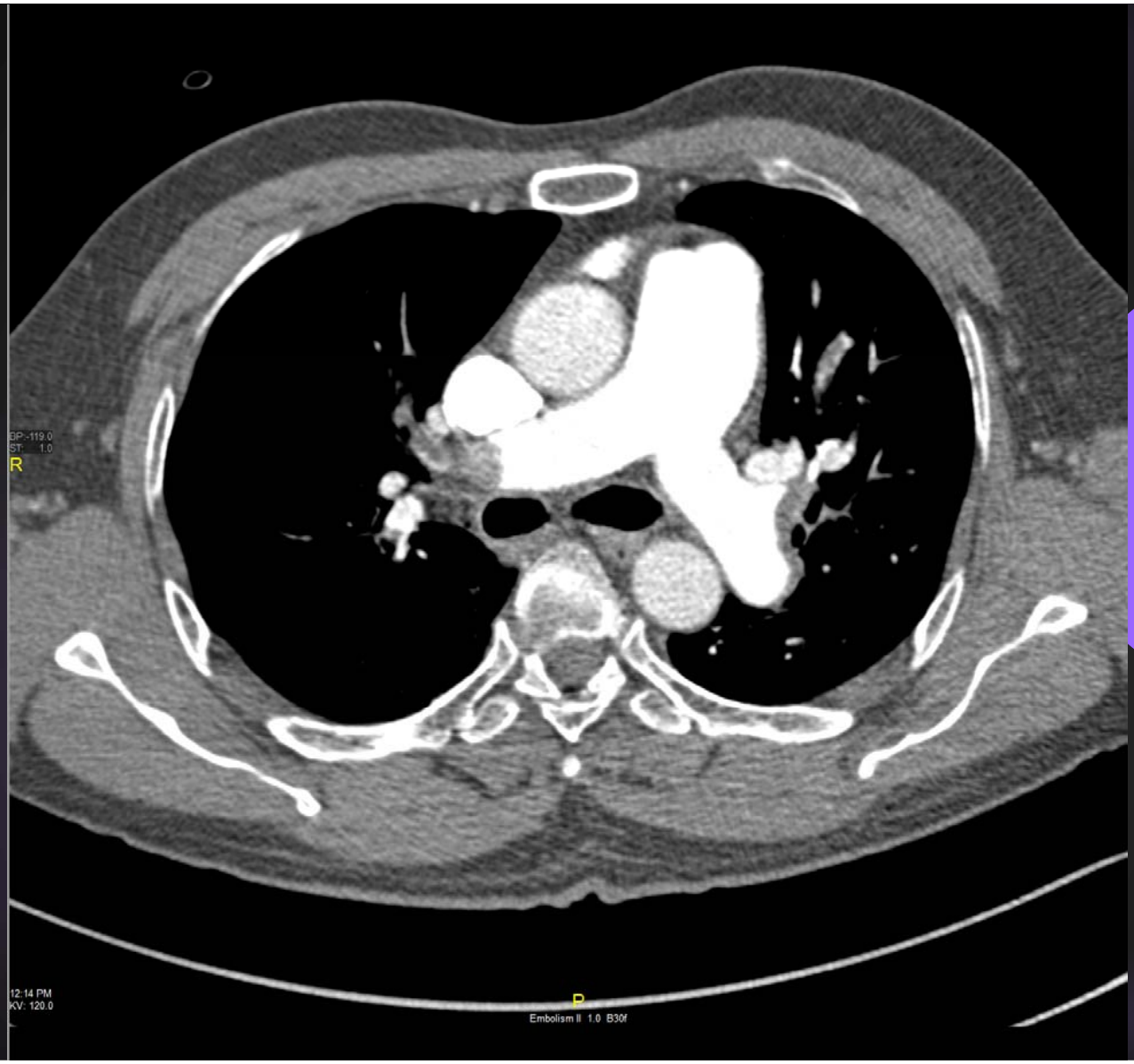
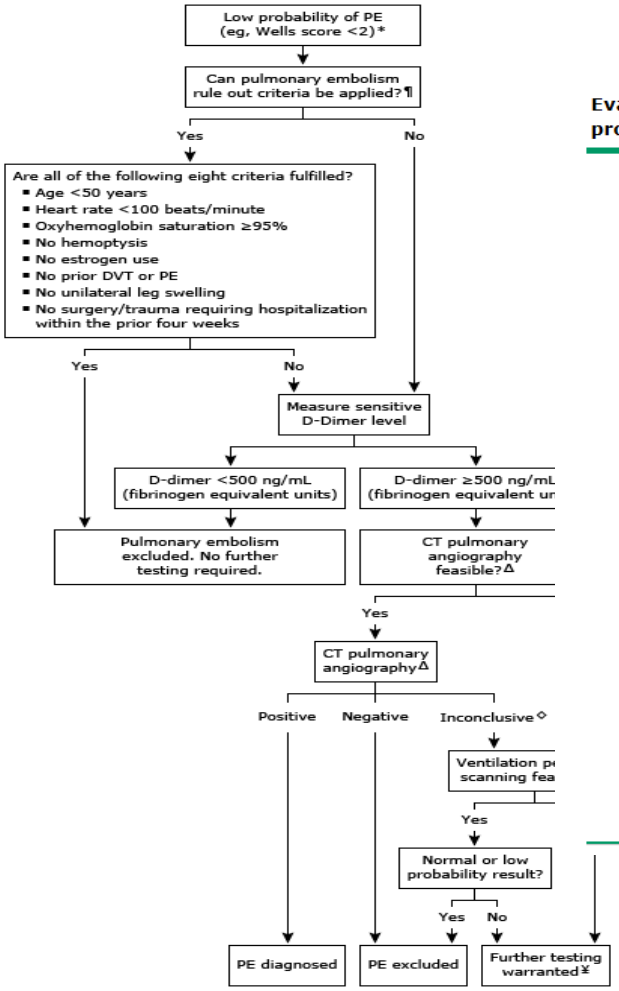
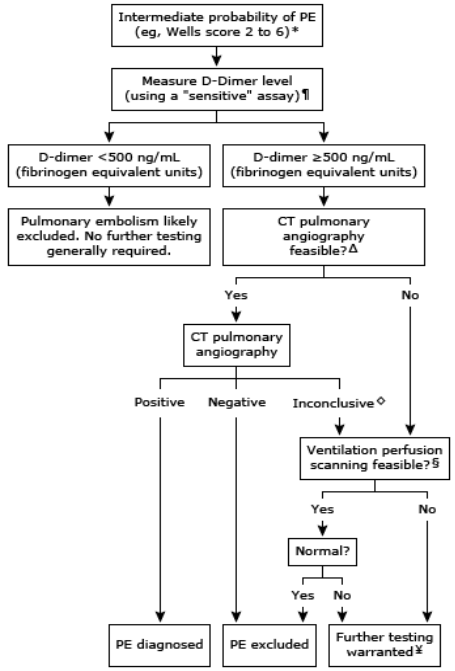
Dept: EMERGENCY
Rate 111
PR 172
QRSD 84
QT 328
QTc 446
--AXIS--
P 54
QRS 81
T 13
GENDER : Male
BLOOD GROUP :
ADMIT DATE : 10/09/2016 13:32
Fac: MALE RIAMS
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Dev: HBE NO. 3> Speed: 25 mm/sec Limb: 10 mm/mV Chest: 10.0 mm/mV
F 50~ 0.50-150 Hz W
PH09
L P?
FOR H. PACKARD M1709A


BP: 119.0
ST: 1.0
R
12:14 PM
KV: 120.0
P
Embolism II 1.0 B30f

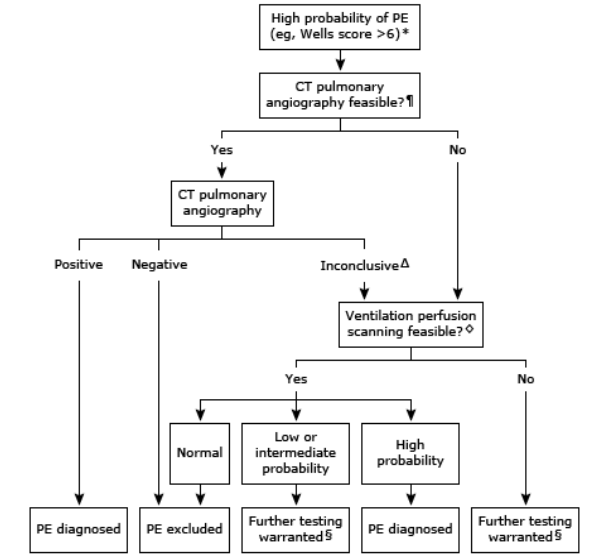
Evaluation of the nonpregnant adult with low probability of pulmonary embolism



Evaluation of the nonpregnant adult with intermediate probability of pulmonary embolism

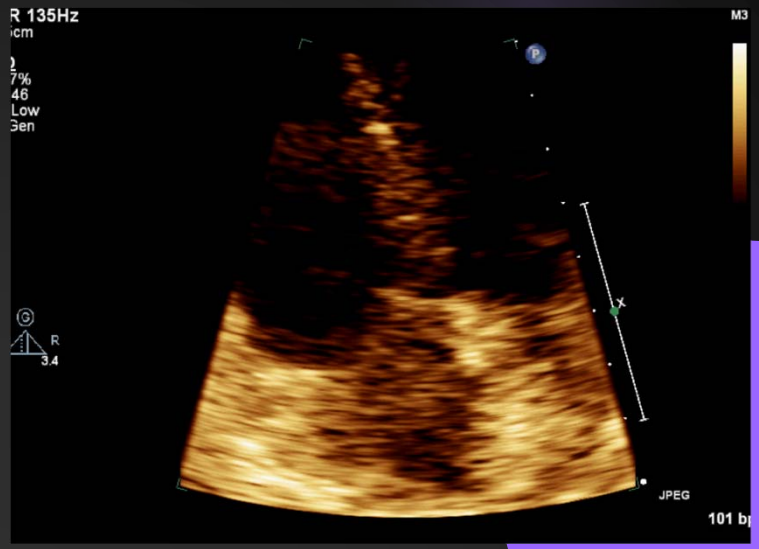


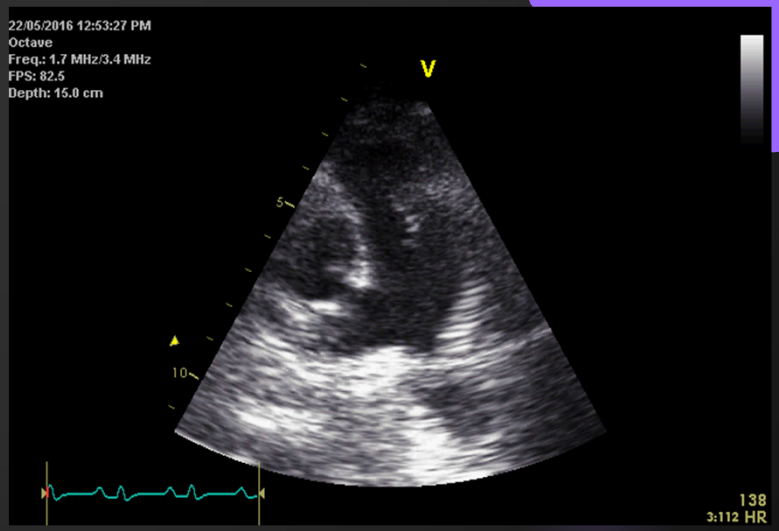
Evaluation of the nonpregnant adult with high probability of pulmonary embolism



Echocardiographic findings in acute PE

- Direct visualization of thromboemboli in the RT heart and PA.
- RV dilatation.
- RV dysfunction.
- Normal or hyper dynamic LV.
- Septal flattening.
- PA dilatation.





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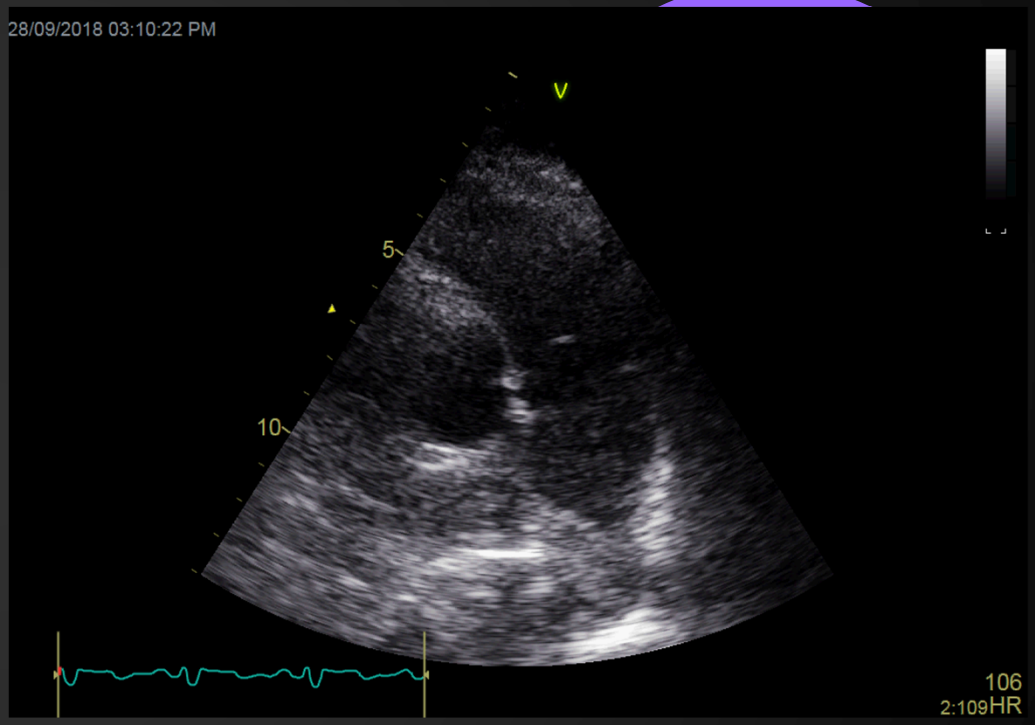

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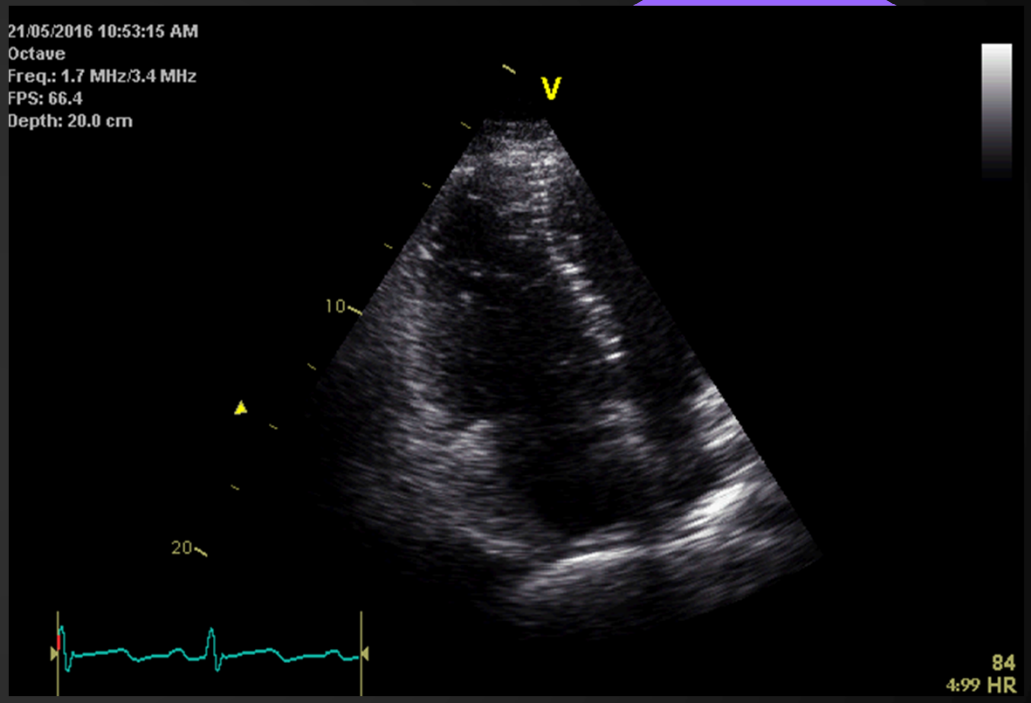
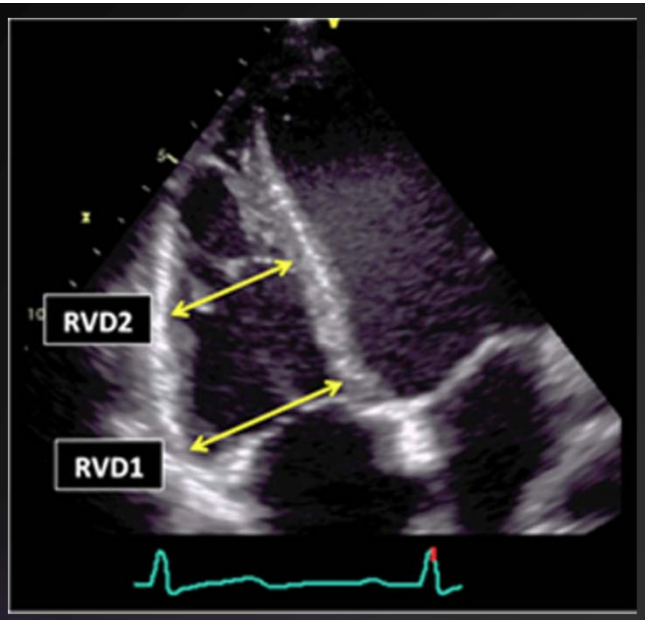
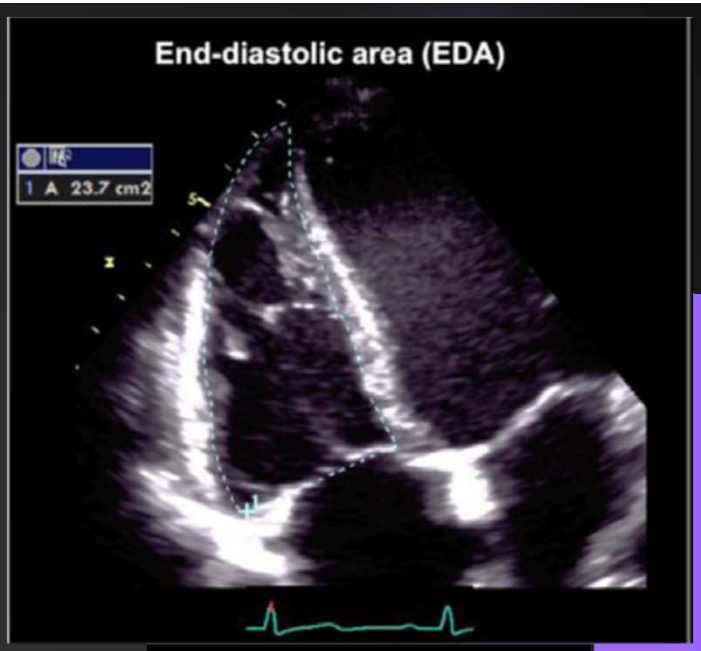
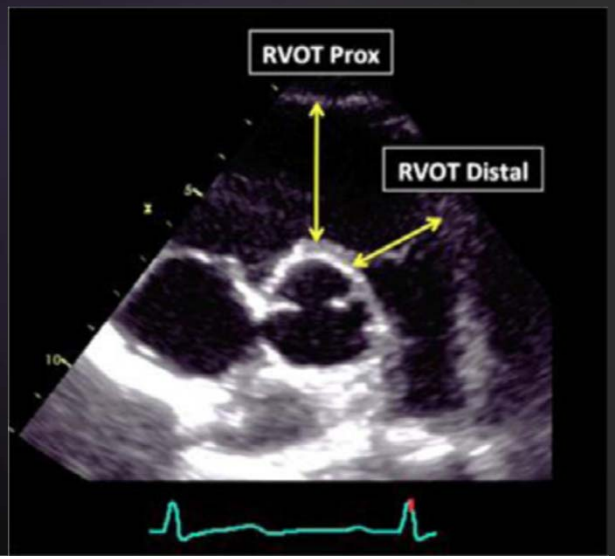
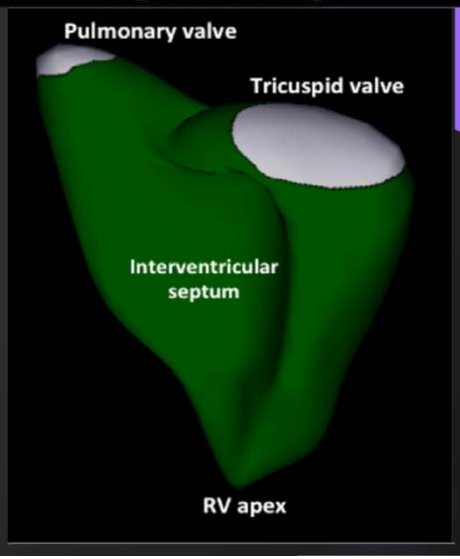



RVD2
RVD1


End-diastolic area (EDA)
1 A 23.7 cm2


RVOT Prox
RVOT Distal


Pulmonary valve
Tricuspid valve
Interventricular septum
RV apex

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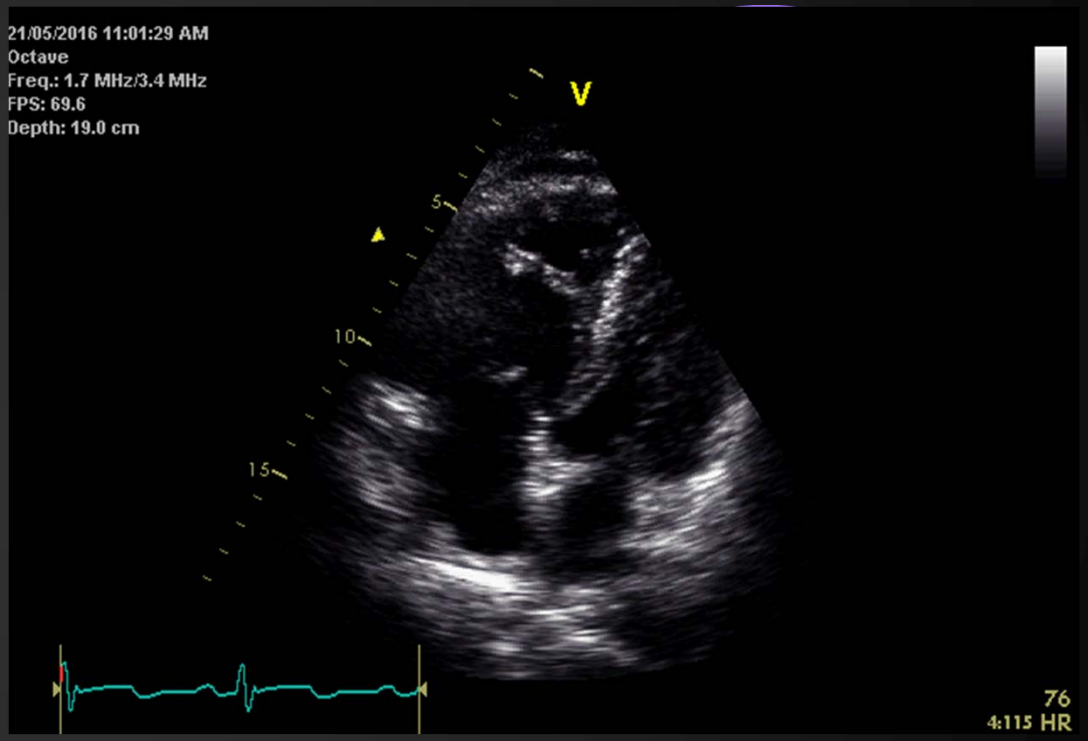
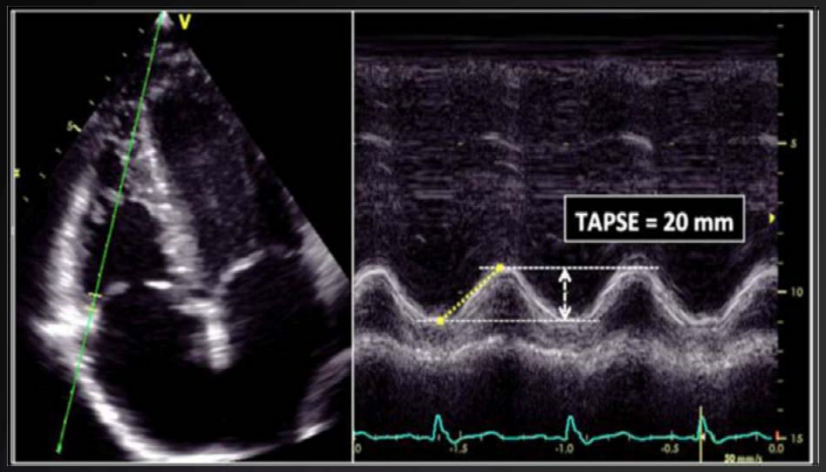
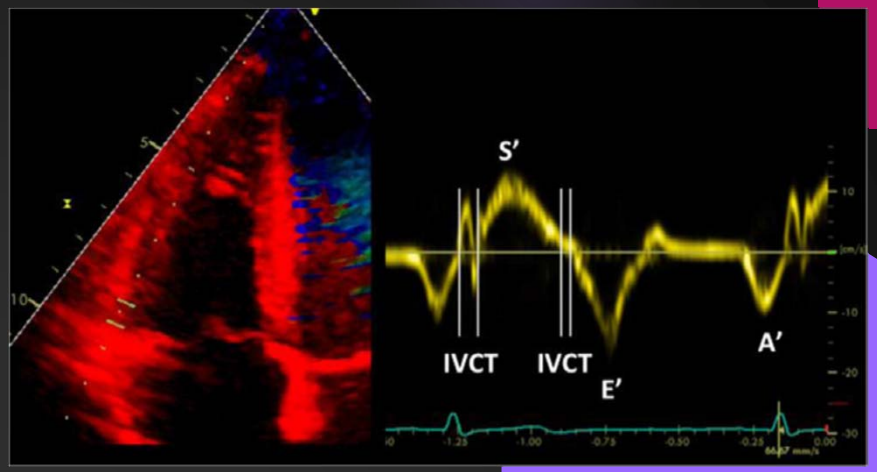
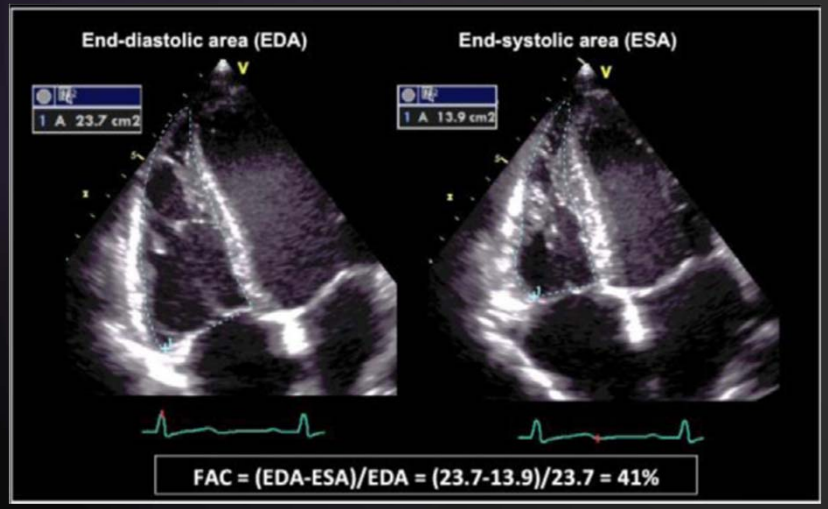
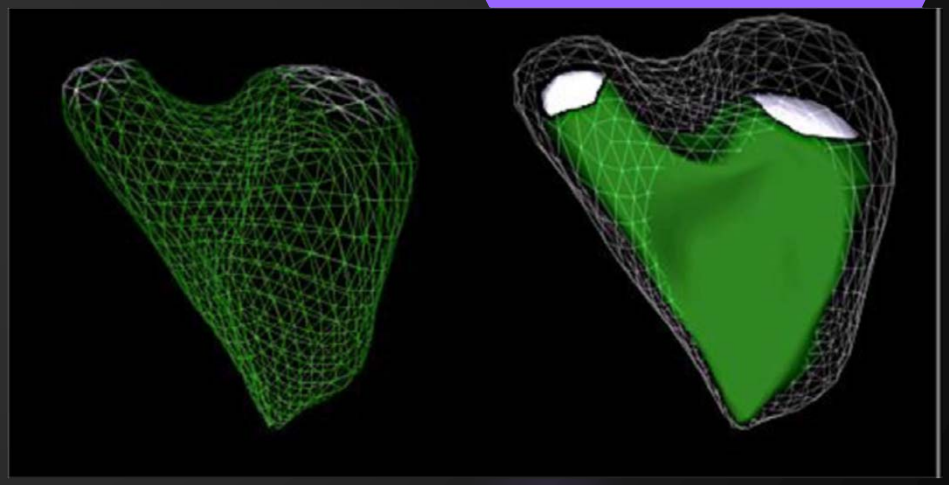



TAPSE = 20 mm


S'
IVCT
IVCT
E'
A'


End-diastolic area (EDA)
End-systolic area (ESA)
1 A 23.7 cm2
1 A 13.9 cm2
FAC = (EDA-ESA)/EDA = (23.7-13.9)/23.7 = 41%



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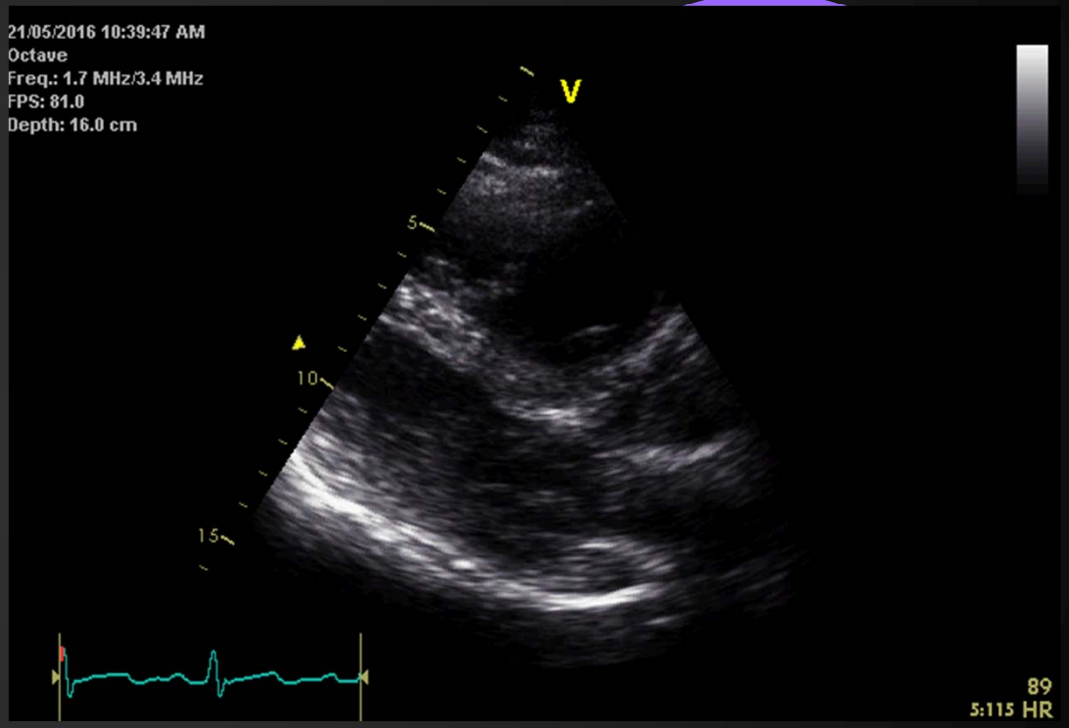

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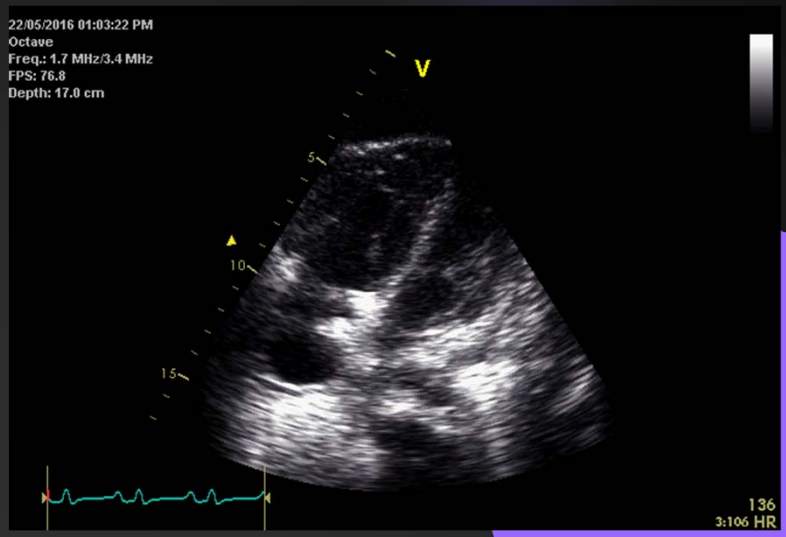

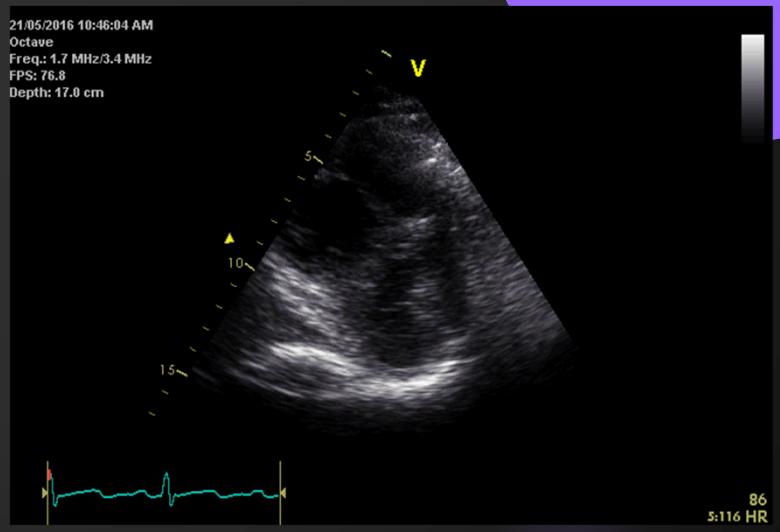

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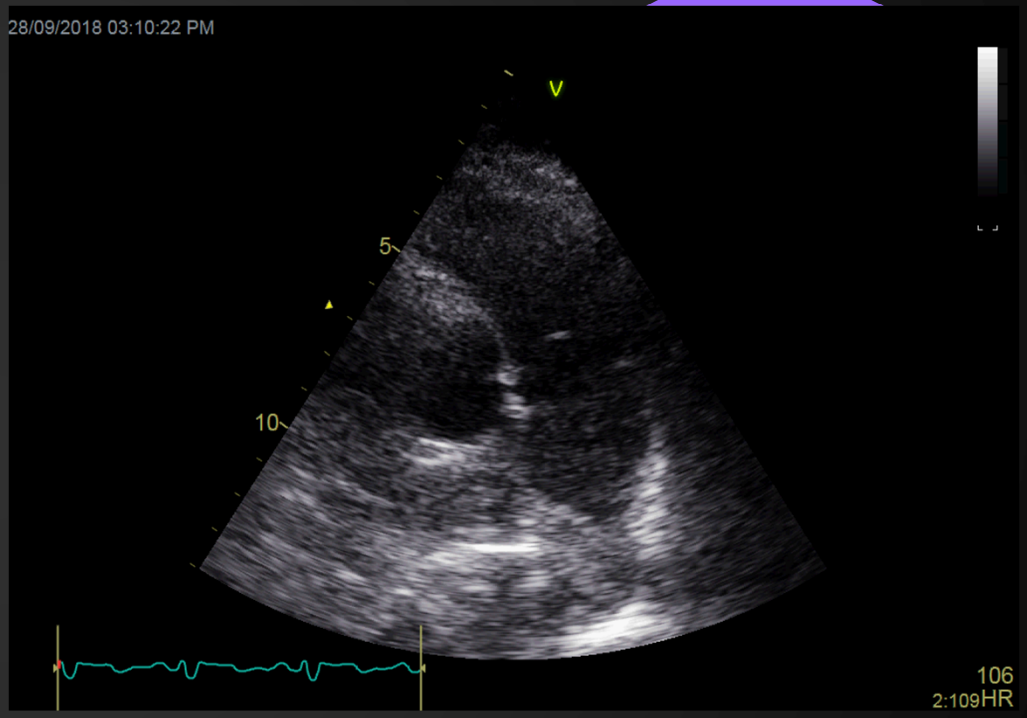
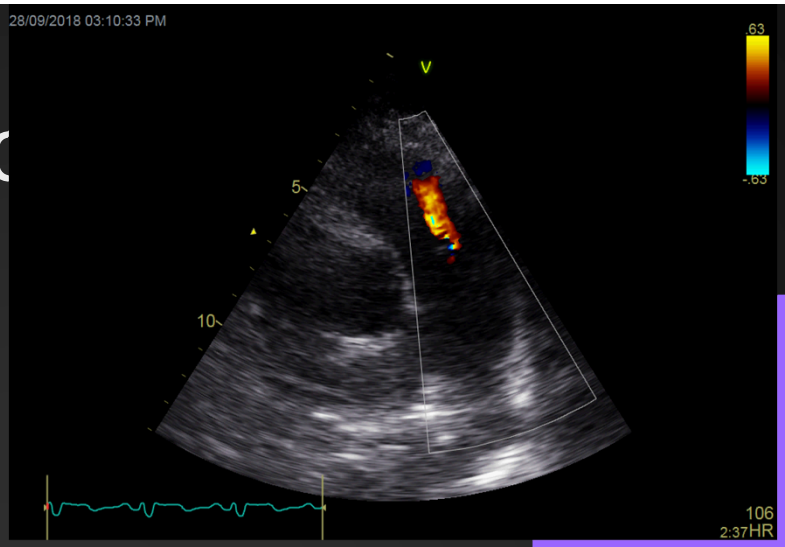
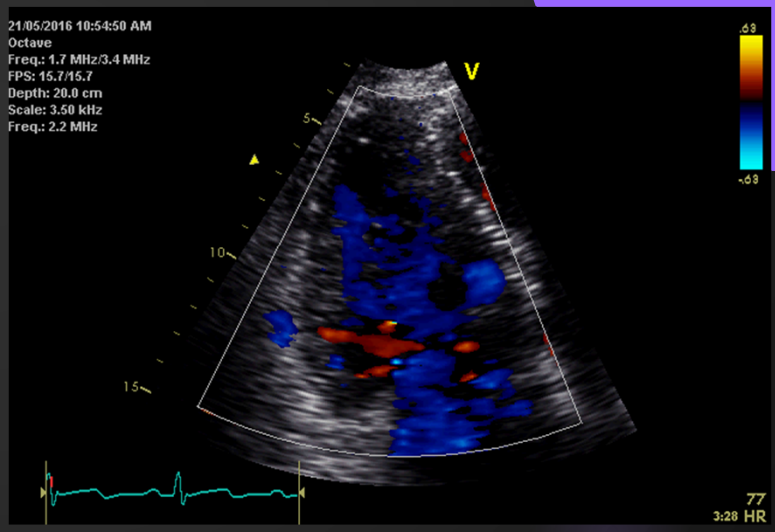


Echocardiographic acute PE

- Unusual degree of TR or PR.
- Increased PA pressure.
- McConnell's sign.
- The 60/60 sign.
- RVOT midsystolic notching.





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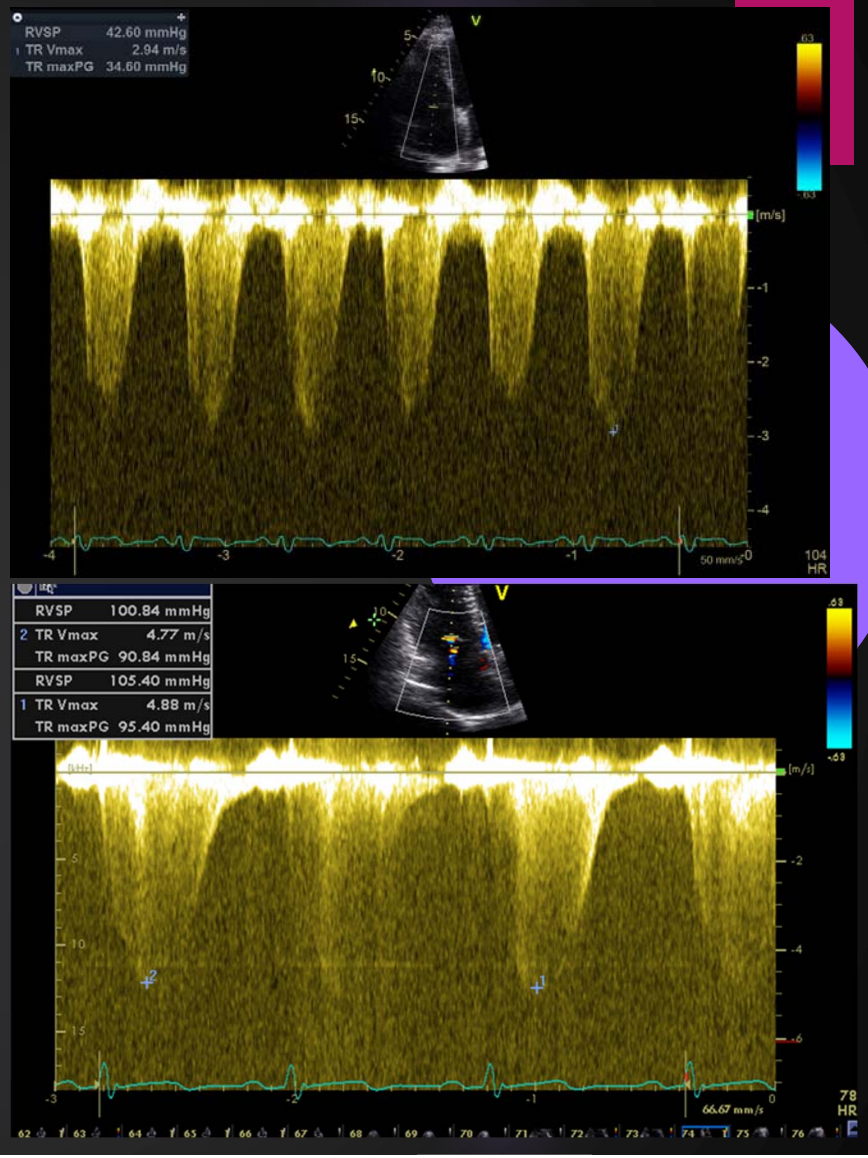

Use the following formula for calculation of RVSP:

RVSP = 4xV2+ RA

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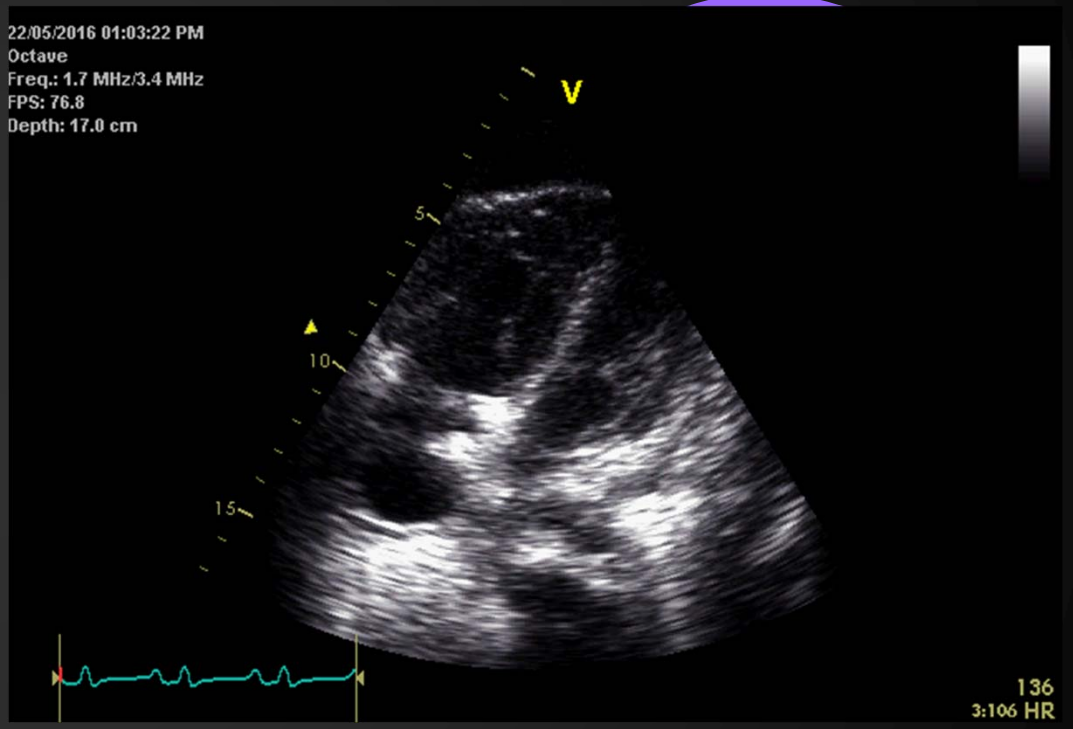

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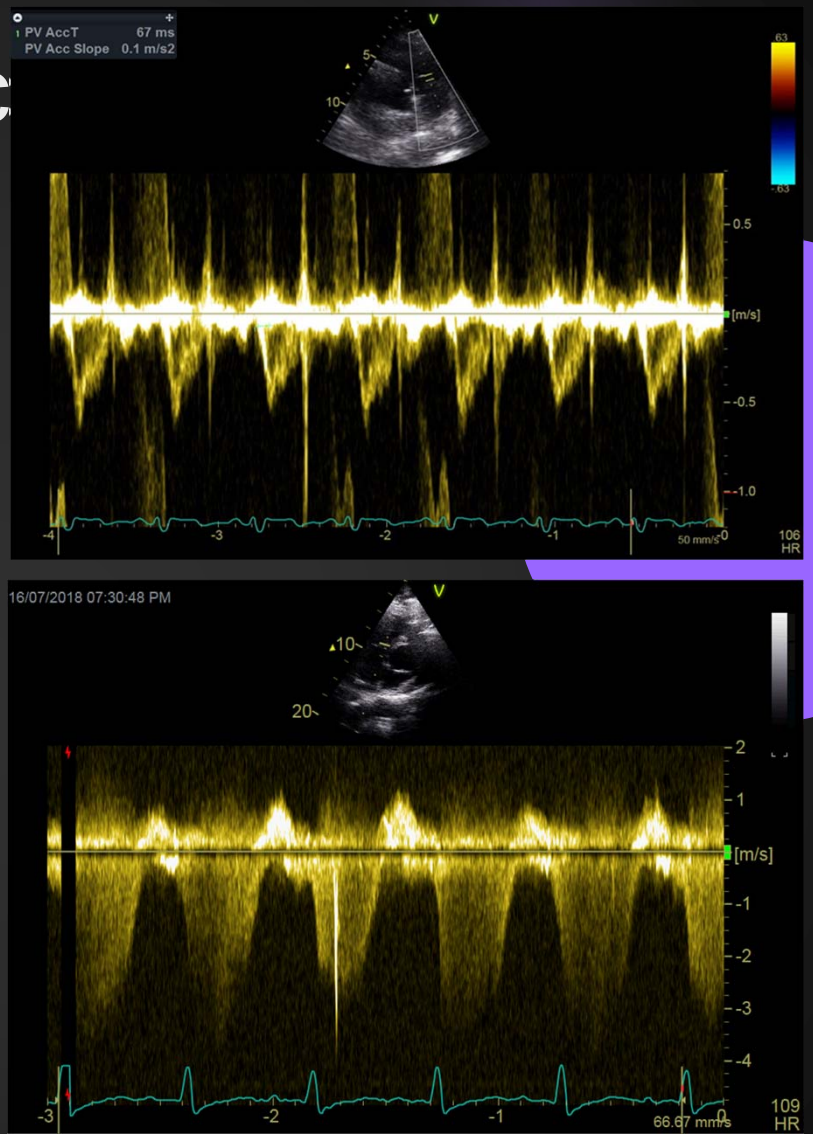

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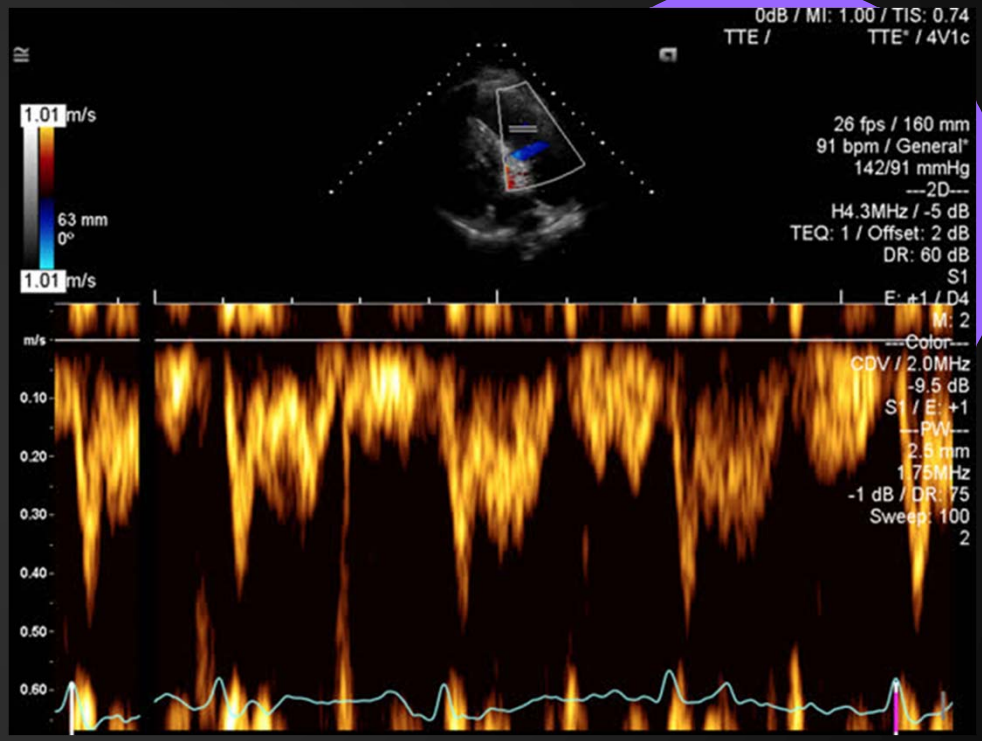
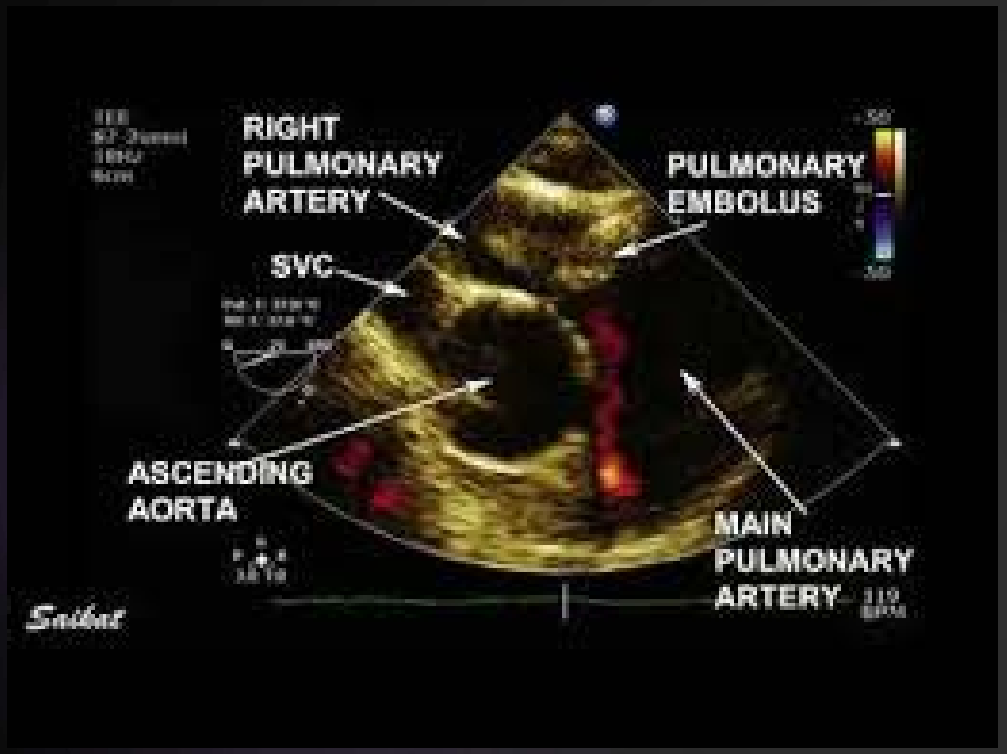
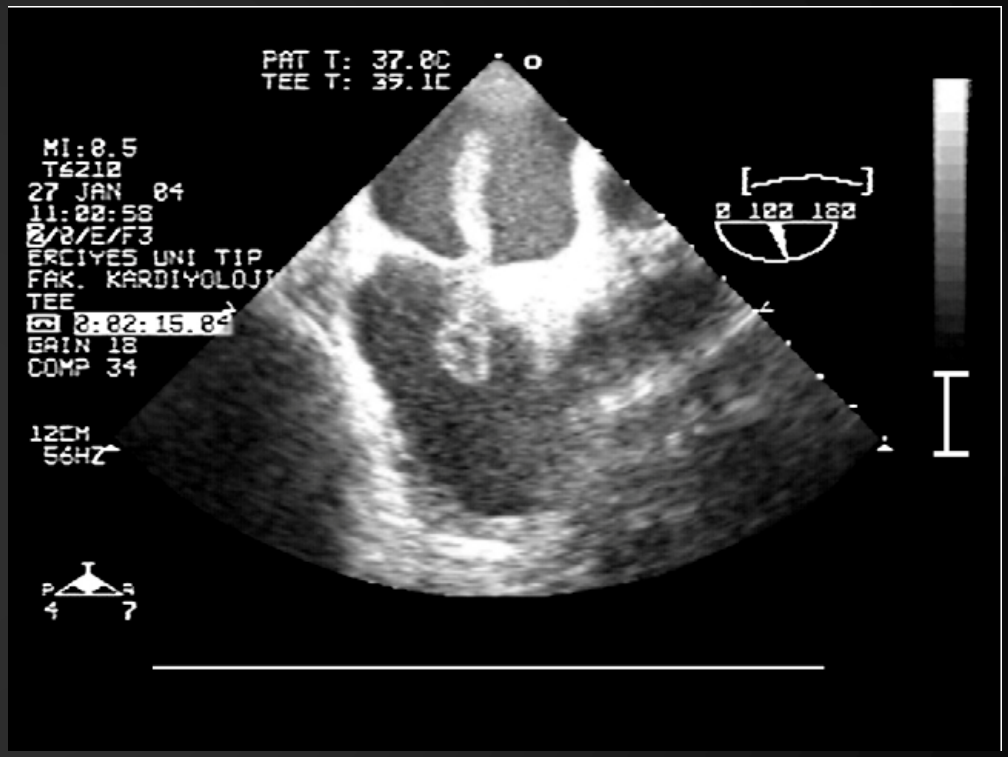


- True sensitivity and specificity of TTE in diagnosing acute PE is difficult to assess. Reported sensitivities ranges from 60% - 90% , and specificities from 80% - 95 %.(...? Overstated).
- Visualizations of an embolus can be considered diagnostic, but negative results must be confirmed with alternative tests such as helical CT.

Role of TEE

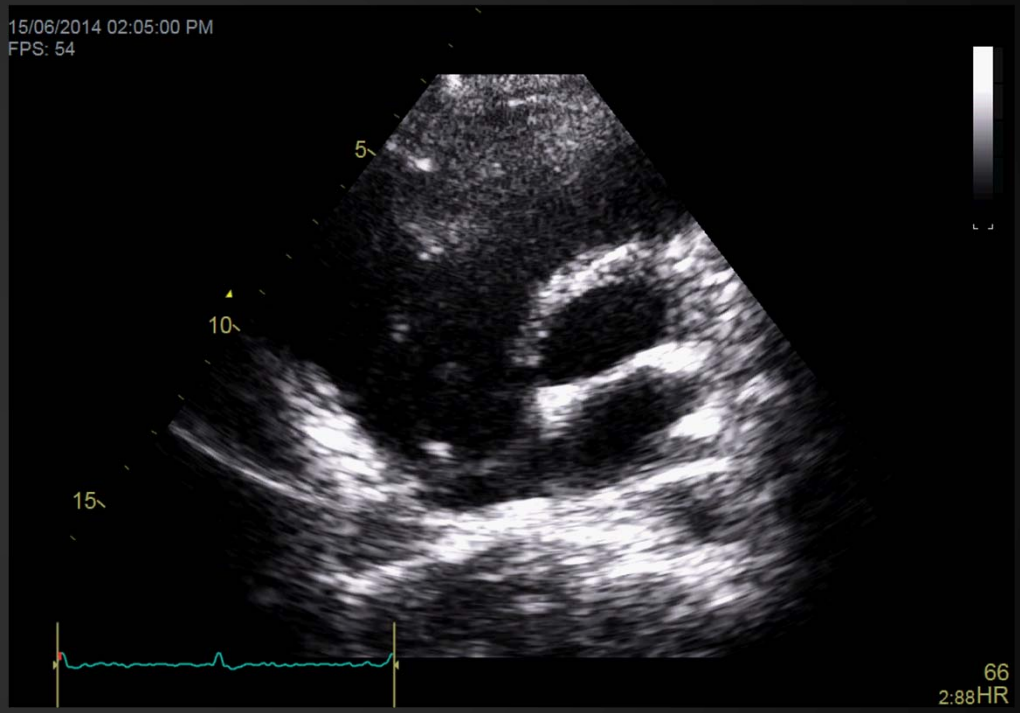
- TEE major advantage is visualization of proximal PA, esp the Rt PA.
- Interatrial septum should be evaluated to R/O PFO.
- Examination of IVC and SVC is important in ICU setting.
- Although TEE should not be implemented as first line test , but still considered as an alternative tool for patients with PE in ICU settings.


RIGHT
PULMONARY
ARTERY
PULMONARY
EMBOLUS
SVC
ASCENDING
AORTA
MAIN
PULMONARY
ARTERY


PAT T: 37.0C
TEE T: 39.1C
MI:0.5
T&Z12
27 JAN 84
11:22:58
2/2/E/F3
ERCIYES UNI TIP
FAK. KARDIYOLOJI
TEE
GAIN 18
COMP 34
12CM
56HZ
0 122 182

Other causes of PE seen in Rt Heart

- Vegetations.
- Masses :
  - Malignant or benign .
- Air embolism.



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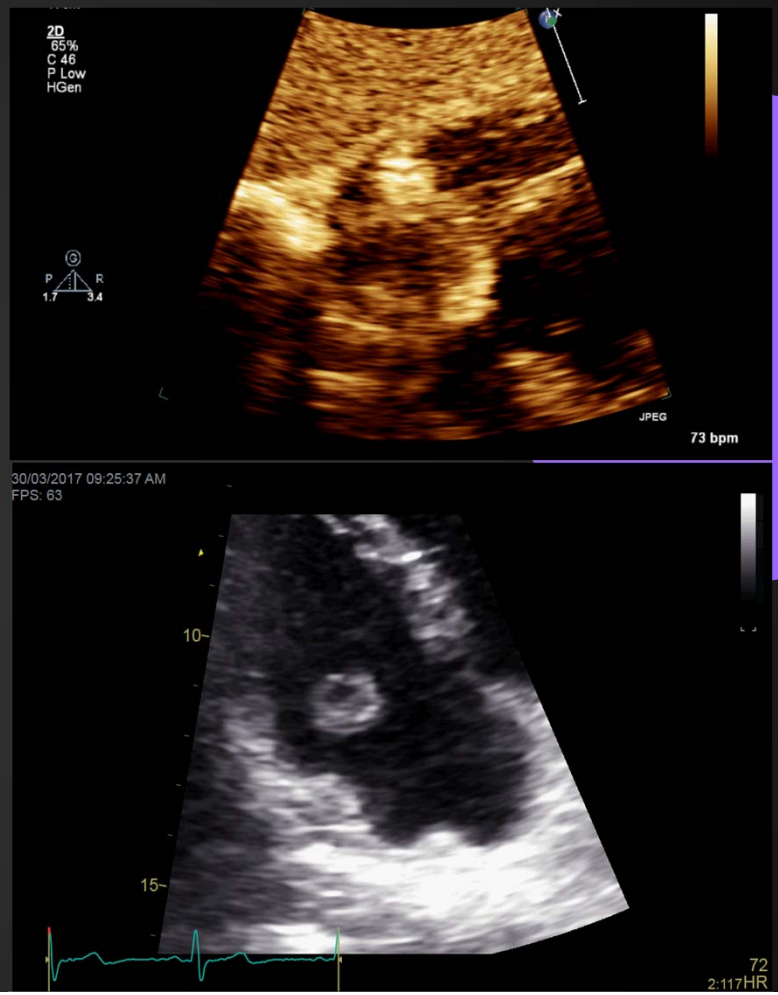

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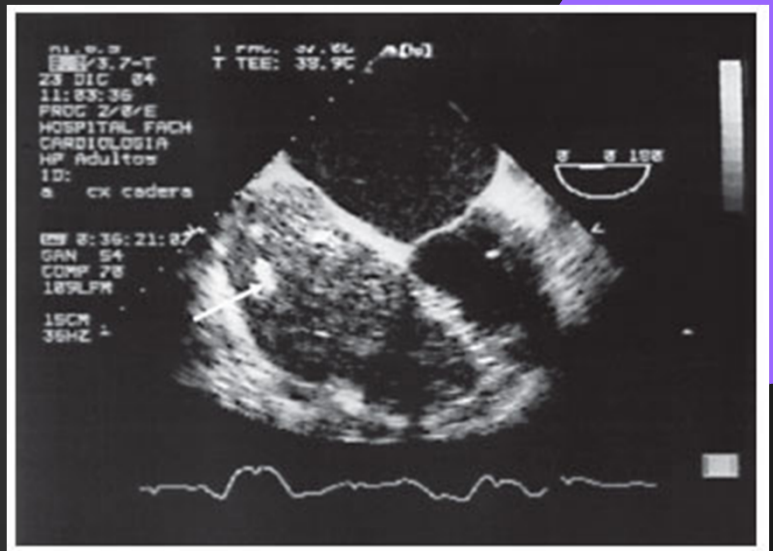


Figure 3. Embolic Phenomena. White arrow shows embolic material in the right atrium.

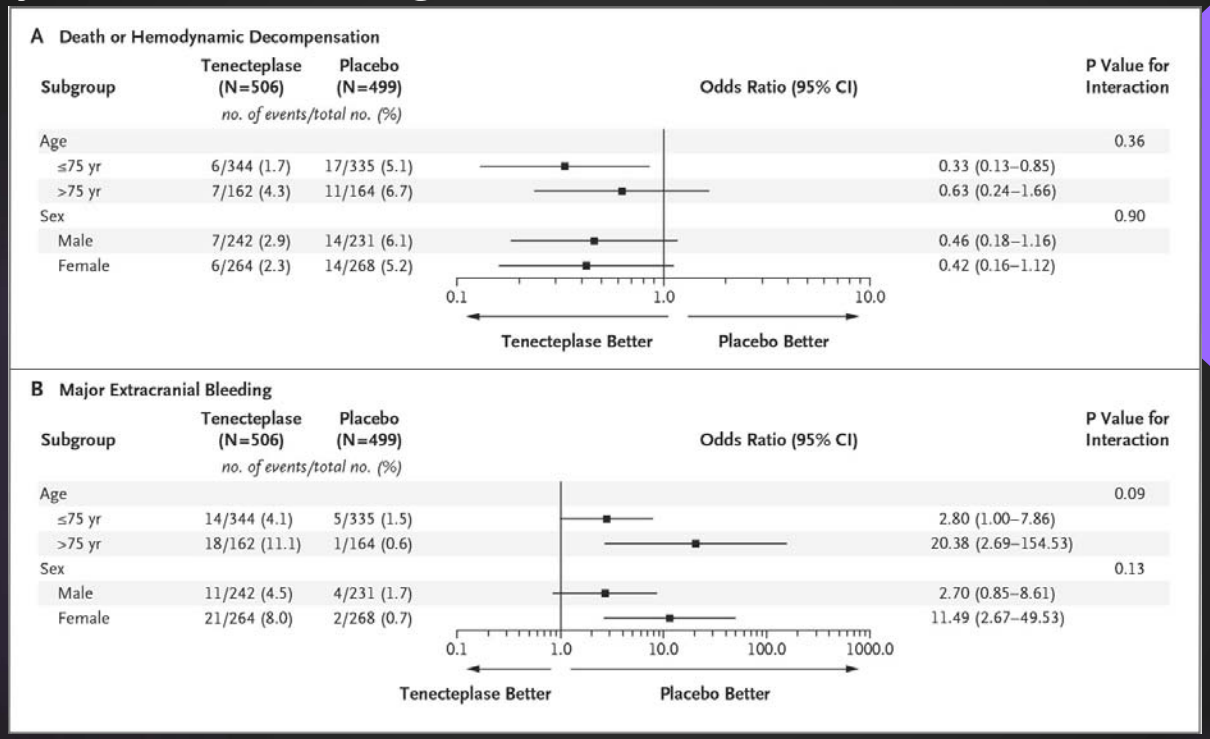
PROGNOSIS

- Several studies have suggested that the degree of RV dysfunction can serve as predictor of mortality.
- Some authors suggested that cases with RV dysfunction may benefit from aggressive therapeutic strategies including thrombolysis.
- Majority of these patients had hypotension.

When to consider thrombolysis?

- Severe or worsening right ventricular dysfunction ("submassive PE")
- Cardiopulmonary arrest due to PE (eg, BP >90 mmHg after resuscitation)
- Extensive clot burden (eg, large perfusion defects on ventilation/perfusion scan or extensive embolic burden on computed tomography)
- Free-floating right atrial or ventricular thrombus

In patients with intermediate-risk pulmonary embolism, fibrinolytic therapy prevented hemodynamic decompensation but increased the risk of major hemorrhage and stroke



A Death or Hemodynamic Decompensation

Subgroup	Tenecteplase (N=506)	Placebo (N=499)	Odds Ratio (95% CI)	P Value for Interaction
	no. of events/total no. (%)			
Age				0.36
≤75 yr	6/344 (1.7)	17/335 (5.1)	0.33 (0.13–0.85)	
>75 yr	7/162 (4.3)	11/164 (6.7)	0.63 (0.24–1.66)	
Sex				0.90
Male	7/242 (2.9)	14/231 (6.1)	0.46 (0.18–1.16)	
Female	6/264 (2.3)	14/268 (5.2)	0.42 (0.16–1.12)	

B Major Extracranial Bleeding

Subgroup	Tenecteplase (N=506)	Placebo (N=499)	Odds Ratio (95% CI)	P Value for Interaction
	no. of events/total no. (%)			
Age				0.09
≤75 yr	14/344 (4.1)	5/335 (1.5)	2.80 (1.00–7.86)	
>75 yr	18/162 (11.1)	1/164 (0.6)	20.38 (2.69–154.53)	
Sex				0.13
Male	11/242 (4.5)	4/231 (1.7)	2.70 (0.85–8.61)	
Female	21/264 (8.0)	2/268 (0.7)	11.49 (2.67–49.53)	

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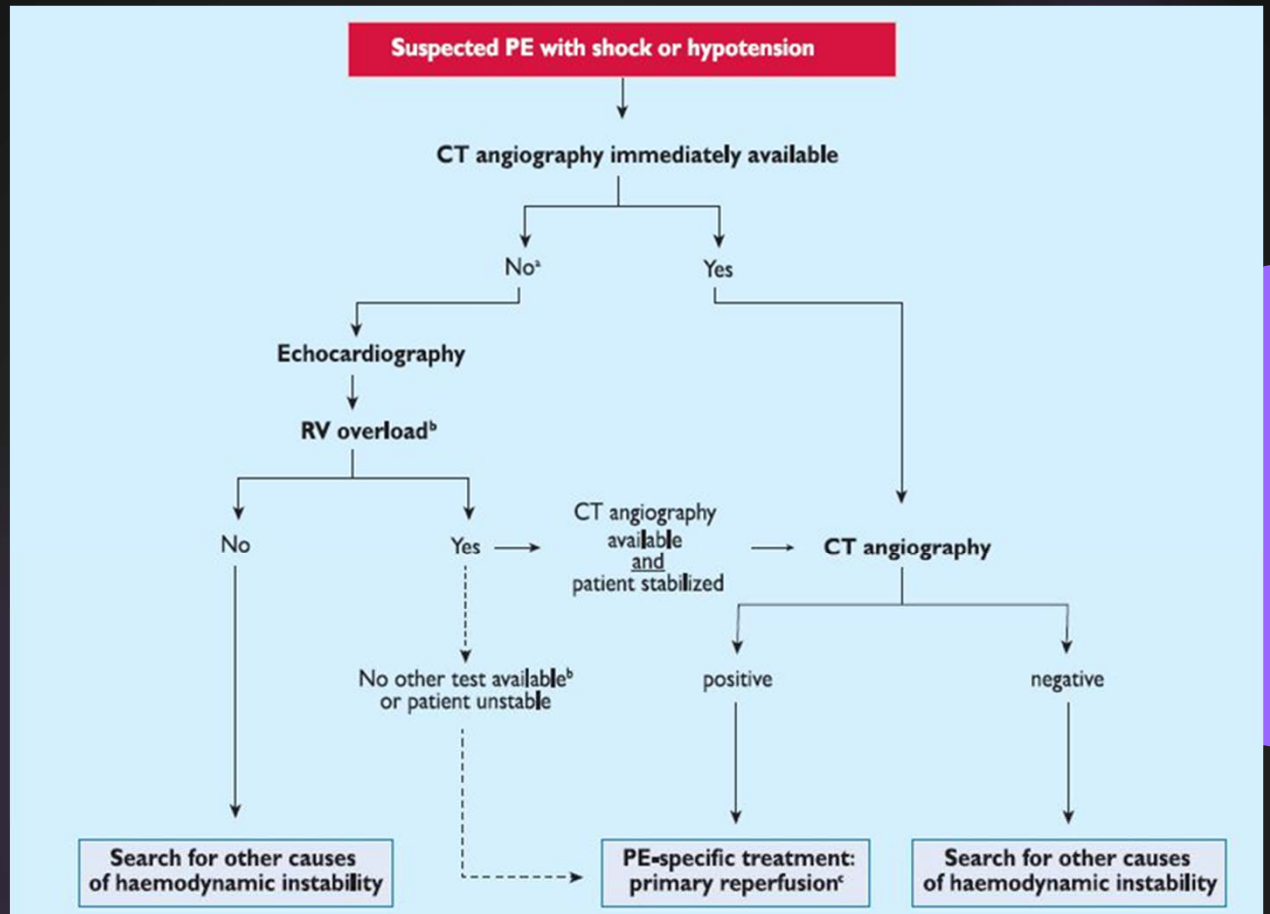

CT = computed tomographic; PE = pulmonary embolism; RV = right ventricular.

[a]Includes the cases in which the patient's condition is so critical that it only allows bedside diagnostic tests.

[b]Apart from the diagnosis of RV dysfunction, bedside transthoracic echocardiography may, in some cases, directly confirm PE by visualizing mobile thrombi in the right heart chambers. Ancillary bedside imaging tests include transoesophageal echocardiography, which may detect emboli in the pulmonary artery and its main branches, and bilateral compression venous ultrasonography, which may confirm deep vein thrombosis and thus be of help in emergency management decisions.

[c]Thrombolysis; alternatively, surgical embolectomy or catheter-directed treatment (Section 5).

Potential roles of Echo for evaluation of known or suspected PE

1) Contribute to the diagnosis (indirect).
2) Evaluate the hemodynamic consequences .
3) Assess the cardiopulmonary responses to therapeutic interventions.
4) Determine management.
5) Exclude other entities.

“Thank you

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