

Echocardiography in Valvular Heart Disease, Heart Failure, and Cardiomyopathies

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Disclosures

Speaker for Zoll Lifevest



Case

- 45 year old Columbian male who migrated to the US 5 years ago (let us assume you did not get this history) comes in with shortness of breath on exertion
- On exam, patient has crackles and JVD
- CXR demonstrates pulmonary vascular congestion
- BNP 500
- Echo with EF 35%

Working diagnosis: Systolic congestive heart failure

- Ischemic
- Non-ischemic: Hypertensive? Idiopathic? Alcoholic?

You proceed with your usual workup... stress test? Cath? Look for clinical clues in history



Systolic

- Ischemic
- Nonischemic
 - Hypertensive
 - Alcoholic
 - Metabolic
 - Hypothyroidism
 - Pheochromocytoma
 - Infiltrative
 - Amyloidosis
 - Diabetes
 - Peripartum

Chagas Disease



Rhodnius prolixus is the principal vector in Colombia, Venezuela, Guatemala, Honduras, and some parts of Nicaragua and El Salvador



American trypanosomiasis, is a [tropical parasitic disease](#) caused by the protozoa [Trypanosoma cruzi](#)

It is spread mostly by insects known as [Triatominae](#)

Early stage, symptoms are typically either not present or mild, and may include fever, swollen [lymph nodes](#), headaches, or local swelling at the site of the bite

30 to 40% of people develop further symptoms 10 to 30 years after the initial infection, including congestive

- LV aneurysm (60-70% patients)
- Myocarditis
- Regional WMA (inferolateral wall)



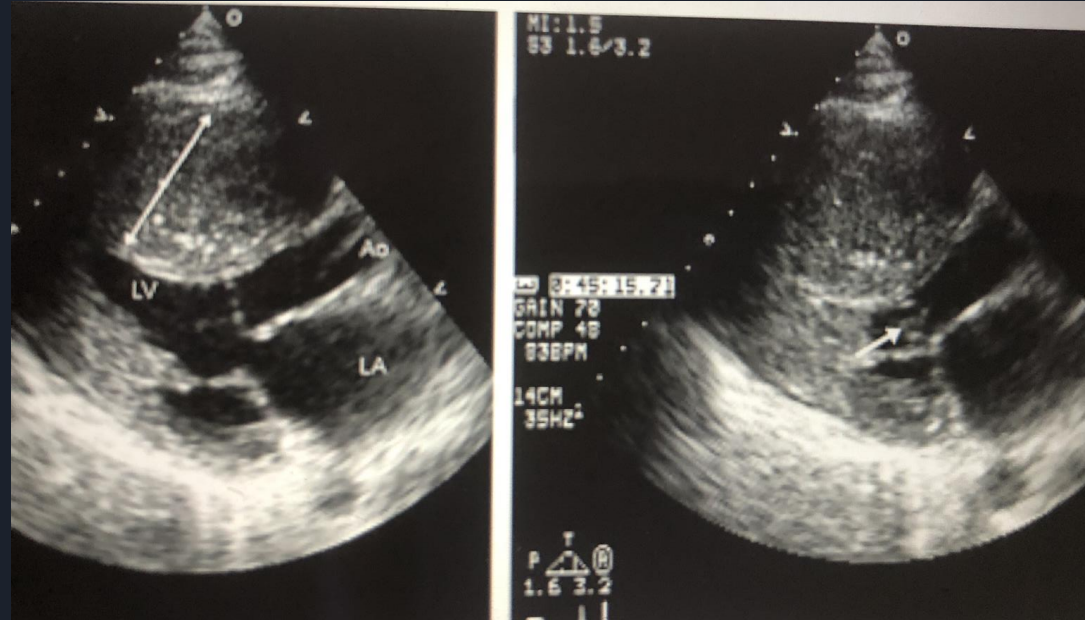



Case

- 55 y/o male with harsh systolic murmur that can be heard at the suprasternal notch but not at the carotid arteries
- Murmur gets quieter with squatting and louder with standing

Hypertrophic cardiomyopathy

- Small LV cavity
- Inappropriate LHV > 1.3 cm
- Classical form has LVOT obstruction
- Apical pattern
- Papillary muscle involvement

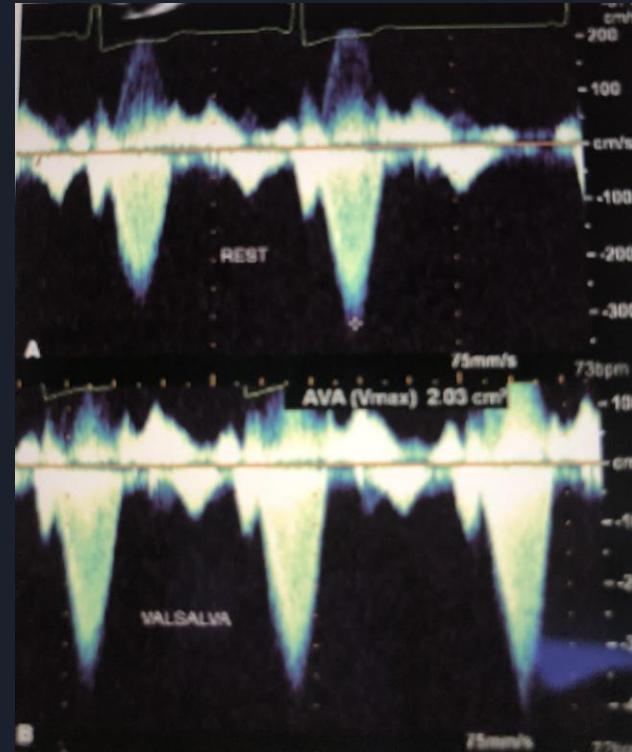


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- M-mode shows 1.3:1 septal to posterior wall hypertrophy
 - Typically anterior septum is involved
 - LVOT obstruction in 40%
 - Mitral regurgitation is late peaking
 - Systolic anterior motion of the mitral valve can also develop

- [illegible]

Valsalva

- Increase in gradient with valsalva





Case

- 80 y/o male with SOB on exertion
- Echo demonstrates severe LVH, restrictive diastolic pattern, and bi-atrial enlargement
- Patient has mild hypertension that has been well controlled for many years
- He brings his BP log from home showing well controlled BP



Diagnosis..

Amyloidosis

Restrictive cardiomyopathy

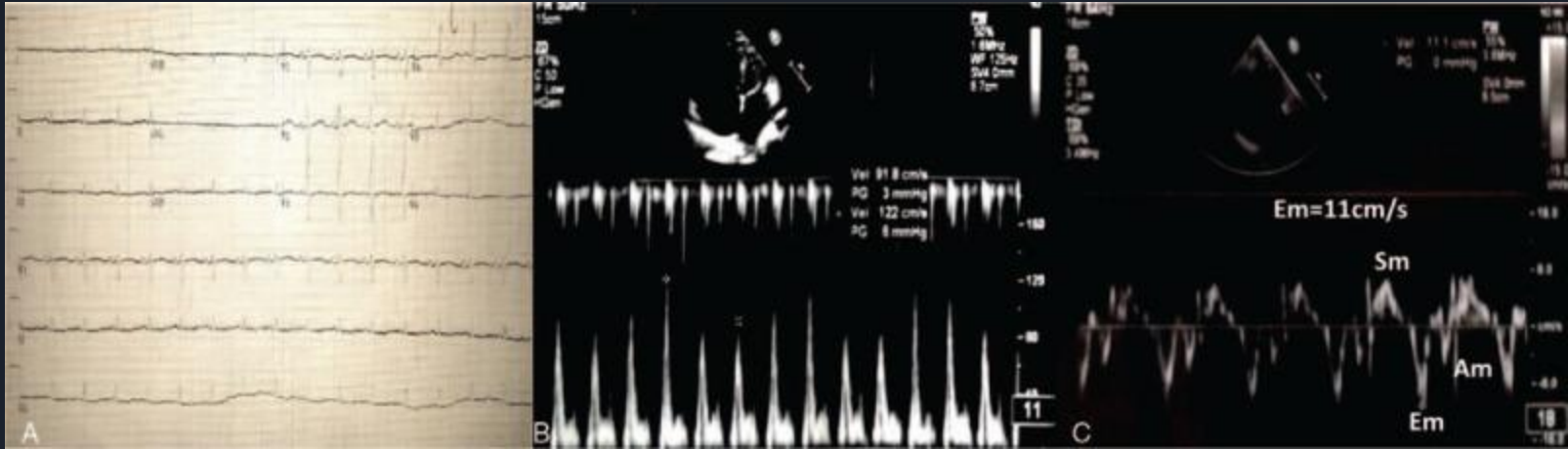
- Not a common cause of cardiomyopathy however must be in the differential
- Findings
 - Bi-atrial enlargement (due to both LV and RV restriction) many times is only early finding
 - Restrictive inflow pattern E/A over 2 and short decel time < 160 ms
 - Pericardial effusion
 - LVH
 - Blunted pulmonary vein systolic inflow





Case

- 57 y/o female with exertional dyspnea, leg edema and ascites
- History of radiotherapy 22 years ago with Co-60 after radical mastectomy for left breast cancer
- EKG demonstrates low voltage
- CXR demonstrates pericardial calcification



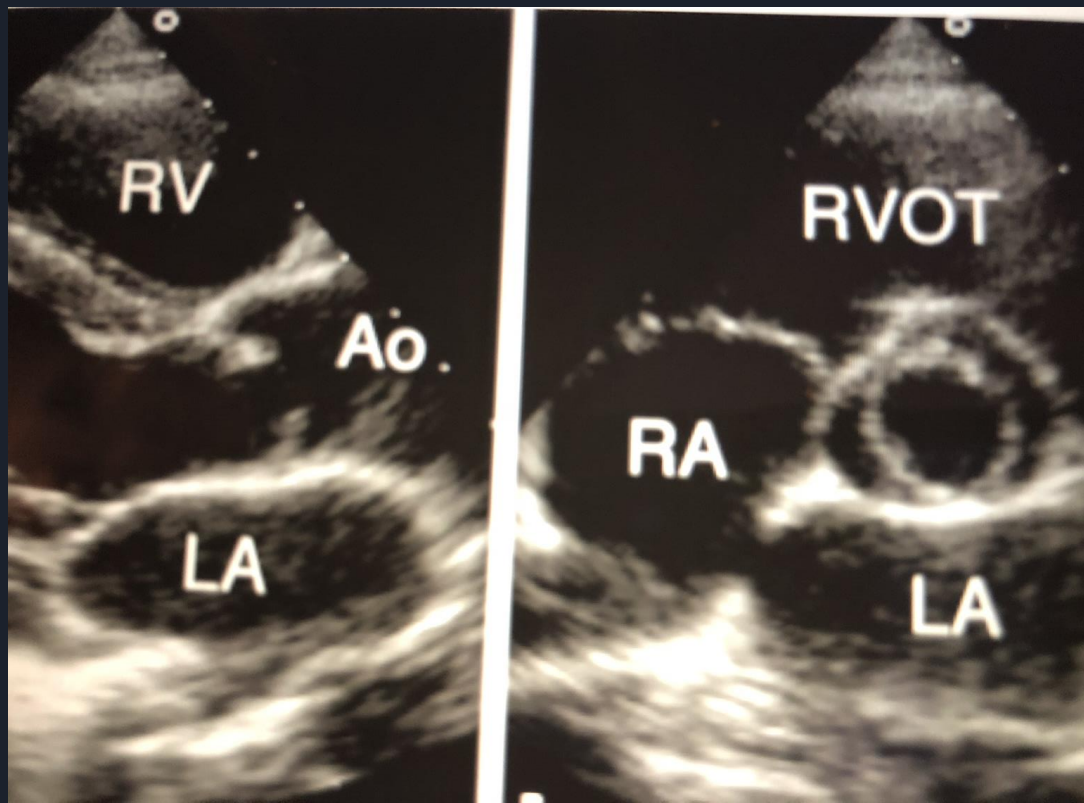
Echo findings: elevated E/A ratio however


- > 25% E wave variation with respiration
- E' velocity is preserved



Valvular heart disease case

- Cardiology fellow decides to do his own echocardiogram in training as his colleague heard a systolic murmur
- Finds systolic doming of the aortic valve
- Eccentric aortic regurgitation jet
- Fish mouth appearance of the aortic valve
- Peak gradient is elevated moderately and mean gradient is elevated only mildly



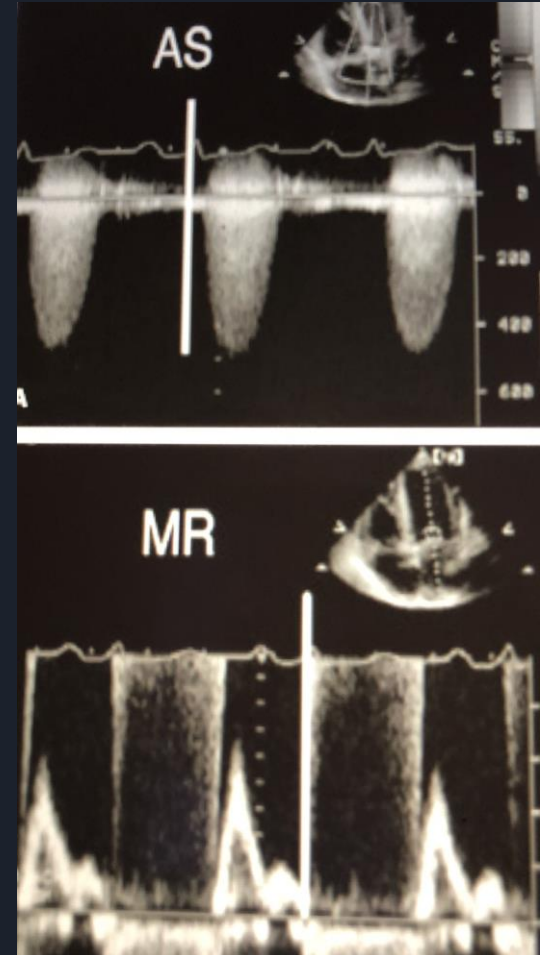


Pearls with AS and AI such as in bicuspid aortic valve

$$\text{Aortic Valve Area (cm}^2\text{)} = \frac{\text{LVOT diameter}^2 \cdot 0.78540 \cdot \text{LVOT VTI}}{\text{Aortic Valve VTI}}$$

- $4V^2$ is used for calculating aortic stenosis gradient
 - In aortic insufficiency cannot ignore LVOT velocity $4(V2^2 - V1^2)$
 - $\text{LVOT diameter}^2 \cdot 0.785 \cdot \text{LVOT VTI}$ is the stroke volume
 - If stroke volume < 35 mL this is considered low flow
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- Pressure recovery phenomenon
 - Aortic stenosis peak gradient is lower in cath lab as jet decelerates downstream
 - Echocardiogram measures highest velocity along the path anywhere
 - Noted most in small aortic roots
 - Mean gradient correlates

- AS and MR waveform can be “contaminated”
- Look for timing of the jet
- AS waveform has a delay compared to R wave
- MR waveform starts immediately after R wave
- AVA calculation by continuity equation
 - Not affected by AI
 - Not affected by LV function





Aortic stenosis

Severe

- $MG > 40 \text{ MMHG}$
- $AVA < 1 \text{ cm}^2$ or indexed $AVA < 0.6 \text{ cm}^2$



Flow reserve

*low flow low gradient gradient severe if with DSE..

*SVI increases by 20%

*MG over 40

*jet over 4

*ava less than 1

*No reserve if DSE gradient less than 40 and ava less than 1 then do calcium score of AV

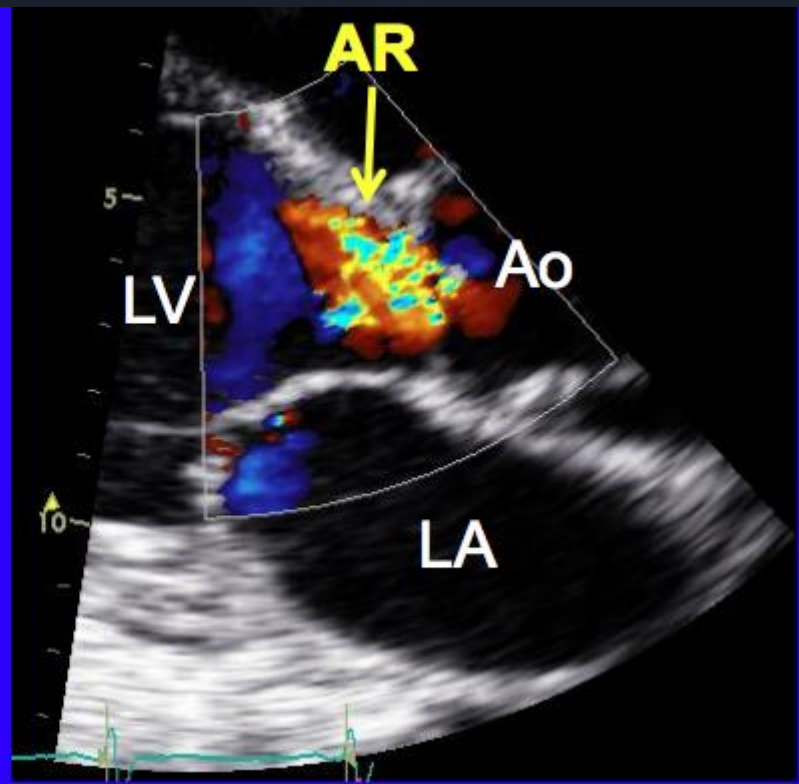
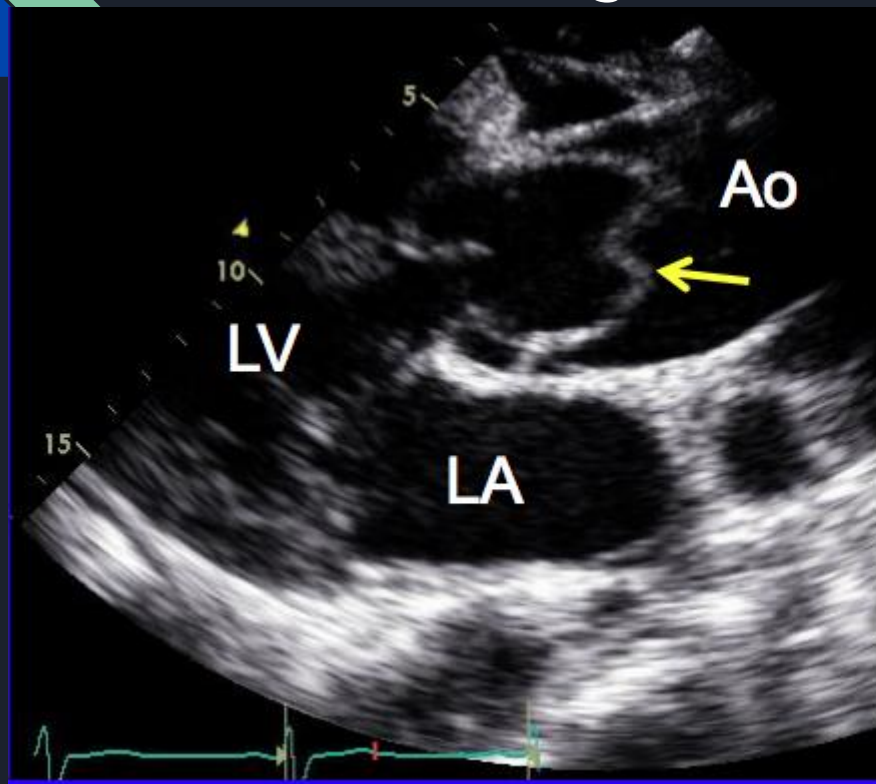
*If over 1200 woman and 2000 man severe by ESC



Case

- 50 year male with uncontrolled hypertension
- Ripping chest pain radiating to the back
- Unequal pulses in the arms
- Stat echocardiogram performed

Echo Findings





Aortic insufficiency causes

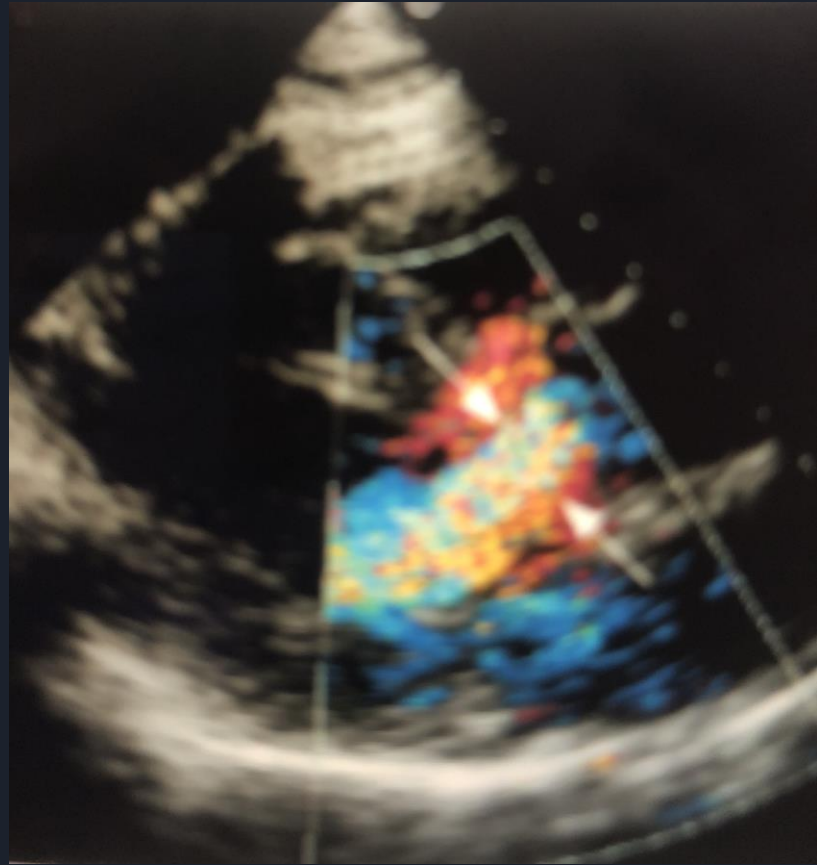
- Aortic root dilation due to hypertension
- Bicuspid aortic valve aortopathy
- Dissection
- Syphilis
- Aortic valve endocarditis





Severe aortic insufficiency

- Pressure half time < 250 ms
- Holodiastolic flow reversal in the descending aorta
- > 60% of LVOT height
- ERO > 0.3 cm²
- VCW > 0.6 cm
- Regurgitant volume > 60 mL
- Regurgitant fraction > 50%



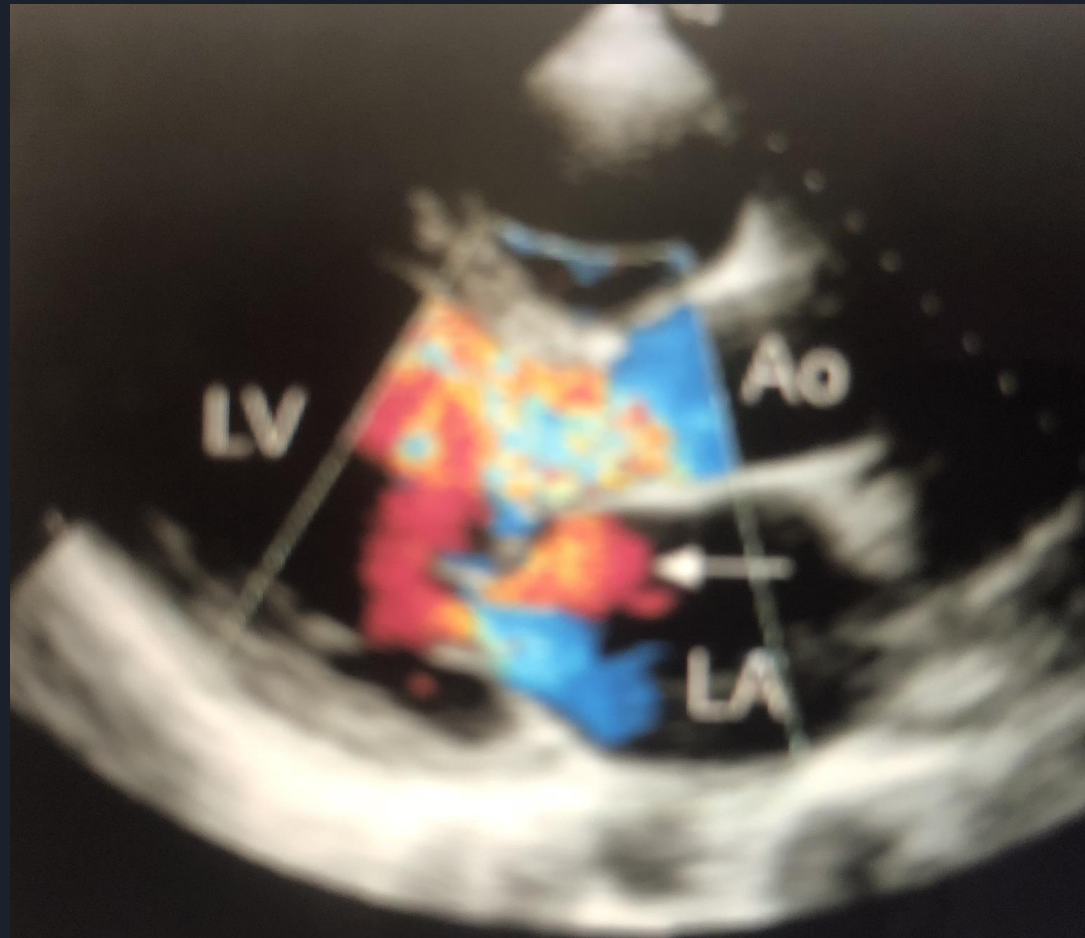


Acute aortic insufficiency causes?

- Dissection
- Endocarditis

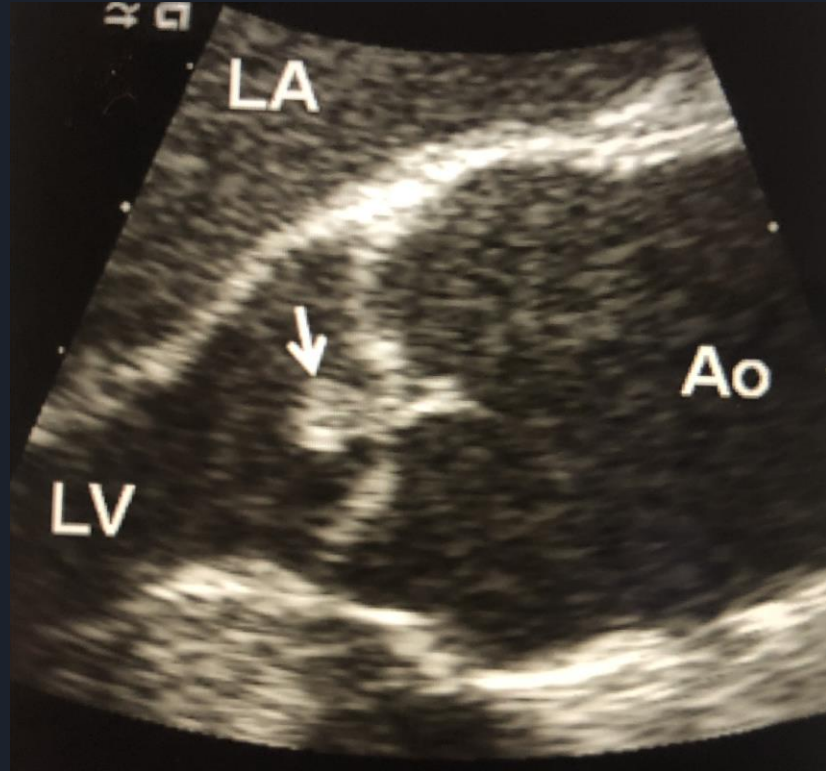
Diastolic MR

- Hallmark of severe AI

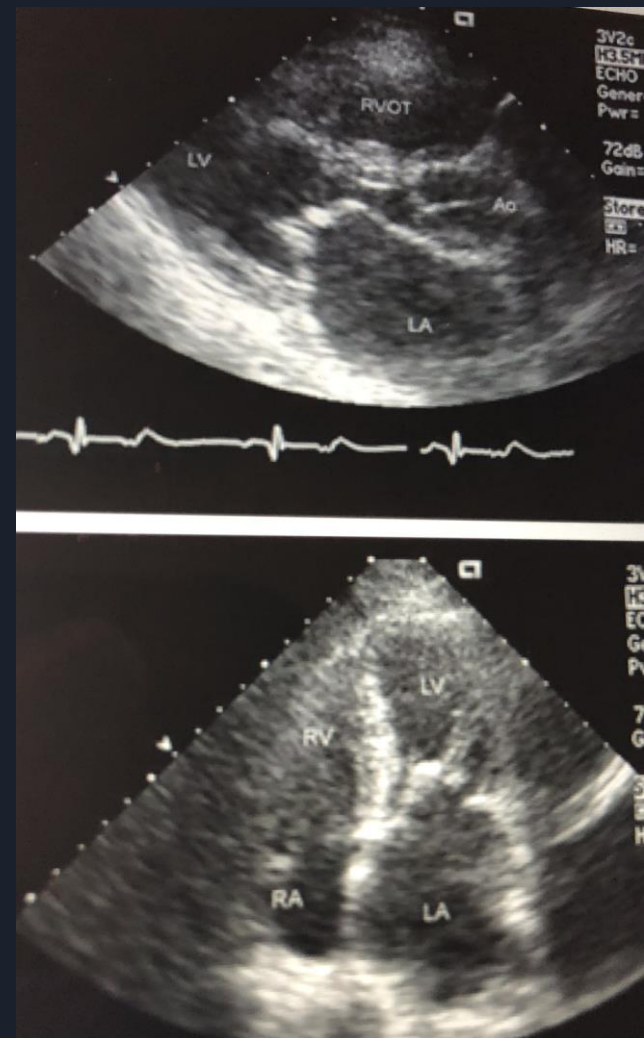


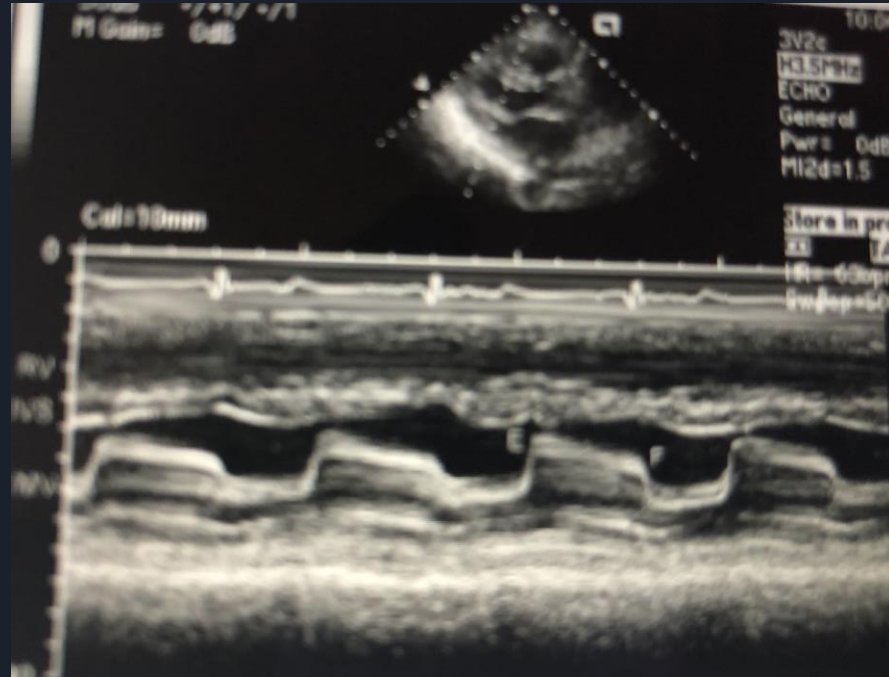
Case

- 60 year old woman with new onset cerebrovascular accident has an echocardiogram
- Answer?



- Echo tech asks you to come take a look at this echocardiogram where he notes a systolic “doming” of the mitral valve and he wants your opinion
- You ask him to get a M-mode across the mitral valve to assess further




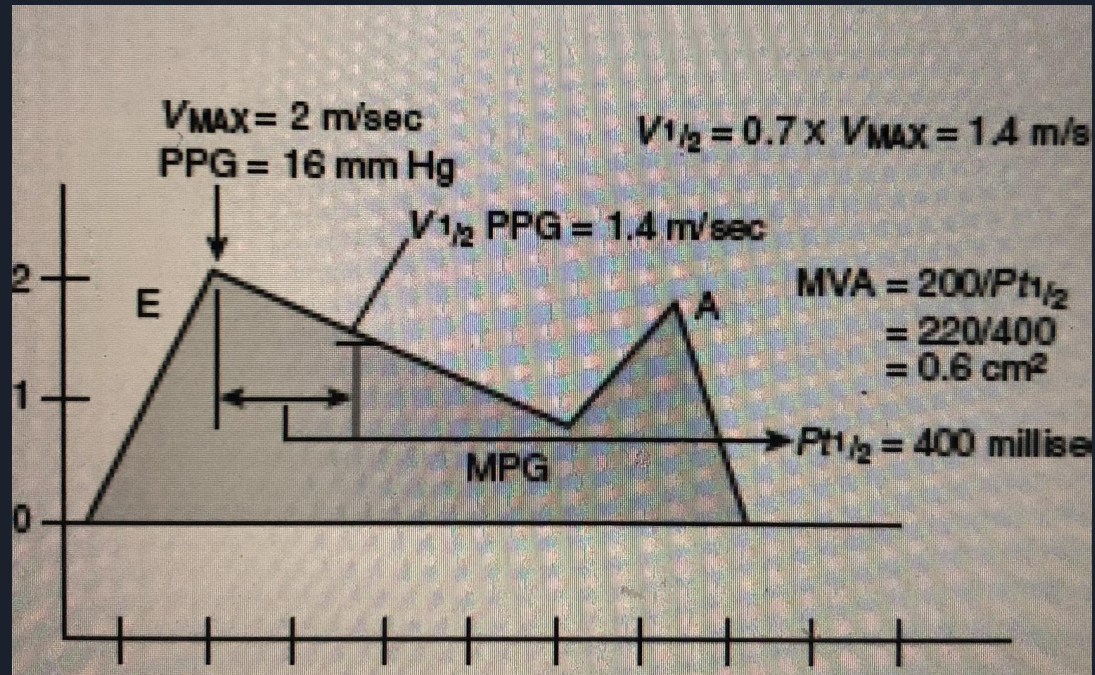




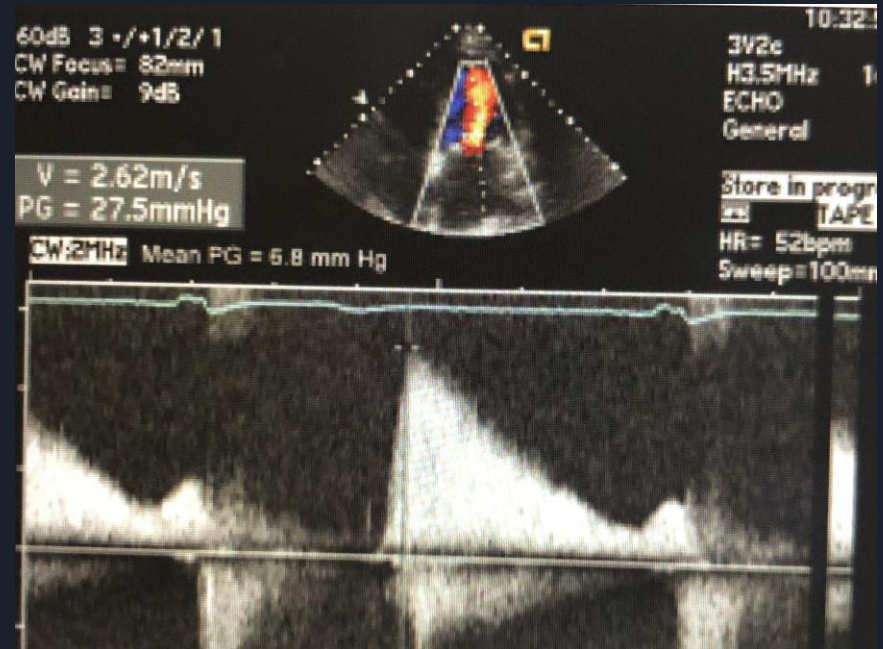
Mitral stenosis

- Rheumatic- most common cause
- Congenital
 - Parachute mitral valve with one papillary muscle
 - Abnormal leaflet with chordae

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- Normal area 4-6 cm²
 - mild > 1.5 cm² gradient < 5
 - mod 1-1.5 gradient 5-10
 - severe < 1.0 gradient > 10
 - Ef slope nl > 60
 - Severe pasp > 50 mmHg
 - Calculated with 220/PHT



- Echo tech calls you into the room because of a high peak mitral gradient but the mean gradient is only mildly elevated
- There is mitral annular calcification and she cannot see the mitral regurgitation jet
- Answer?





Mitral regurgitation

- Leaflet problem
- Apparatus problem

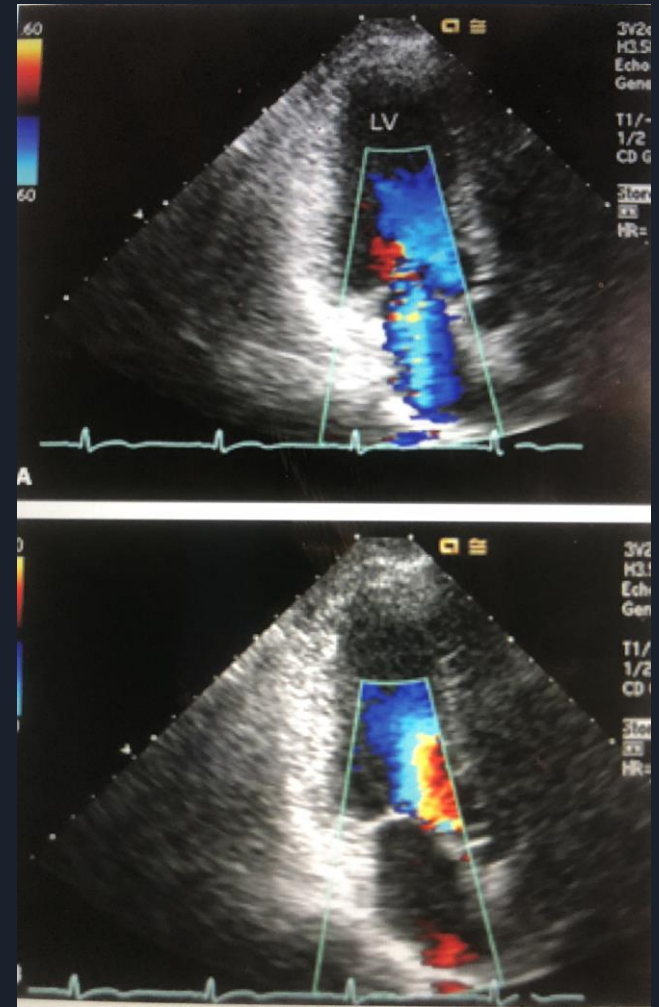


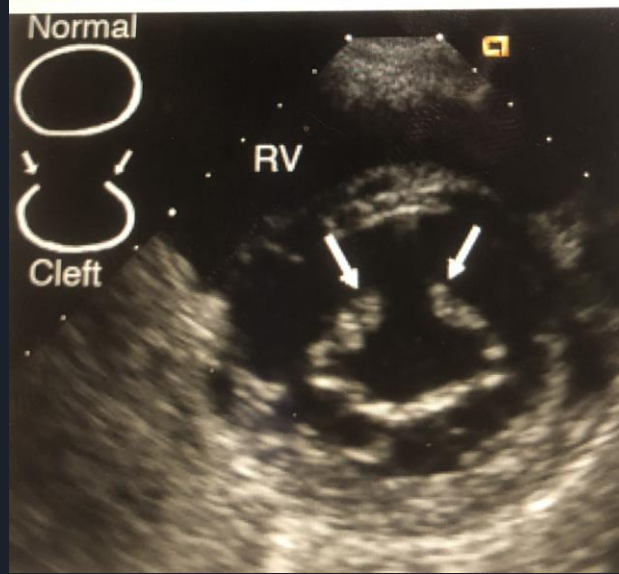
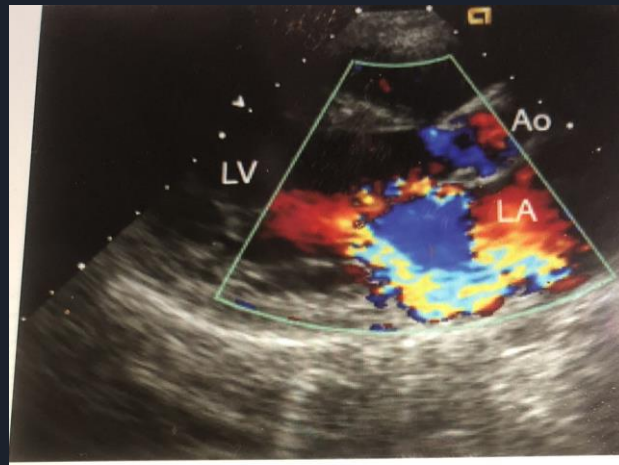
True mitral regurgitation

- Goes through systole (not just early)
- Has convergence of jet (vena contracta)

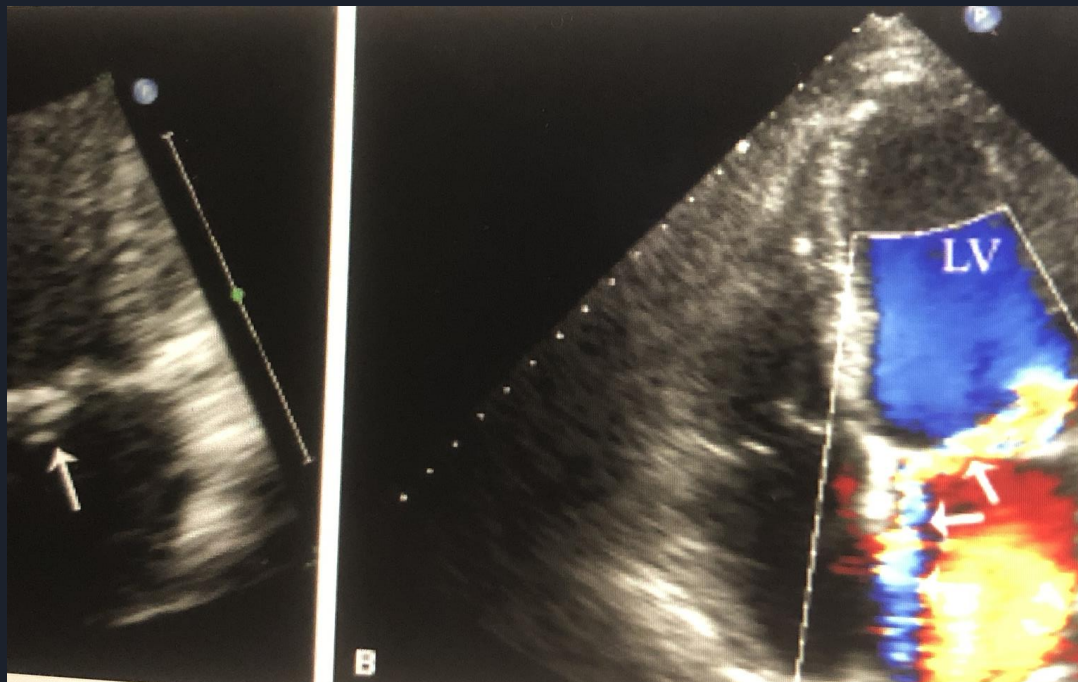
Non-true MR

- 50 ms later no mitral regurgitation is noted

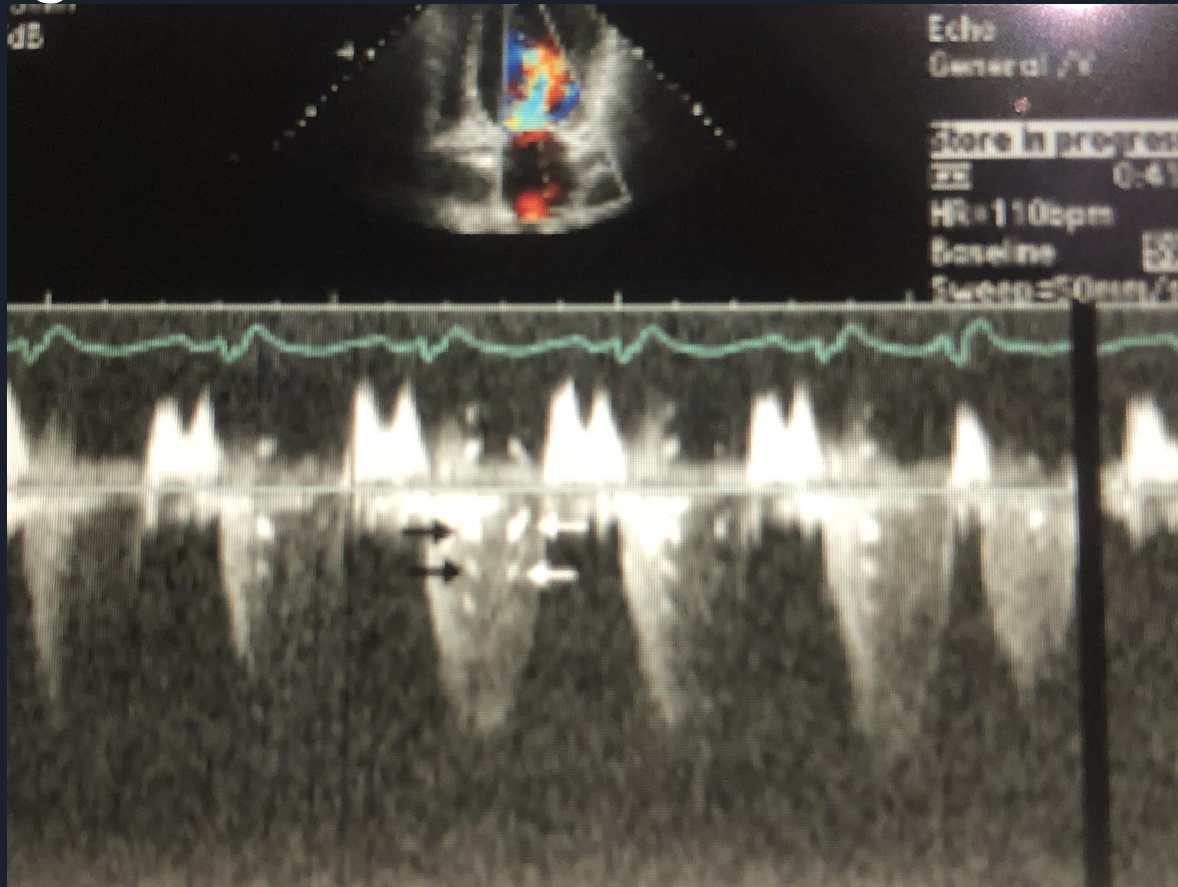




Flail leaflet with severe mitral regurgitation



Flail mitral valve CW signal with tissue signature

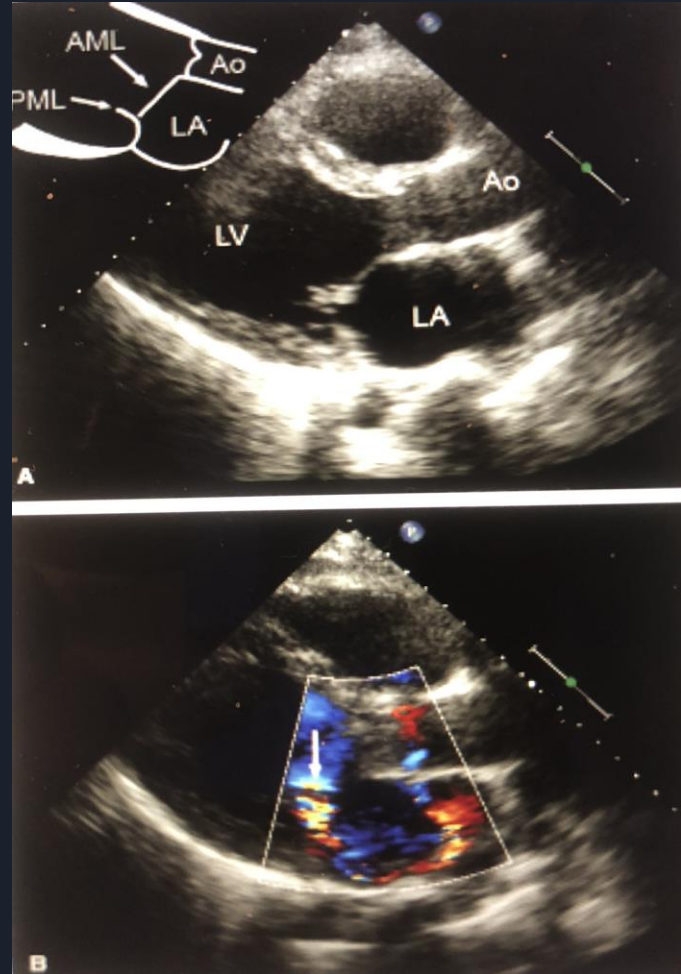


MR due to cardiomyopathy

Apically displaced mitral valve due to dilated left ventricle



Tethering of the posterior mitral leaflet due to posterior myocardial infarction and ipsilateral severe jet





Mitral regurgitation grading

- Severe $vc > 0.7$ volume > 60 $rf > 50$ $ero > 0.4$ (for secondary mitral regurgitation the ero cut off is greater than 0.2)
- Mild $vc < 0.3$ volume < 30 $rf < 30$ $ero < 0.2$
- End systolic dimension > 40 $ef < 60$ class, I indication also $pap > 50$ or afib class iia
- 60 50 40 rule $ef < 60$ $pap > 50$ $esd > 40$
- MV REPLACEMENT is class iii in rheumatic mr if less than 50% posterior leaflet is involved. MV repair is recommended



Thank you