Diagnosing Heart Failure With Echocardiography

Dr. Alison Duncan

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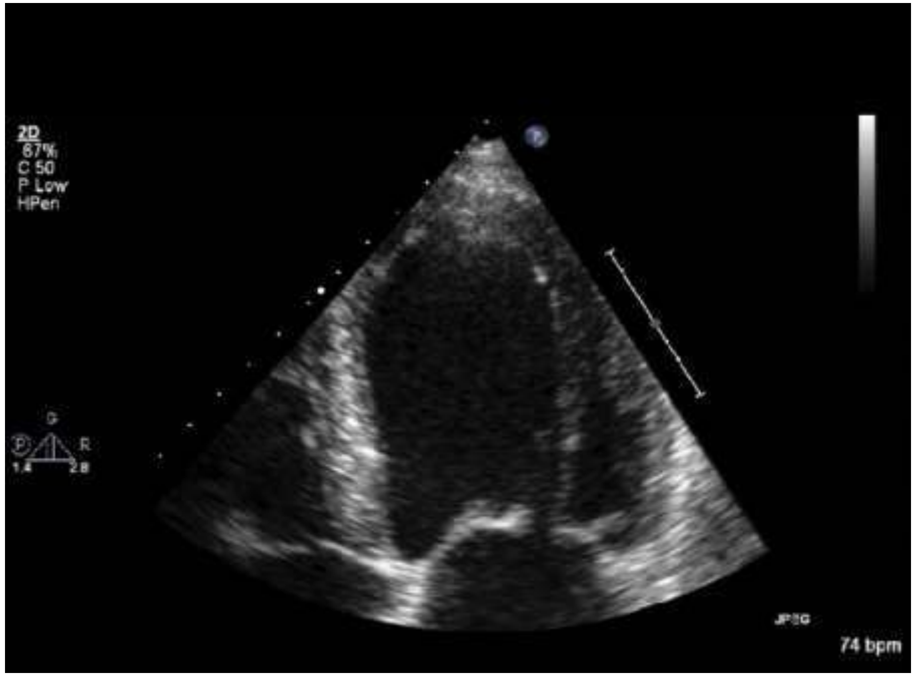
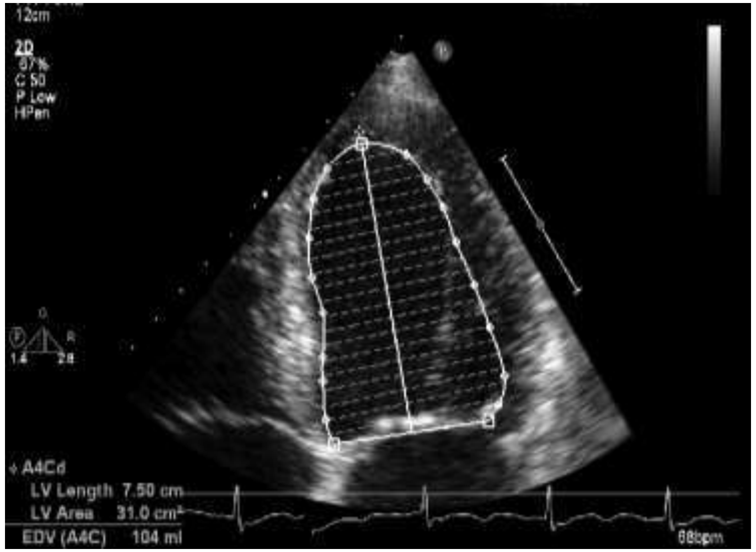
Part of Guys and St. Thomas' Foundation Trust

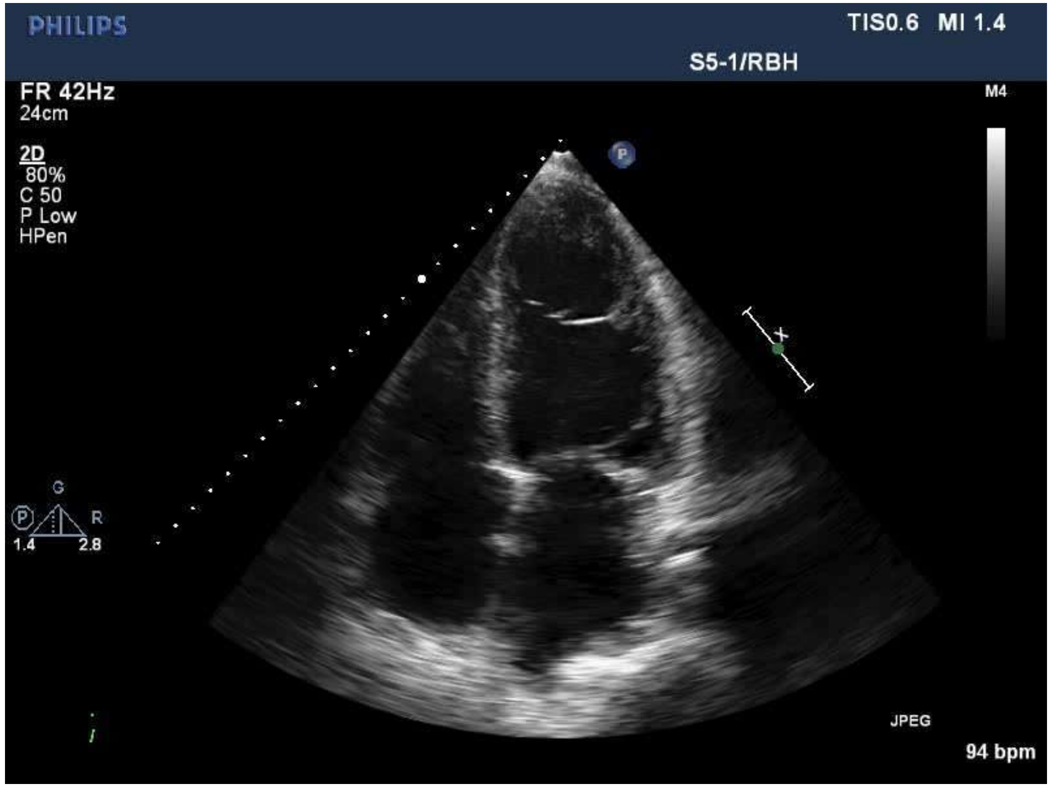
Measuring LVEF with 2D Echo

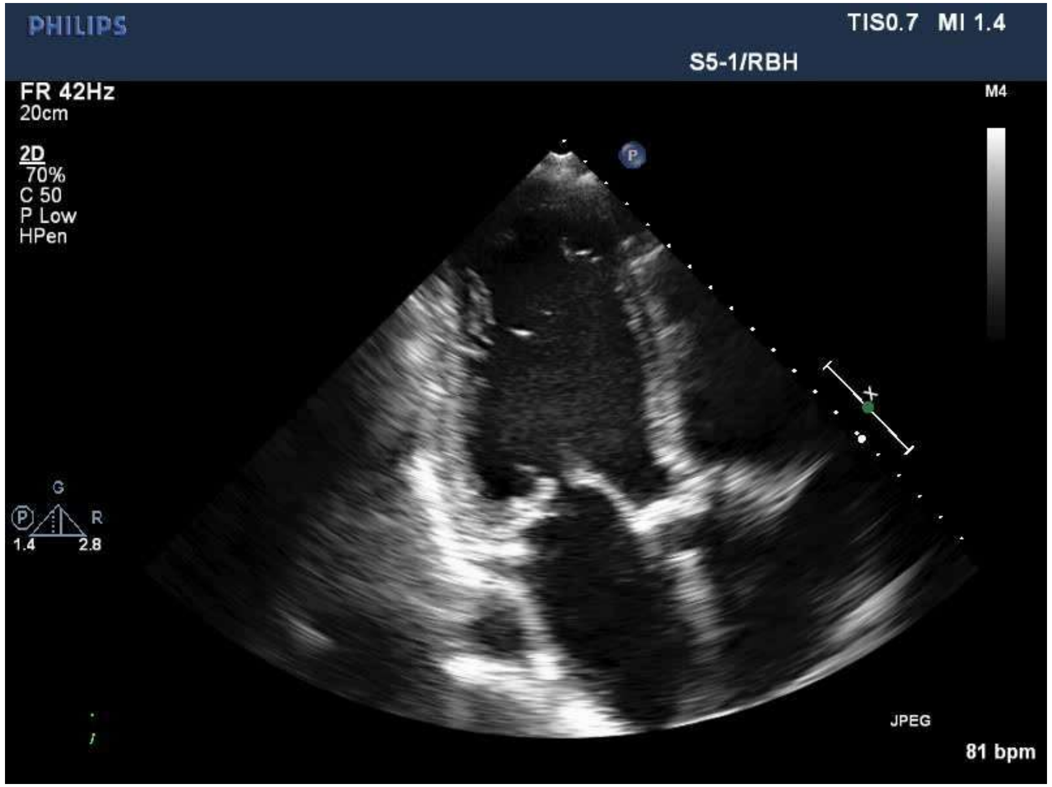




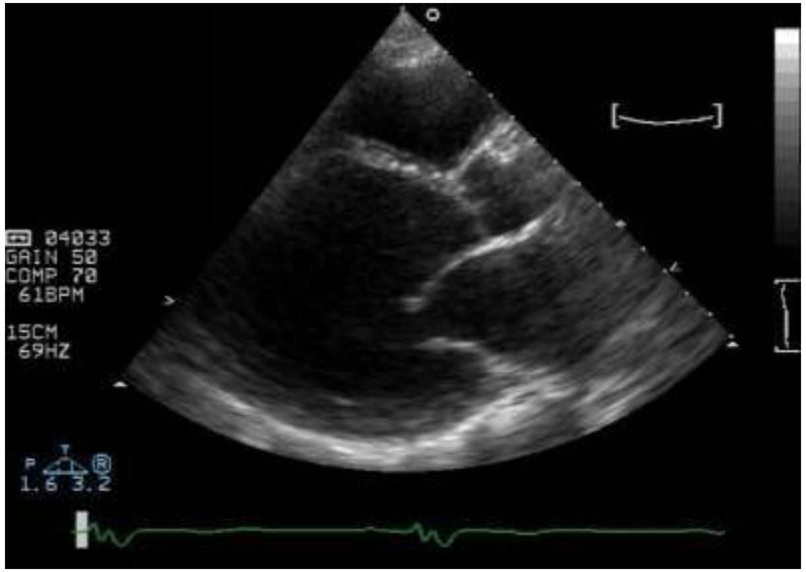
- Modified biplane Simpson's rule
- Measures EDV and ESV (ml)
- Calculated EF (%) $= \dfrac{EDV - ESV * 100}{EDV}$

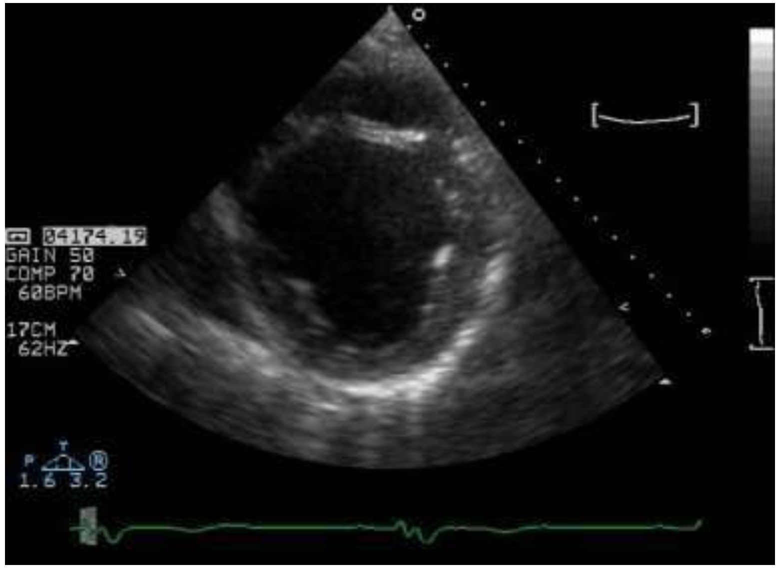
HFrEF <40%

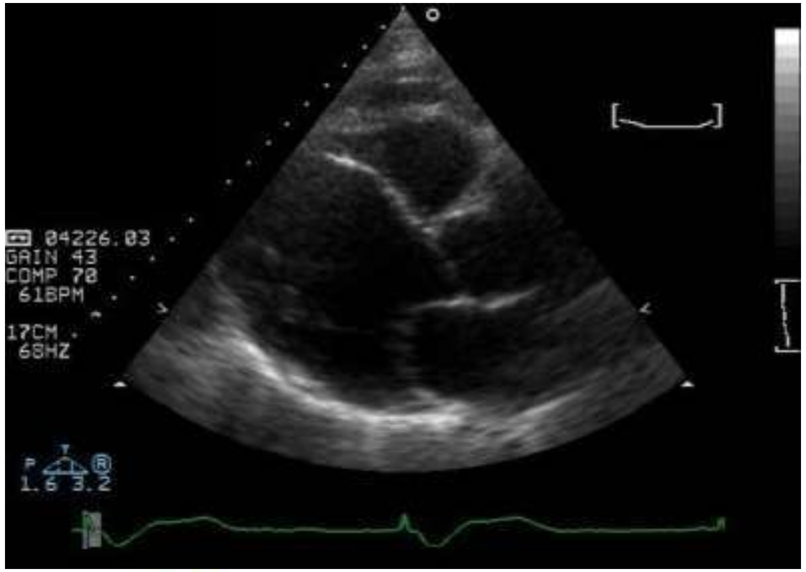

PHILIPS
TIS0.6 MI 1.4
S5-1/RBH
FR 42Hz
24cm
2D
80%
C 50
P Low
HPen
M4
JPEG
94 bpm

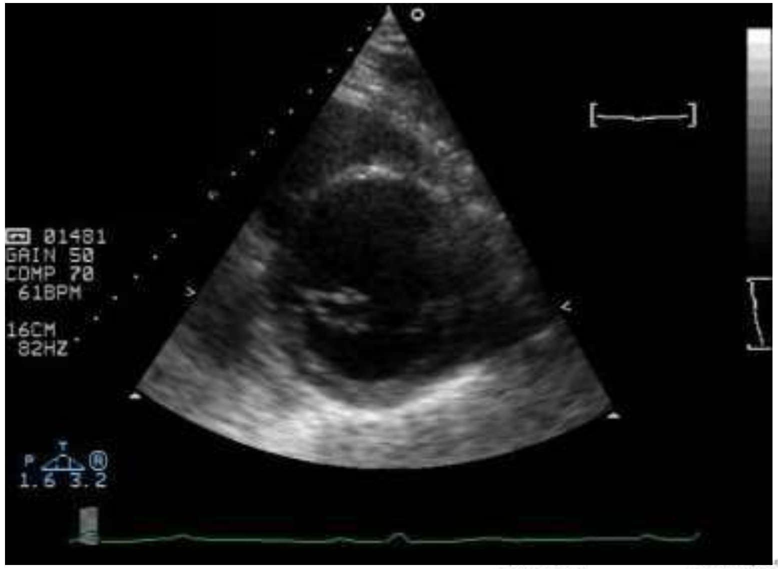

PHILIPS
TIS0.7 MI 1.4
S5-1/RBH
FR 42Hz
20cm
2D
70%
C 50
P Low
HPen
M4
JPEG
81 bpm

DCM and Ischaemic CM

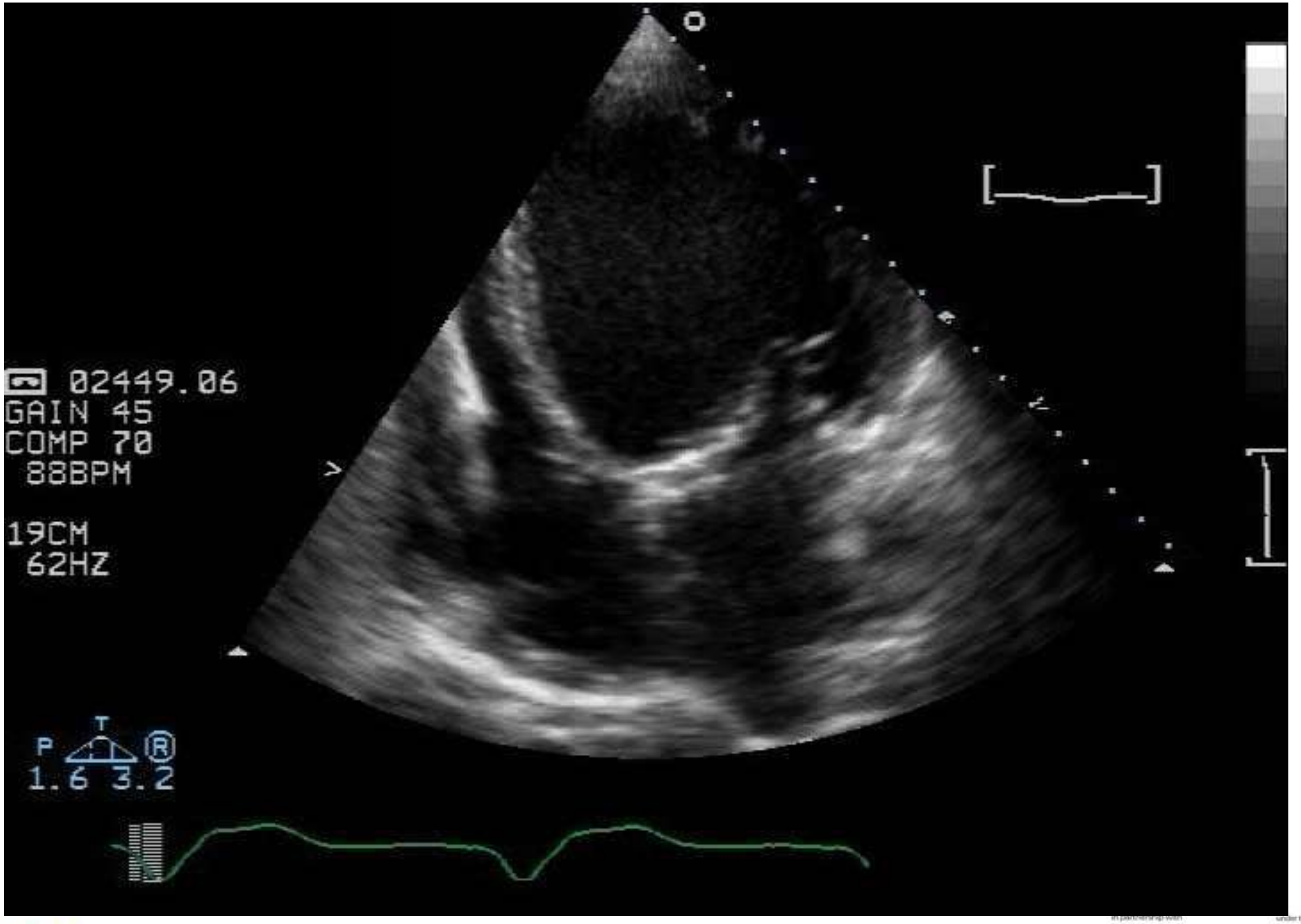




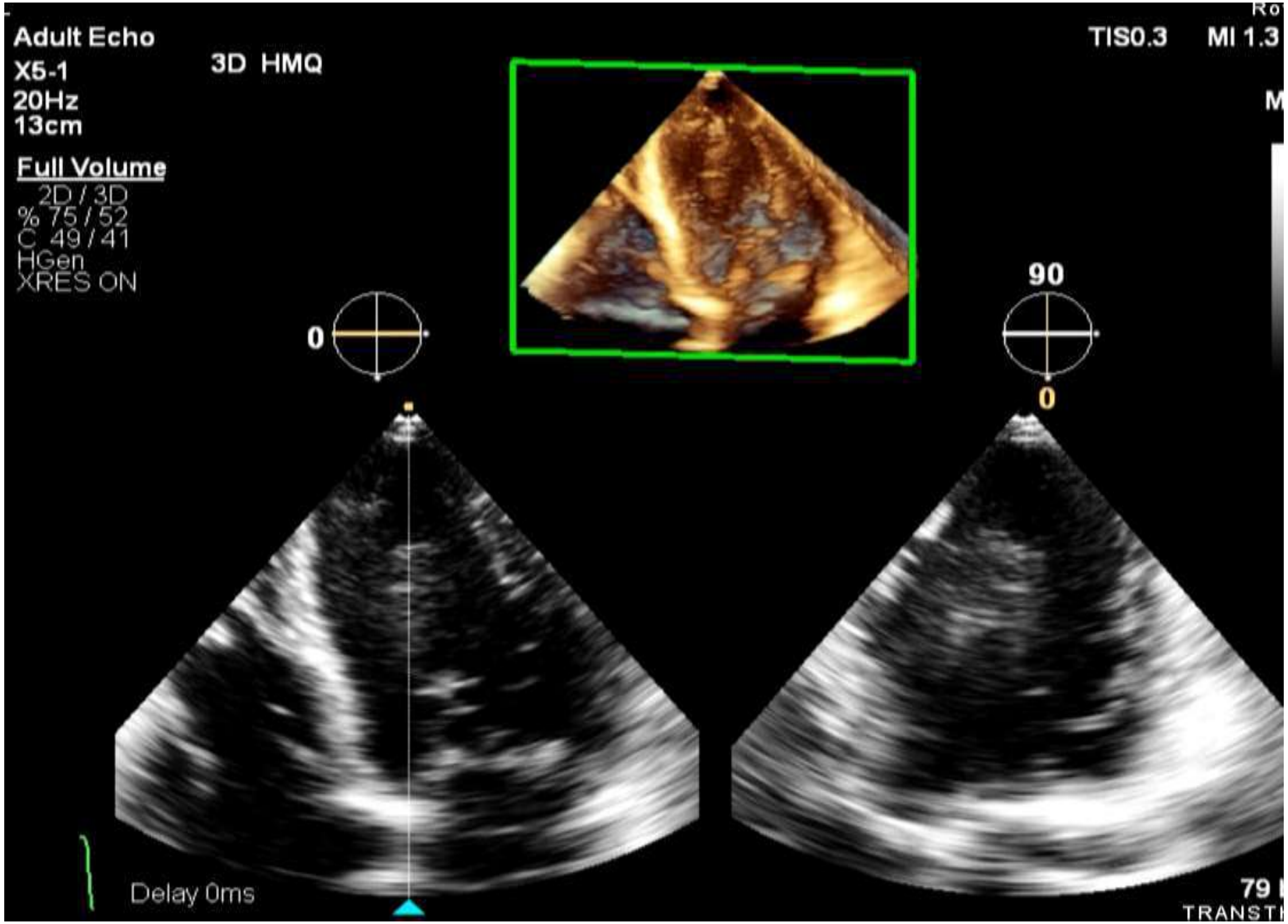




Incoordinate LV



Diagnosing HF with 3D Echo



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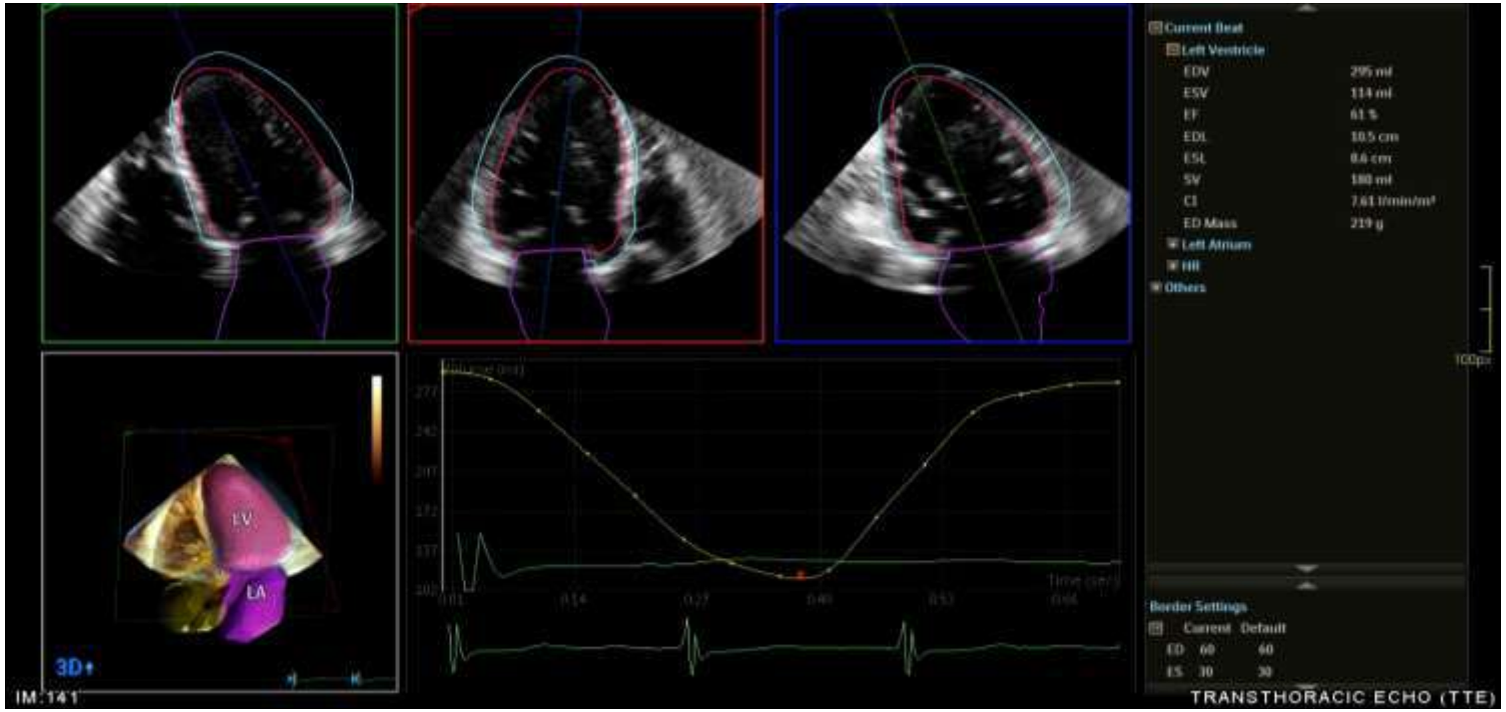
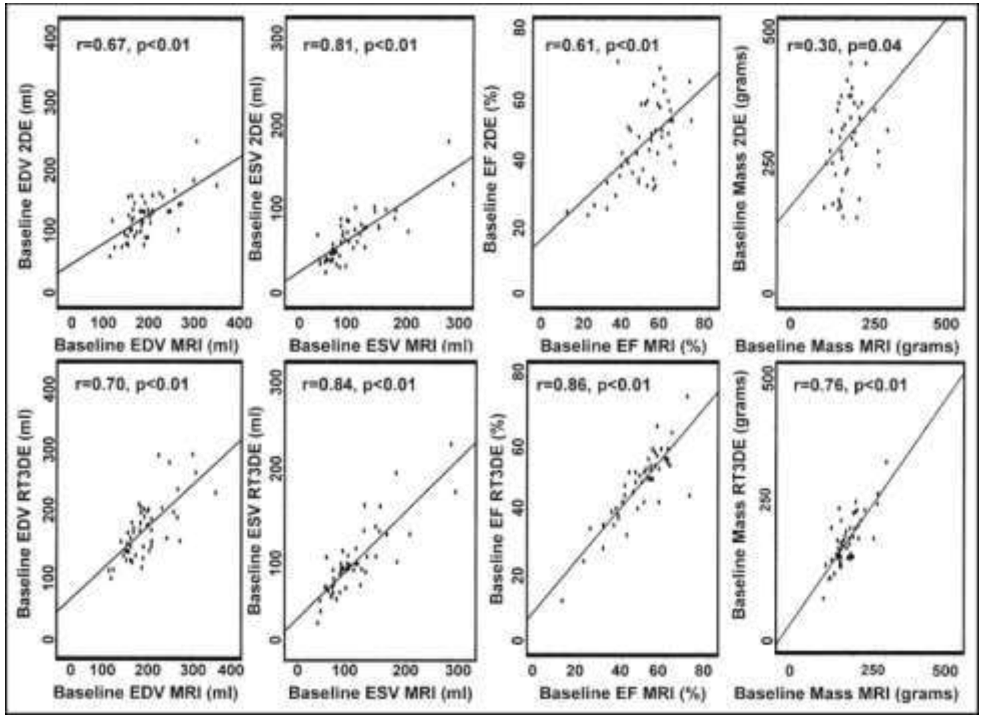
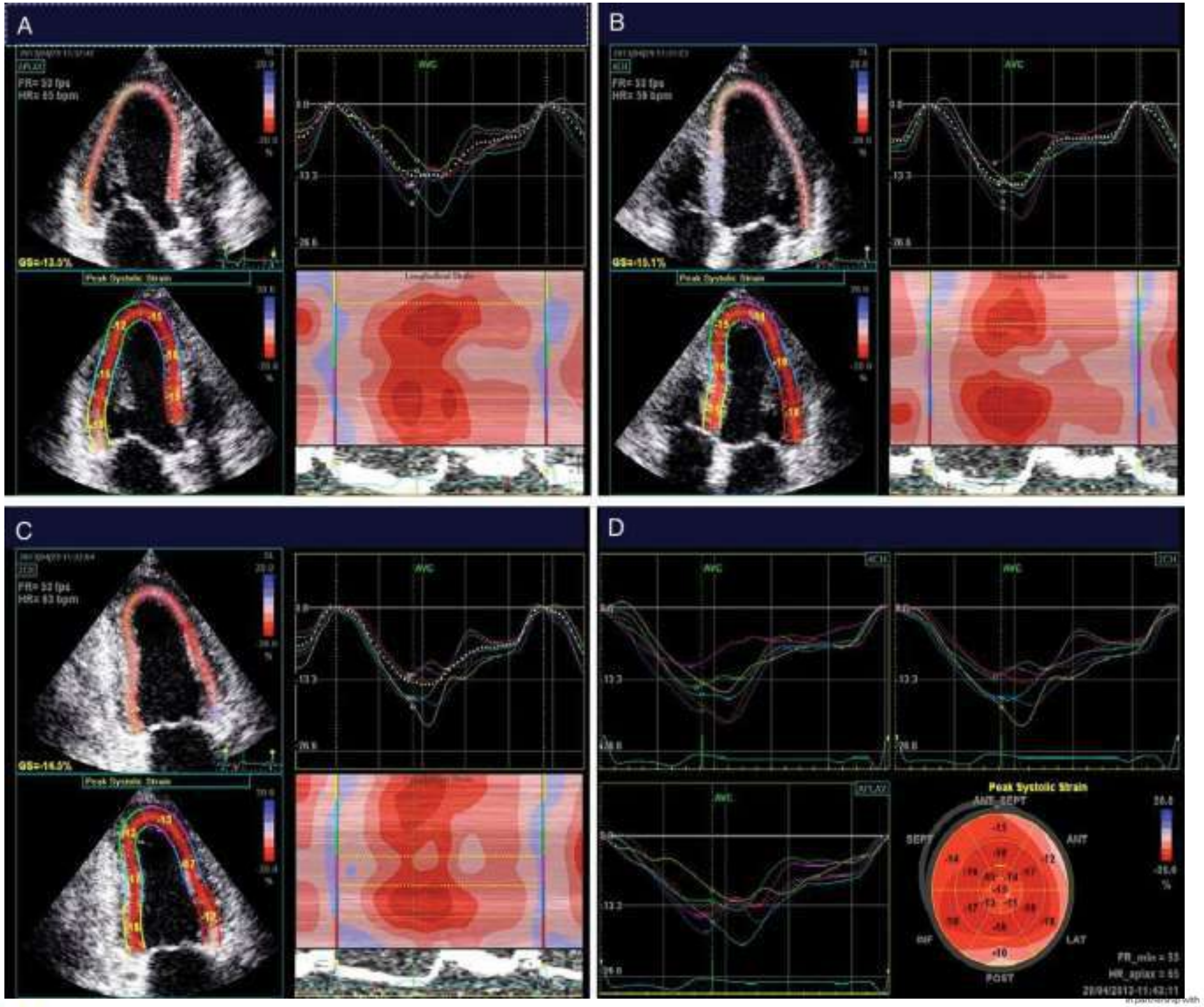




Detecting subclinical LV disease: GLS



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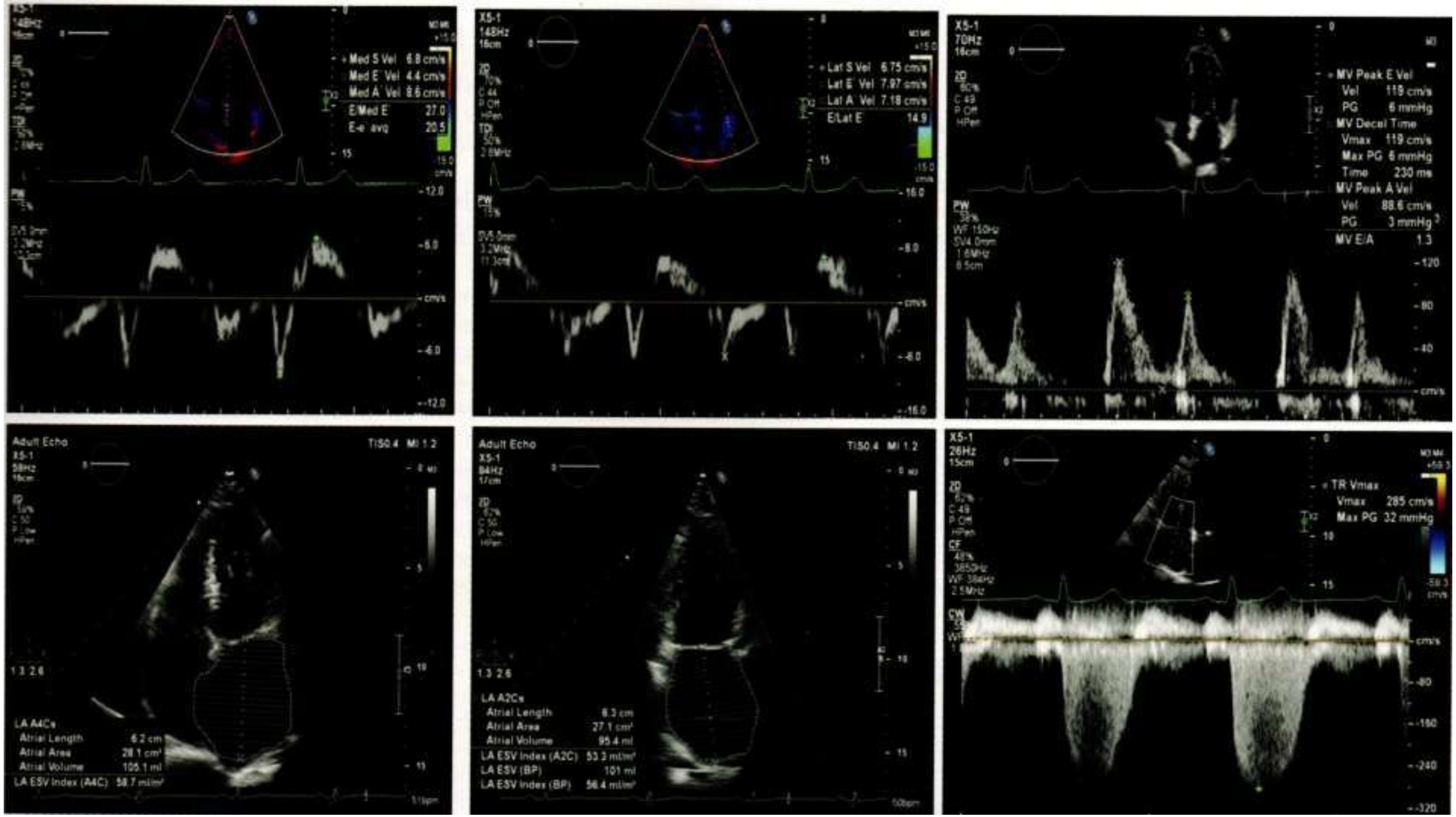
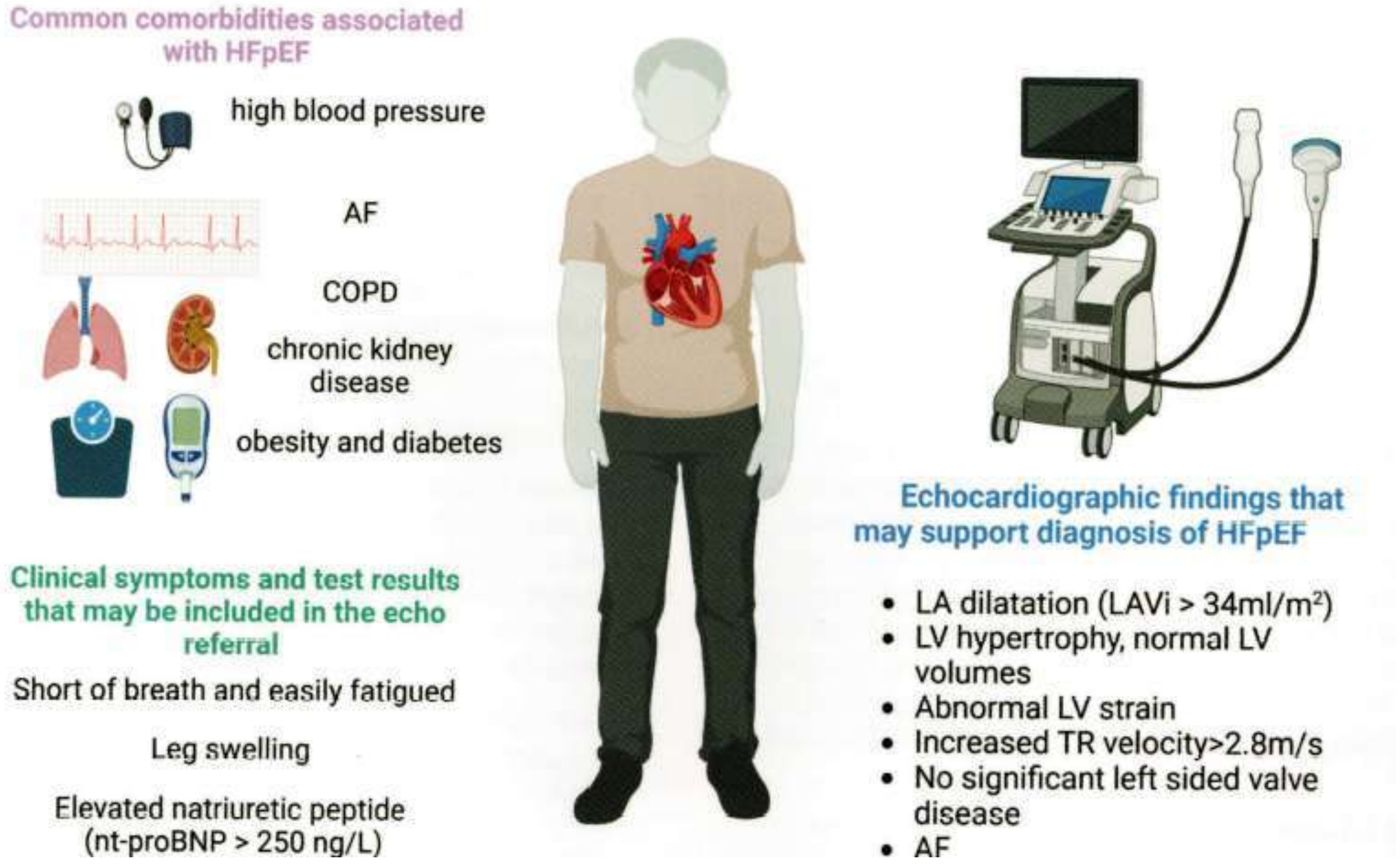
HF2PEF Score

HFA-PEFF Score

Diagnosing HF preserved LVEF

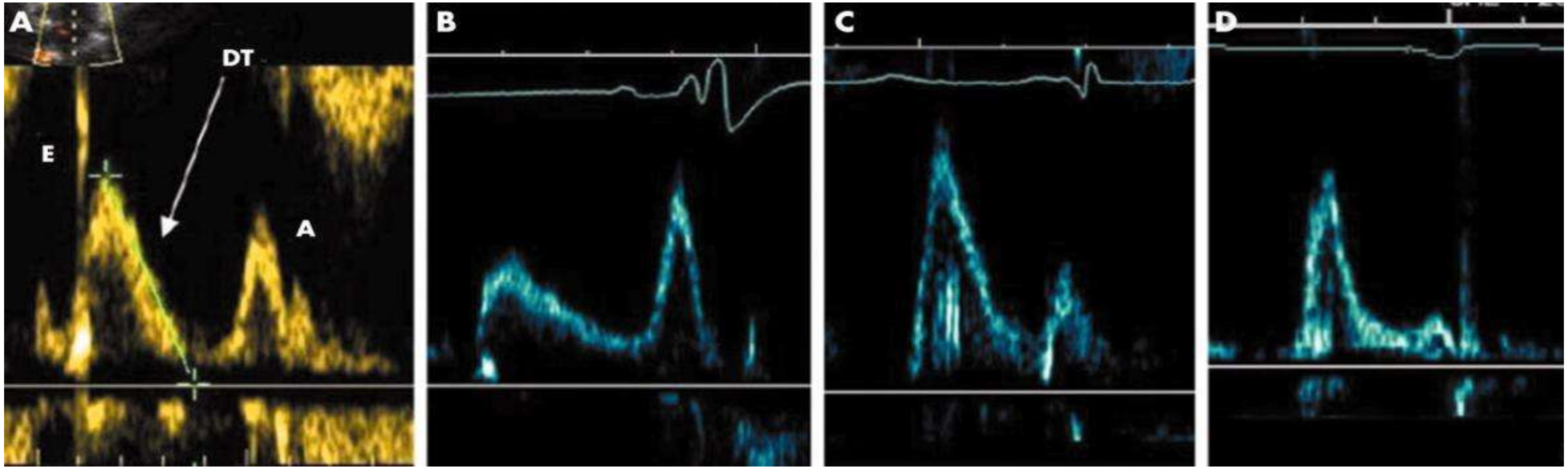


When to suspect HFpEF



Diagnosing HF preserved LVEF

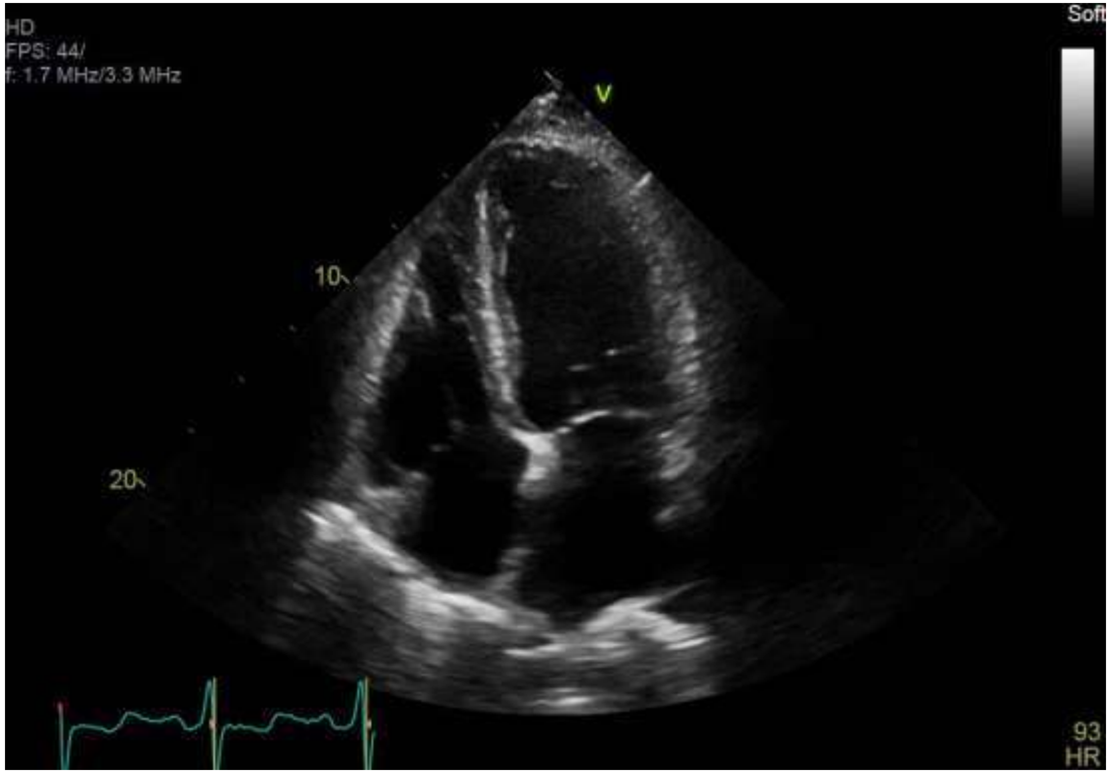
Normal	Dominant A	Pseudonormal	Restrictive

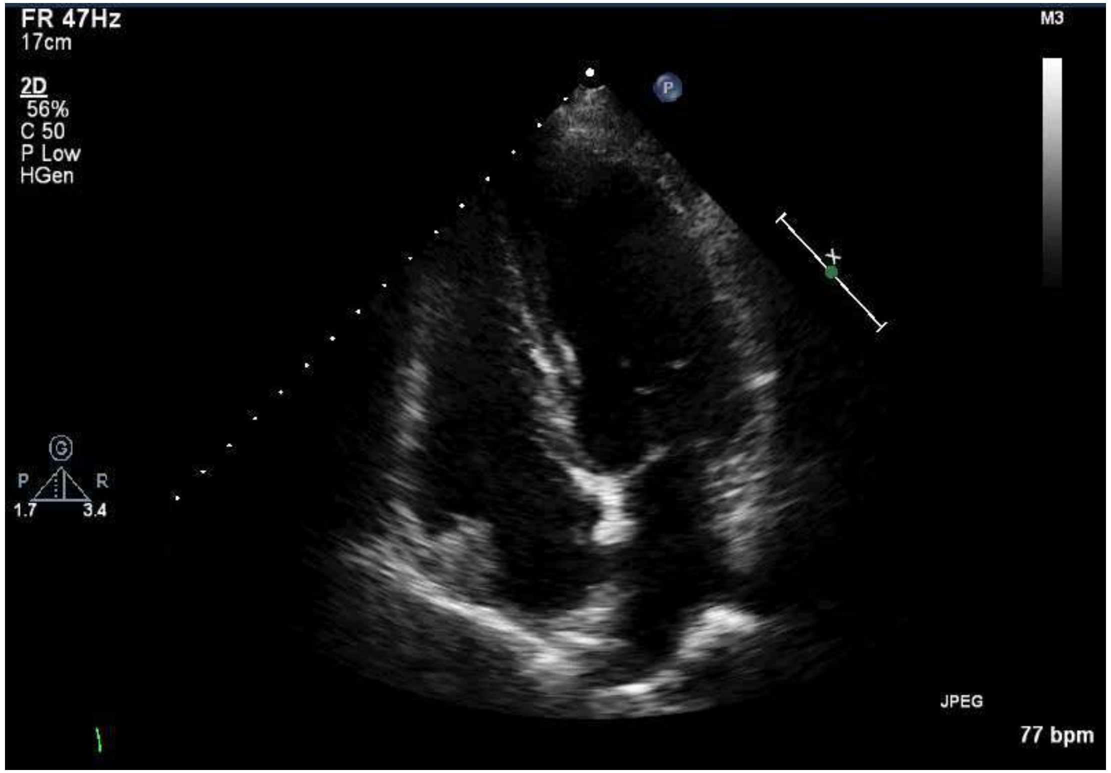


E:A >1	E:A <1	E:A1.0-1.5	E:A >2
EDT 150-220ms	EDT >250ms	EDT 150-220ms	EDT <150
IVRT <90ms	IVRT >90ms	IVRT <90ms	IVRT <70ms

So far.... So easy....

LVEF in presence of severe AS

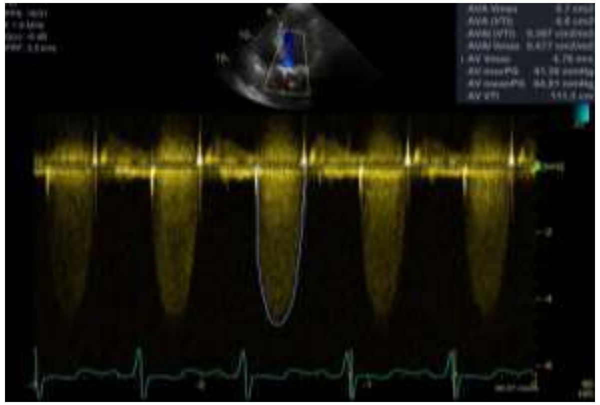
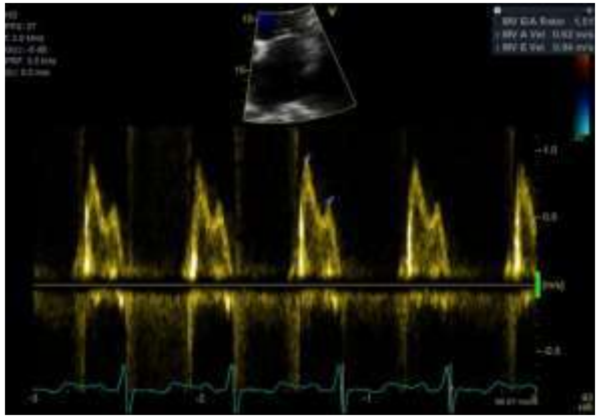
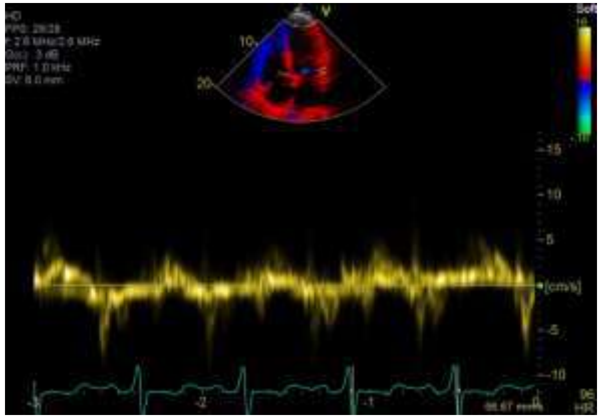




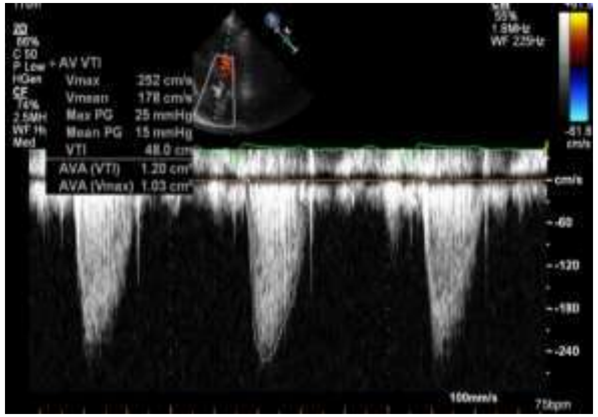
Physiology of Heart Failure

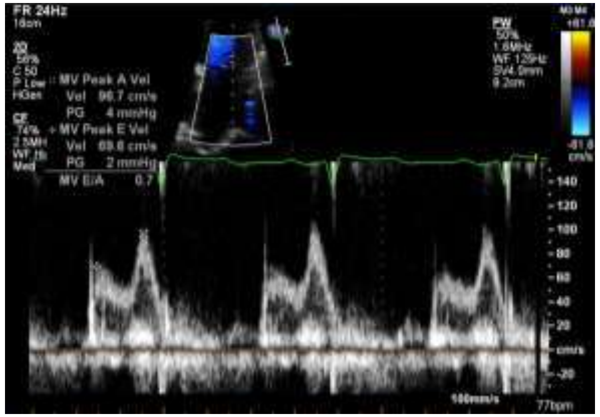
Master Course in Heart Failure 25 BAKU
Baku Marriott Hotel Boulevard
30th of May - 1st of June

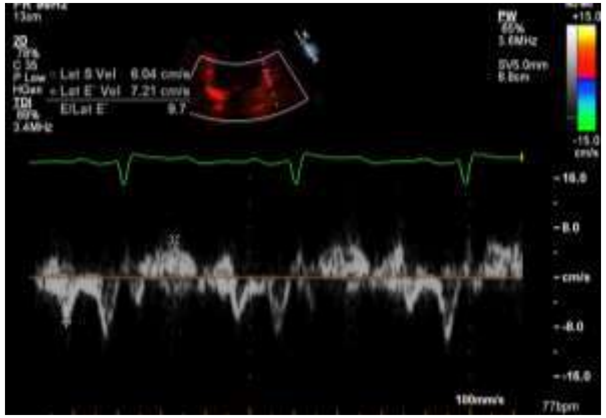
Before TAVR

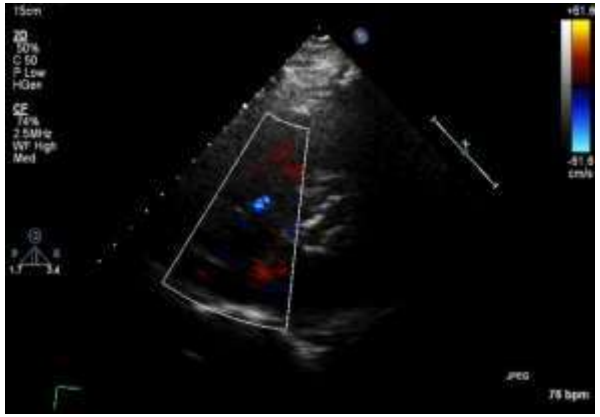





8 weeks after TAVR

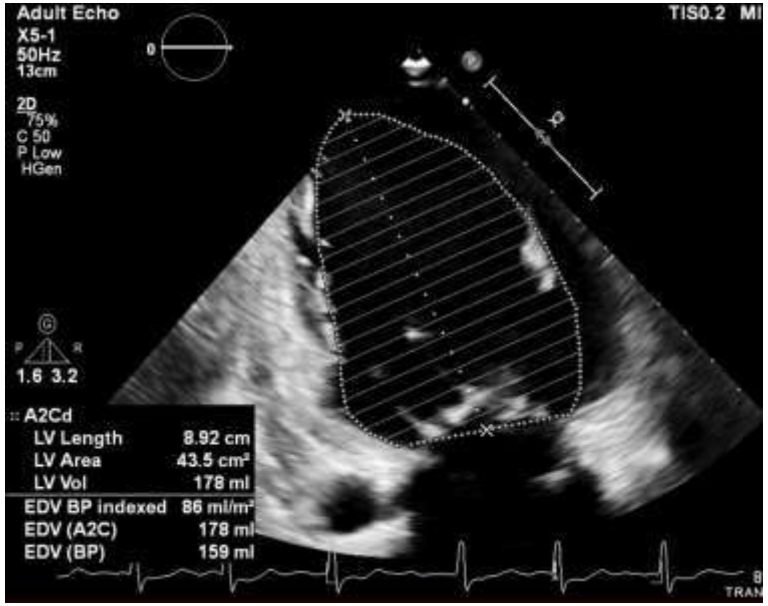


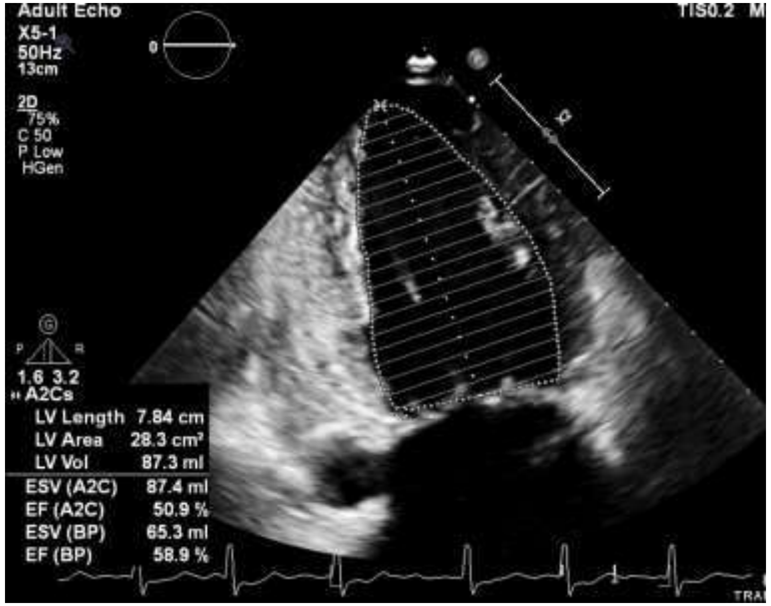


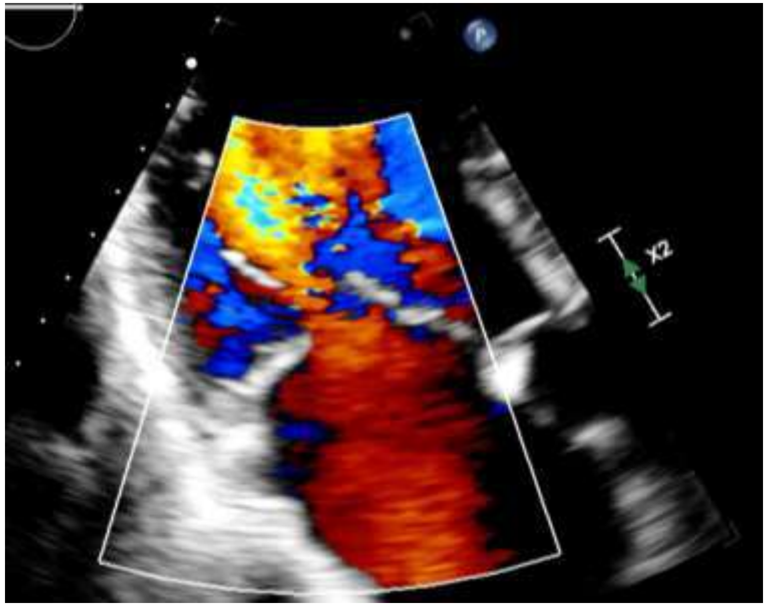




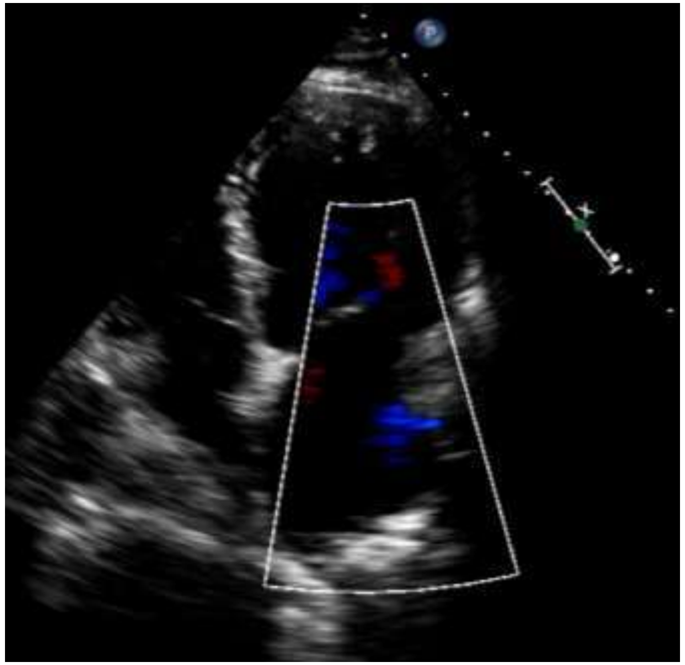
LVEF in presence of severe MR

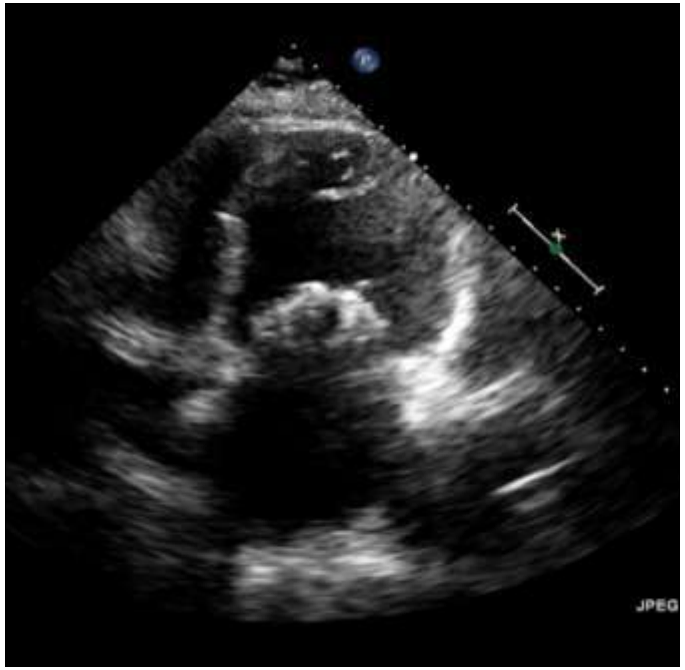


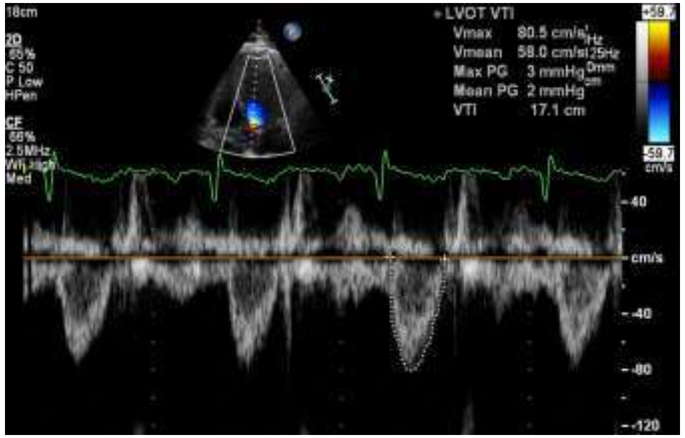


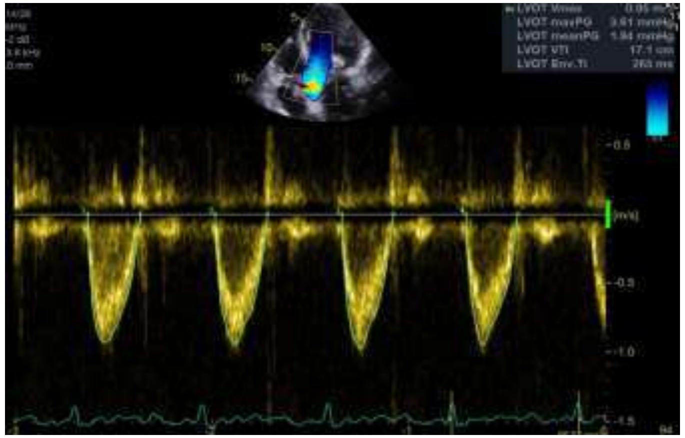


LVEF before and after TMVR



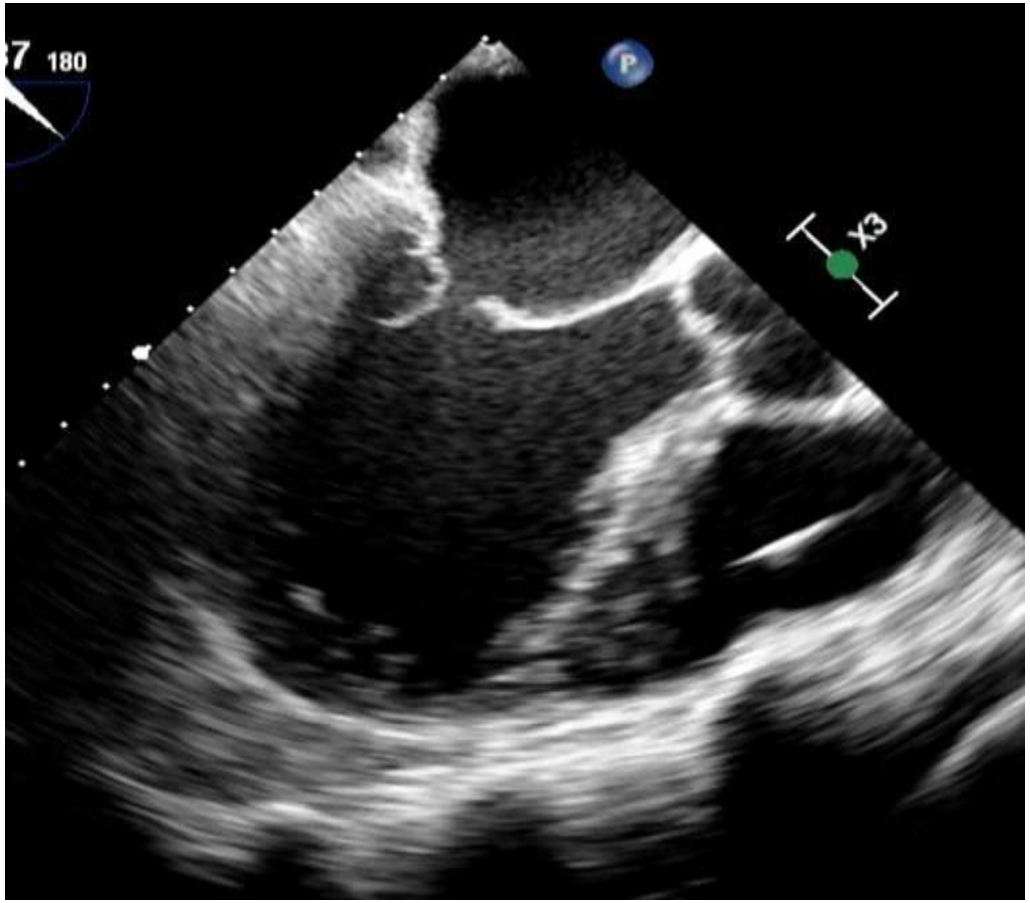




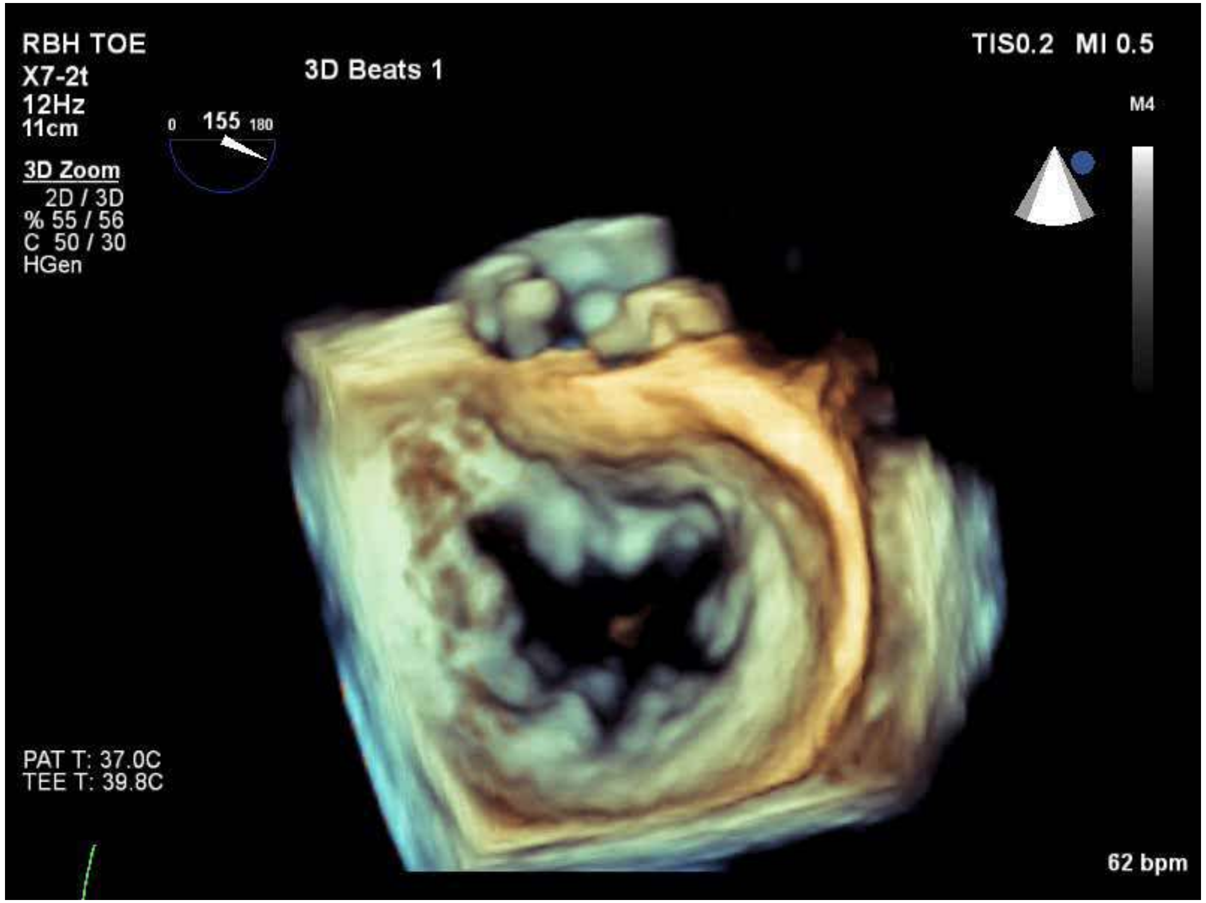


Secondary MR

2D

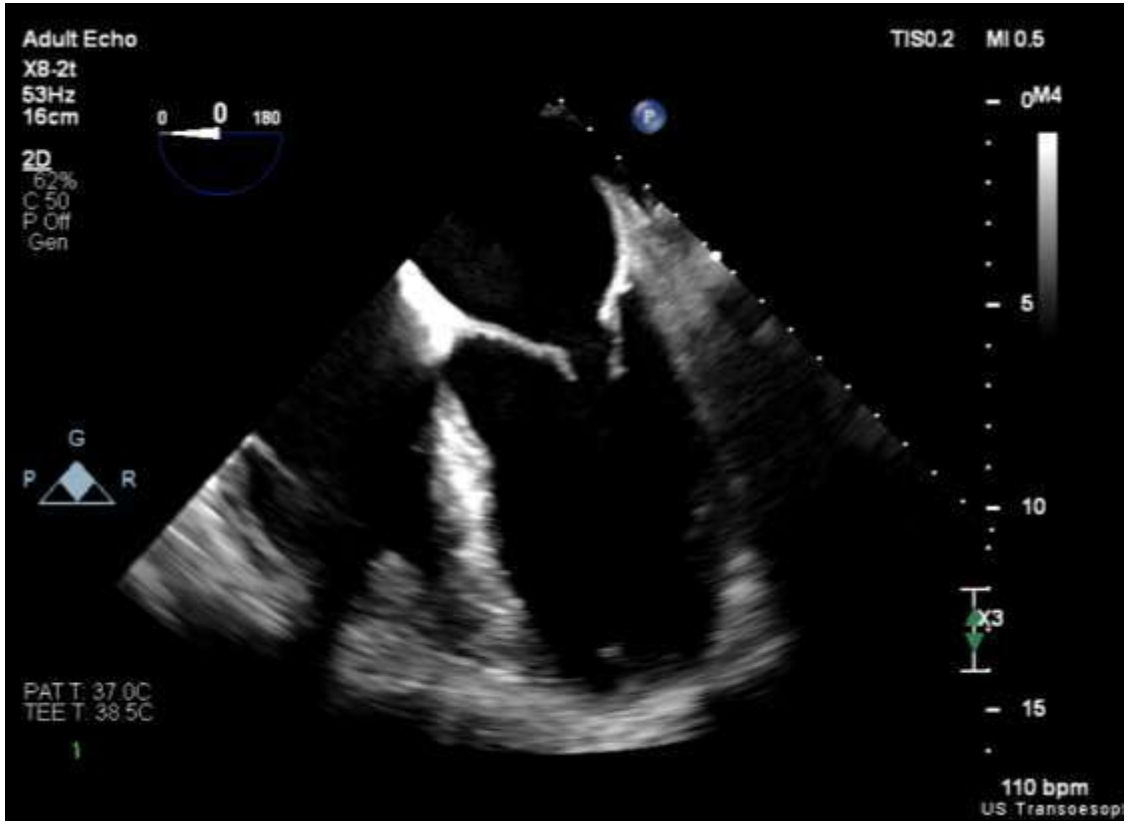


3D

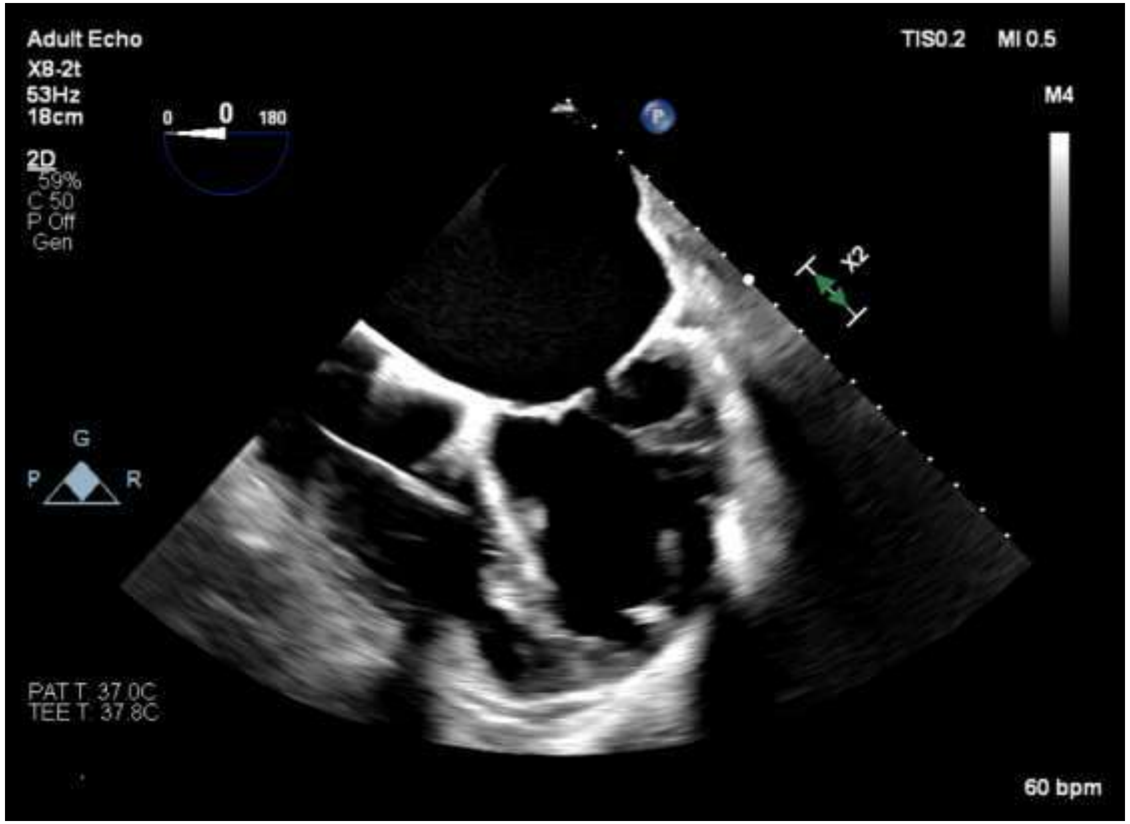


SMR in Heart Failure

Secondary ventricular MR



Secondary atrial MR



SMR physiology in Heart Failure

SV 29ml, CO 2.0L/min, CI 0.93

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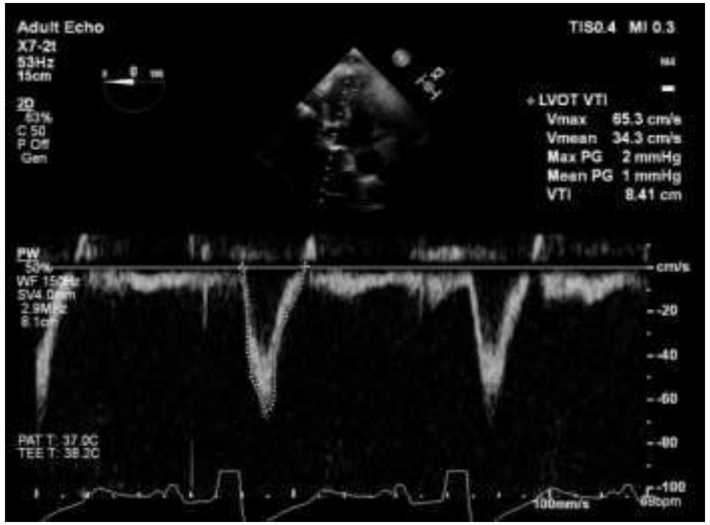

Add dobutamine

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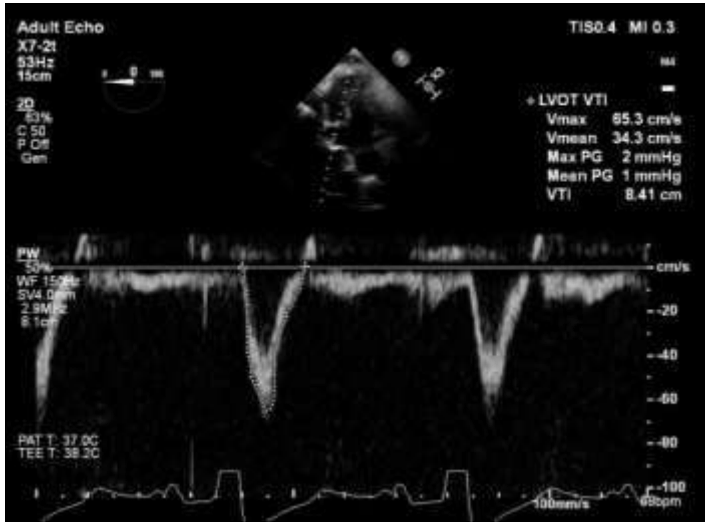

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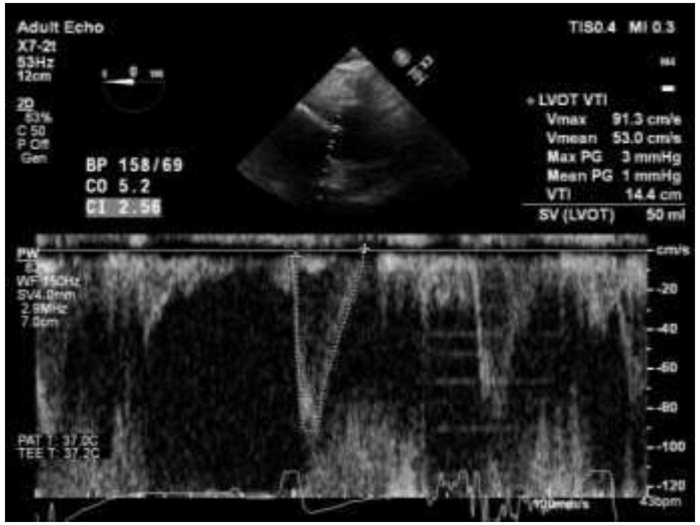

Increase pacing rate

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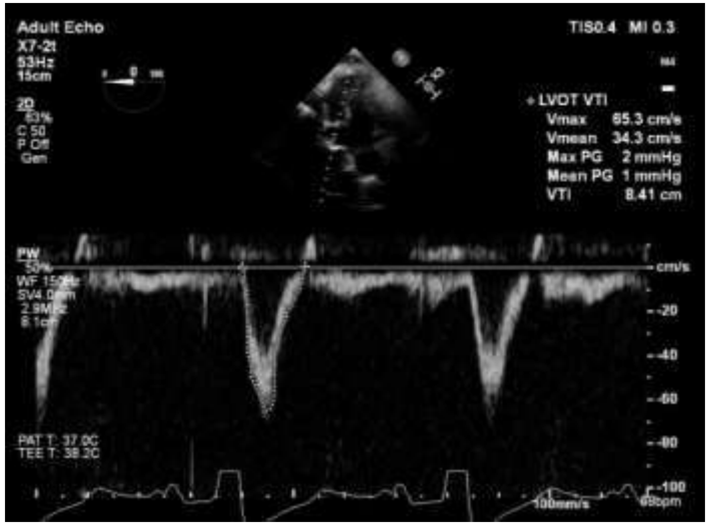

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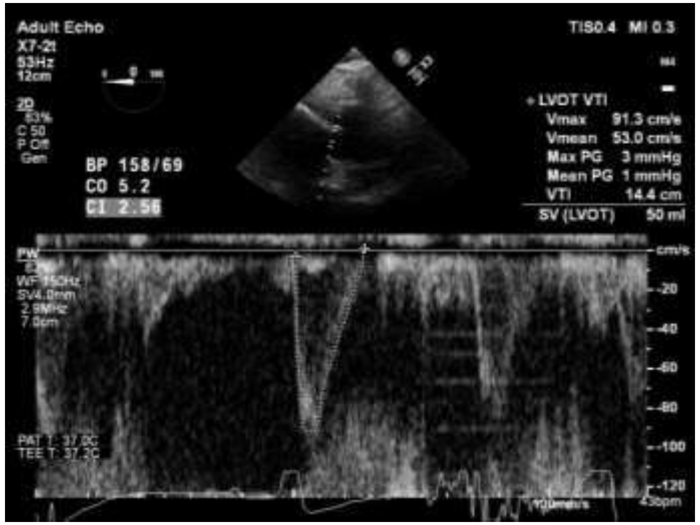

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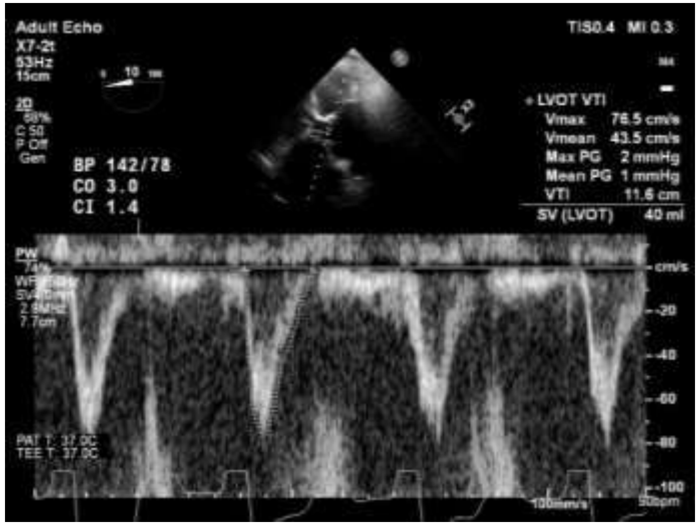
SV 40ml, CO 3.6L/min, CI 1.67



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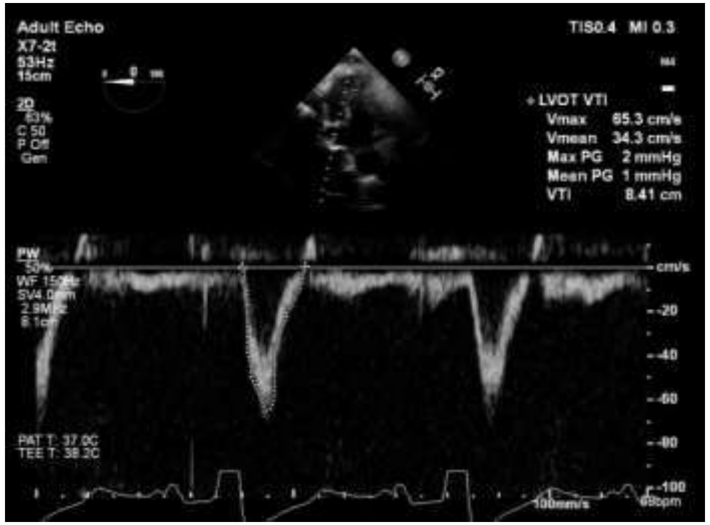

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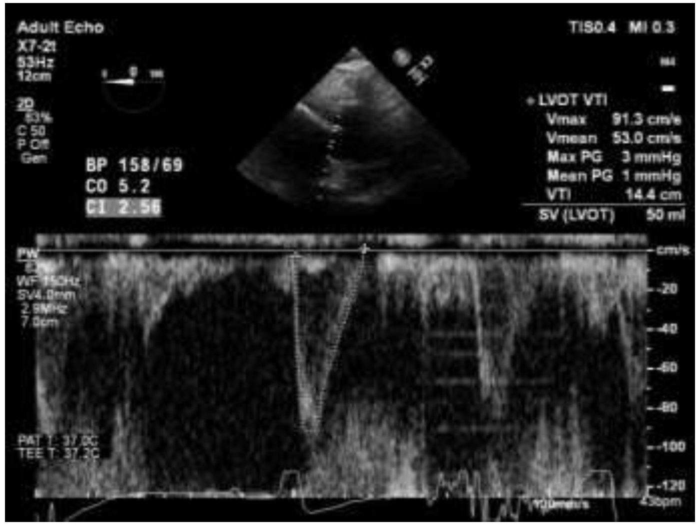

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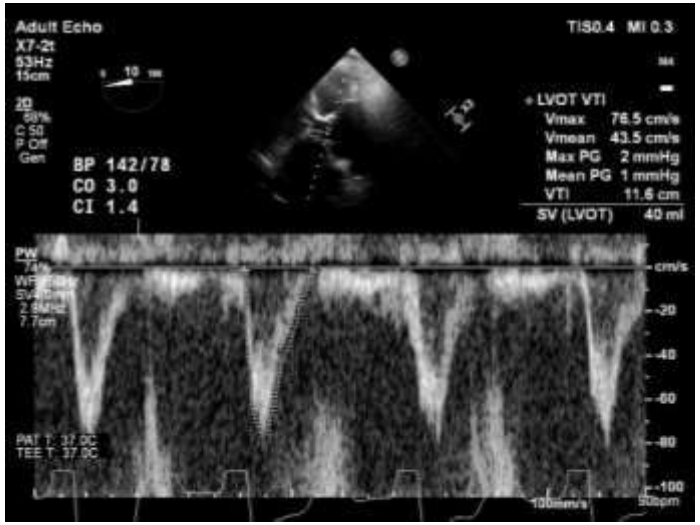
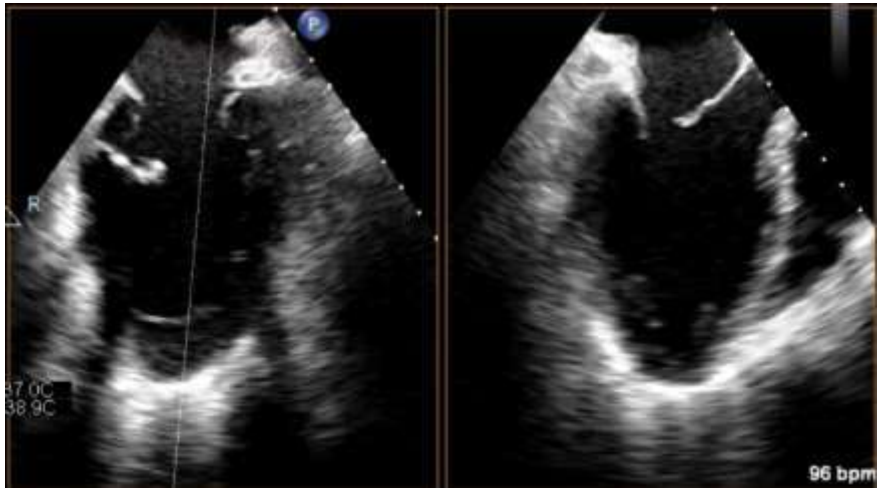
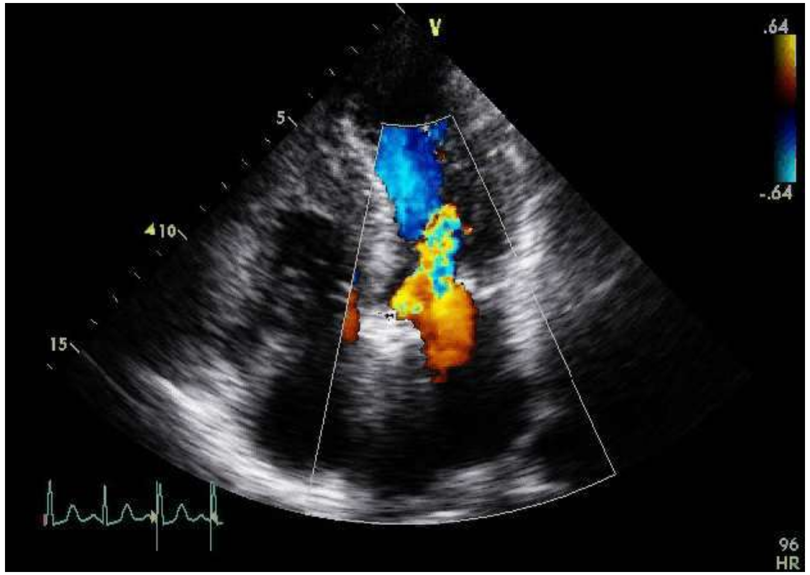
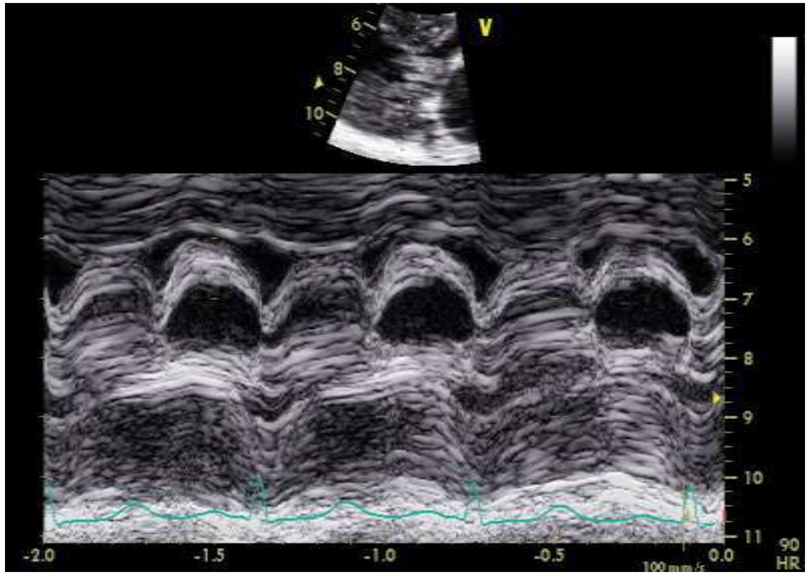
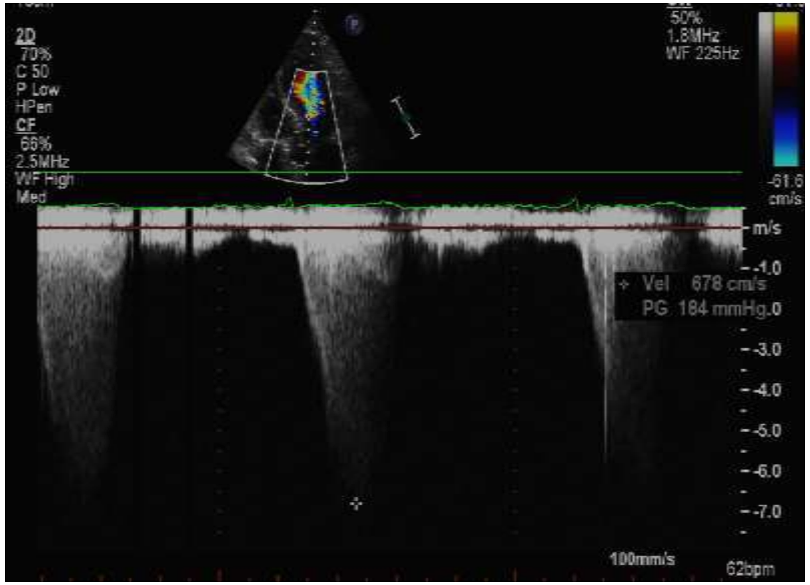




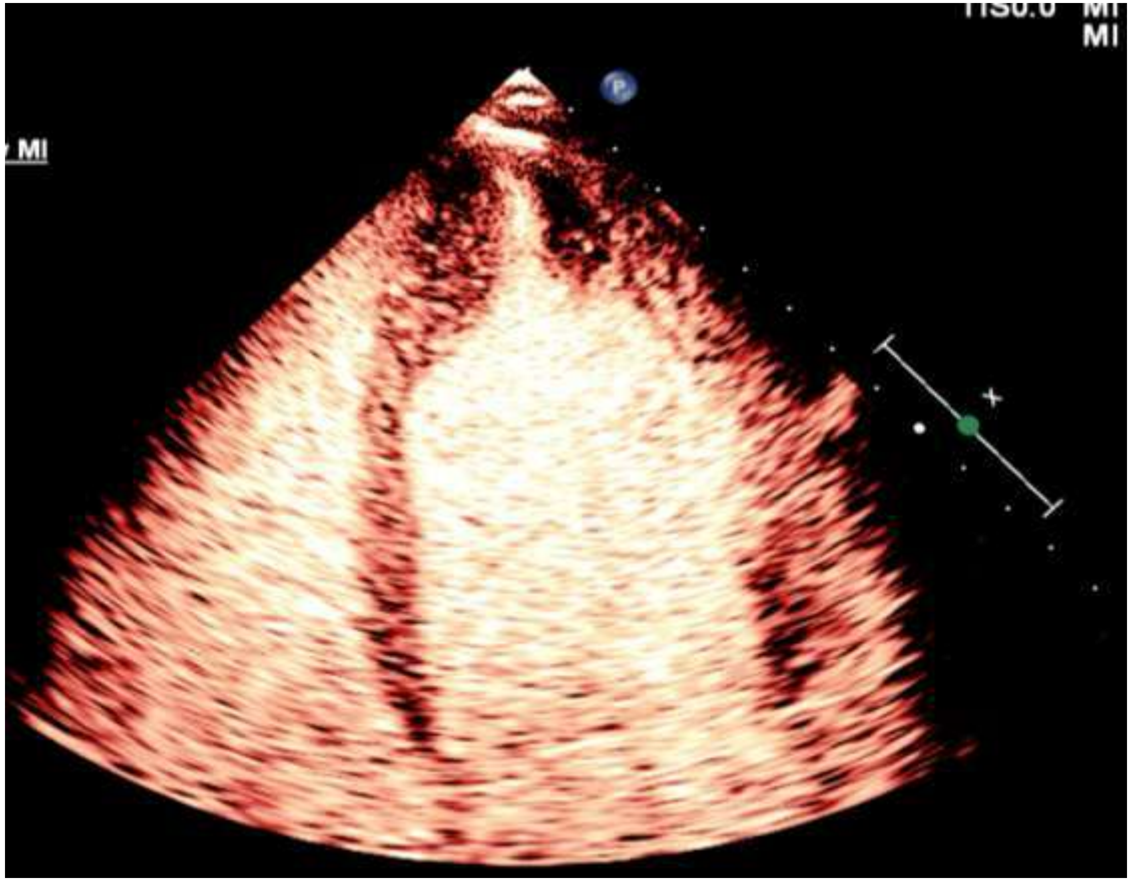
Hypertrophic Cardiomyopathy





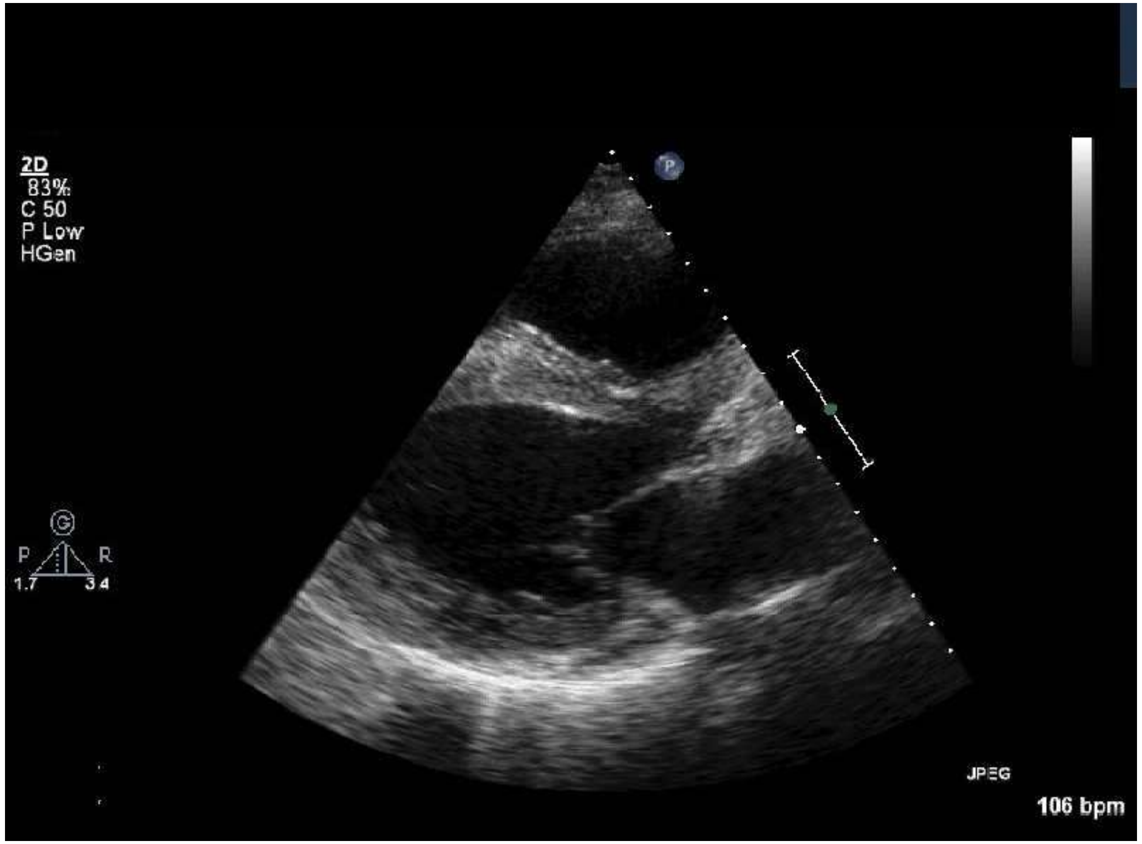


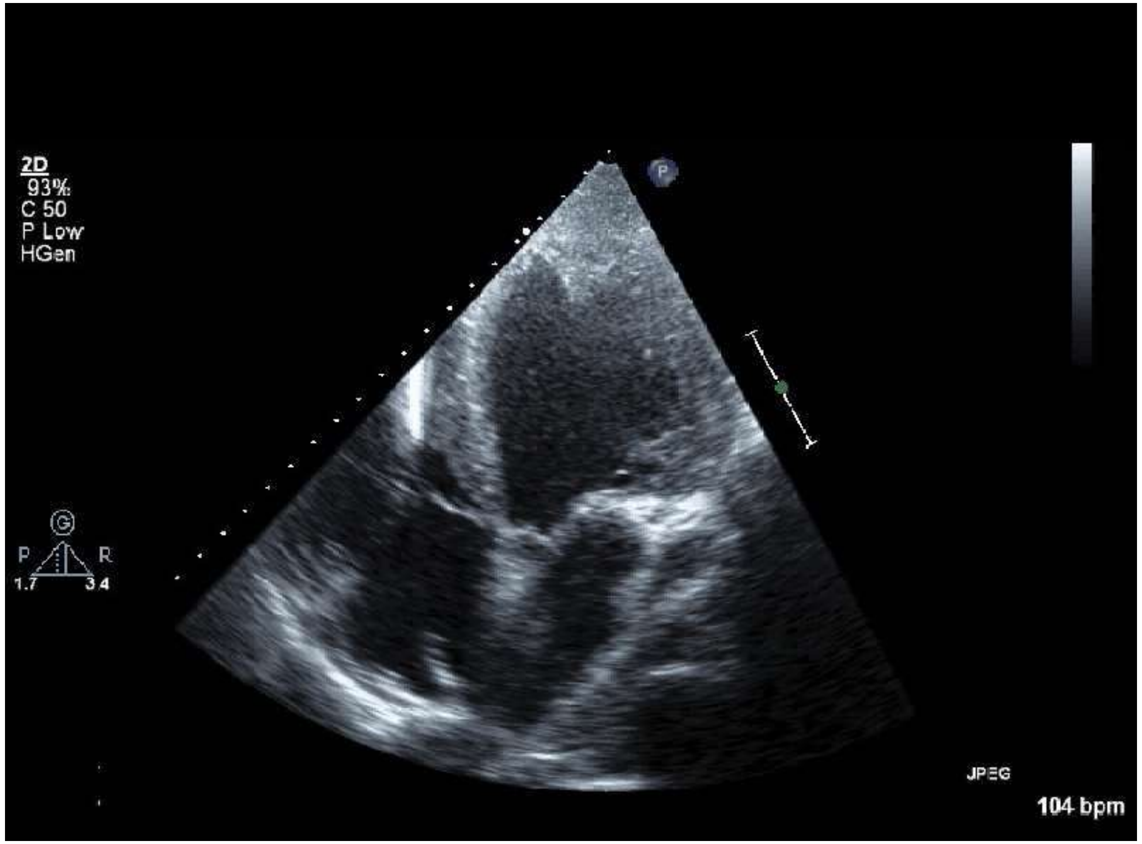
Apical HCM



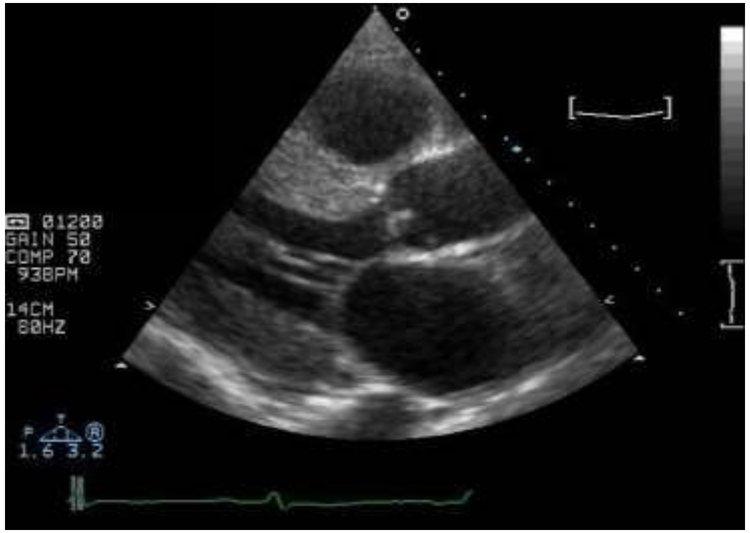
Non-Compaction LV

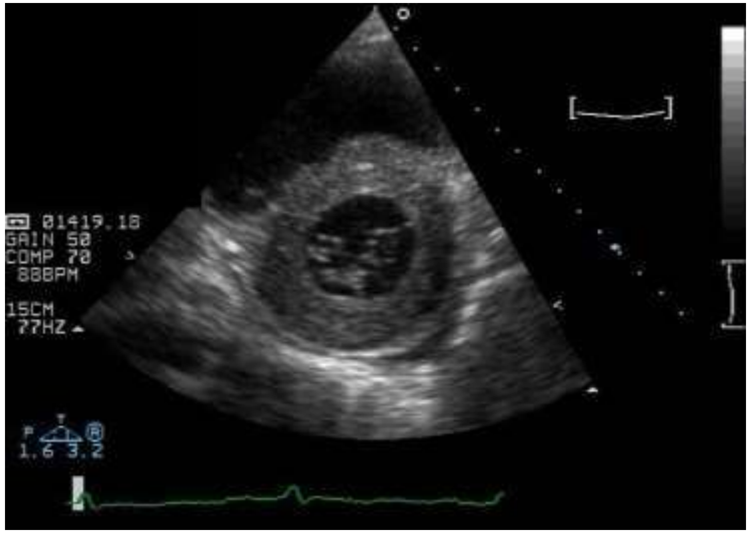
? Hypertrophic Cardiomyopathy

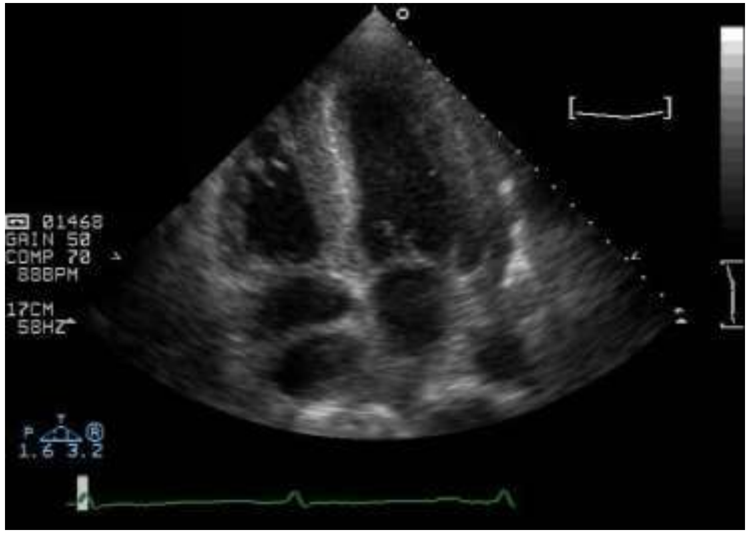


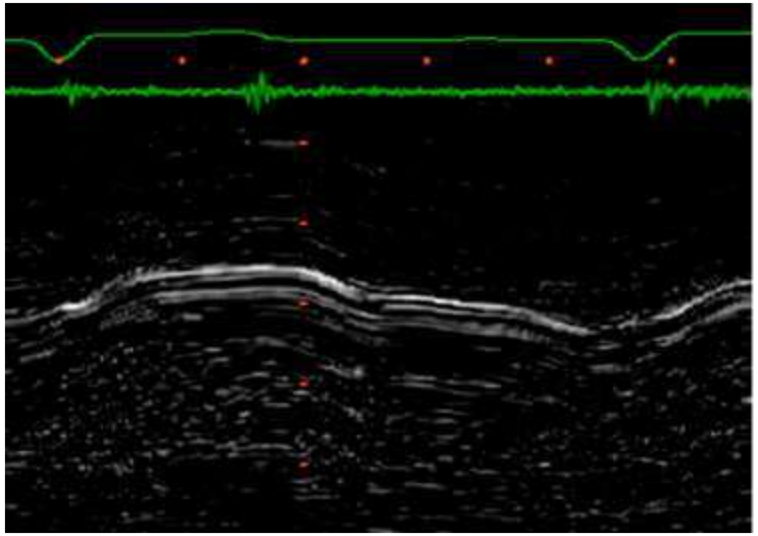


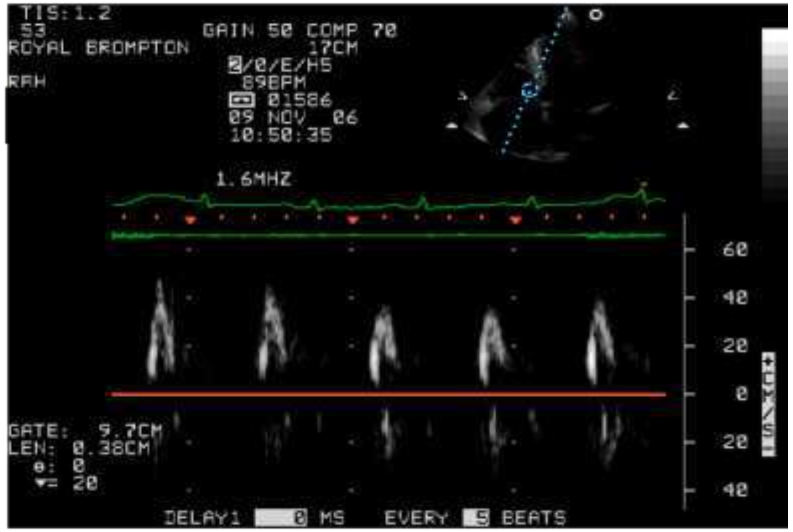
Restrictive Cardiomyopathy

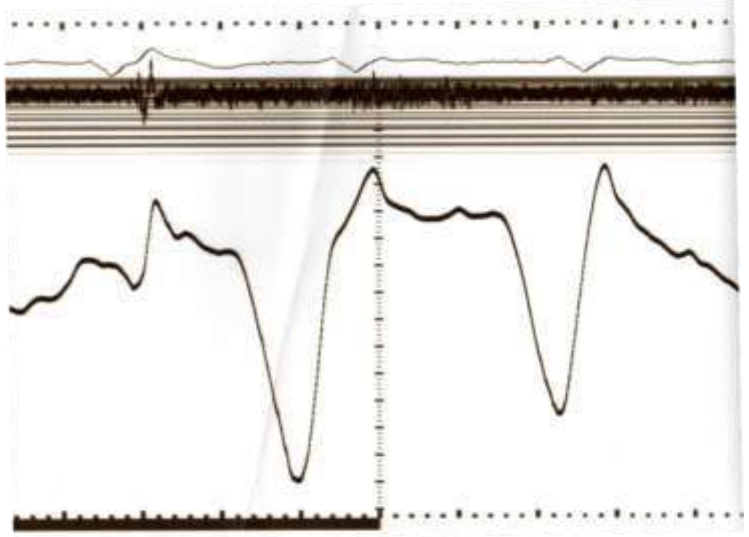




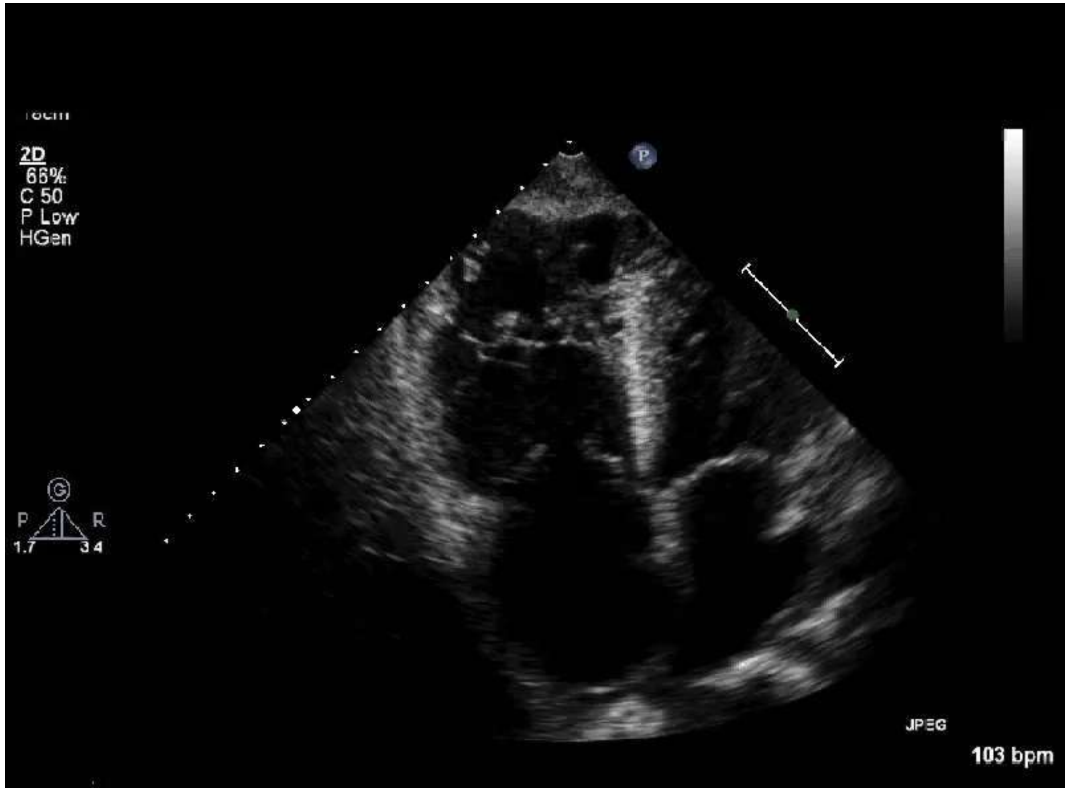


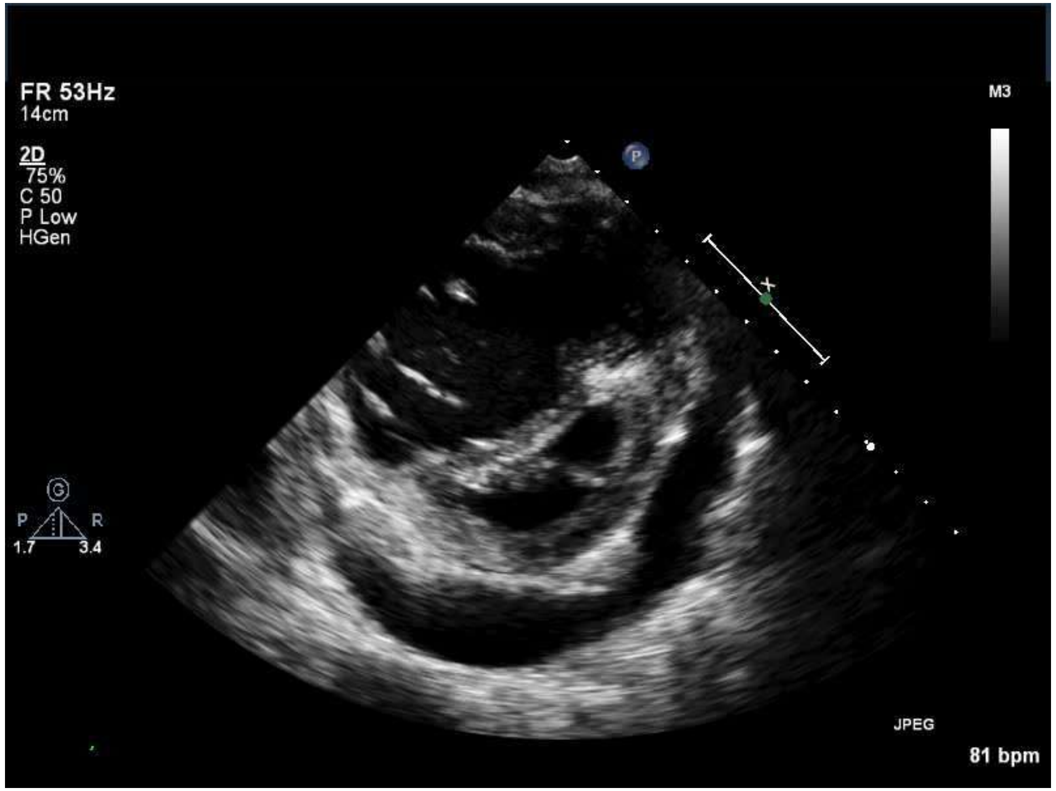






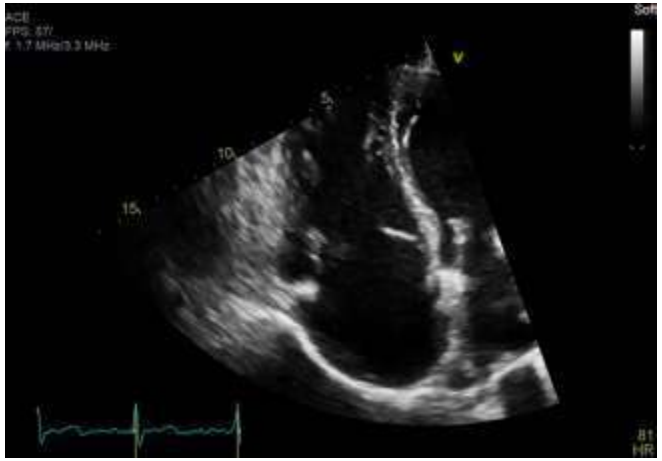
Right heart dilatation and failure



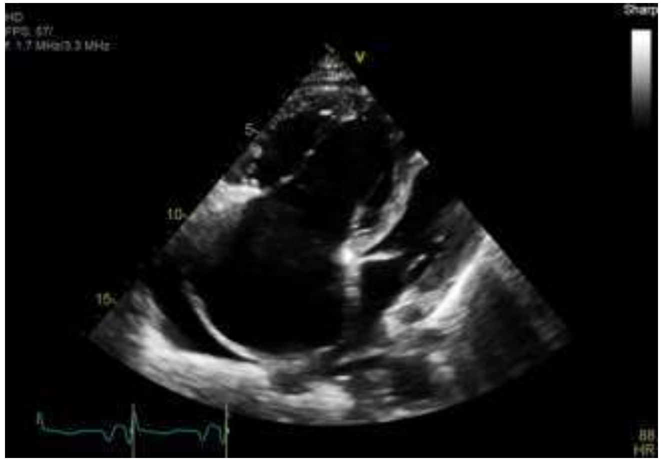


Mechanisms of TR

Primary TR



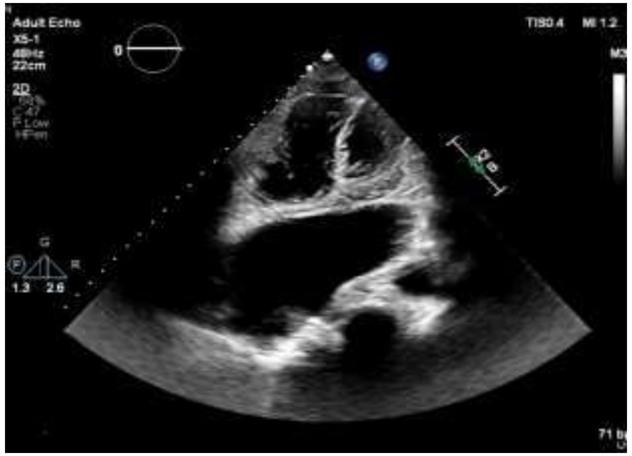
Secondary Atrial TR



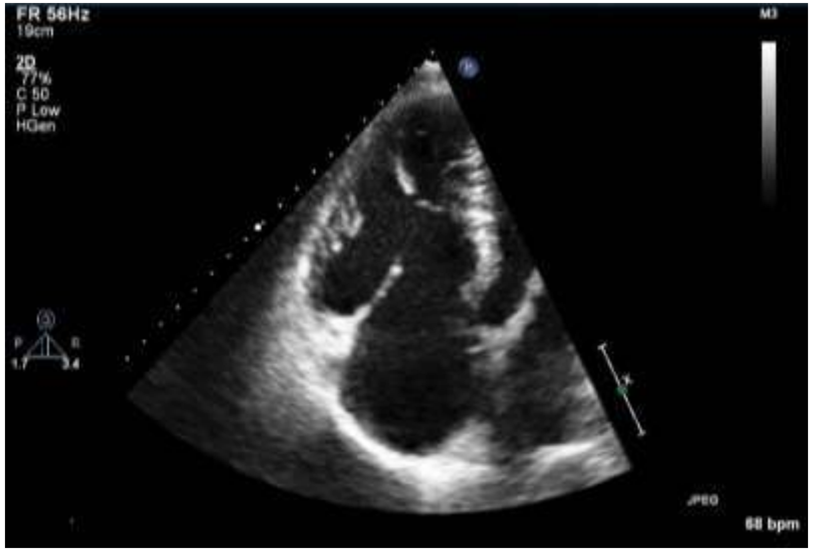
Secondary Ventricular TRv

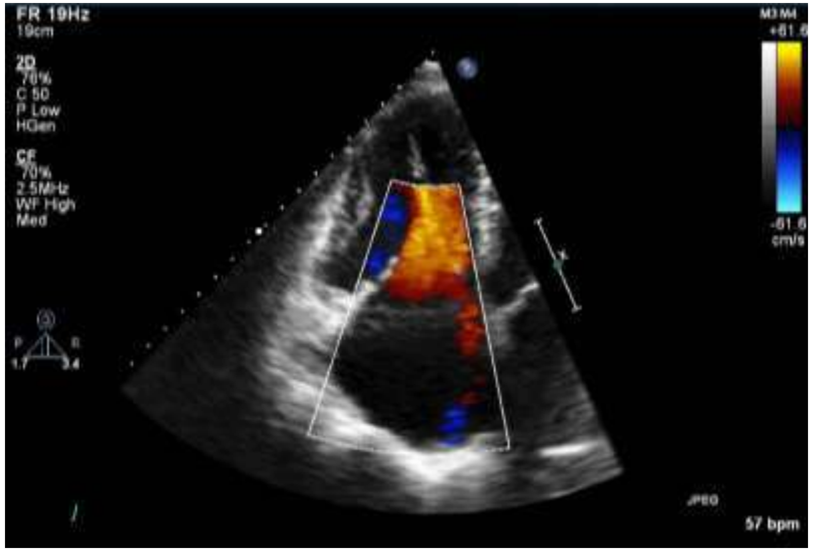
CEID TR

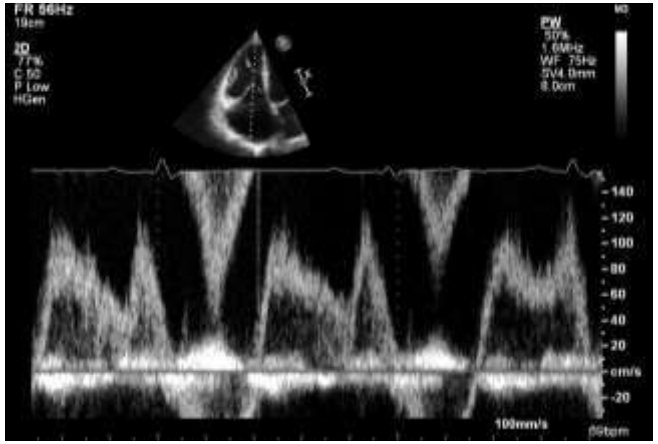
Persistent SVC, dilated CS

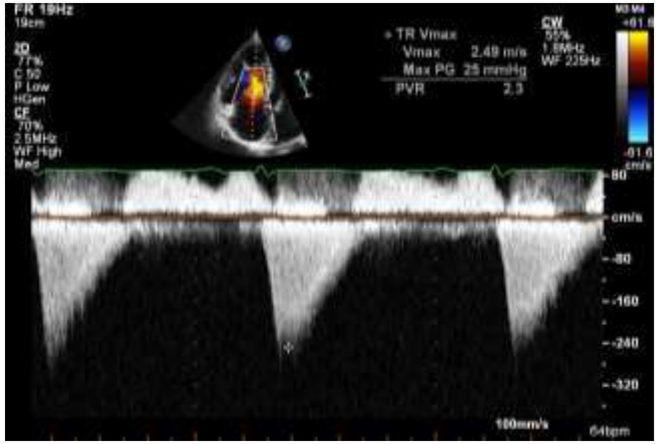


Carcinoid Heart Failure

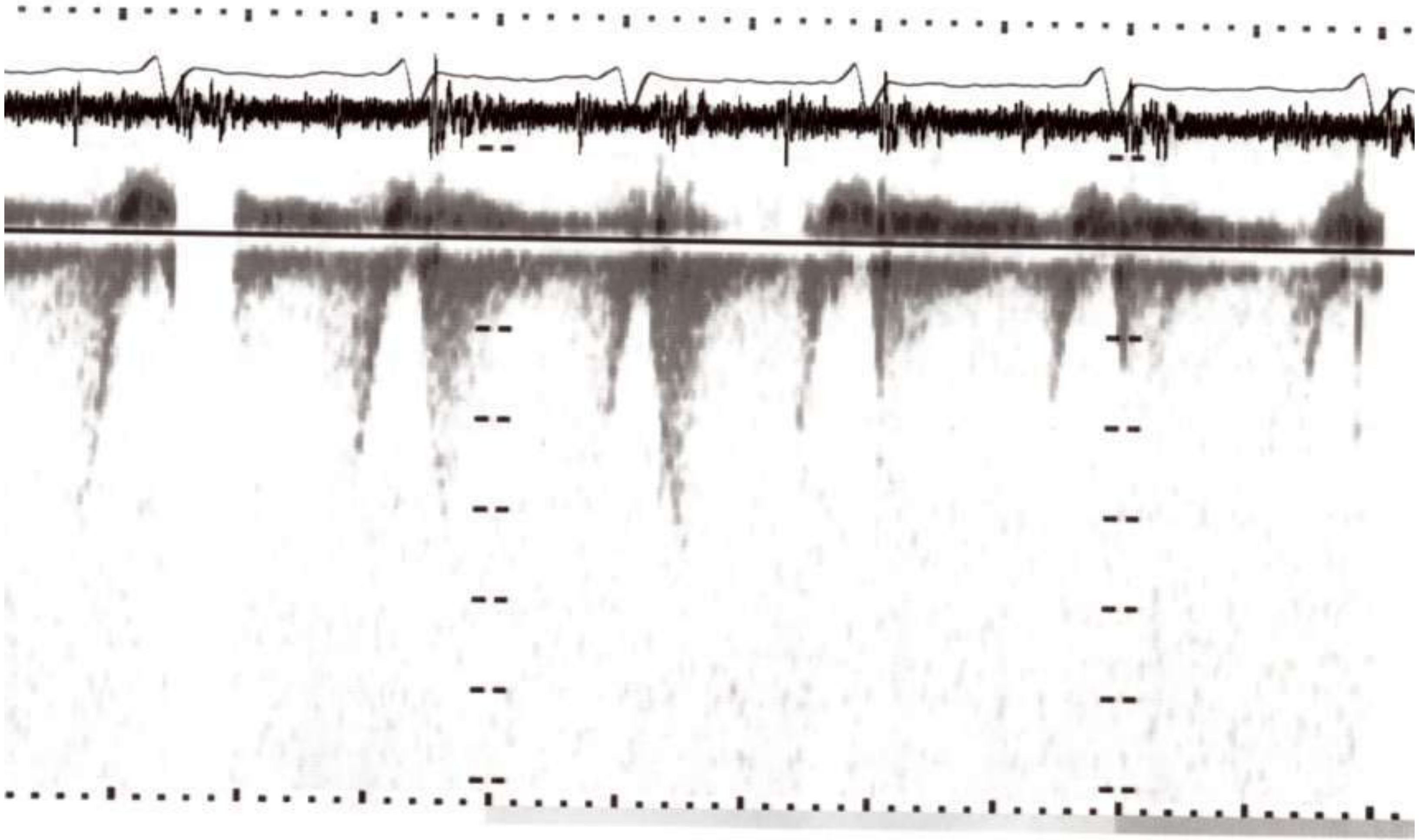






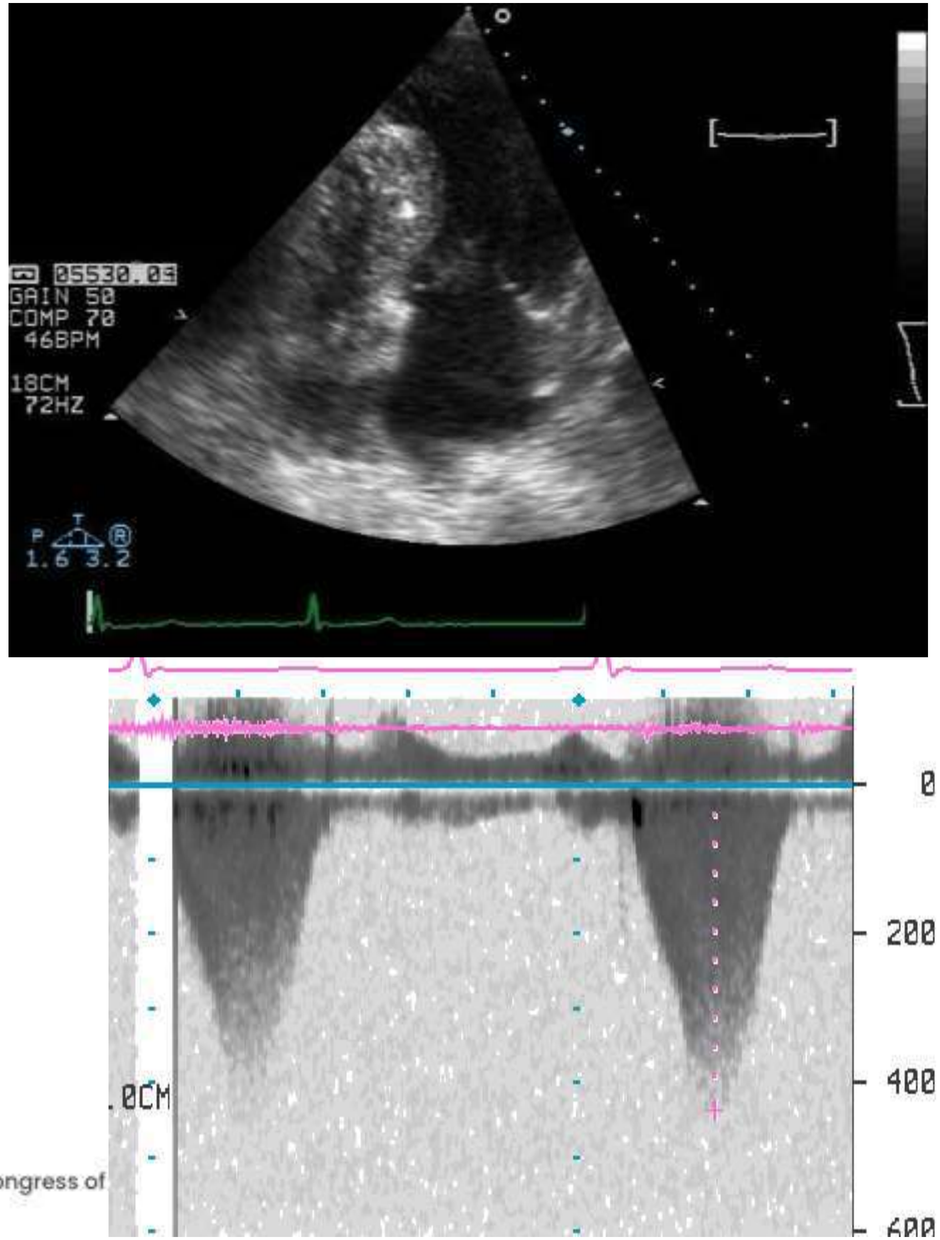


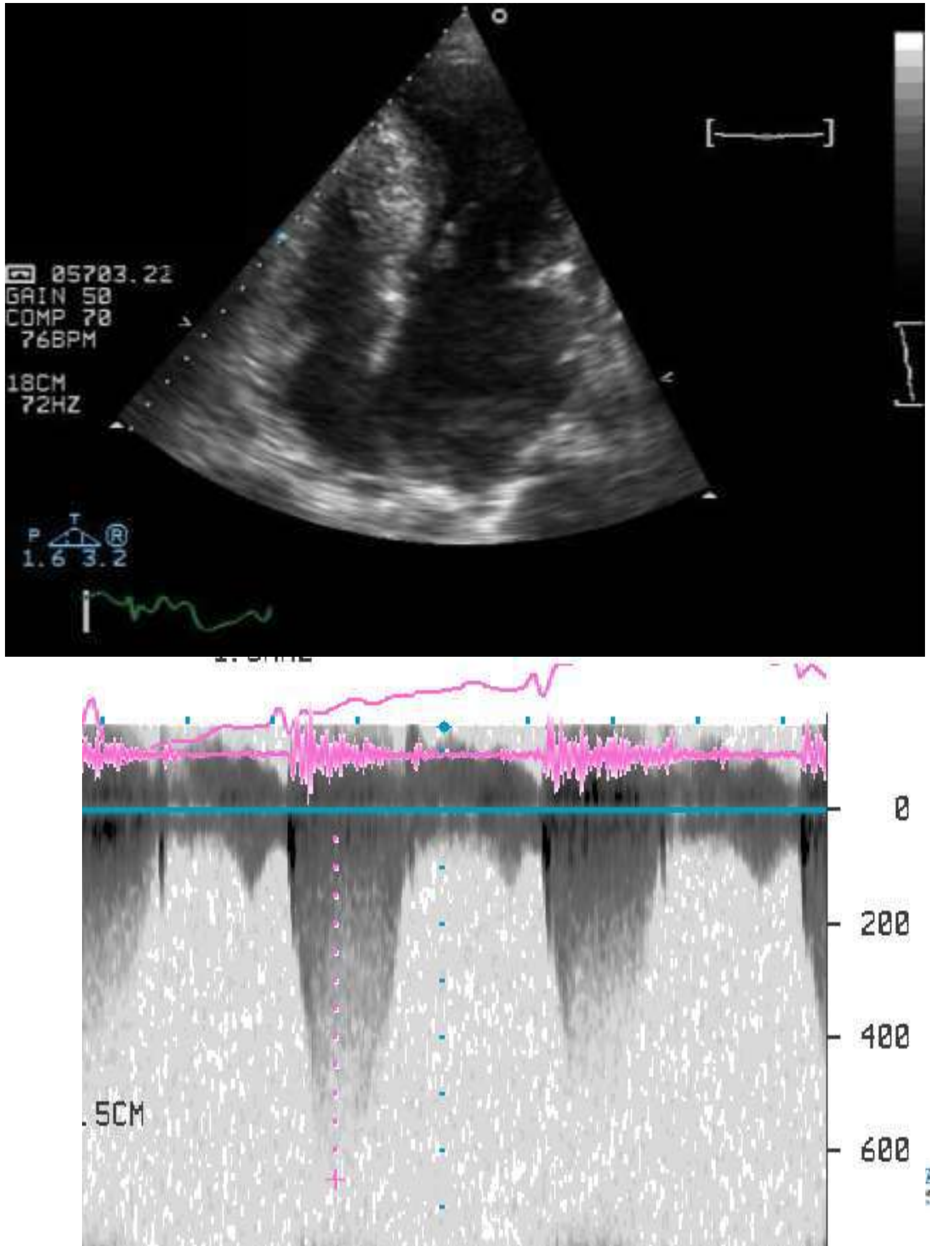
Atrial Tachycardia



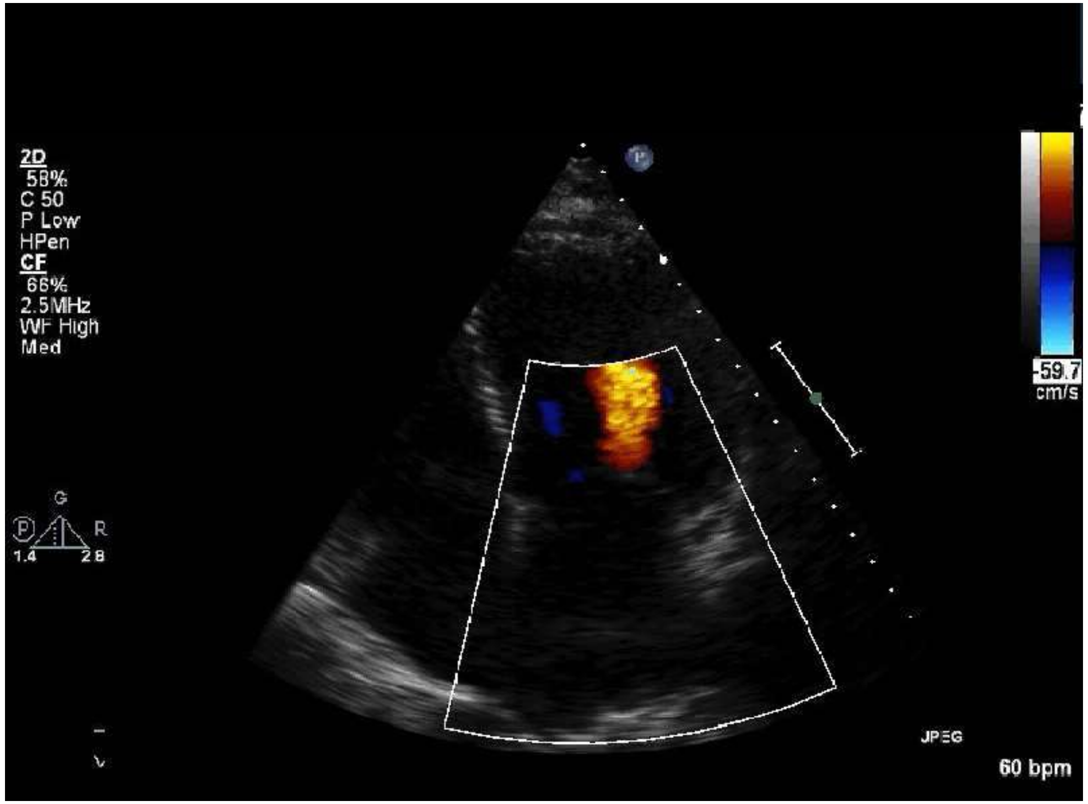
Short RR interval
Normal systolic time (MR)
No time for LV filling

Exercise Echo: Dynamic LVOTO

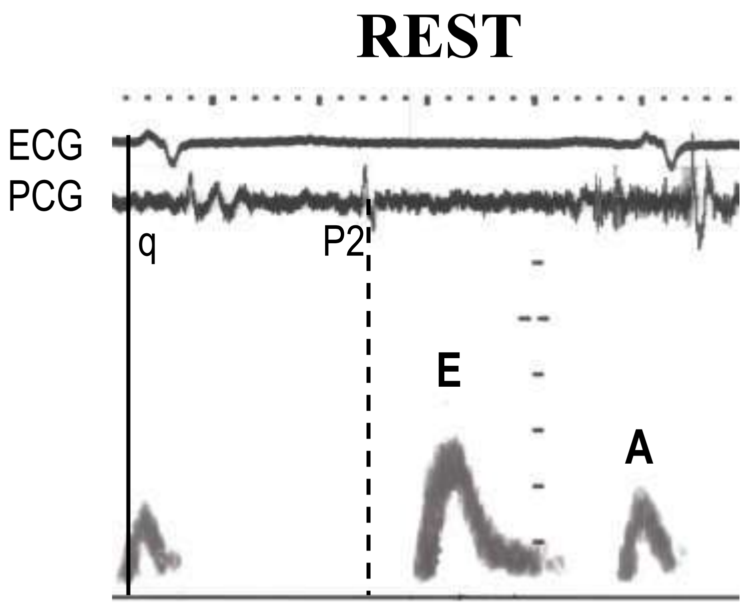




Exercise Echo: Stress-induced MR

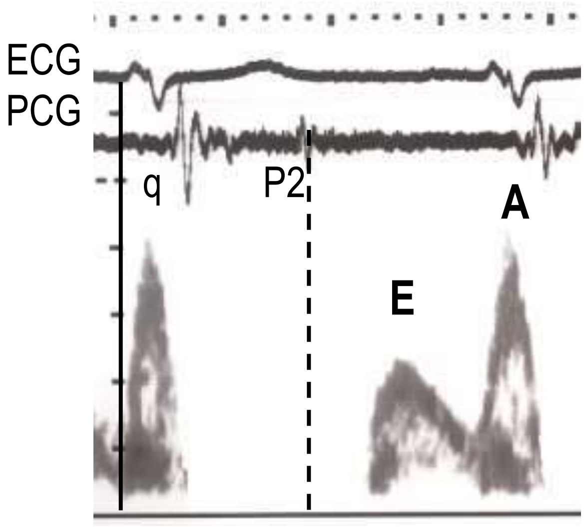


Importance of Restrictive Filling

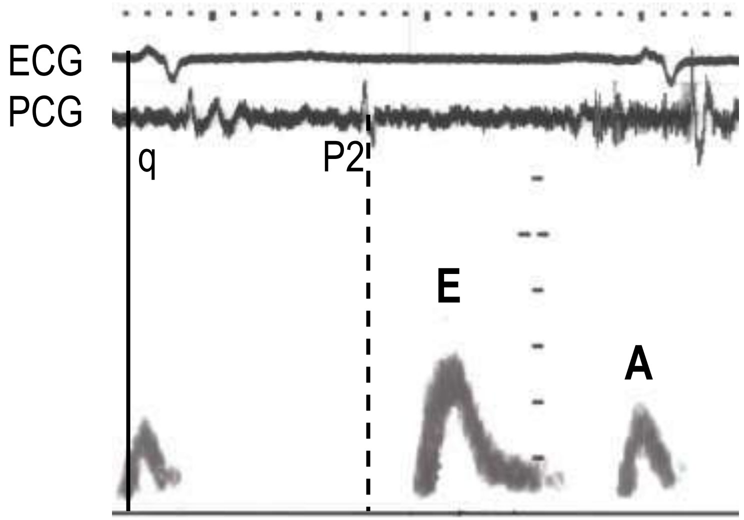


Importance of Restrictive Filling

STRESS

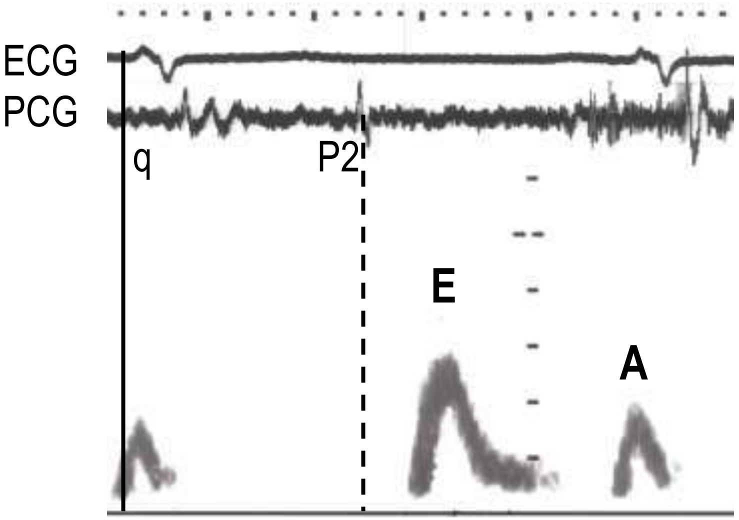


REST

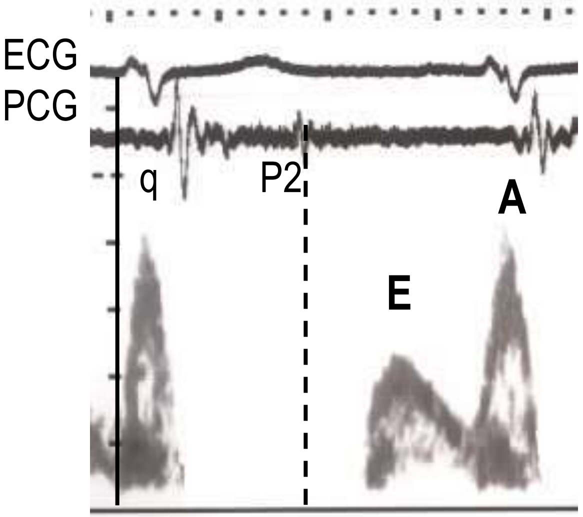


Importance of Restrictive Filling

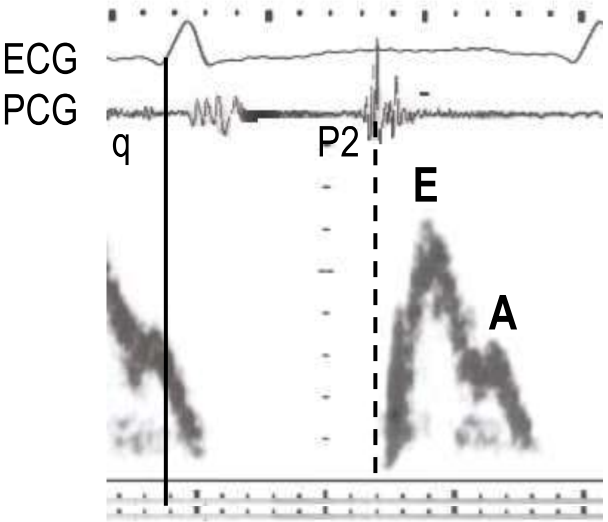
REST



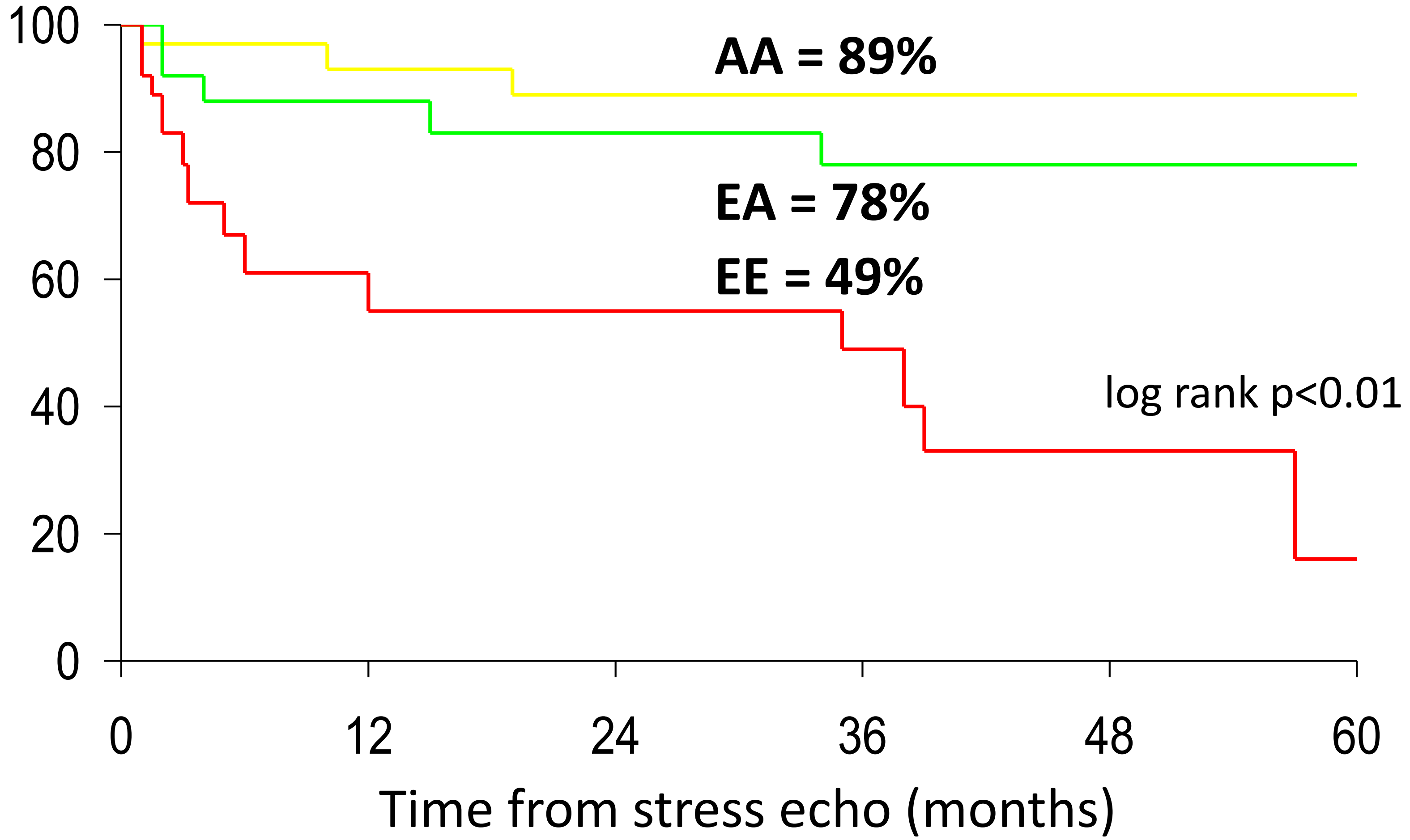
STRESS



STRESS



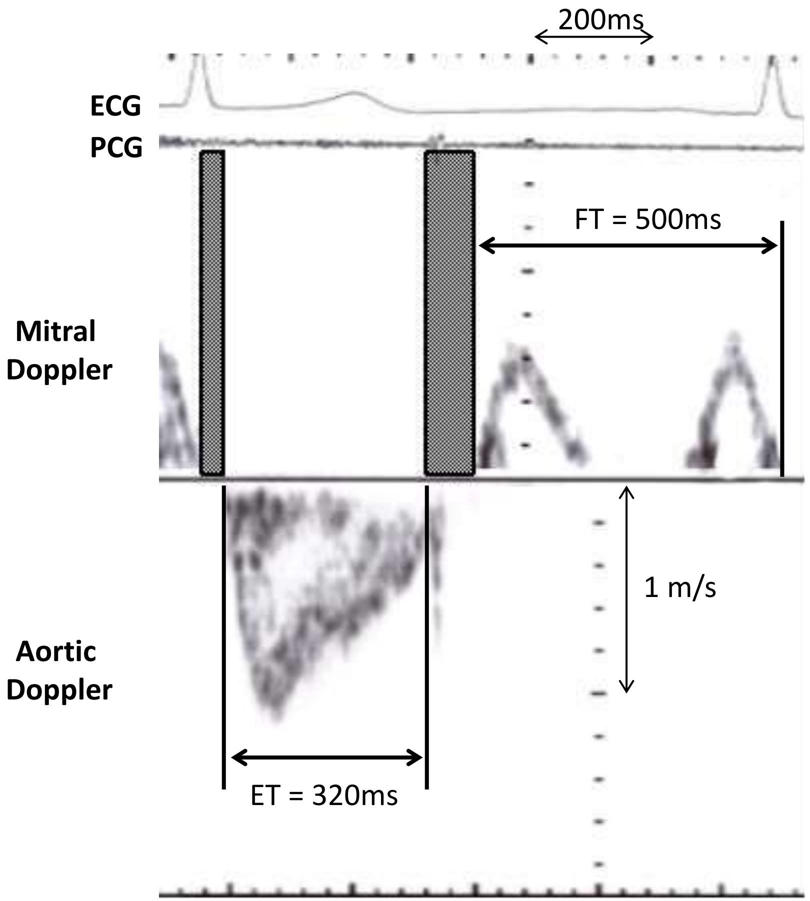
Survival



Hazard ratio compared with AA EE = 9.5, p<0.001 (95%CI 4.3-14.7)
EA = 1.9, p=NS (95% CI -4.2-+8.1)

Duncan et al. JACC 2005

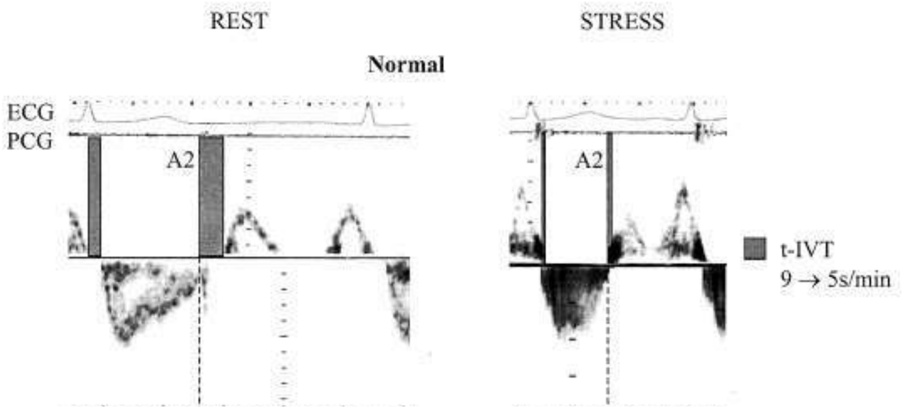
Total Isovolumic Time



HR = 63bpm	
ET = 320ms or 0.32x63	= 20s/min
FT = 500ms or 0.50x63	= 32s/min
T-IVT = 60 - (20+32)	= 8s/min

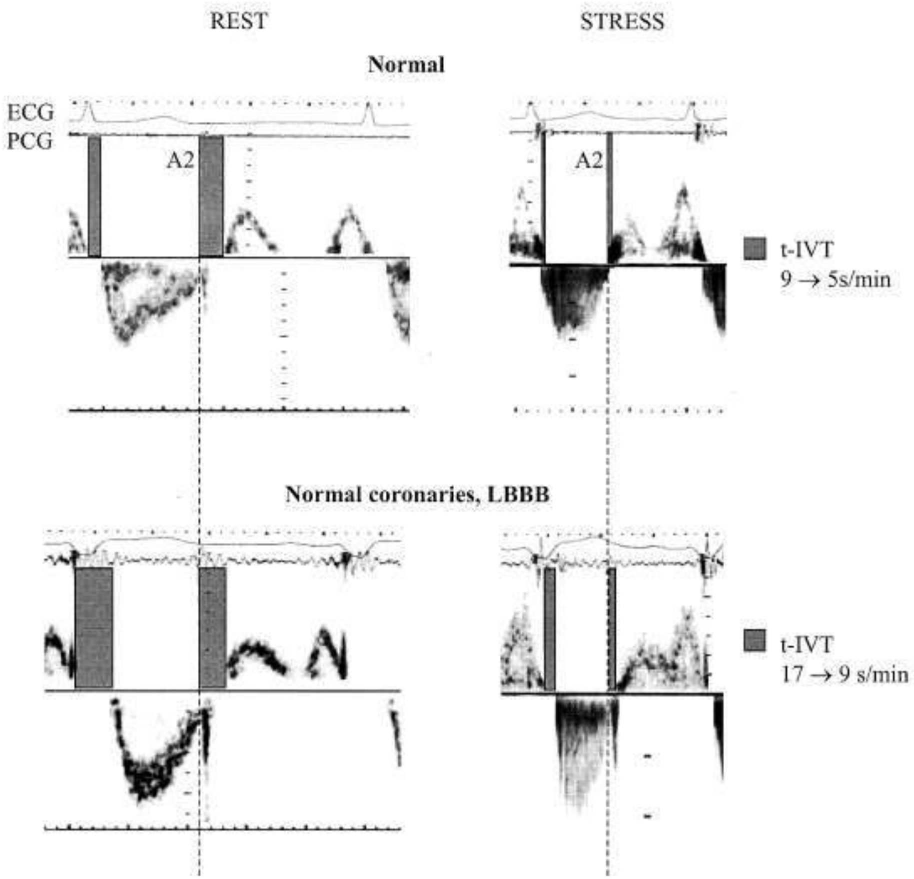
Duncan et al. JACC 2003

Total isovolumic Time with Stress



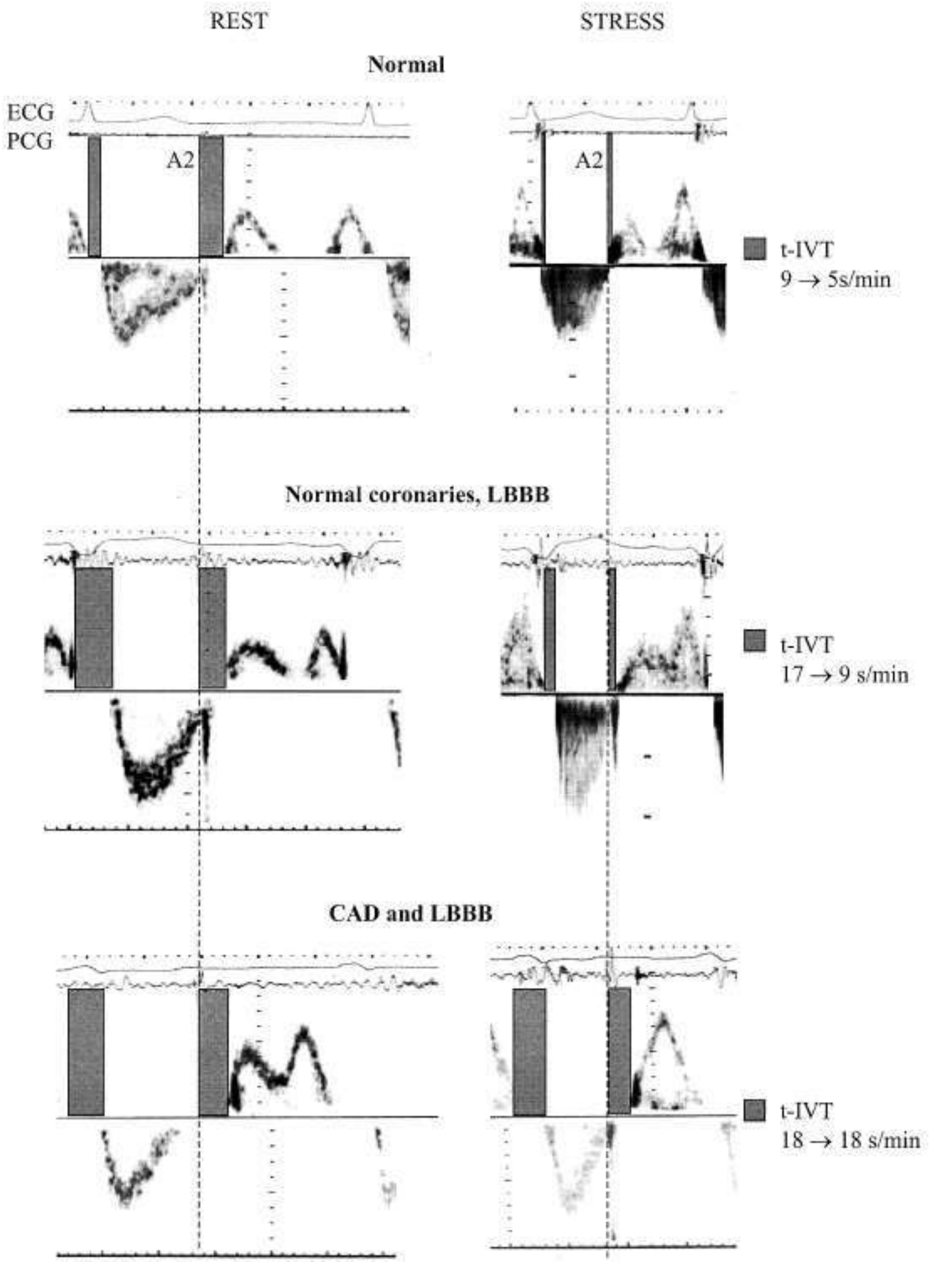
Duncan et al. JACC 2003

Total isovolumic Time with Stress



Duncan et al. JACC 2003

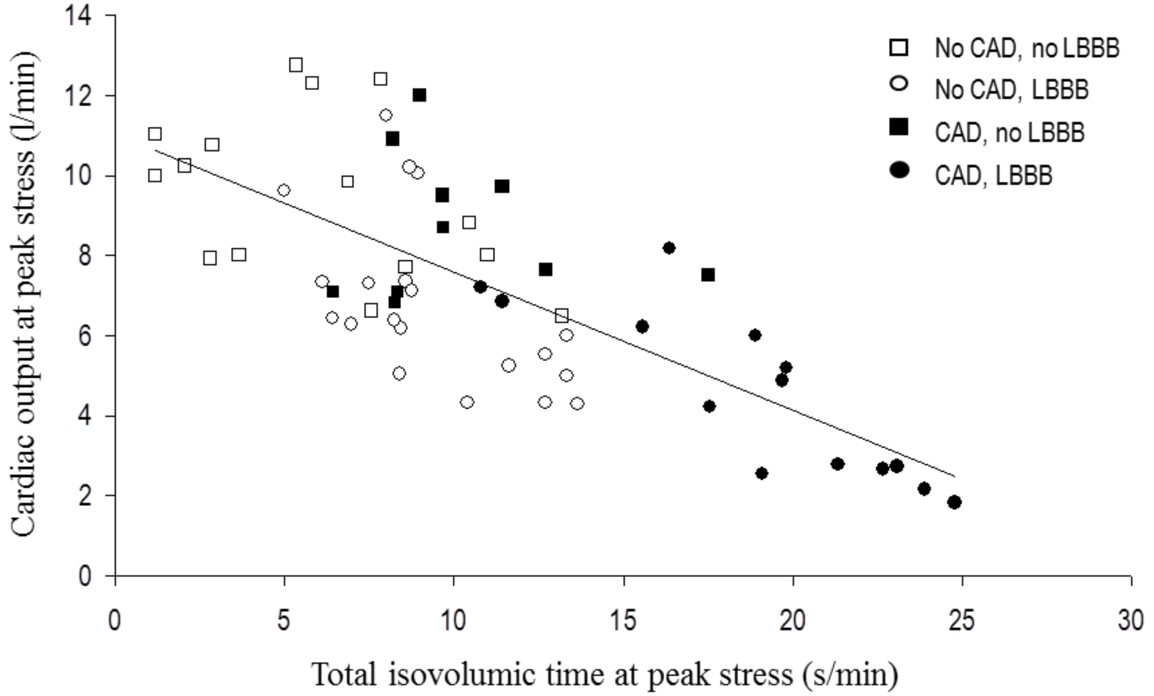
Total isovolumic Time with Stress



Duncan et al. JACC 2003

Total Isovolumic Time

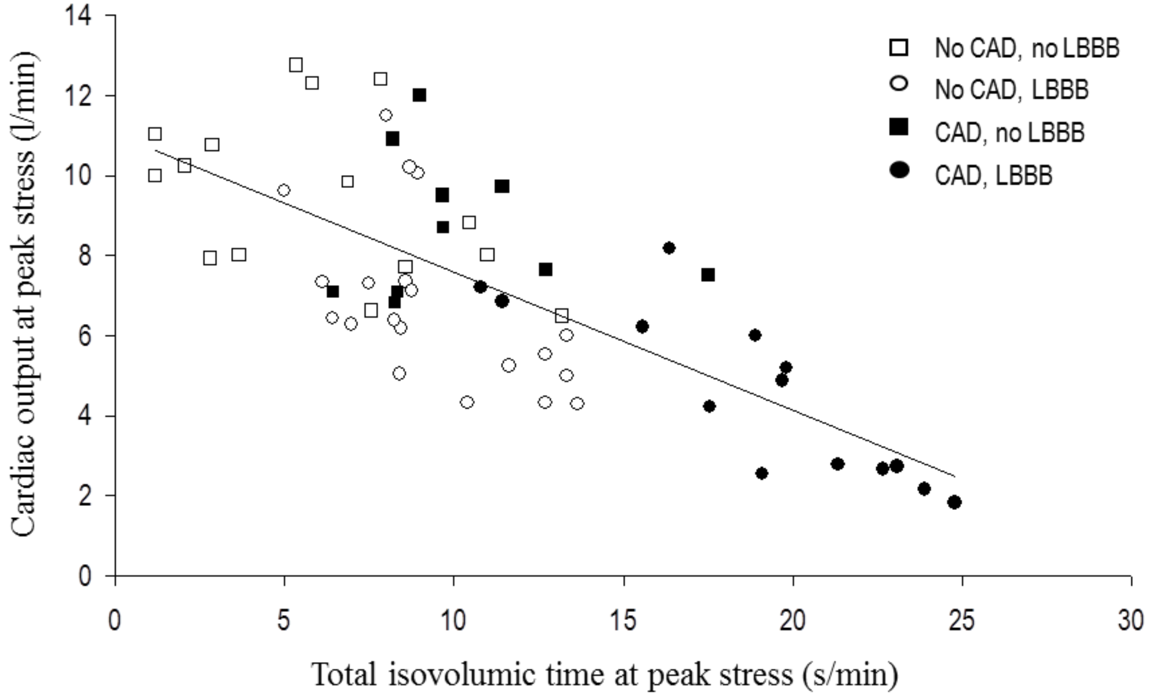
Correlation between peak stress total isovolumic time and peak stress cardiac output



Duncan et al. JACC 2003

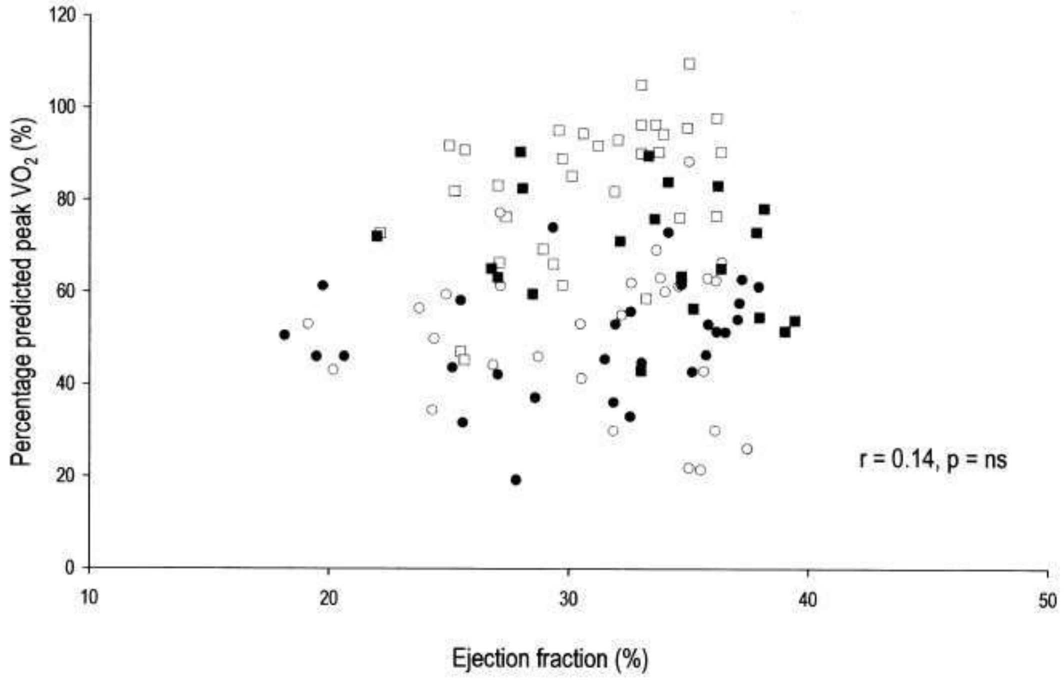
Total Isovolumic Time

Correlation between peak stress total isovolumic time and peak stress cardiac output



Duncan et al. JACC 2003

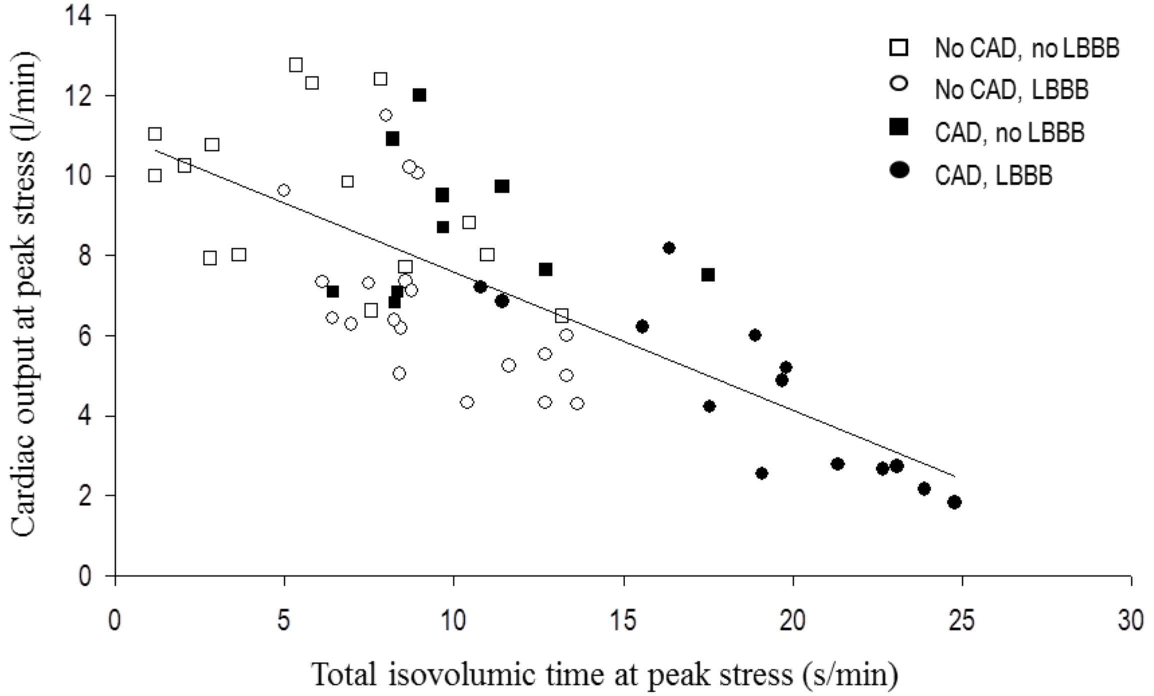
No correlation between peak stress total isovolumic time and peak LVEF



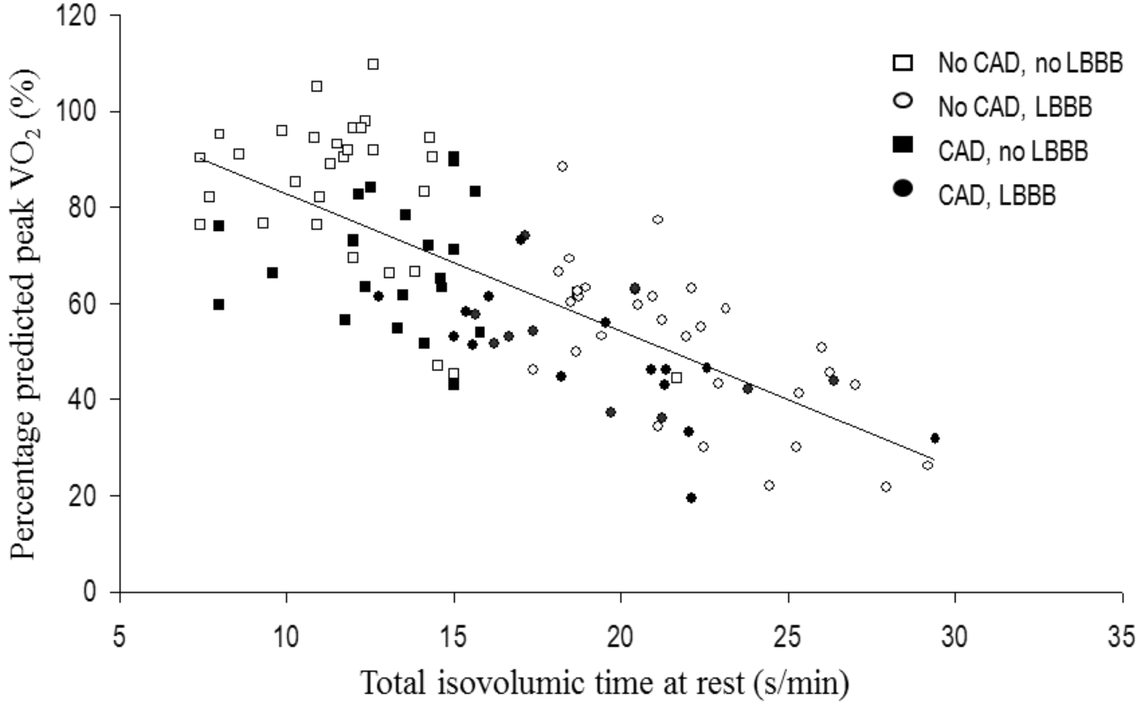
Duncan et al. JACC 2004

Total Isovolumic Time

Correlation between peak stress total isovolumic time and peak stress cardiac output



Correlation between resting total isovolumic time and peak exercise capacity



Duncan et al. JACC 2003

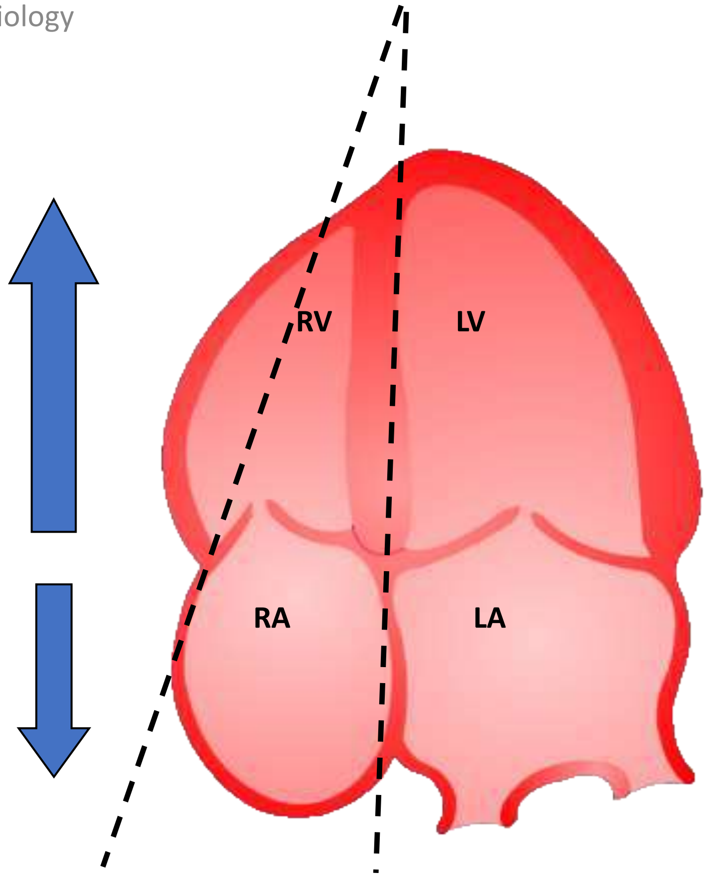
Duncan et al. JACC 2004

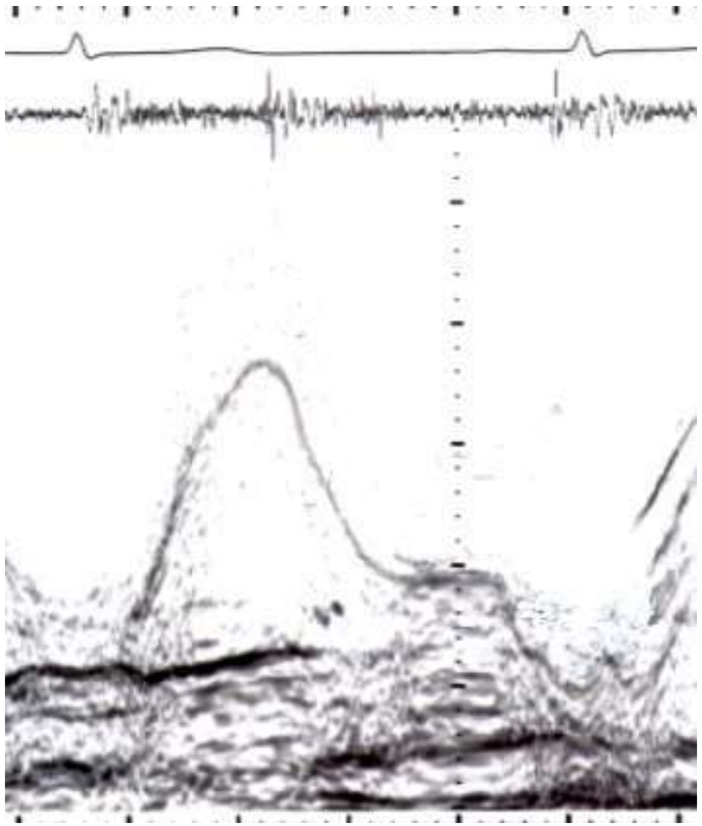
Diagnosing Heart Failure With Echocardiography

Can you take any more ?

Normal cardiac physiology

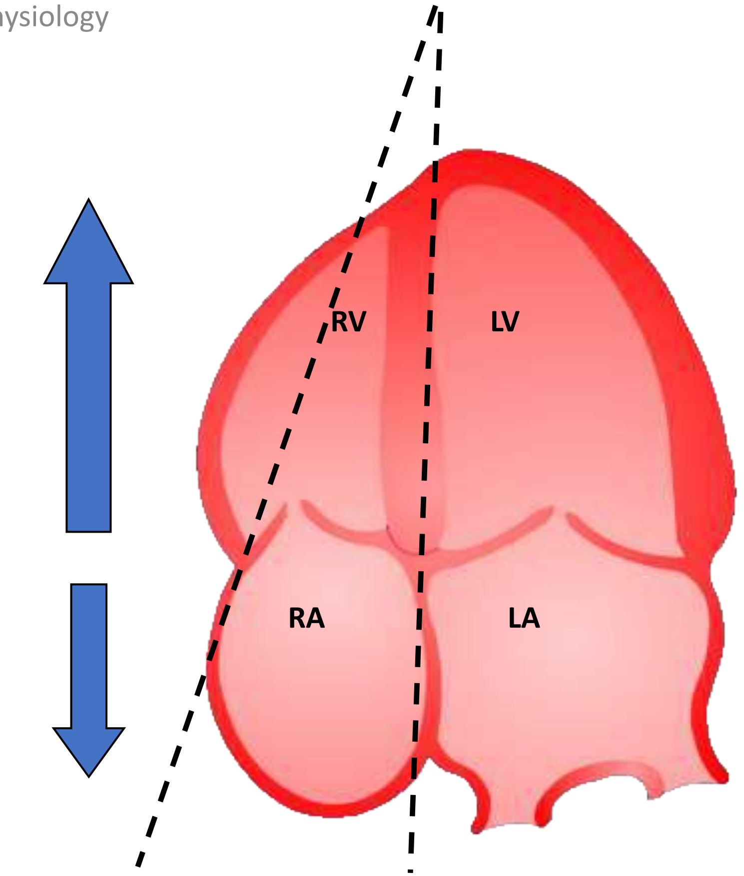
Normal Cardiac Physiology

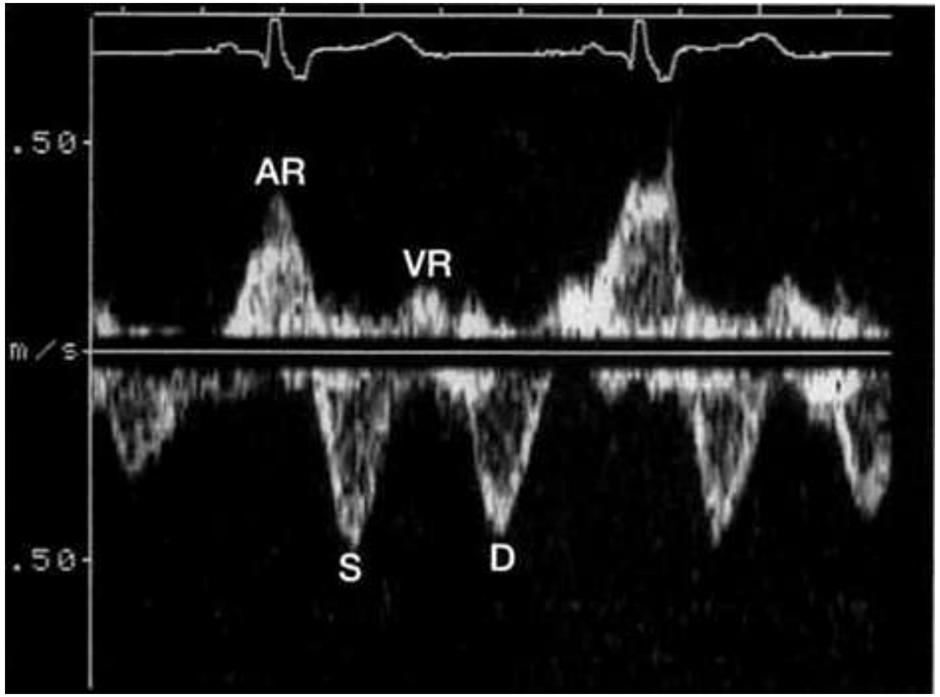




Normal cardiac physiology

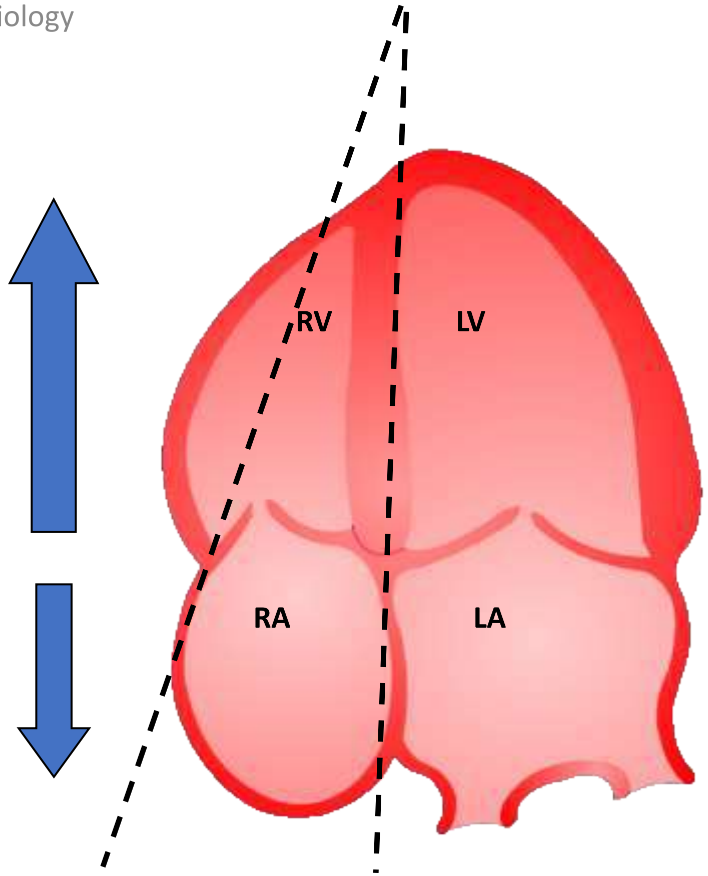
Normal Cardiac Physiology



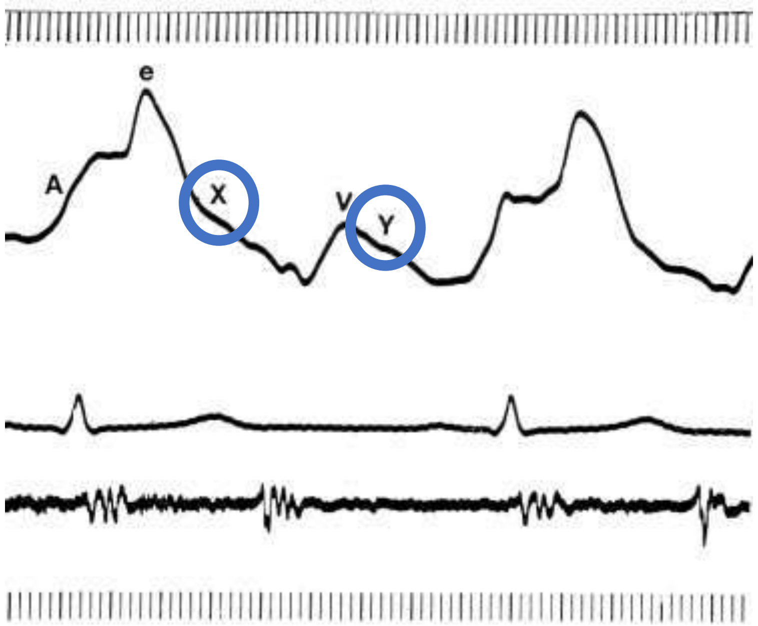


Normal cardiac physiology

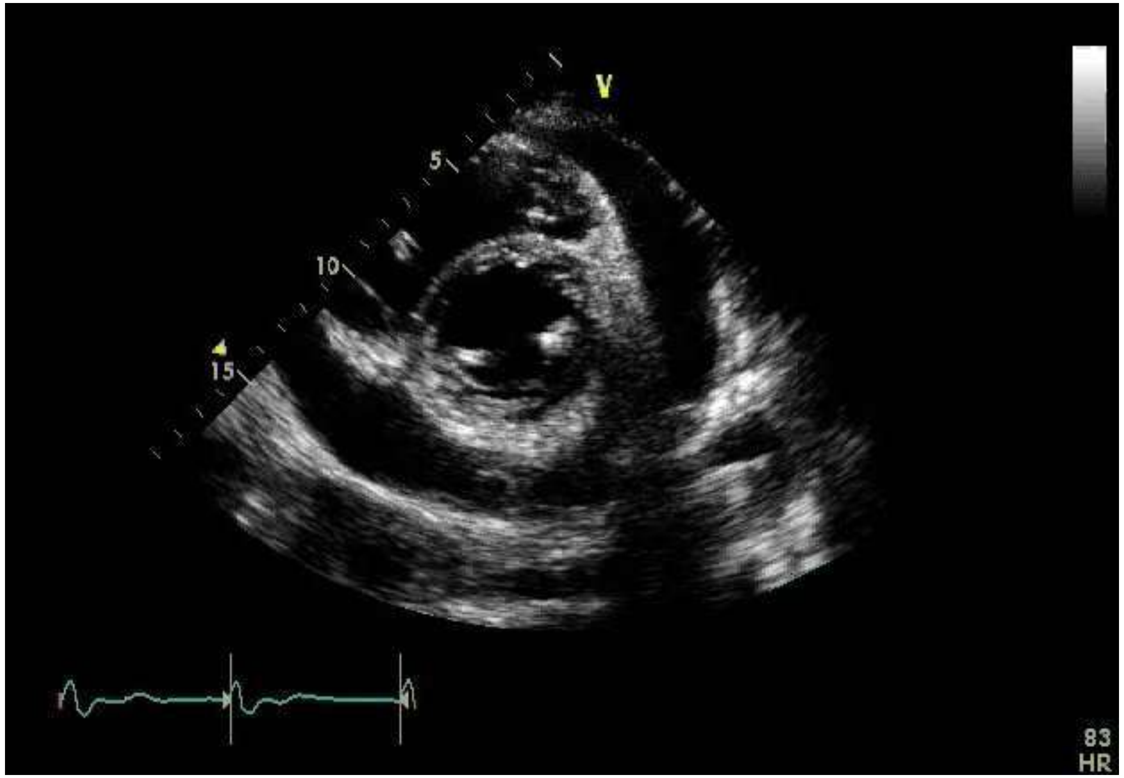
Normal Cardiac Physiology

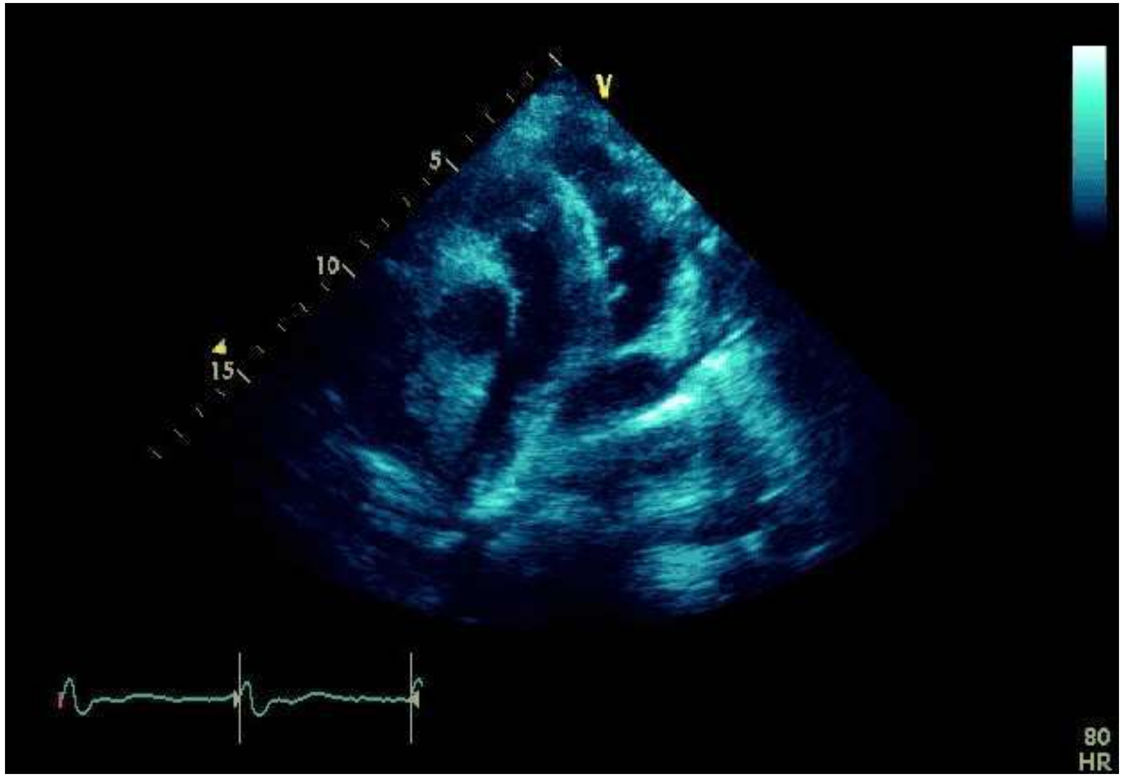


Normal JVP

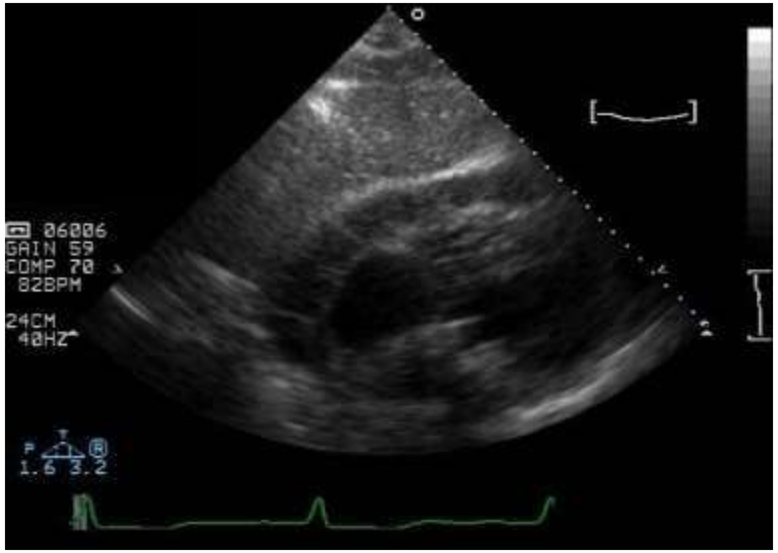


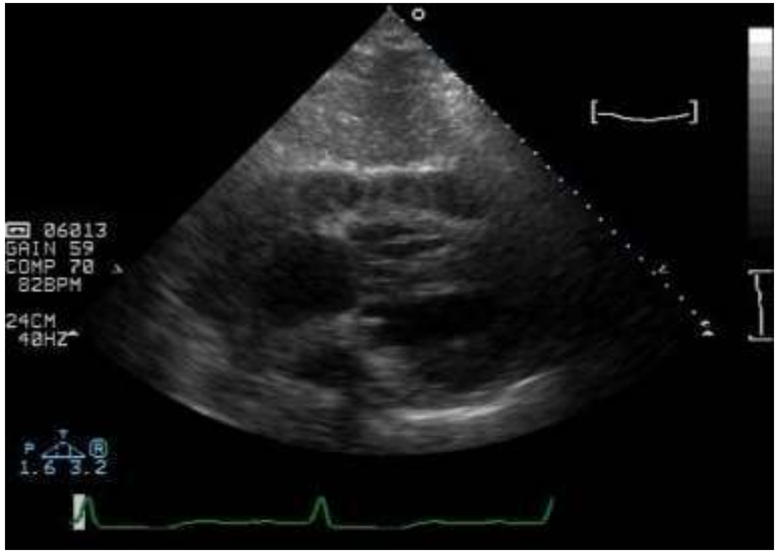
Pericardial Adhesions



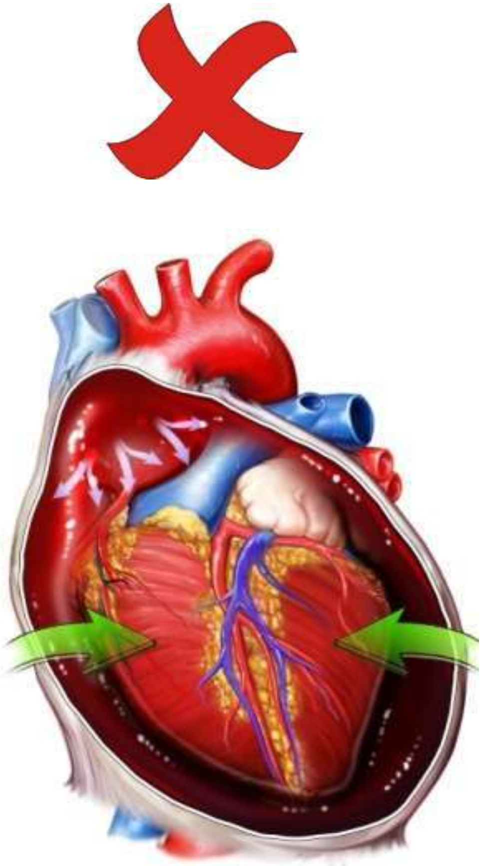


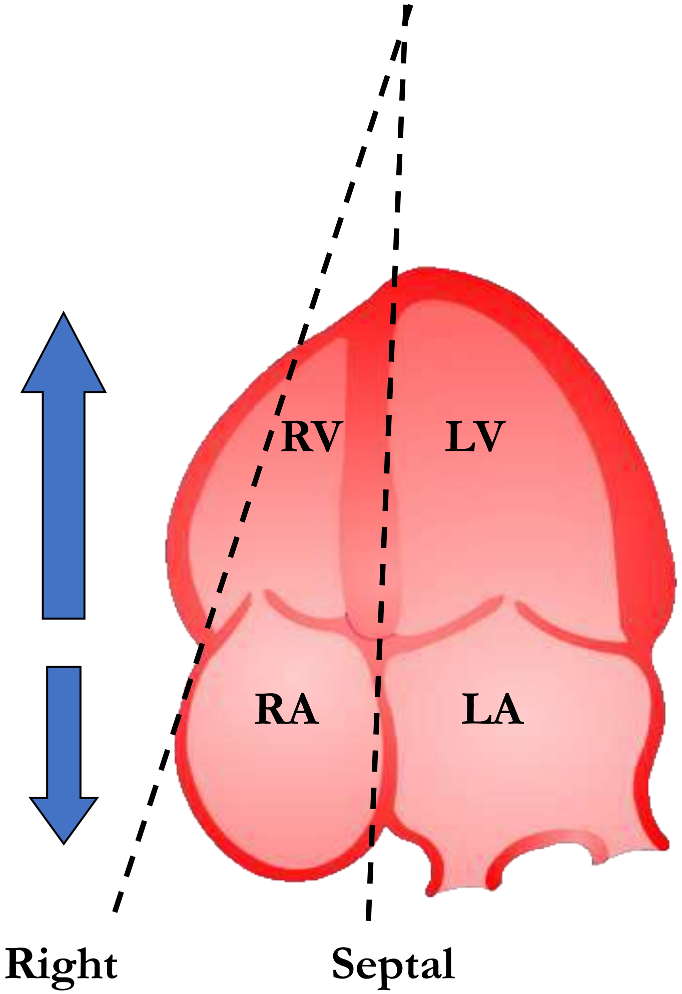
Pericardial Adhesions

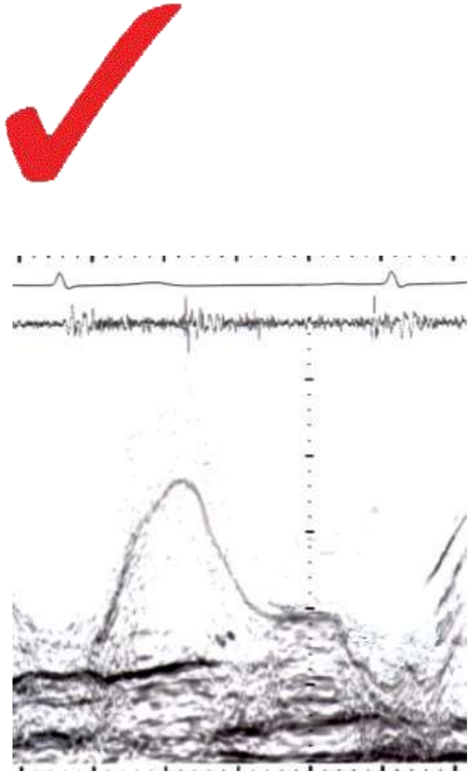




Pathophysiology Pericardial Constriction



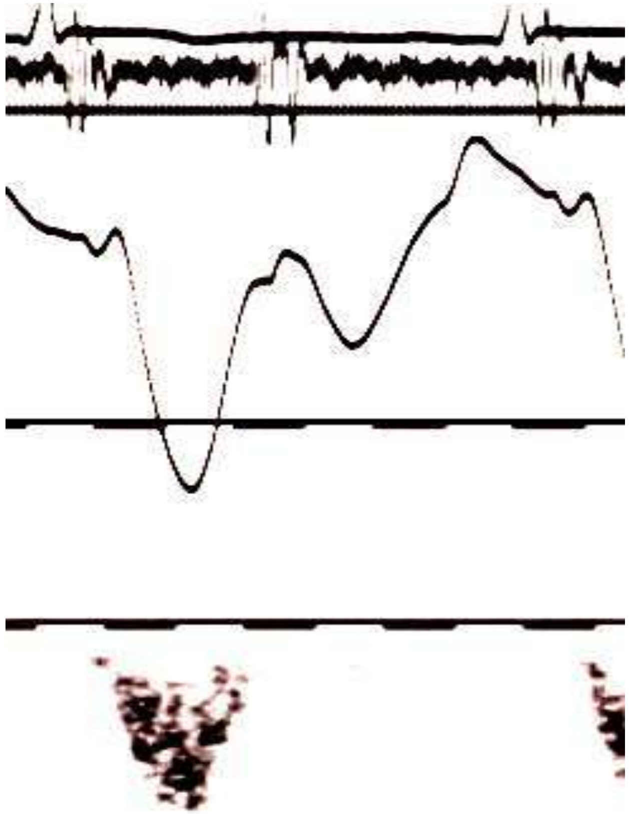




Pathophysiology Pericardial Constriction

Systole:

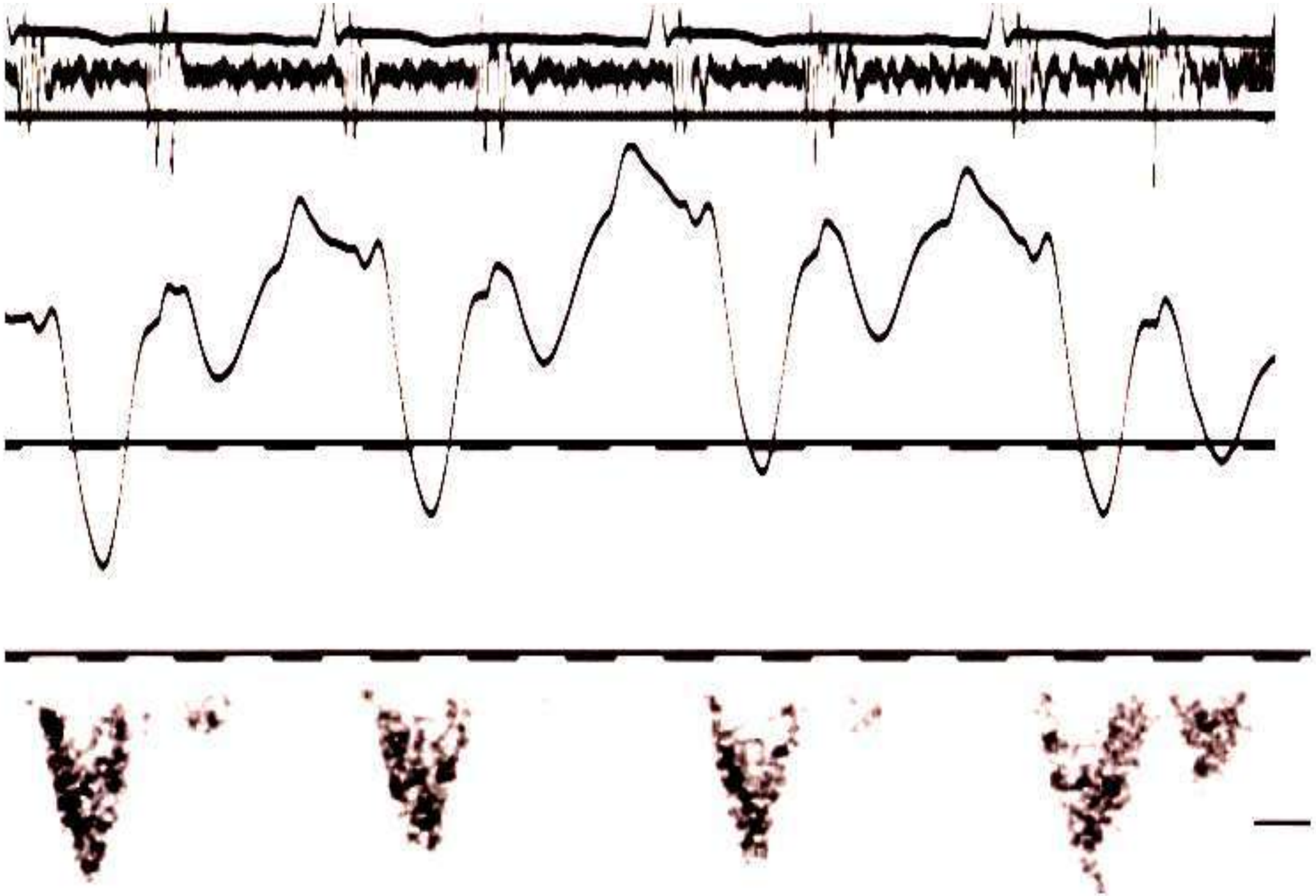
- preserved RV long axis systolic motion
- So dominant X descent on JVP is preserved
- Associated with dominant systolic wave on SVC flow



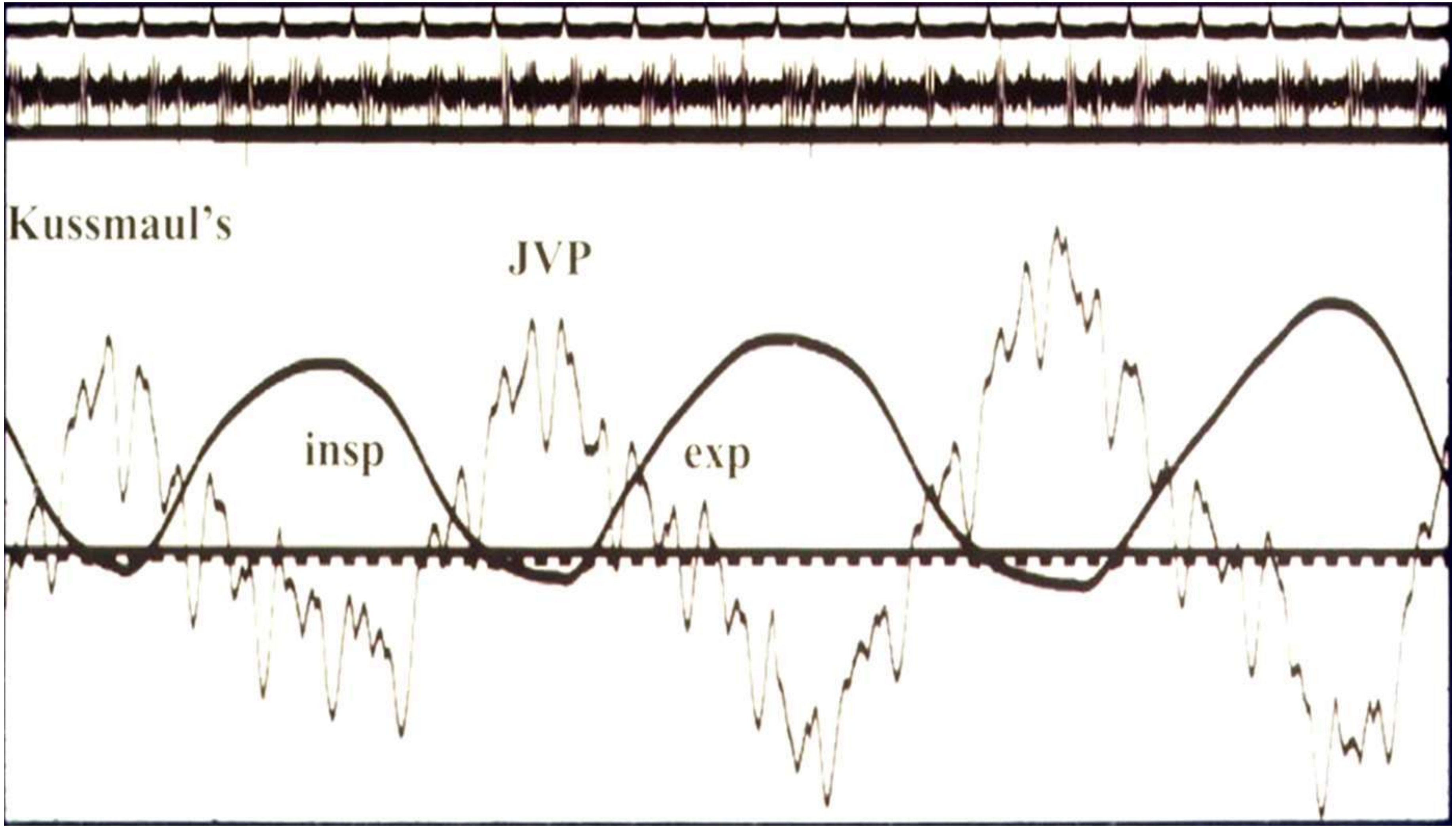
Diastole

- tricuspid valve opens
- Y descent on JVP
- diastolic wave on SVC flow
- Y descent < X descent as intrapericardial pressure higher during diastole

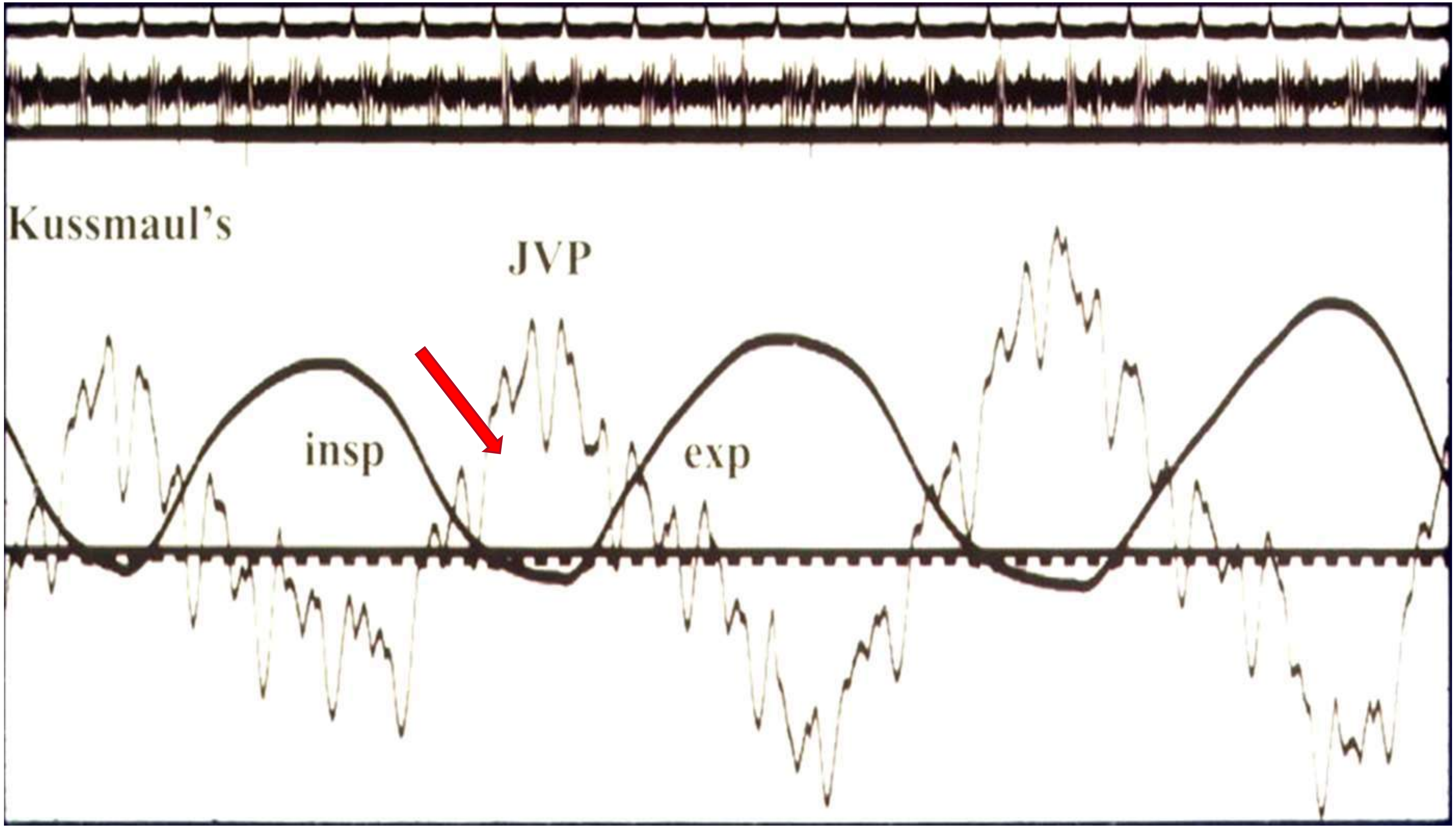
Pathophysiology Pericardial Constriction



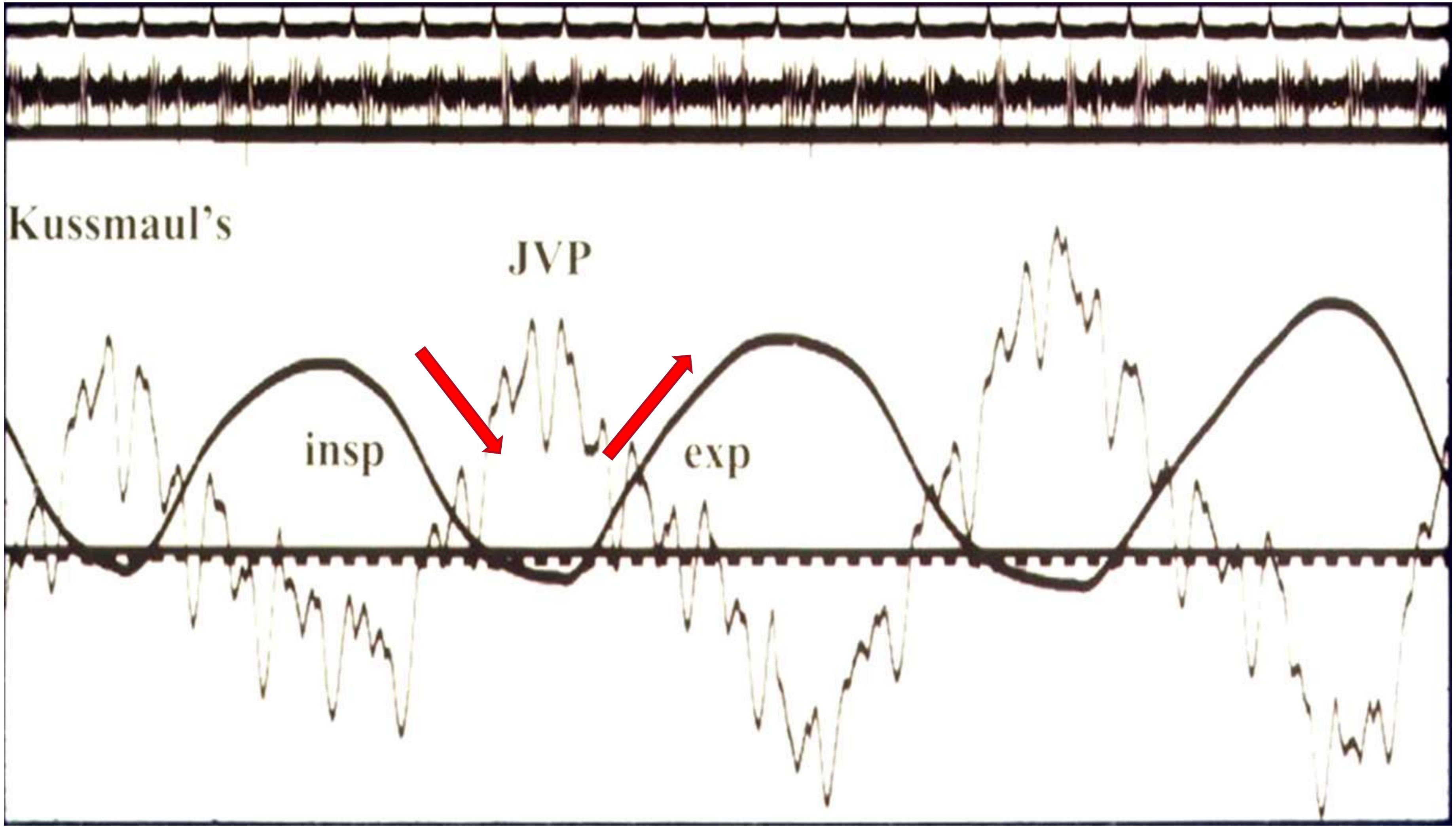
Pathophysiology Pericardial Constriction



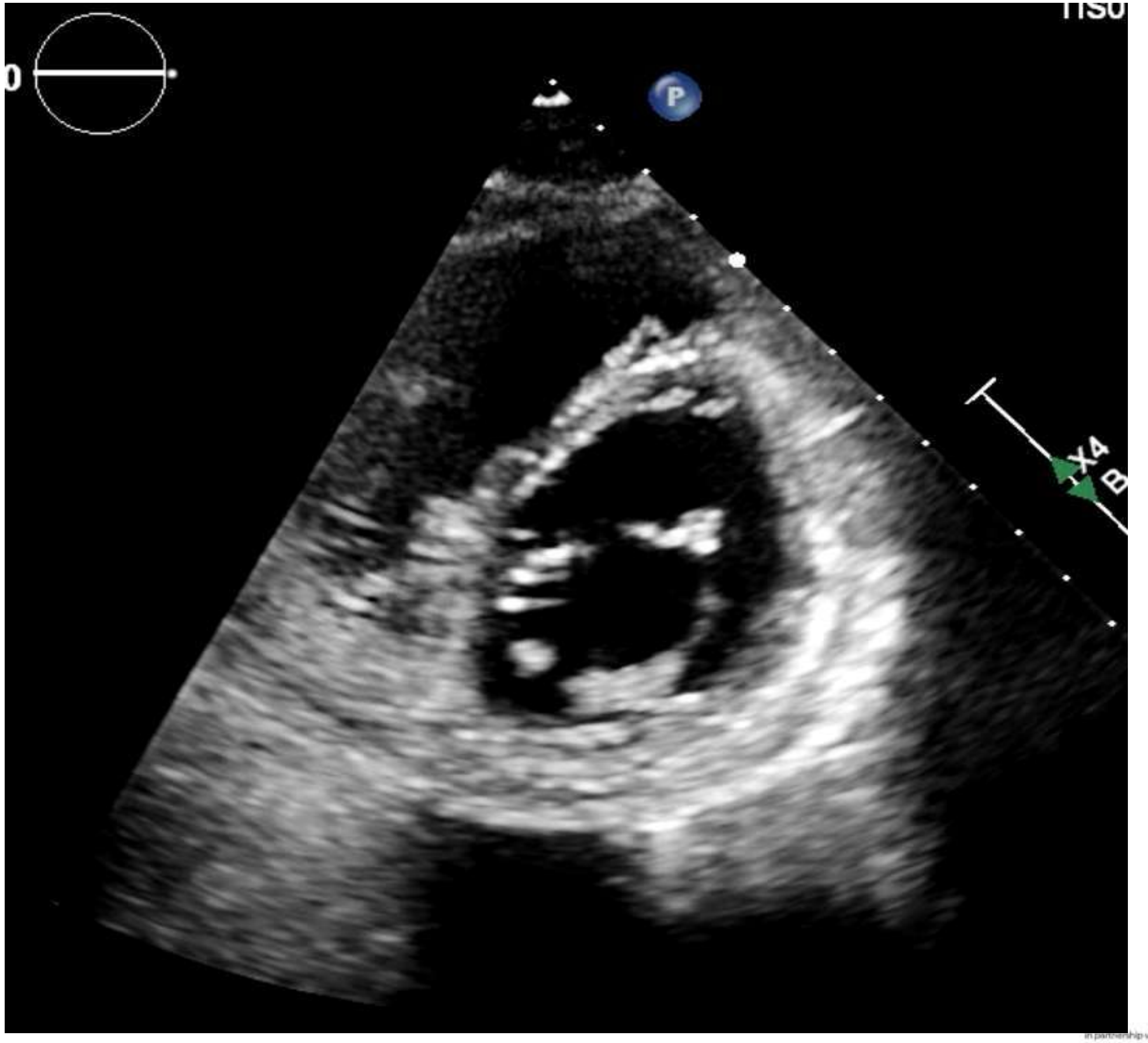
Pathophysiology Pericardial Constriction



Pathophysiology Pericardial Constriction



Ventricular Interdependence with Respiration



Ventricular Interdependence with Respiration

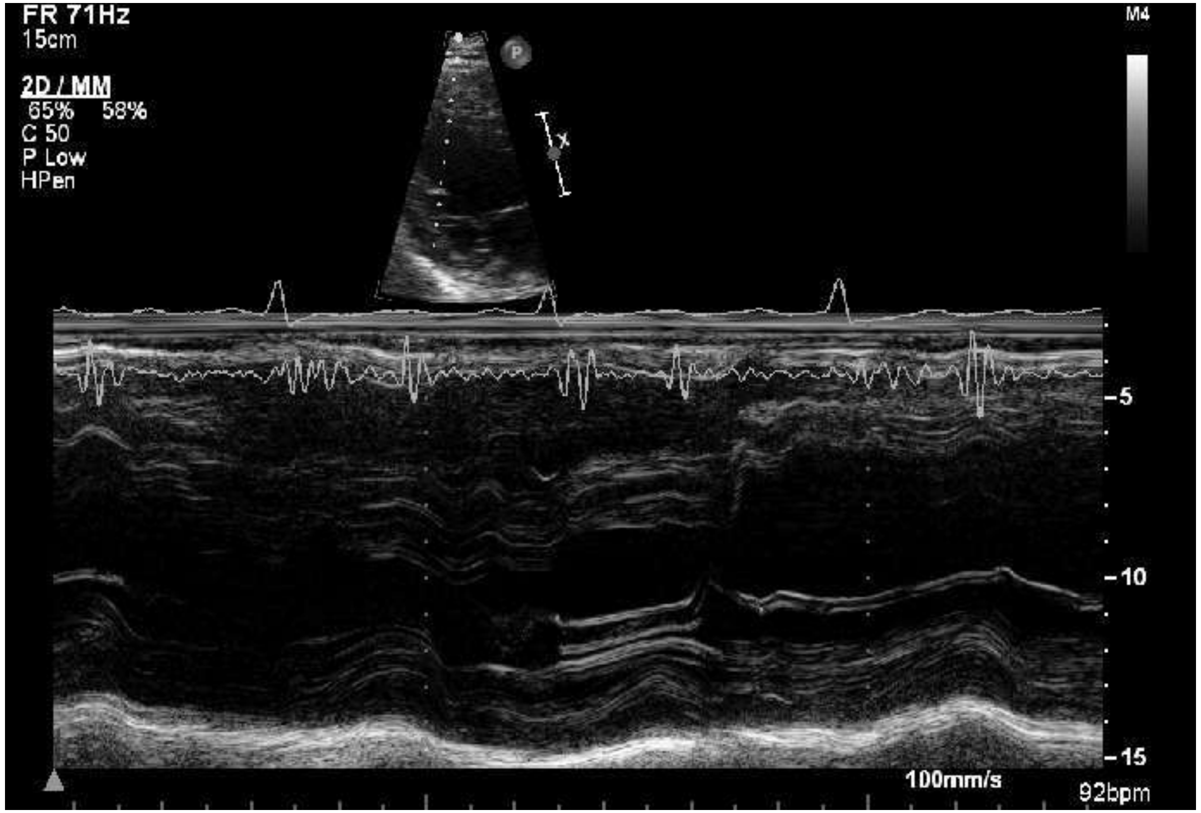
↑ pericardial pressure > CVP and PV pressure, filling influenced by variation in intrathoracic pressures

Ventricular Interdependence with Respiration

↑ pericardial pressure > CVP and PV pressure, filling influenced by variation in intrathoracic pressures

Inspiration

- -ve intra-thoracic pressure → ↑ flow into RV
- IVS bulge towards LV
- Pooling blood pulmonary veins
- ↓se LV filling
- Pulsus paradoxus



Ventricular Interdependence with Respiration

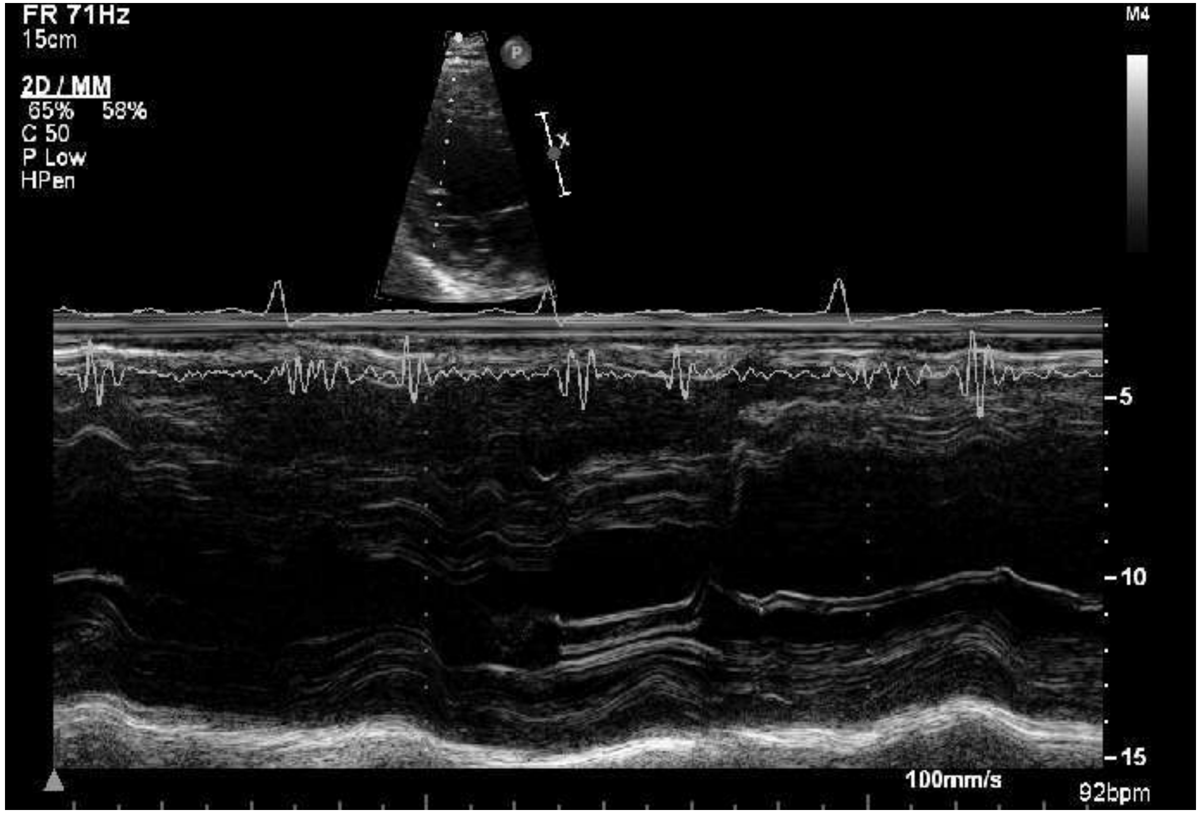
↑ pericardial pressure > CVP and PV pressure, filling influenced by variation in intrathoracic pressures

Inspiration

- -ve intra-thoracic pressure → ↑ flow into RV
- IVS bulge towards LV
- Pooling blood pulmonary veins
- ↓se LV filling
- Pulsus paradoxus

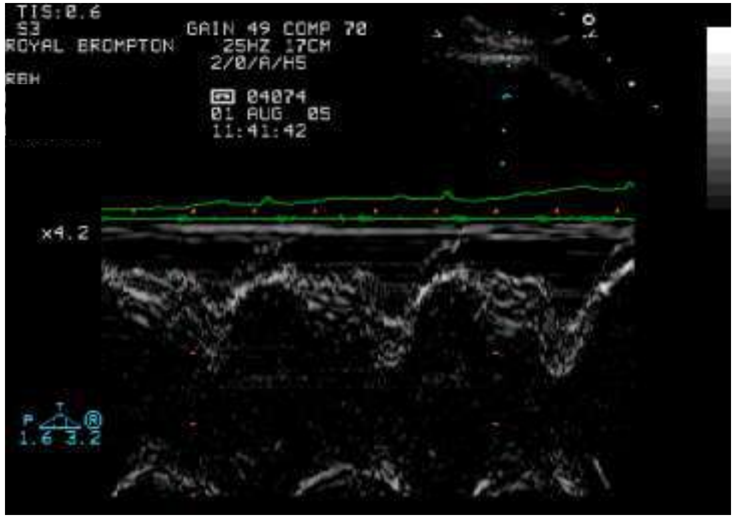
Expiration

- Intra-thoracic pressure increases
- Less blood from vena cava enters RV
- IVS bulge towards RV
- Increased PV flow
- ↑se LV filling

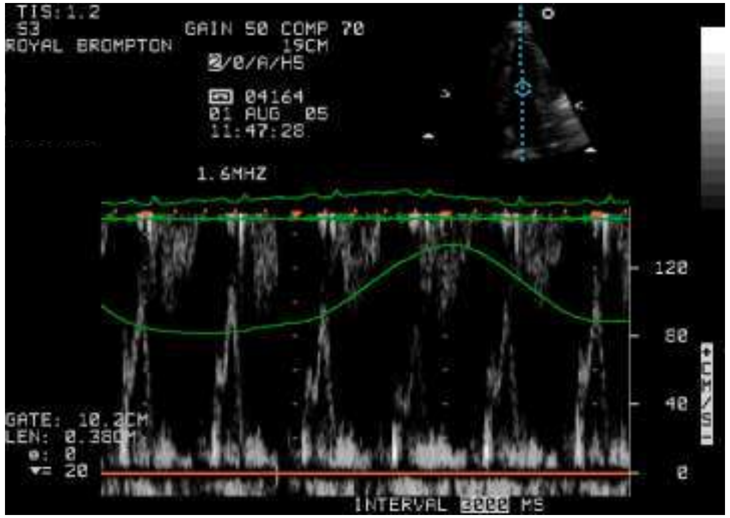


Constriction: Pathophysiology with Respiration

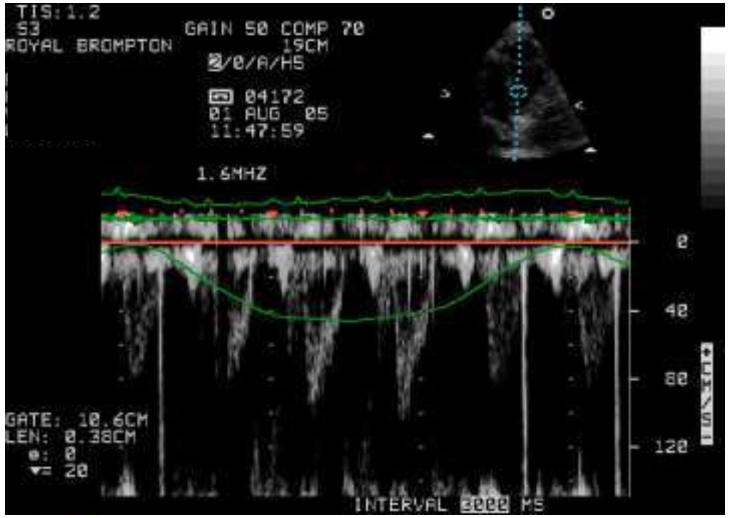
RV



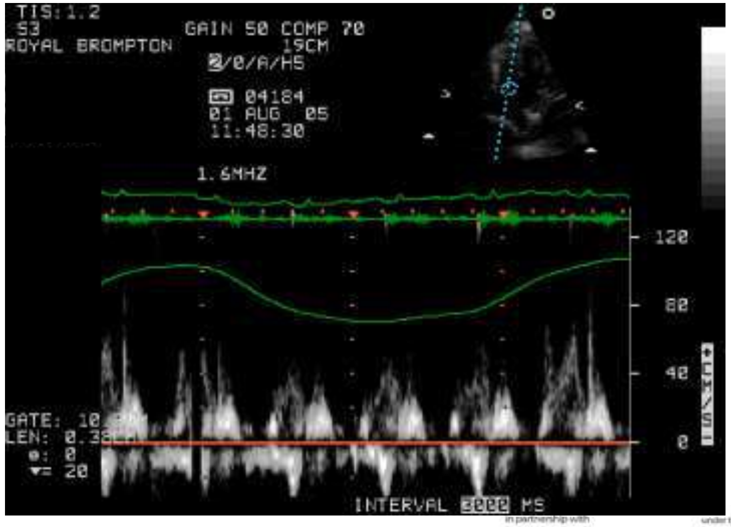
MV



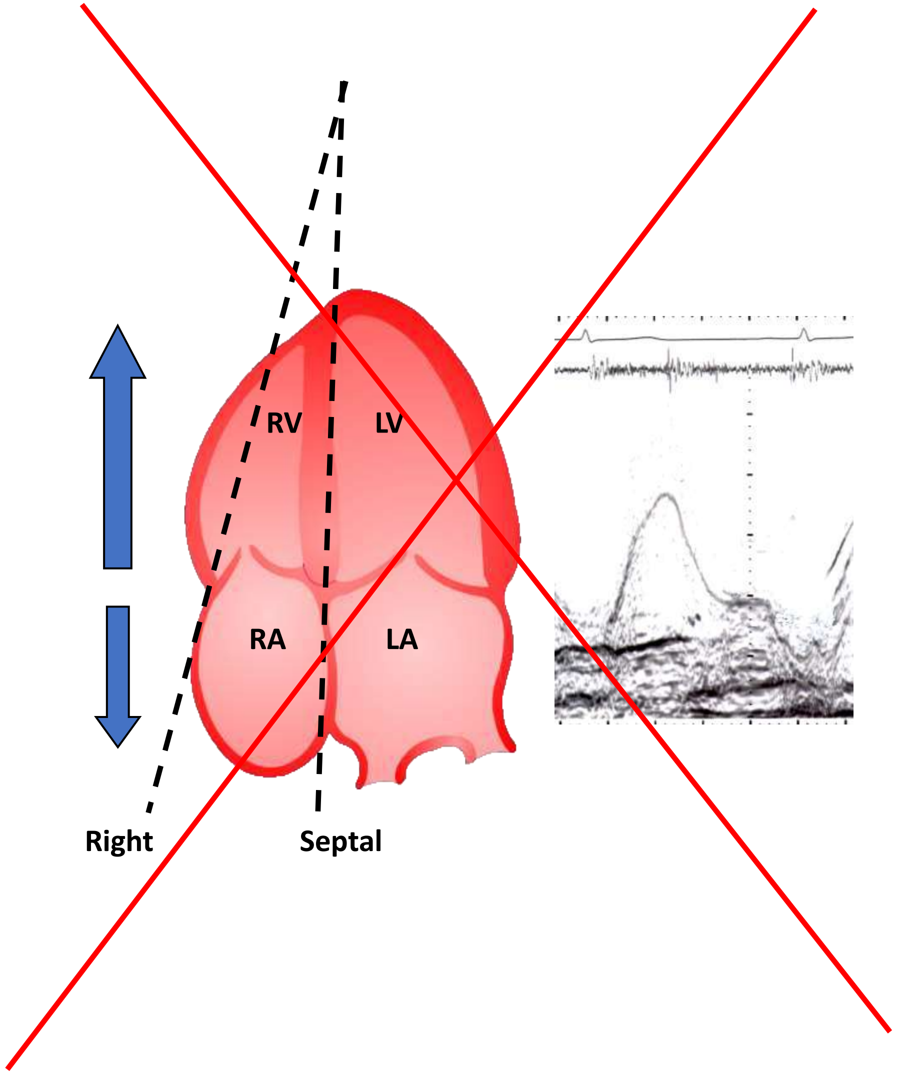
AV



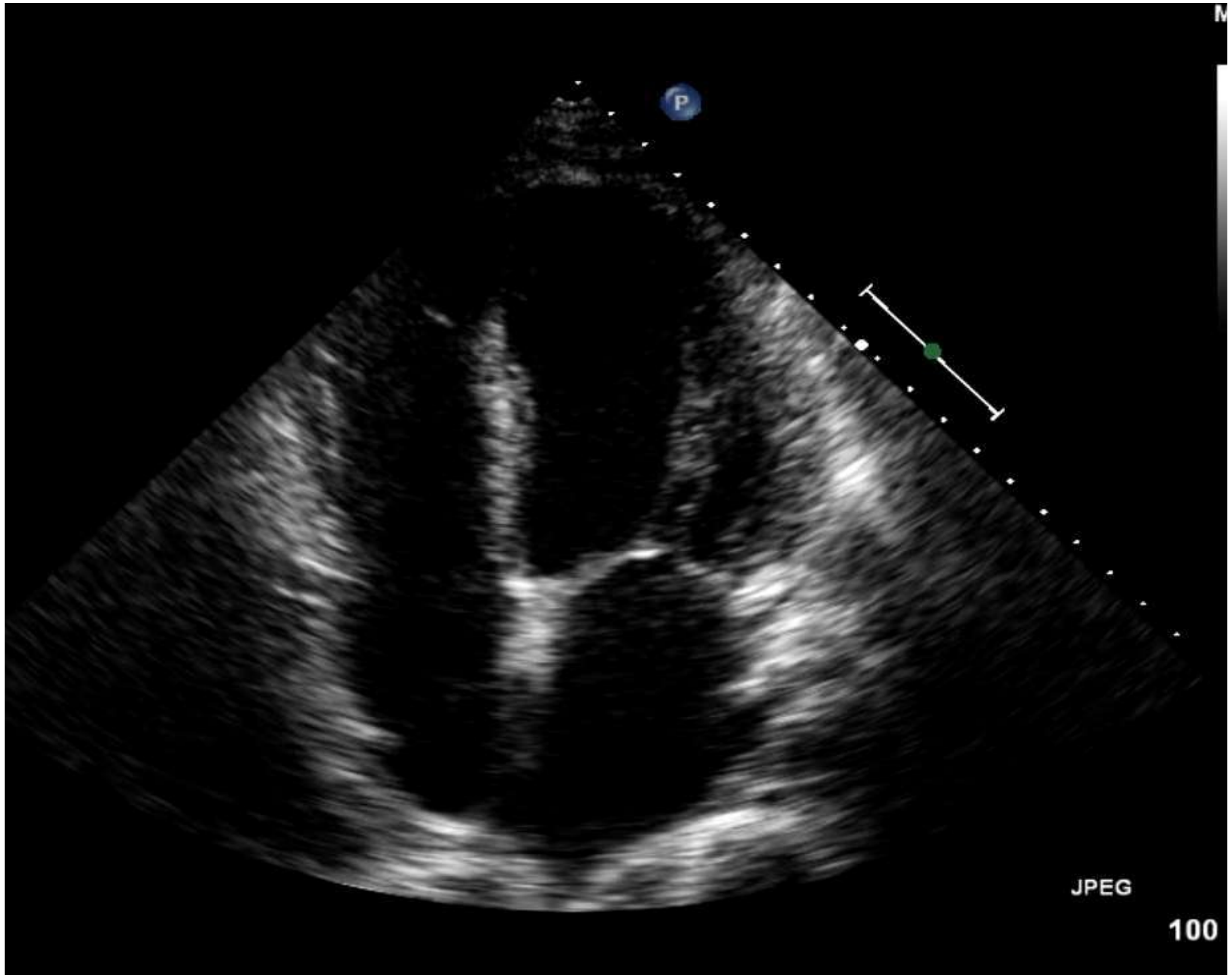
TV



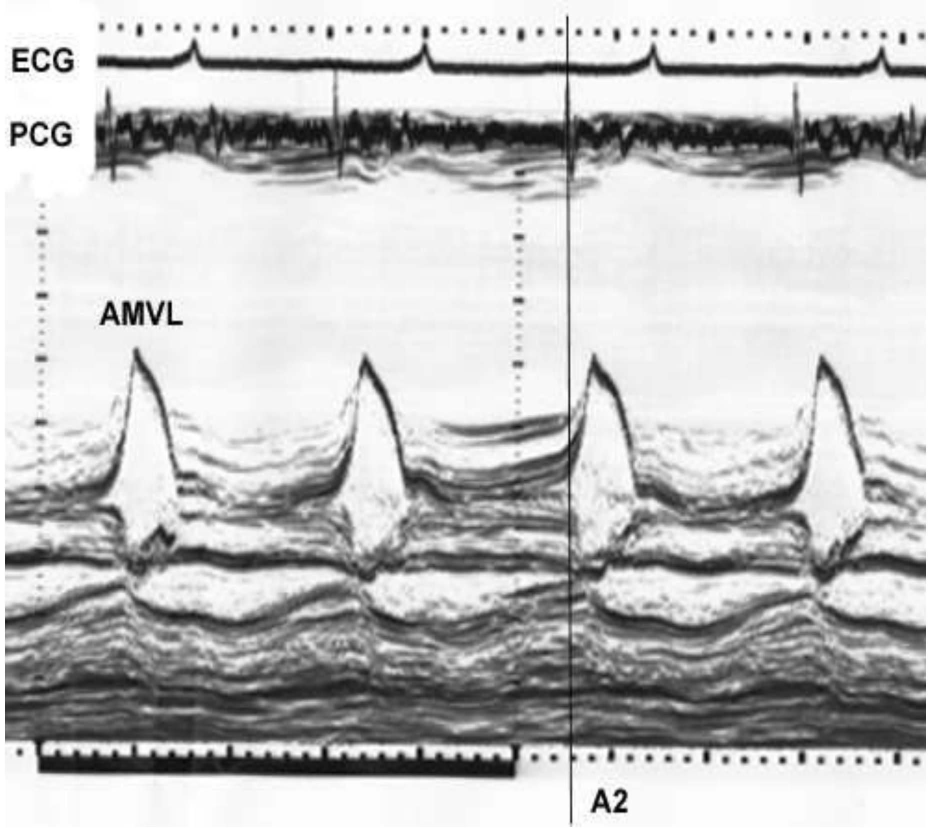
Restrictive Physiology

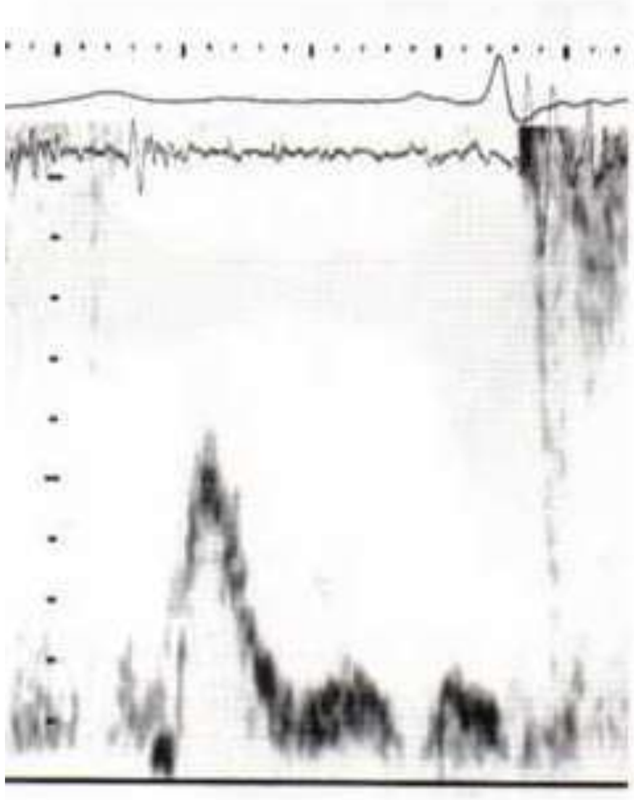


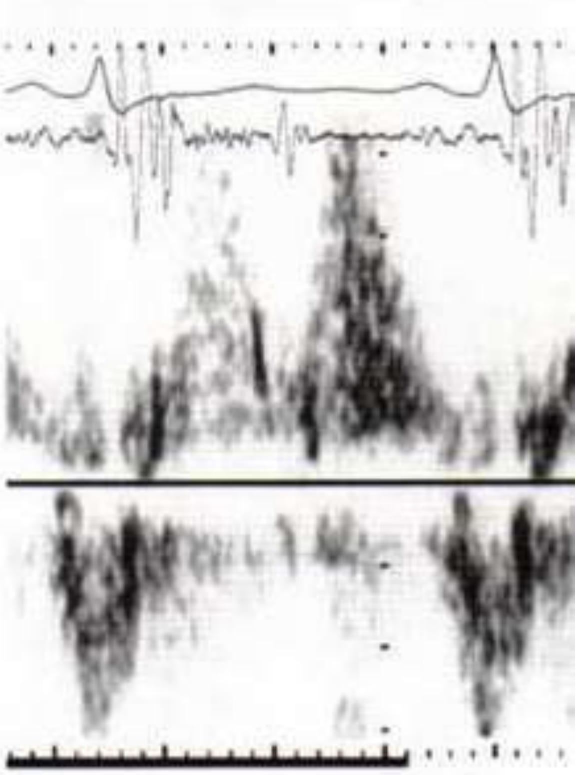
Restrictive Physiology



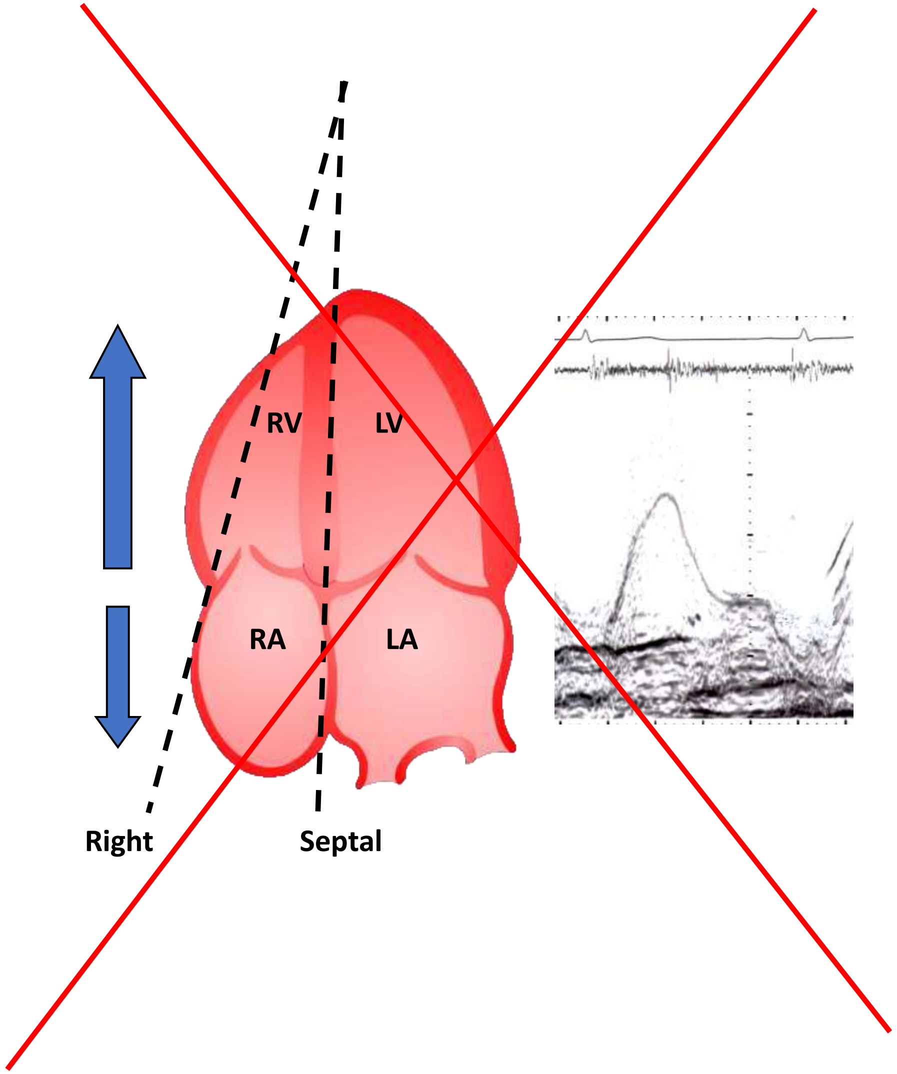
Restrictive Physiology

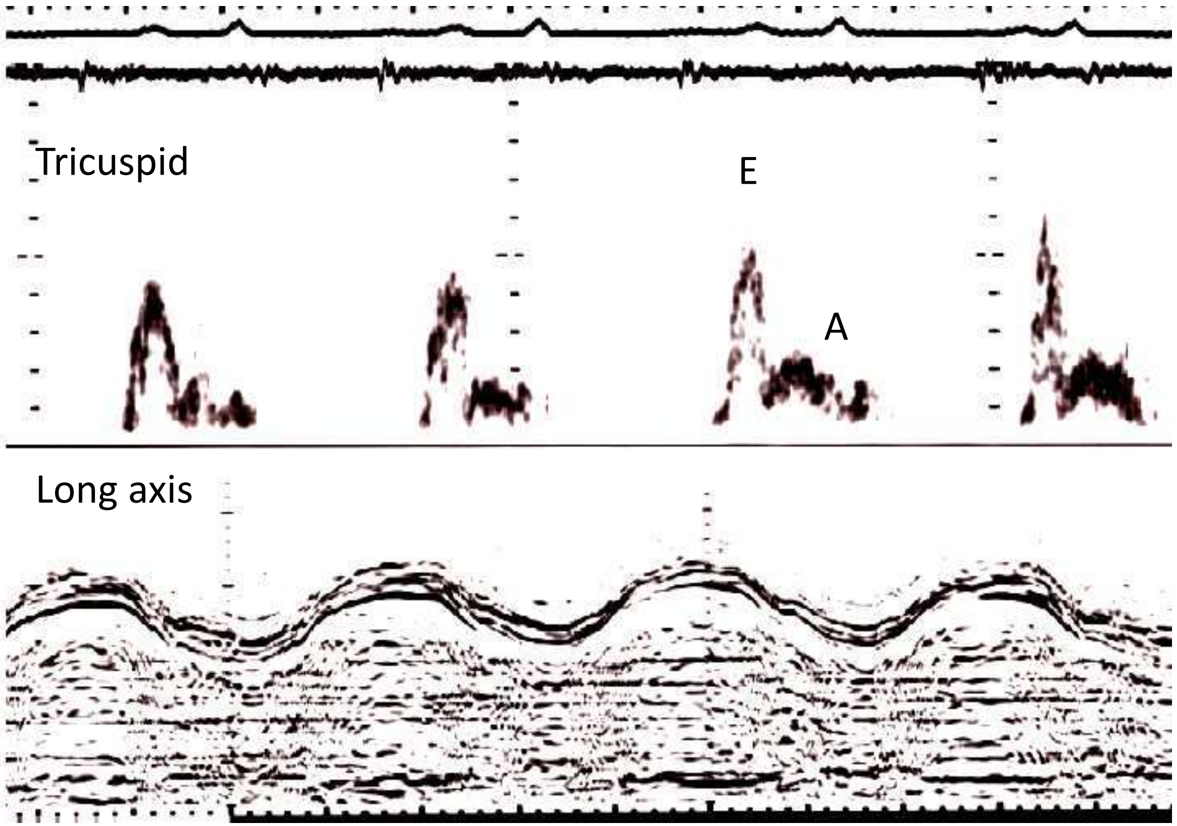




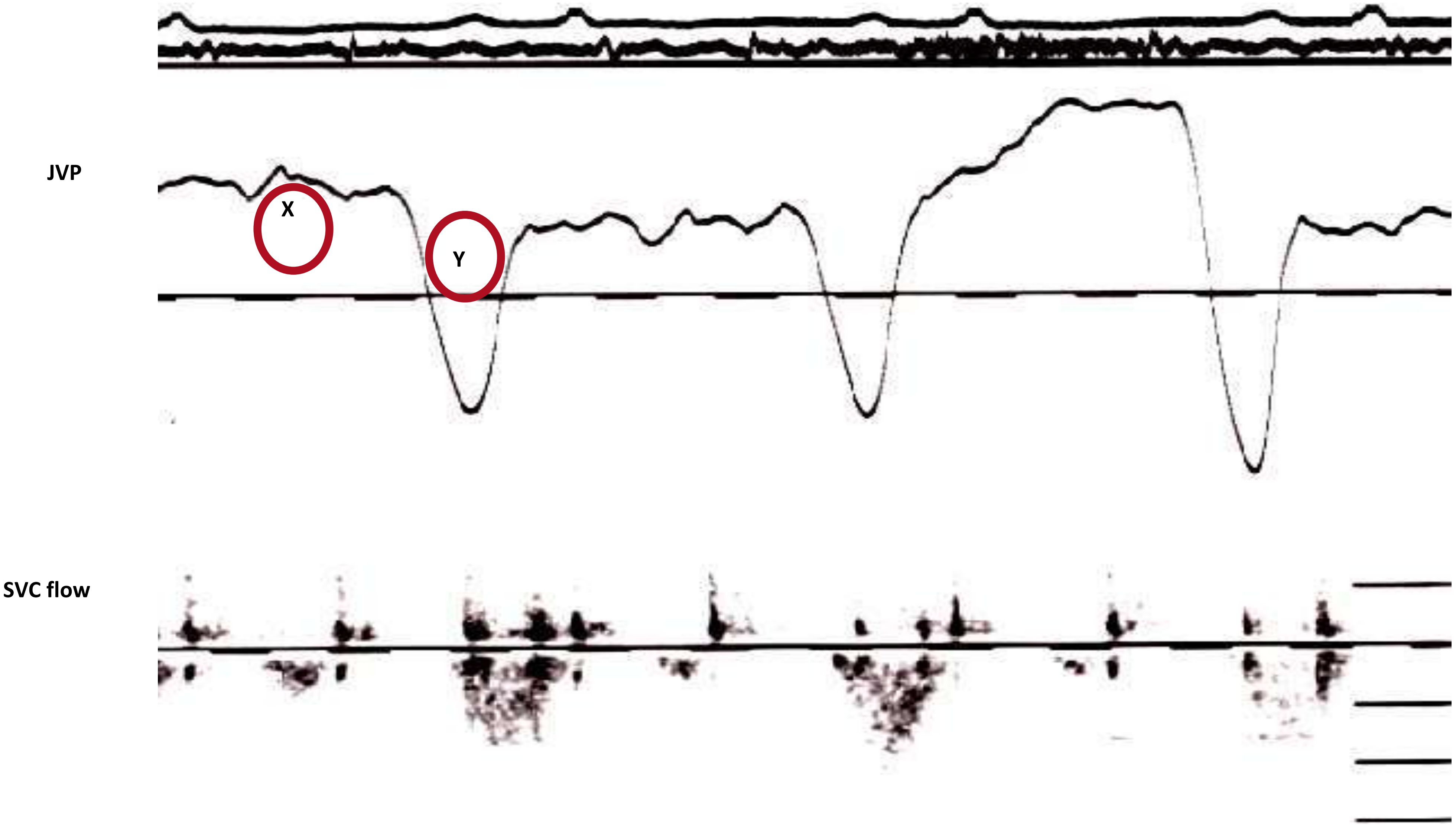


Restrictive Physiology





Dominant Y in JVP: diastolic flow in SVC



Multiple Uses Echo in Heart Failure

Thank you very much for listening and for inviting me to wonderful Baku