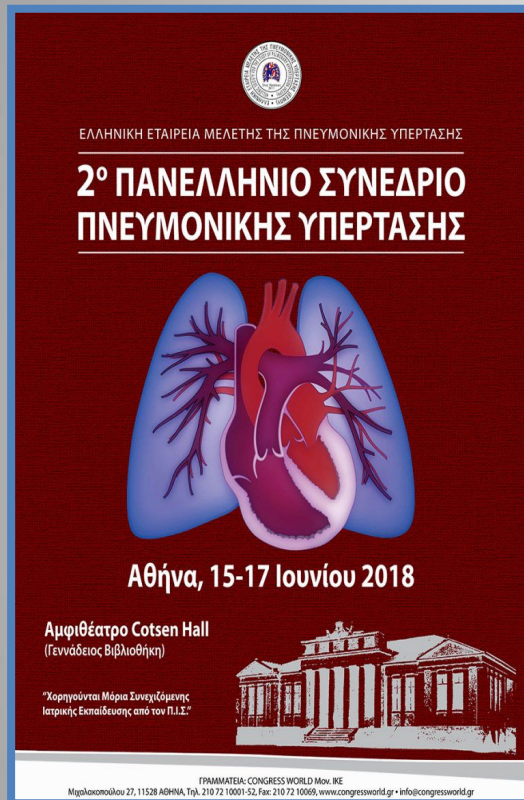




No conflict of interests
Related to this presentation

ECHOCARDIOGRAPHY

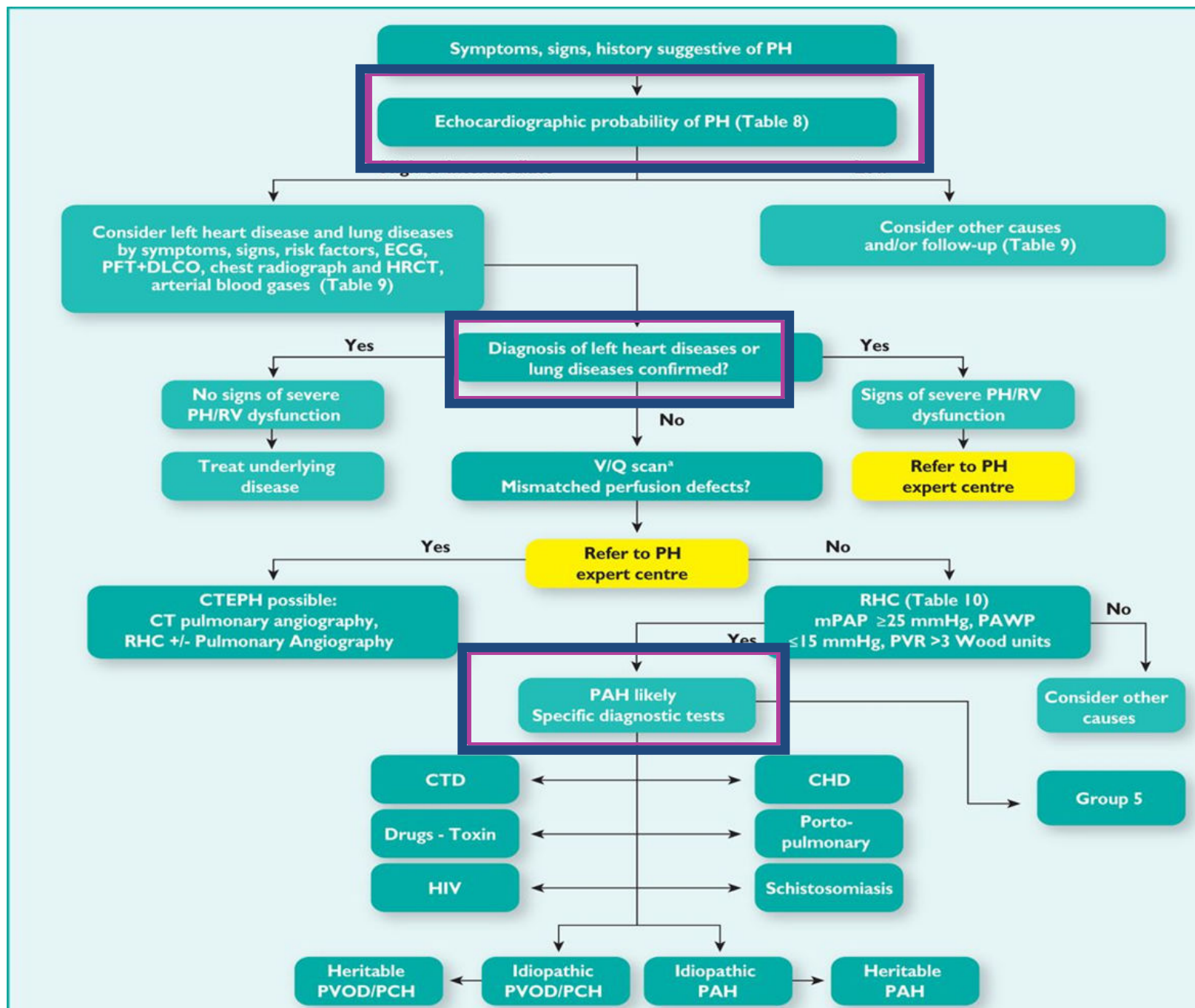
Left heart disease

or PAH?

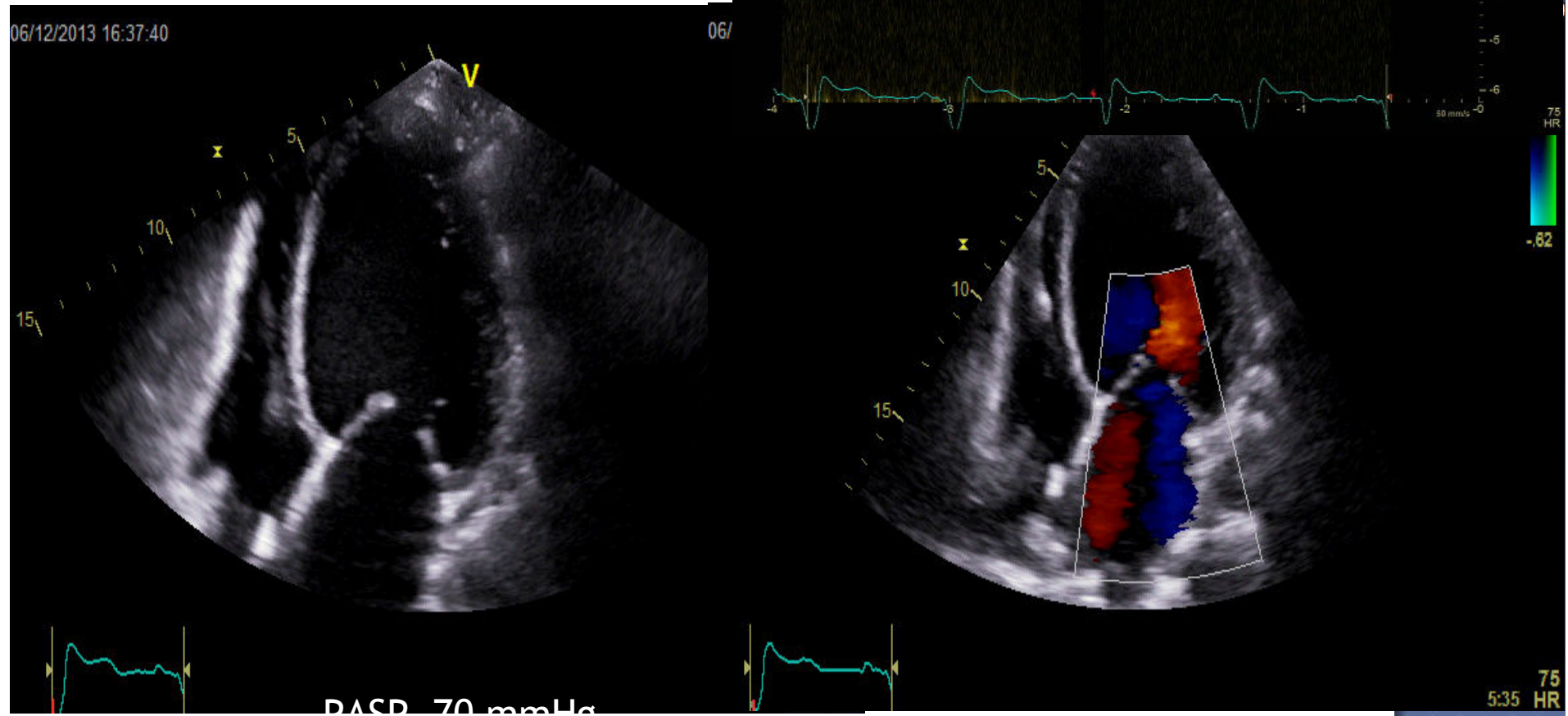
Eftychia Demerouti MD, MSc, PhD

Cardiologist

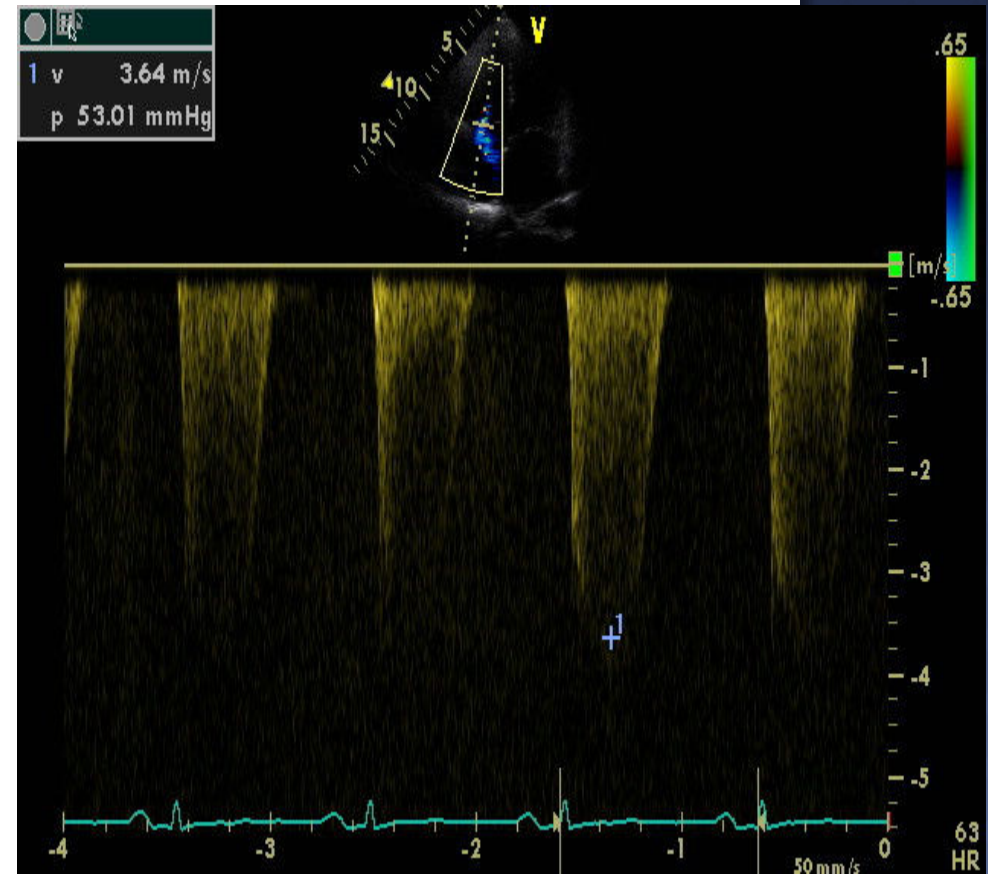
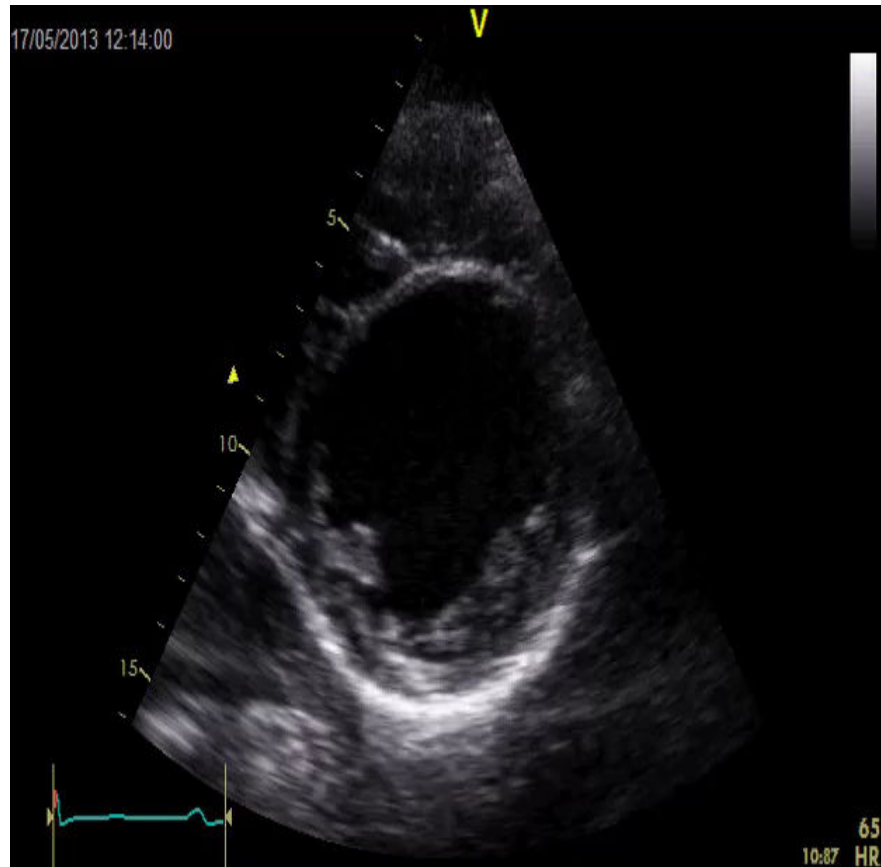
Onassis Cardiac Surgery Center



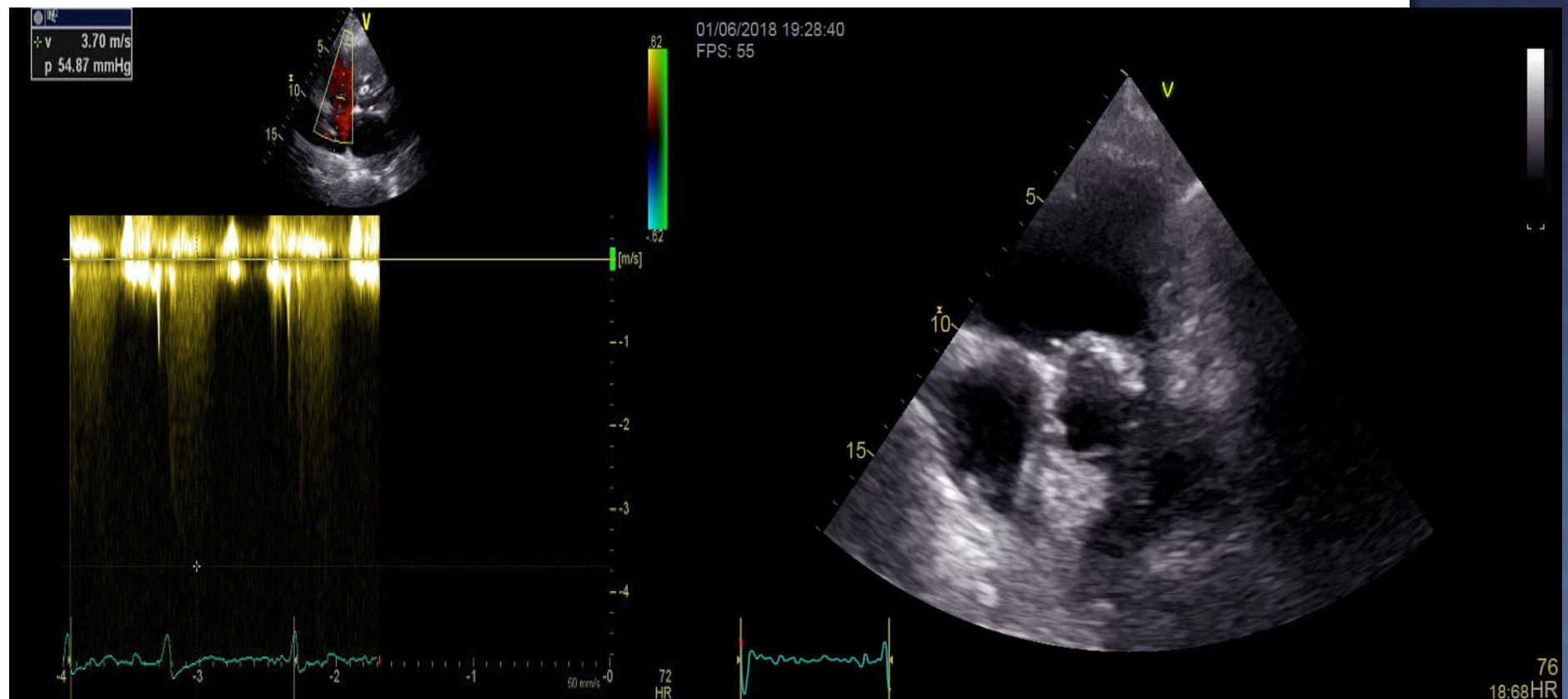
PH - LHD CASE 1



PH - LEFT HEART FAILURE CASE 2

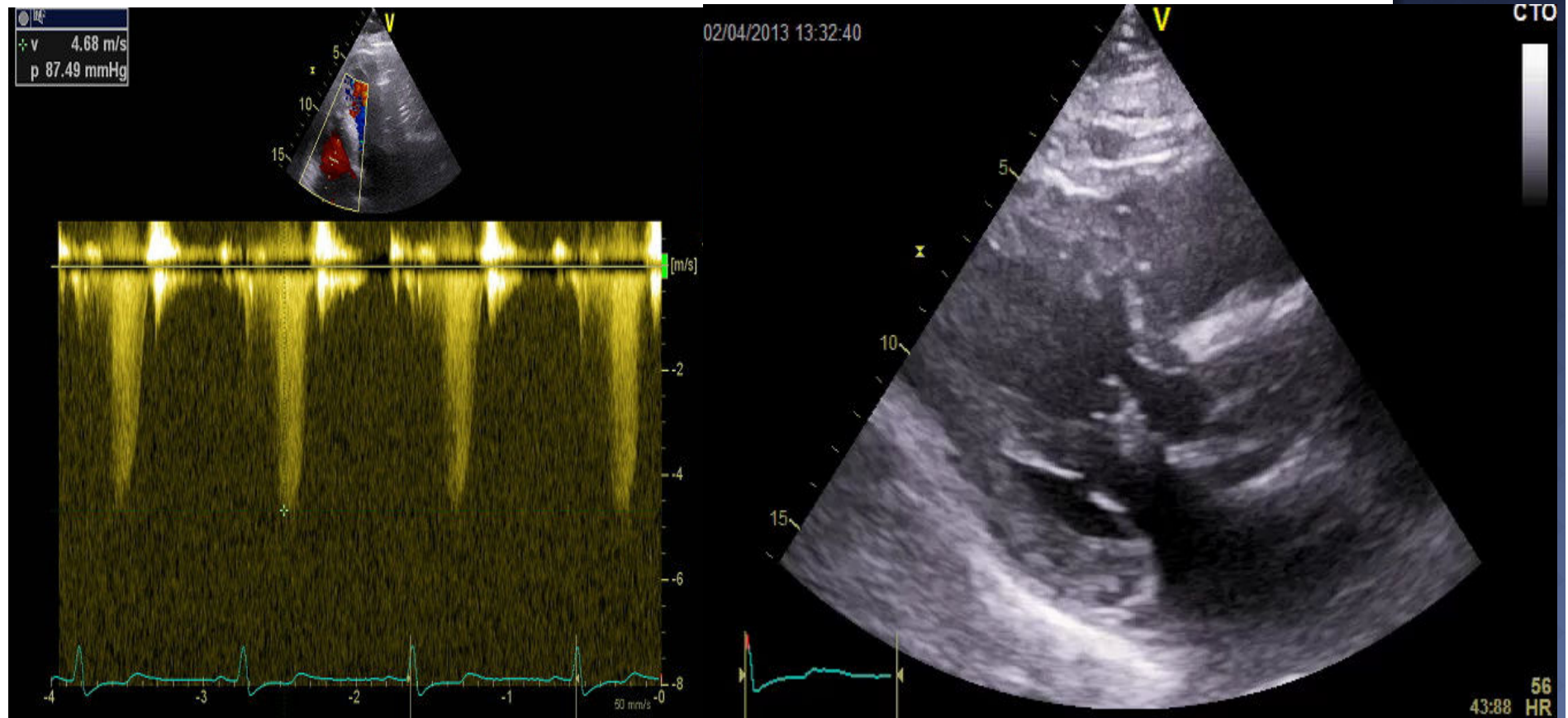


PH - AORTIC STENOSIS CASE 3



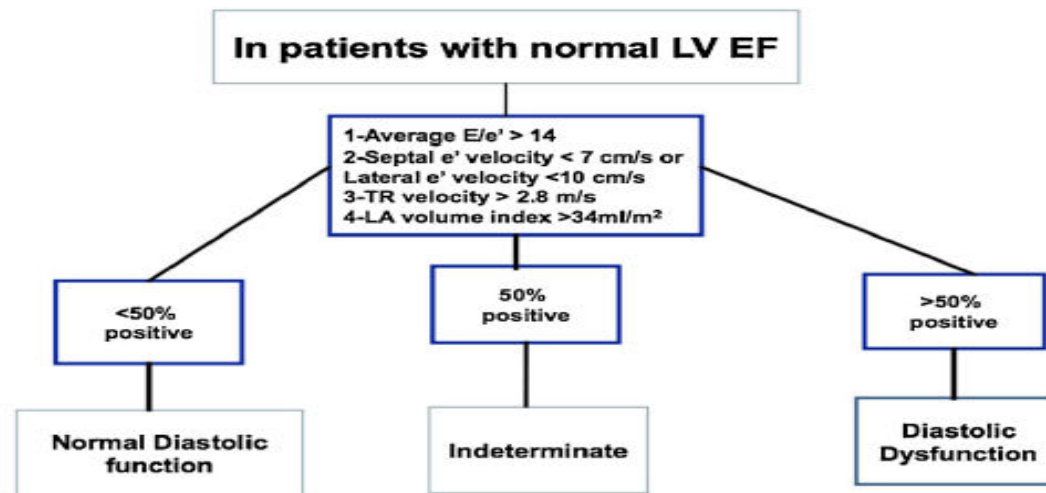
HYPERTROPHIC CARDIOMYOPATHY

CASE 4

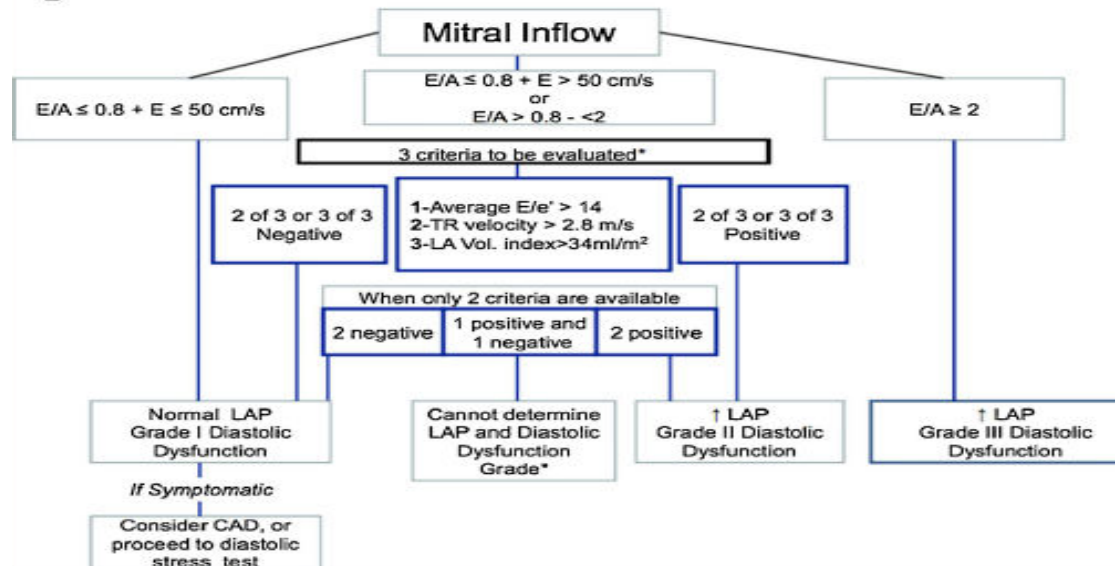


RECOMMENDATIONS FOR THE EVALUATION OF LV DIASTOLIC FUNCTION BY ECHOCARDIOGRAPHY: AN UPDATE FROM THE ASE AND EACVI

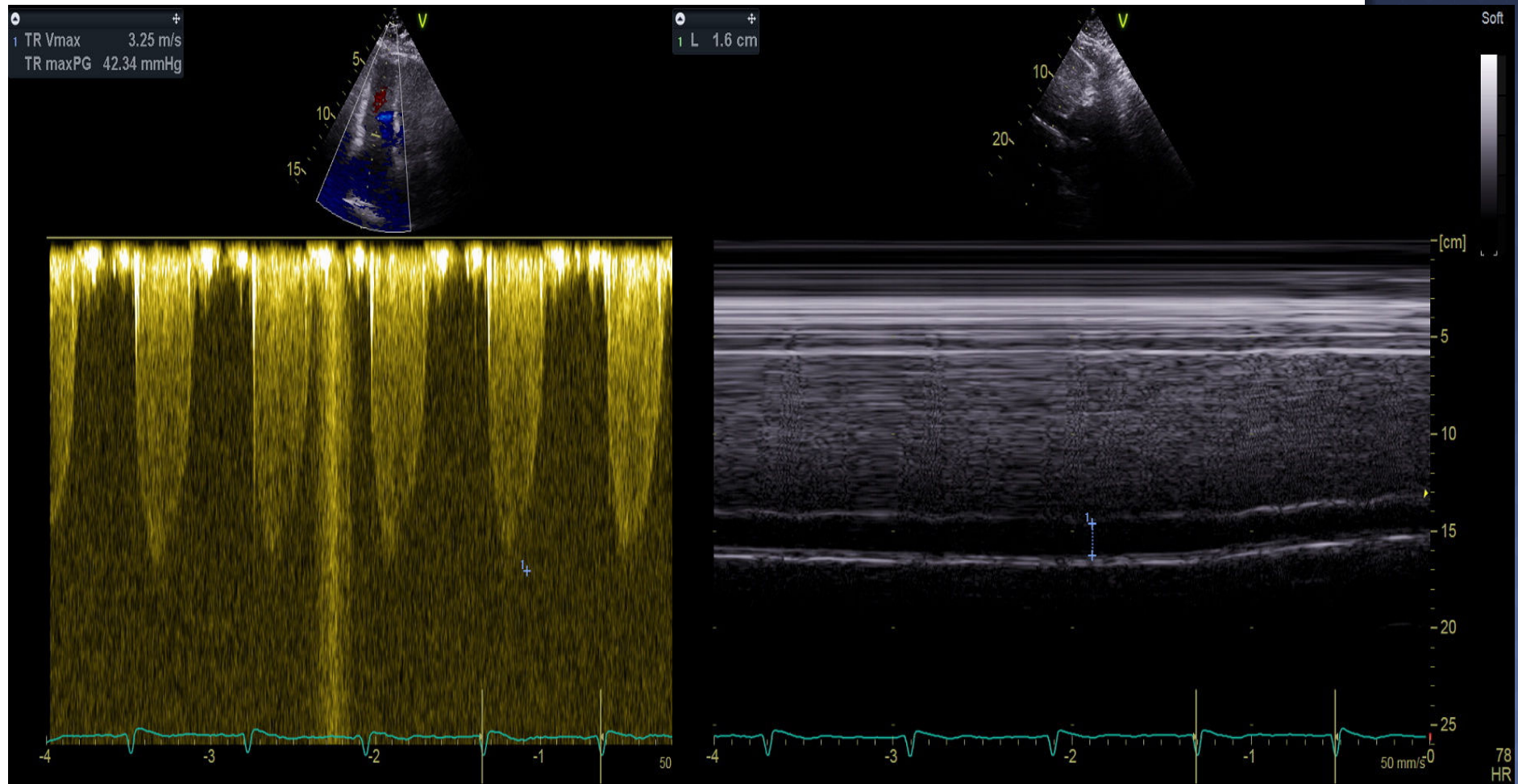
A



B



A MAN 70 Y.O. CASE 5



PAH & LHD CASE 5

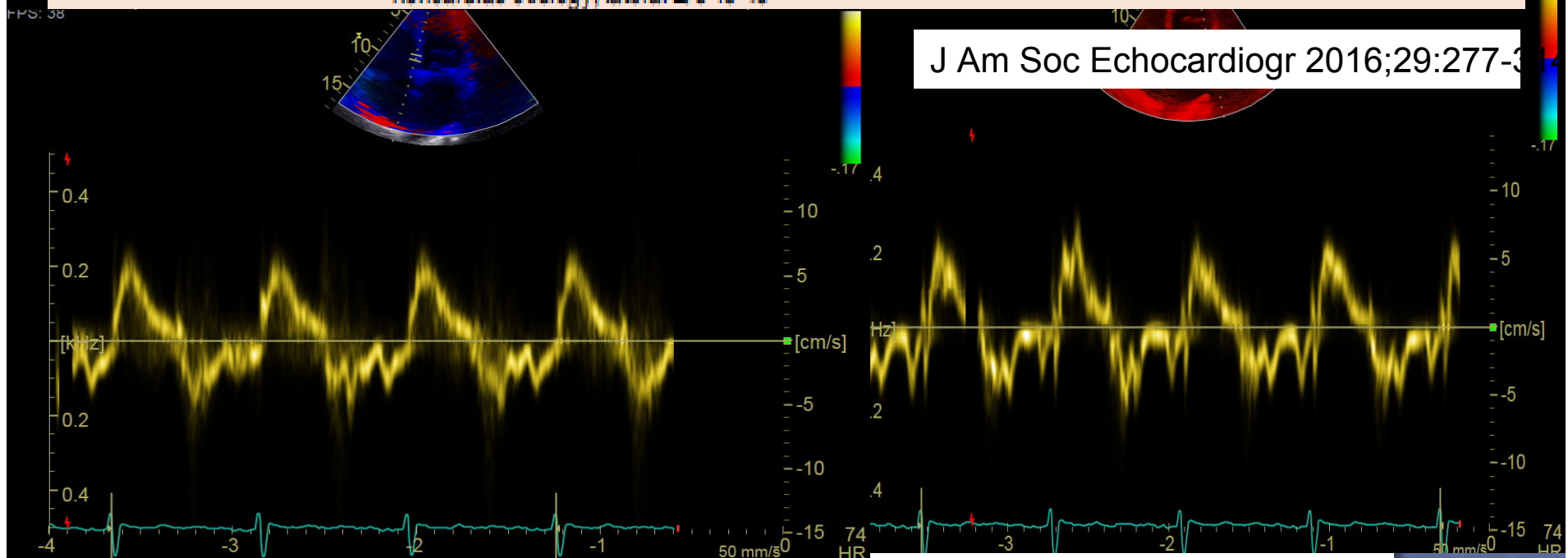
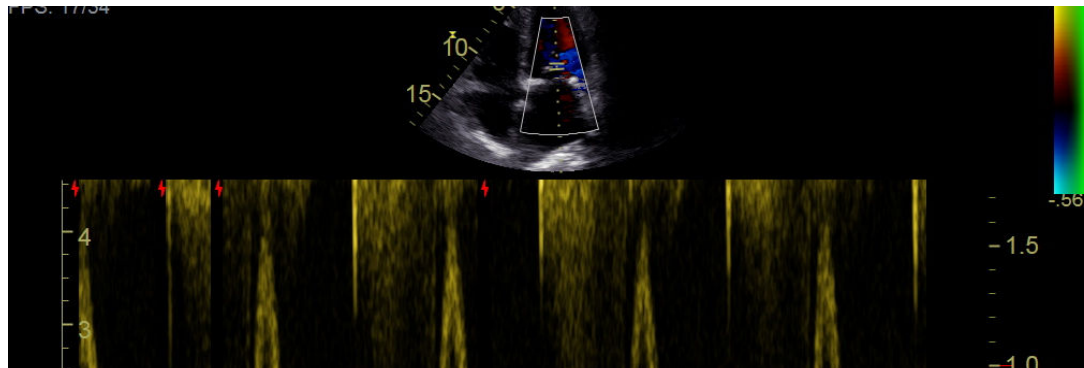
Table 6 Assessment of LV filling pressures in special populations

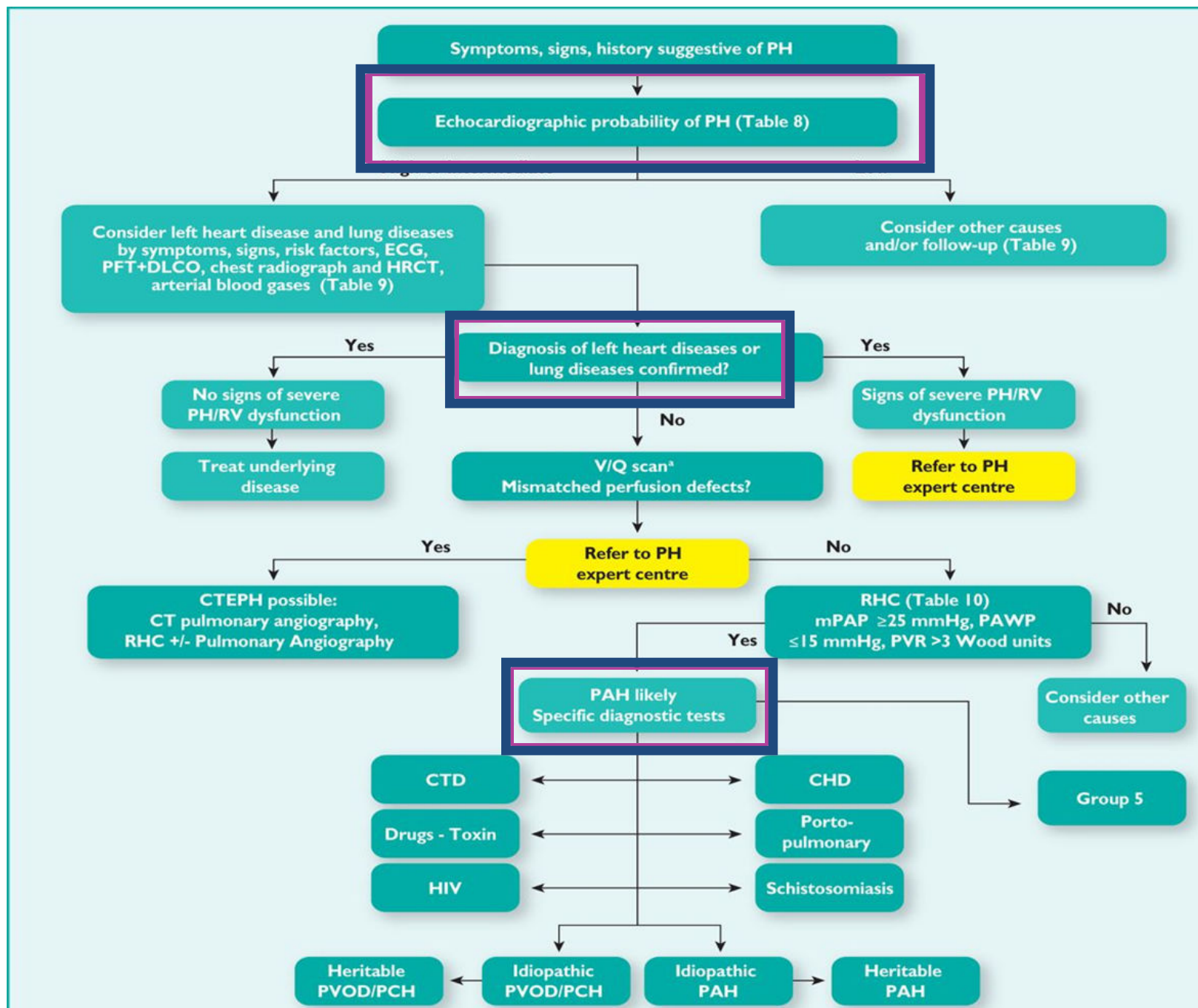
Noncardiac pulmonary
hypertension³²

Lateral E/e' can be applied to determine whether a cardiac etiology is the underlying reason for the increased pulmonary artery pressures

When cardiac etiology is present, lateral E/e' is >13 , whereas in patients with pulmonary hypertension due to a noncardiac etiology, lateral E/e' is <8

J Am Soc Echocardiogr 2016;29:277-3





ECHOCARDIOGRAPHIC PROBABILITY

SYMPTOMATIC PATIENT

WITH SUSPICION OF PAH

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	
2.7–3.4	Yes	High <i>RHC</i>
>3.4	Not required	

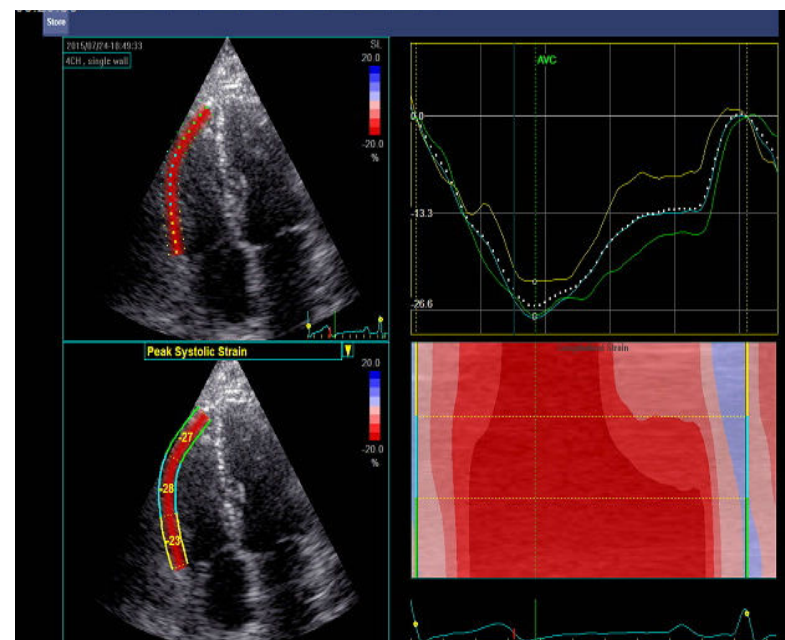
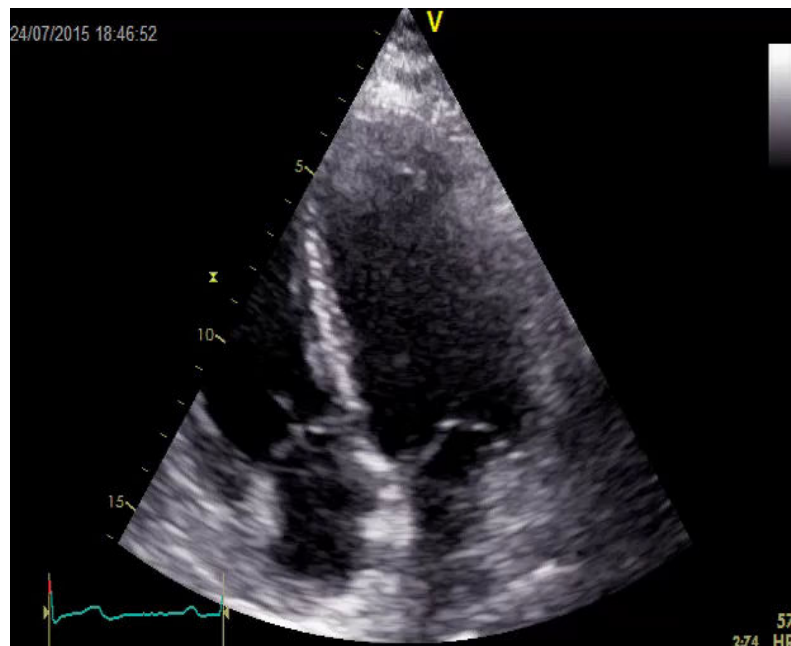
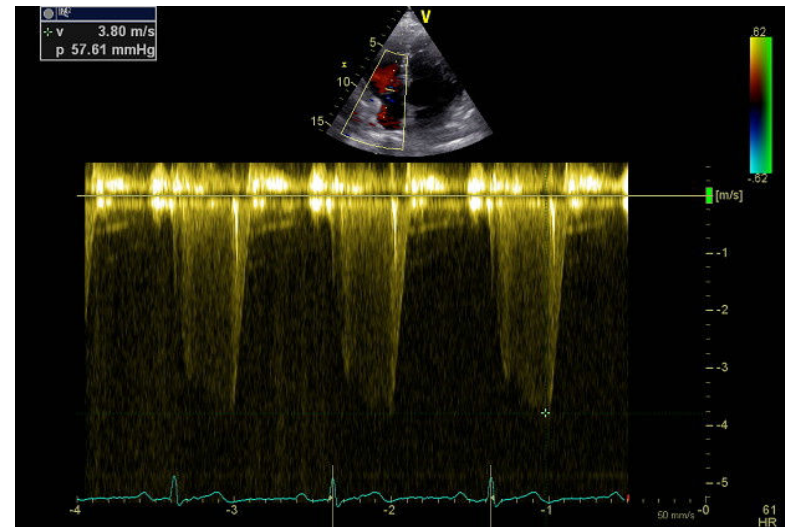
ESC GUIDELINES, 2015

A 60 Y.O. MAN CASE 6

DYSPNEA ON EXERTION , WHO II

WITHOUT SIGNS OF RV DYSFUNCTION

RA (mmHg)	4
PA (mmHg)	68/19/46
PAWP (mmHg)	4
PVR (WU)	8,26
C.I. (l/min/m2)	2,5



ECHOCARDIOGRAPHIC PROBABILITY

SYMPTOMATIC PATIENT WITH SUSPICION OF PAH

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	Intermediate
2.9–3.4	Yes	High
>3.4	Not required	High

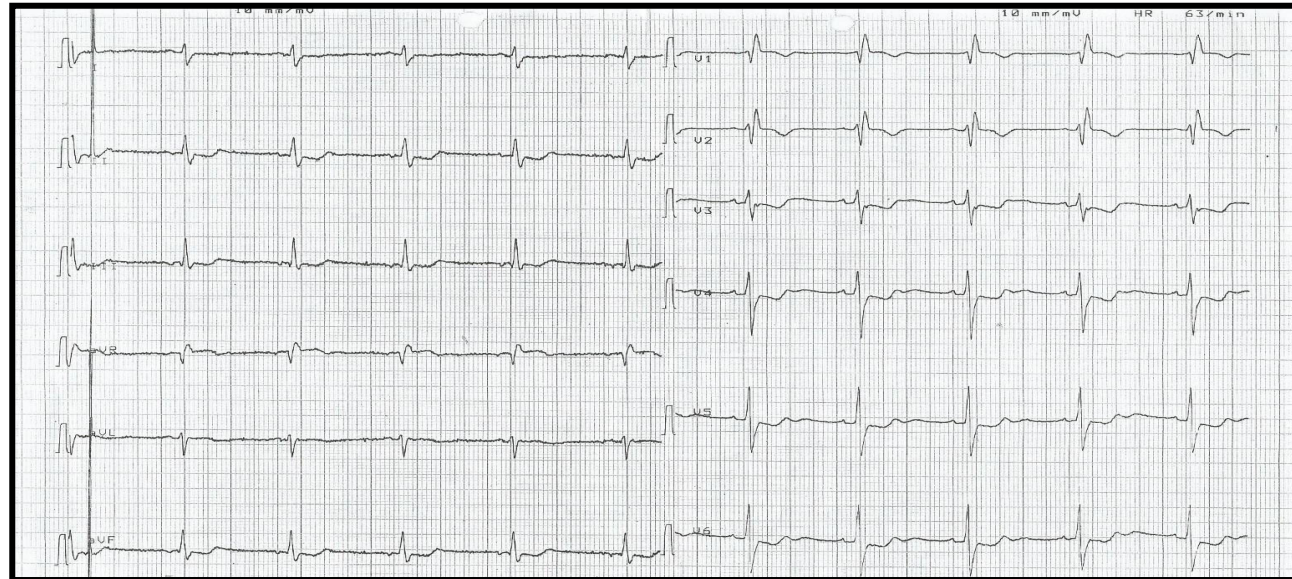
WITH RISK FACTORS & ASSOCIATED CONDITIONS

RHC

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.	

A 64 Y.O. MAN

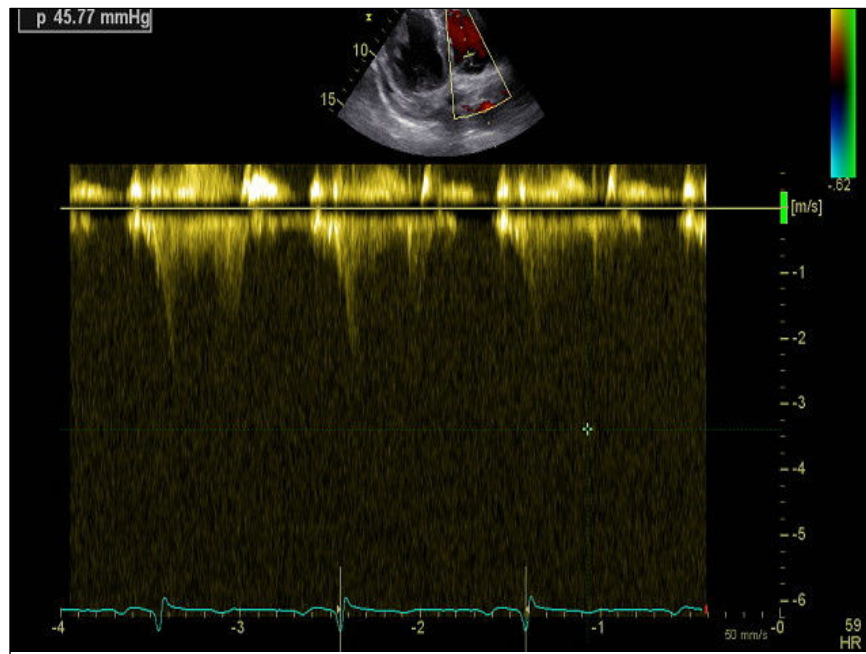
CASE 7



Dyspnea on exertion

Ankle edema 3m ago

Furosemide 40mg

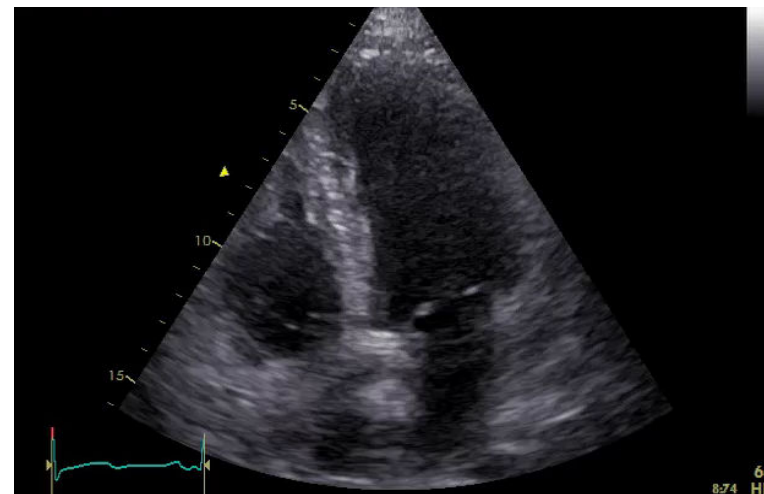
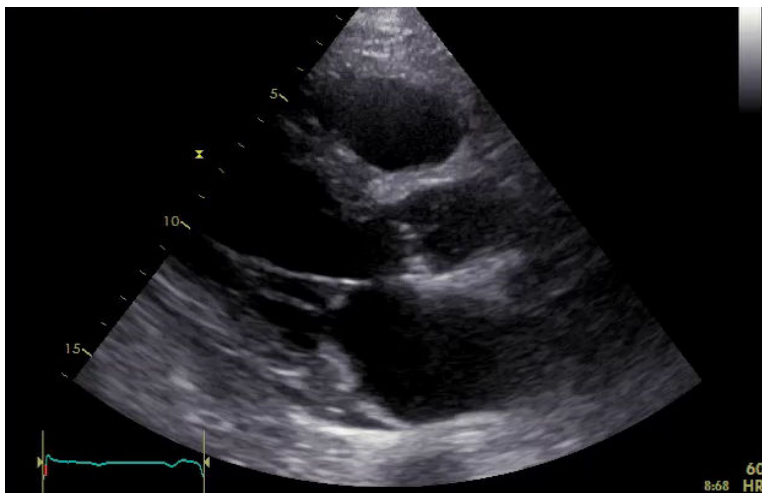
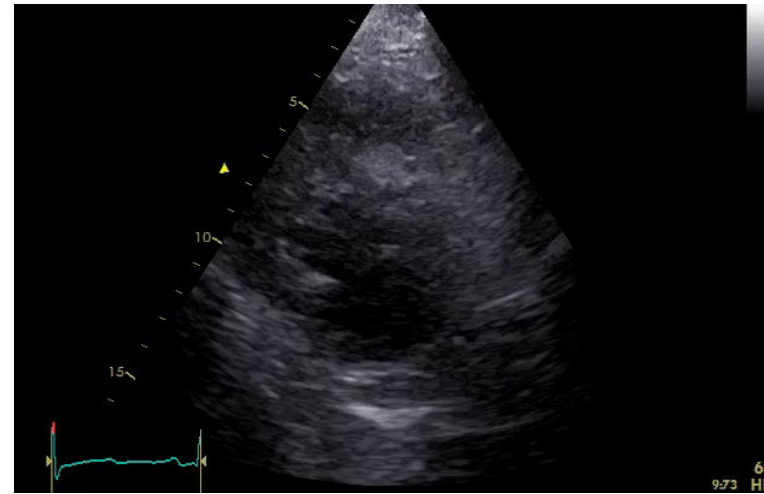


ECHOCARDIOGRAPHY

**A 64 Y.O. MAN
CASE 7**

RV/LV BASAL DIAMETER > 1.0

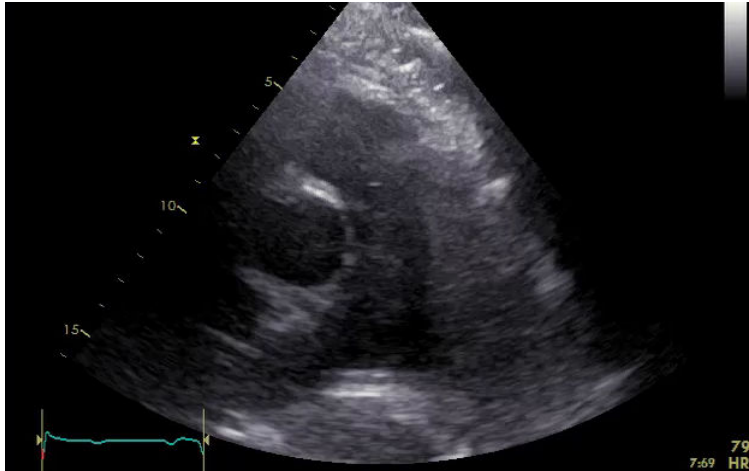
ECCENTRICITY INDEX > 1.1 (S OR D)



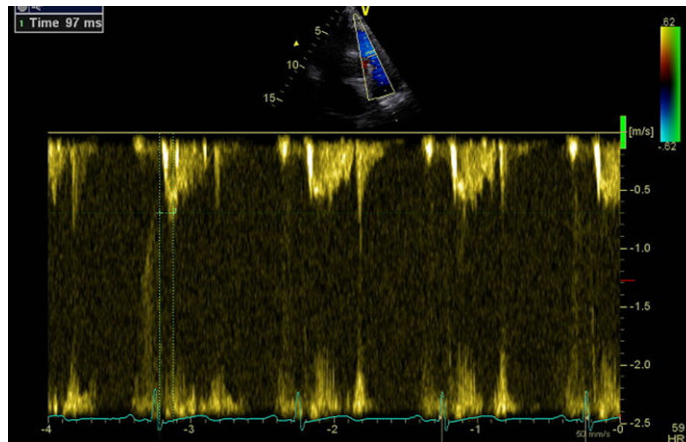
A 64 Y.O. MAN

CASE 7

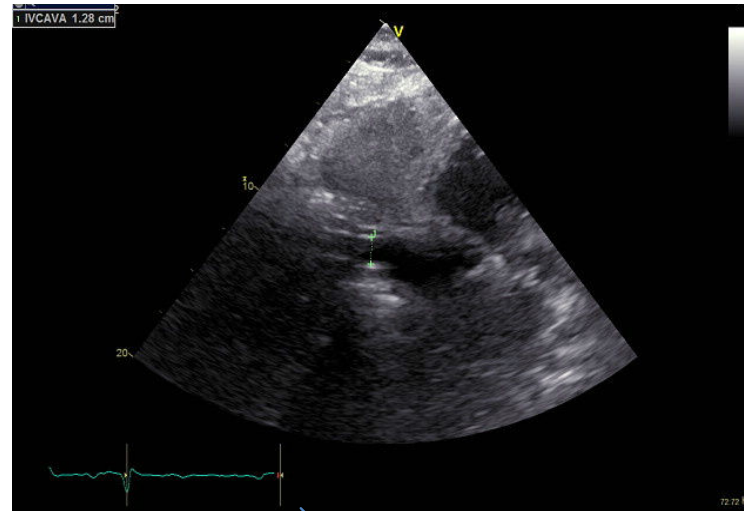
PA diameter > 25 mm



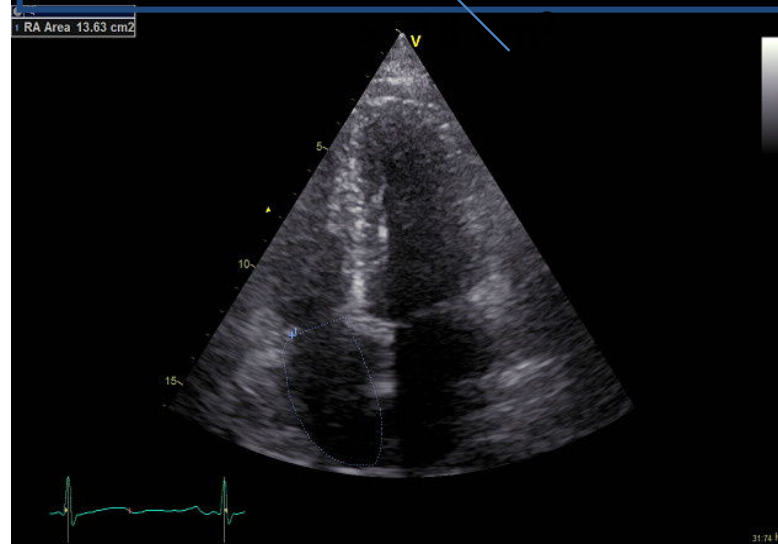
RVOT AccT < 105 msec



IVC > 2.1cm with decreased respiratory collapse



RIGHT ATRIUM AREA end-systole



A 64 Y.O. MAN CASE 7

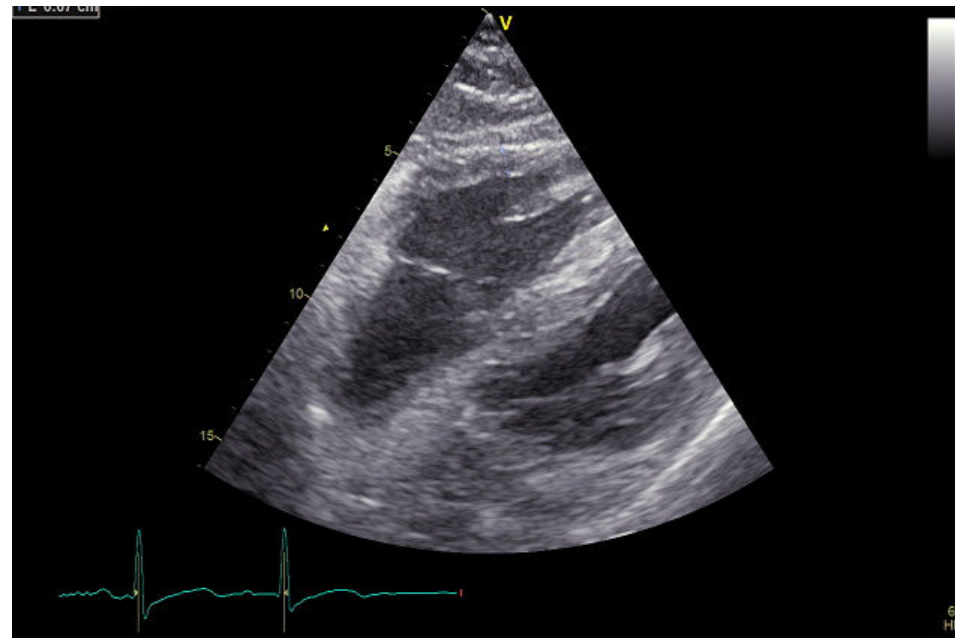
WHO III

BP 110/70 mmHg

SaO₂: 98%

6MWT: 300m → 90%

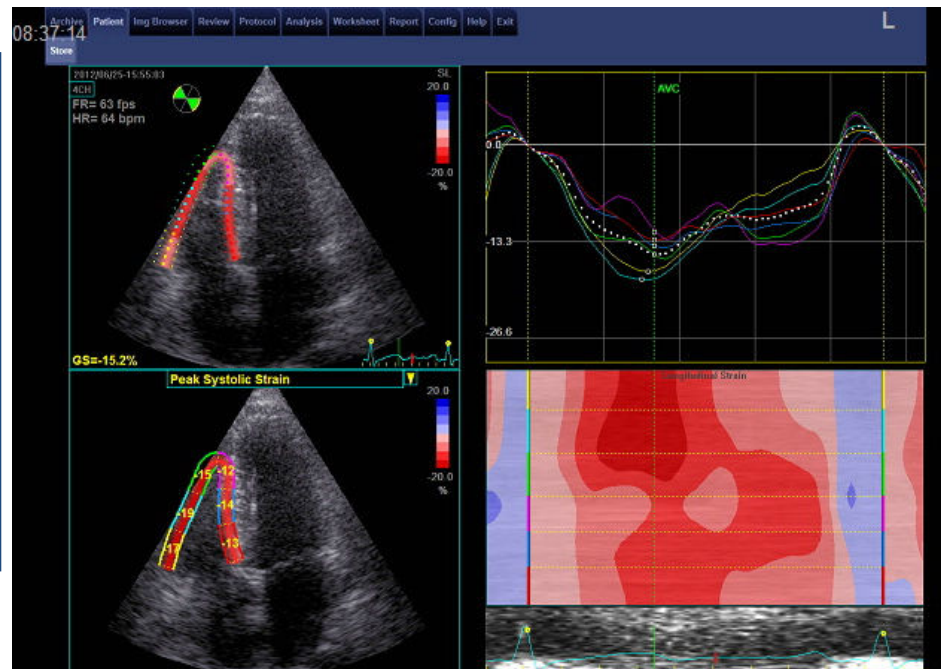
NT-proBNP: 950 pg/ml



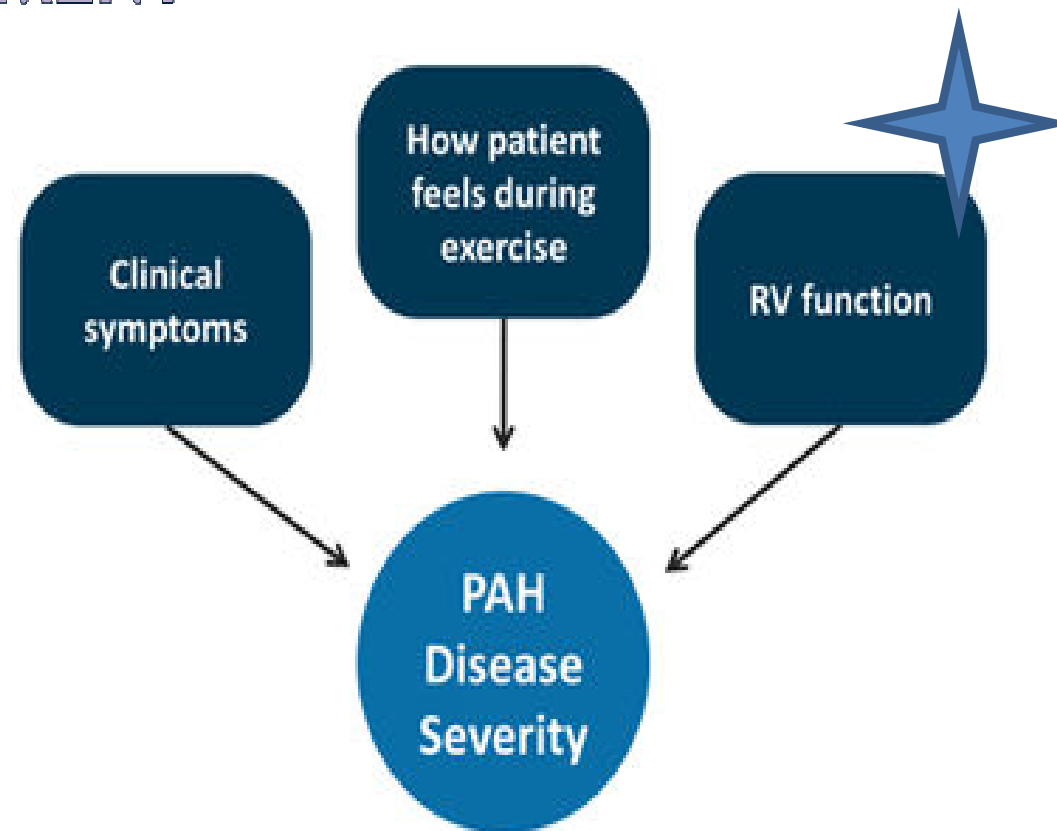
RHC

RA (mmHg)	12
PA (mmHg)	100/36/58
PAWP (mmHg)	10

PVR (WU)	9,6
C.I. (l/min/m ²)	2,1



COMPONENTS OF A COMPREHENSIVE RISK ASSESSMENT



It is important to be comprehensive and use all components of the risk assessment to determine disease severity.

DISTINGUISHING PAH AND PH-LHD USING ECHOCARDIOGRAPHY

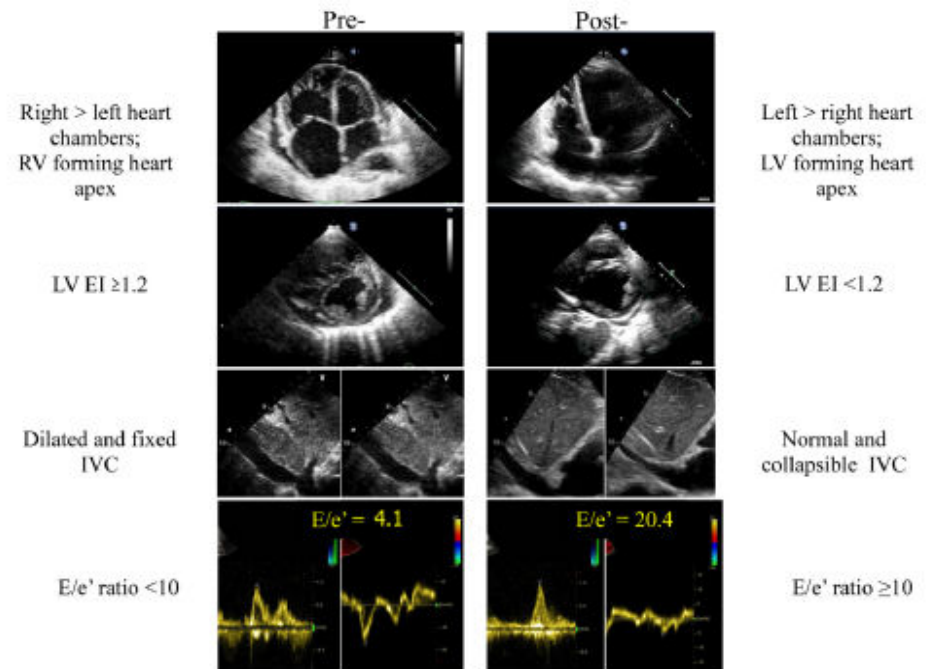
Echo parameter	Echo finding	Likelihood of	
		PH-LHD	PAH
Ejection fraction	<50%	↑	↓
Left atrial size	LAD > 40 mm LAVI > 28 mm/m ²	↑	↓
LV wall thickness	>11 mm	↑	↓
Transmitral Doppler	Grade II/III diastolic dysfunction	↑	↓
Mitral regurgitation	Severity > 1+	↑	↓
RV size	RV-to-LV area > 1.0	↓	↑
Interventricular septum	Systolic flattening Lateral-septal TDI disparity	↓	↑
Interatrial septum	Bowing into LA	↓	↑
RV systolic function	TAPSE <1.5 cm	↓	↑
RVOT Doppler	Notching	↓	↑

PULMONARY HYPERTENSION

Echocardiographic Prediction of Pre- versus Postcapillary Pulmonary Hypertension

Table 4 Selected echocardiographic variables of potential predictive value entered as variables in the univariate and multivariate logistic regression

Variable	Cutoff value	Univariate logistic regression	
		P	SE
Right > left heart chamber	1	.0018	0.34
EI	≥ 0.9	.0039	0.33
IVC	>20 mm, no collapse	.0076	0.39
E/E' ratio	≤ 10	.00001	0.38
RV forming apex	Present	.0144	0.35
PA notch	Present	.2085	0.34
Pericardial effusion	Present	.7805	0.52
Moderate to severe left valve disease	Present	.1784	0.44
Total score			

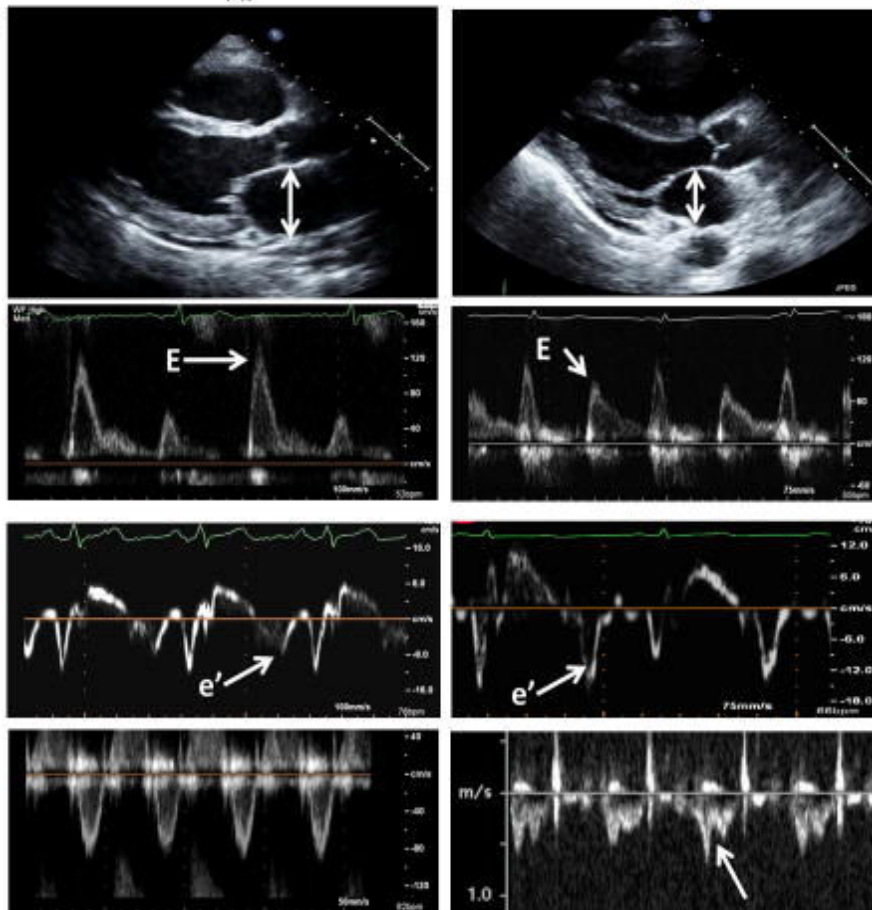


152 pts

53% had precapillary PH, and 40% had postcapillary PH.

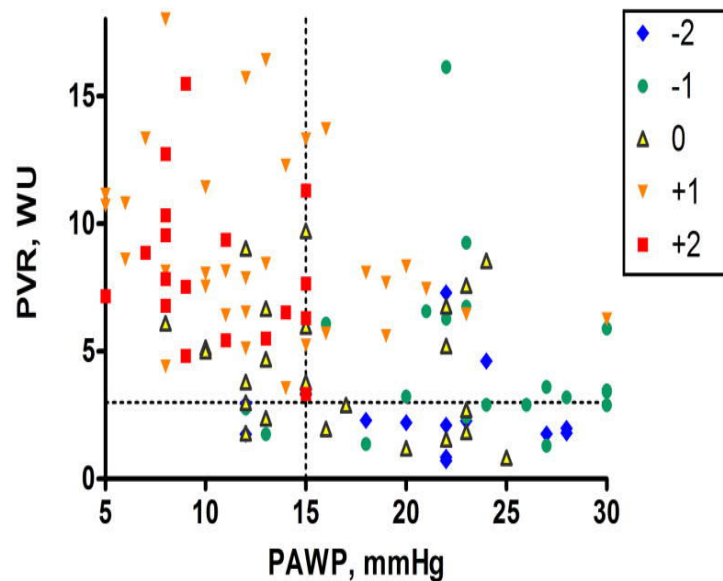
A SIMPLE ECHOCARDIOGRAPHIC PREDICTION RULE FOR HEMODYNAMICS IN PH

The derived prediction rule ranged from -2 to +2



+1 point for LA <3.2 cm
-1 for LA >4.2 cm
+1 for AccT <80 ms
-1 for lateral mitral E:e' >10

Hemodynamic Profile by Echo Score



A score ≥ 0 had 100% sensitivity
and 69.3% PPV for PH(PVD) PRECAPILLARY
PH, with 62.3% specificity

A CLINICAL AND ECHOCARDIOGRAPHIC SCORE TO IDENTIFY PH DUE TO HFPEF

Simple clinical characteristics (atrial fibrillation, diabetes mellitus) and echocardiographic features (left ventricular mass index, left atrial area, and end-diastolic right ventricular area) may help physicians to differentiate PH-HFpEF and precapillary-PH.

The score was internally validated and may have clinical interest, a point that needs to be prospectively studied

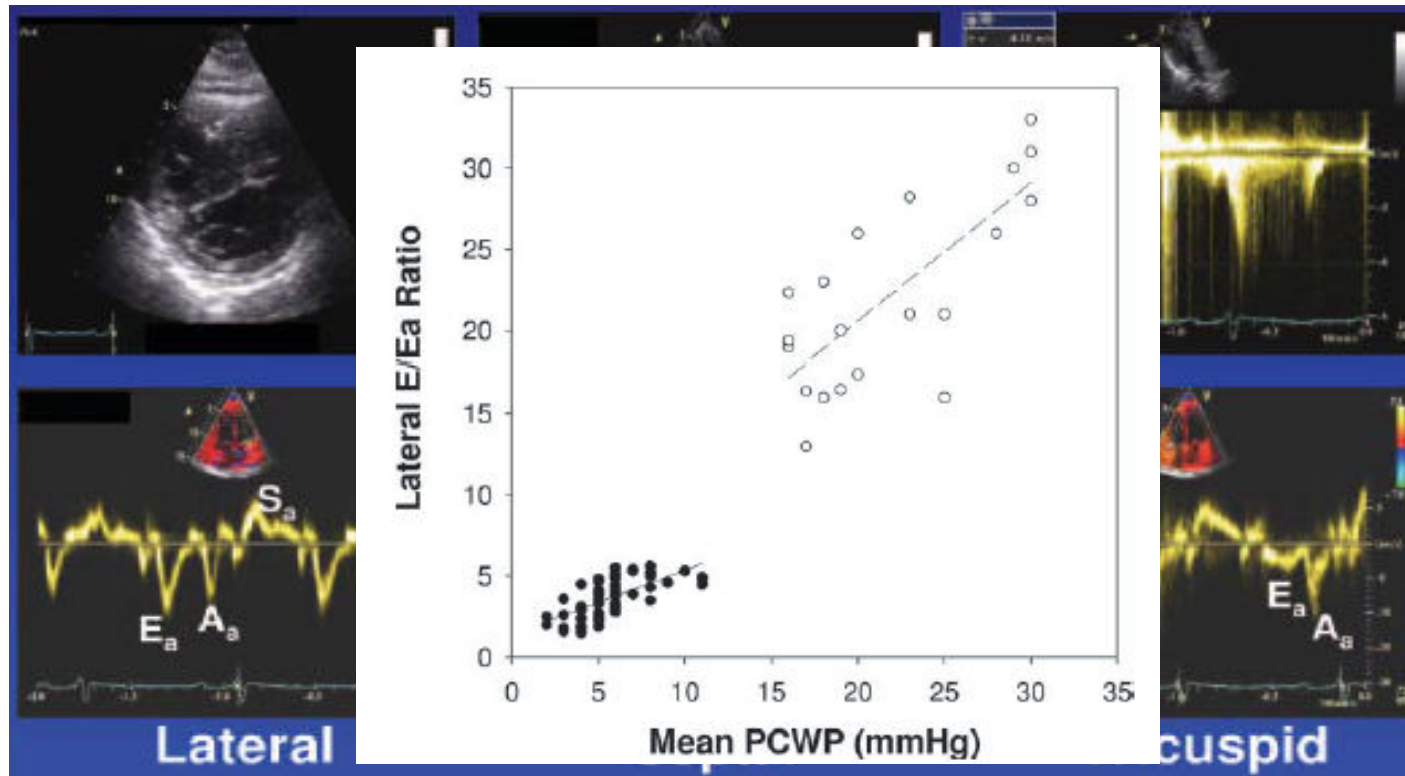
[J Card Fail.](#) 2017 Jan;23(1):29-35

A SIMPLE DERIVED PREDICTION SCORE FOR THE IDENTIFICATION OF AN ELEVATED PAWP USING PRECATHETERIZATION CLINICAL DATA IN PATIENTS REFERRED TO A PH CENTER

The optimal model for predicting PAWP > 15 mm Hg was composed of age (> 68 years), BMI (> 30 kg/m²), absence of right ventricular enlargement, and presence of left atrial enlargement (area under the curve, 0.779

[Chest.](#) 2016 May;149(5):1261-8

CLINICAL APPLICATION OF TISSUE DOPPLER IMAGING IN PATIENTS WITH IPAH



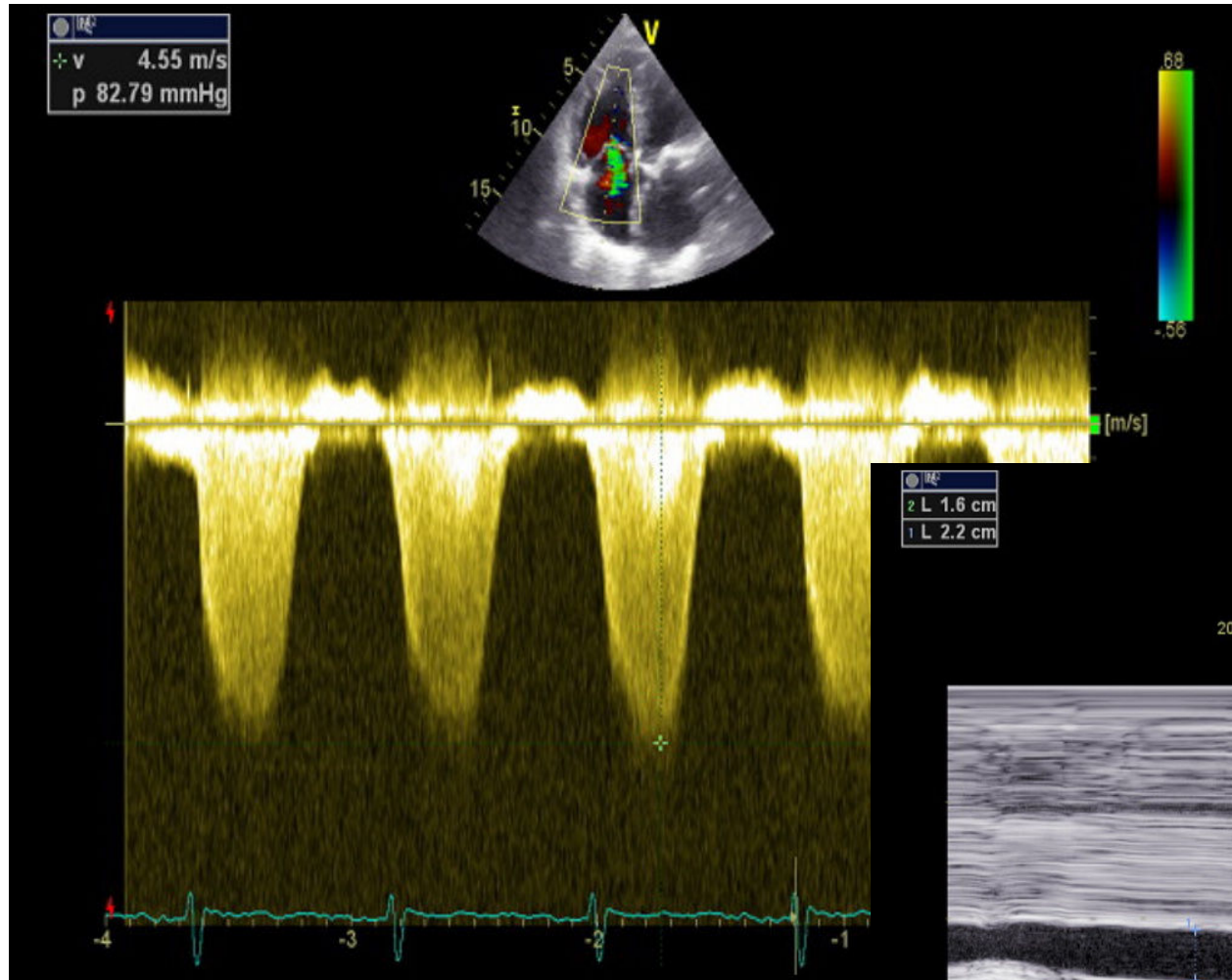
Unlike E_a at the lateral side of the mitral annulus, septal E_a increased because of the improvement in RV relaxation. Therefore, lateral and not septal, E/E_a ratio should be applied to track changes in LV filling and LA pressure with long-term targeted therapy for idiopathic PH.

CHEST 2007; 131:395–401

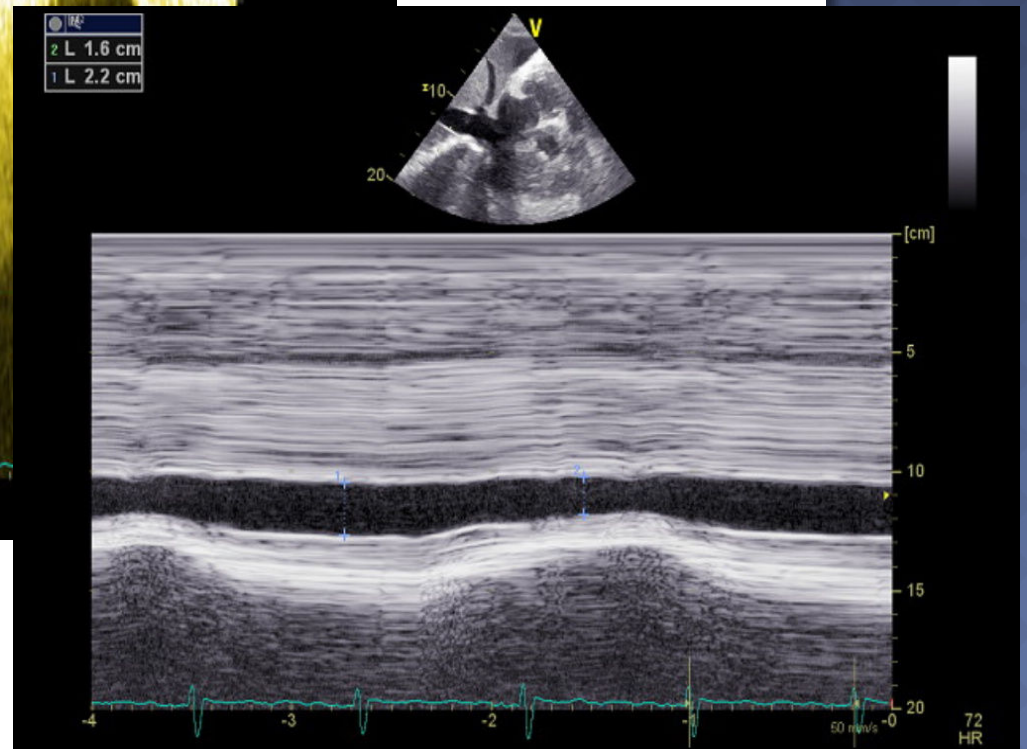
KEY FACTORS SUGGESTIVE OF GROUP 2 PULMONARY HYPERTENSION

Clinical presentation	Echocardiography	Other features
Age >65 years	Structural left heart abnormality • Disease of left heart valves • LA enlargement (>4.2 cm) • Bowing of the IAS to the right • LV dysfunction • Concentric LV hypertrophy and/or increased LV mass	ECG • LVH and/or LAH • AF/Afib • LBBB • Presence of Q waves
Symptoms of left heart failure	Doppler indices of increased filling pressures • Increased E/e' • >Type 2–3 mitral flow abnormality	Other imaging • Kerley B lines • Pleural effusion • Pulmonary oedema • LA enlargement
Features of metabolic syndrome	Absence of • RV dysfunction • Mid systolic notching of the PA flow • Pericardial effusion	
History of heart disease (past or current)		
Persistent atrial fibrillation		

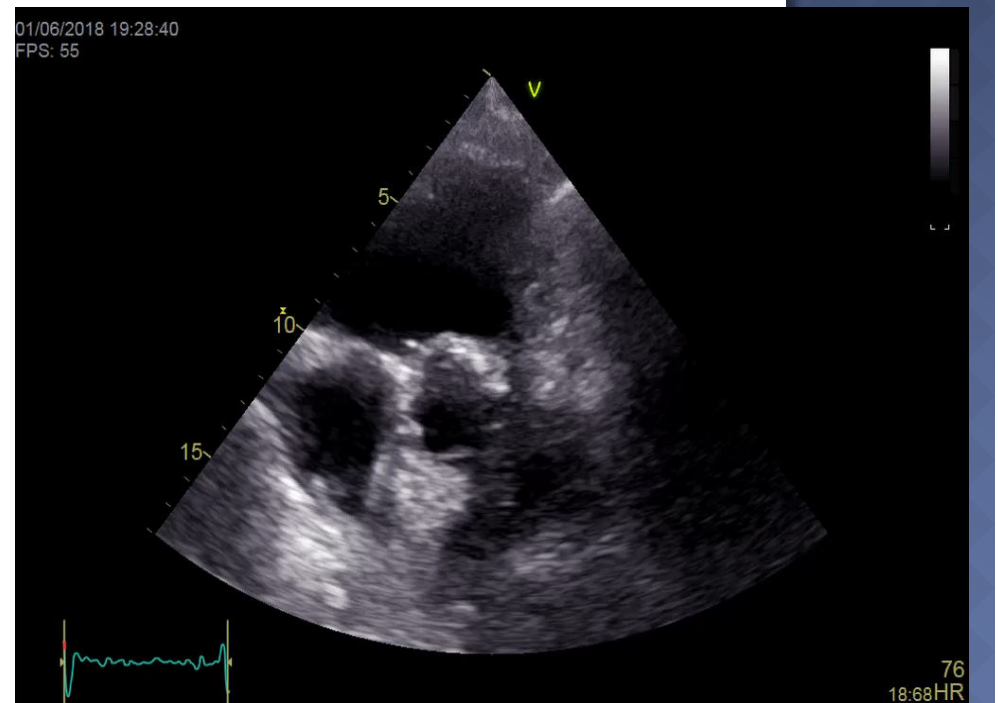
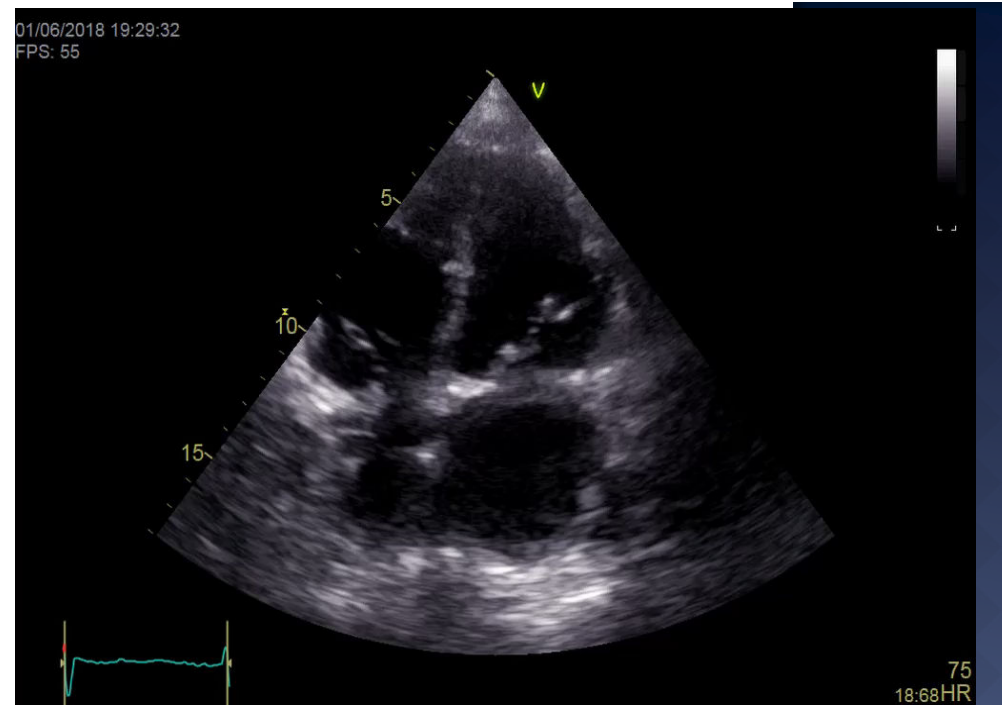
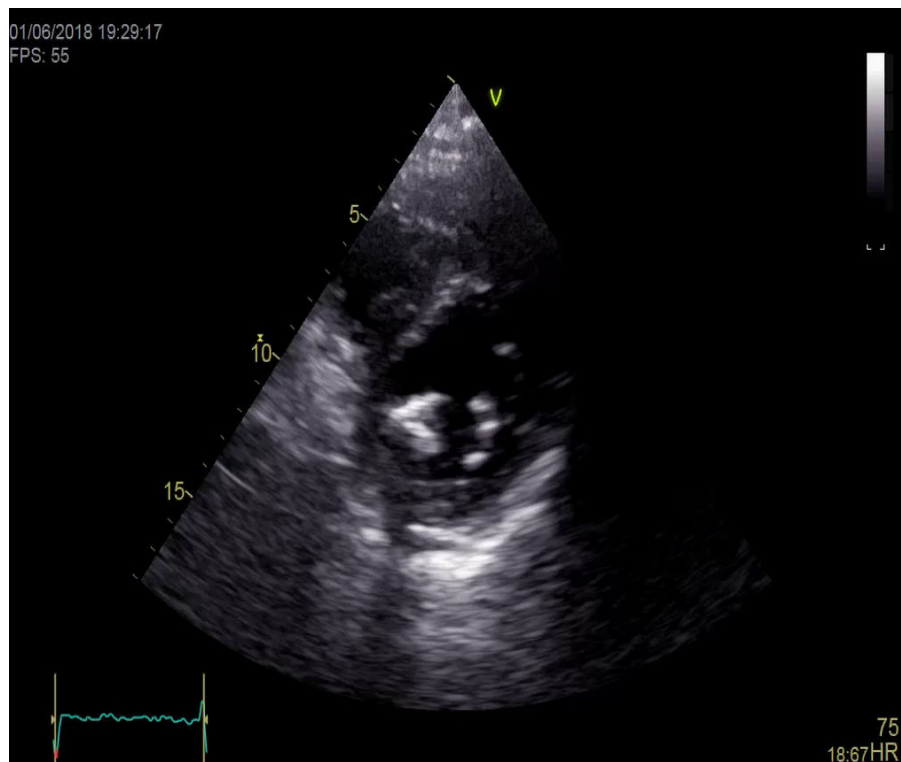
PAH OR PH GROUP 2? CASE 8



Woman 76 y.o.



PAH OR LHD ? CASE 8



STRENGTHS AND WEAKNESSES OF ECHOCARDIOGRAPHY FOR THE DIAGNOSIS OF PH

Definition	Characteristics ^a
PH	PAPm ≥ 25 mmHg
Pre-capillary PH	PAPm ≥ 25 mmHg PAWP ≤ 15 mmHg
Post-capillary PH	PAPm ≥ 25 mmHg PAWP > 15 mmHg
Isolated post-capillary PH (lpc-PH)	DPG < 7 mmHg and/or PVR ≤ 3 WU ^c
Combined post-capillary and pre-capillary PH (Cpc-PH)	DPG ≥ 7 mmHg and/or PVR > 3 WU ^c

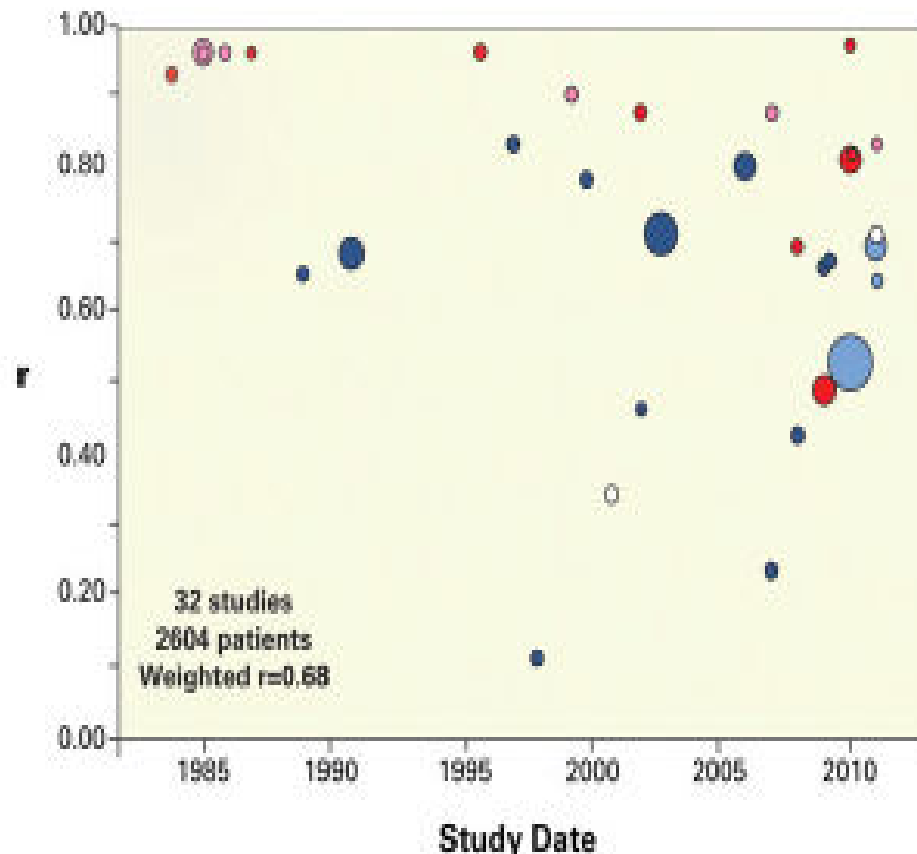
Right heart catheterization remains the gold standard for pulmonary hypertension diagnosis.

Nevertheless, invasive parameters must be integrated by clinical picture and echo imaging to achieve an ultimate and correct diagnosis of pulmonary hypertension.

LIMITATIONS AND STRENGTHS OF DOPPLER/ECHO

PASP-RHC CORRELATIONS:

A SYSTEMATIC LITERATURE REVIEW



Red = predominately left heart pathology in that study;
blue = predominately right heart;
white = neither predominating.

The darkness of the color is proportional to a greater percent of that pathology.

The size of the circles crudely represents the study's patient sample size.

The D PASP correlates well with RHC values in patients with left heart pathology while it fares more poorly in right heart pathology

Thank you
for your attention

In Greek mythology,
Echo (Greek, ἠχώ ; Ēkhō ; Sound) is a
mountain nymph who loves her own voice.

Although it is indeed beautiful,
the voice of echocardiography is insufficient as
a solo instrument used in the diagnosis of PAH.

