Evaluation of native mitral regurgitation: Diagnose first

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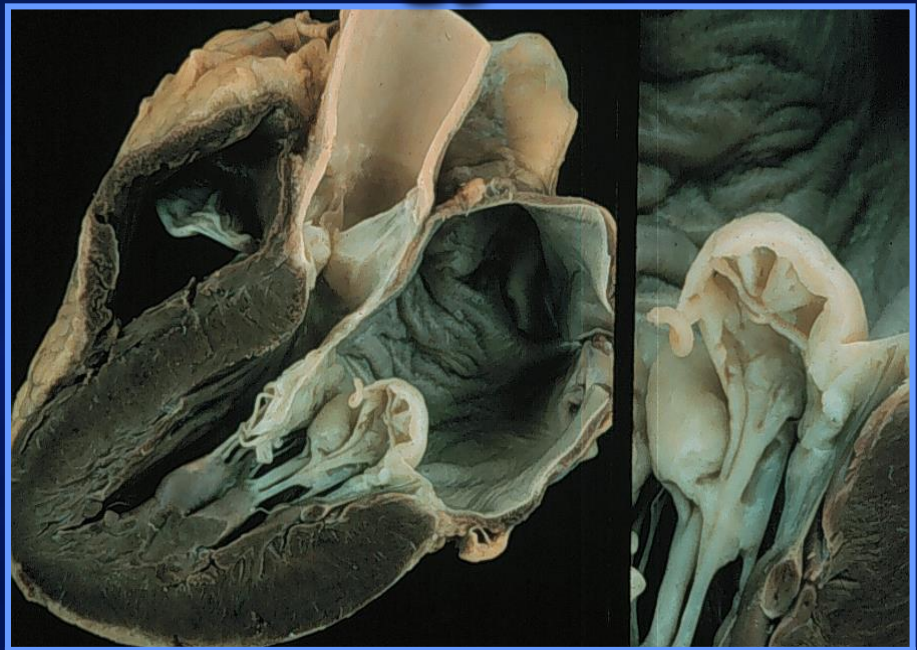
MR

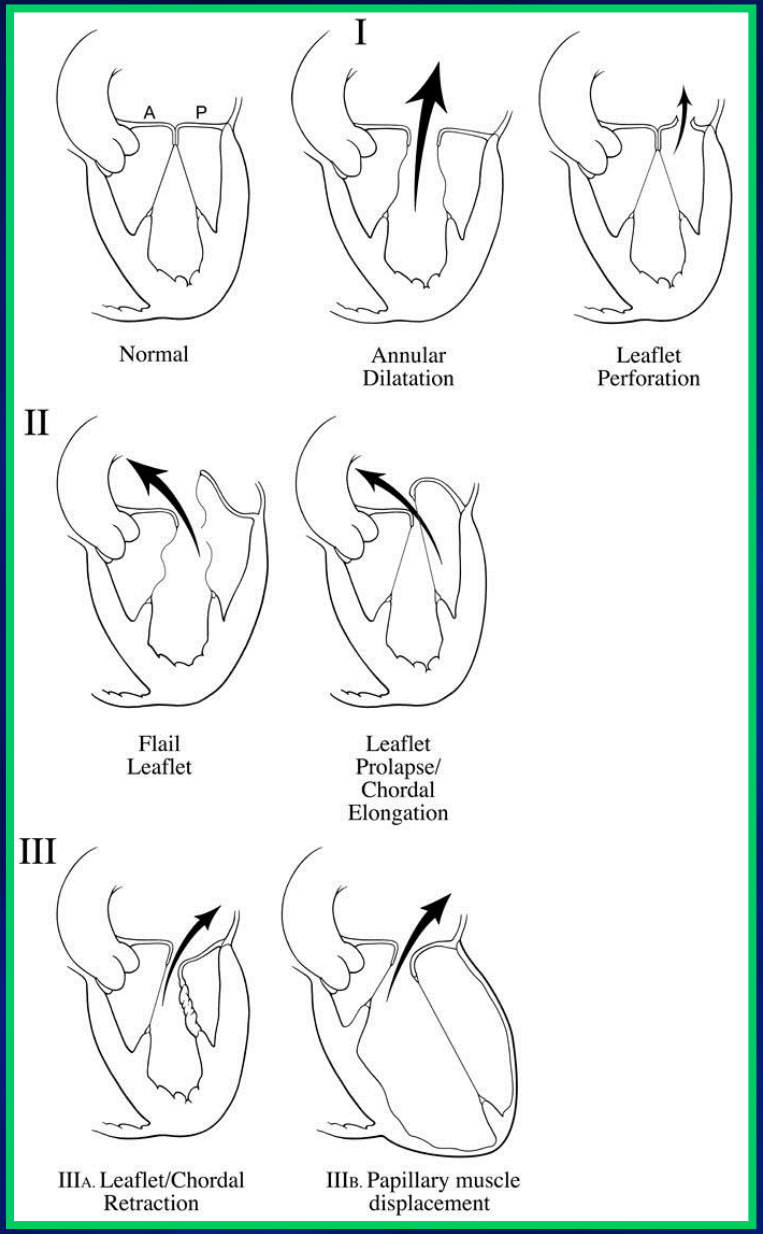
Mindset for Regurgitation Evaluation

Professors Carpentier and McGoon

- Mechanism, resulting from the disease
- Severity of regurgitation, resulting from the mechanism
- Echo⇒ define the mechanism, quantify the regurgitation severity

Etiology and Mechanisms in MR

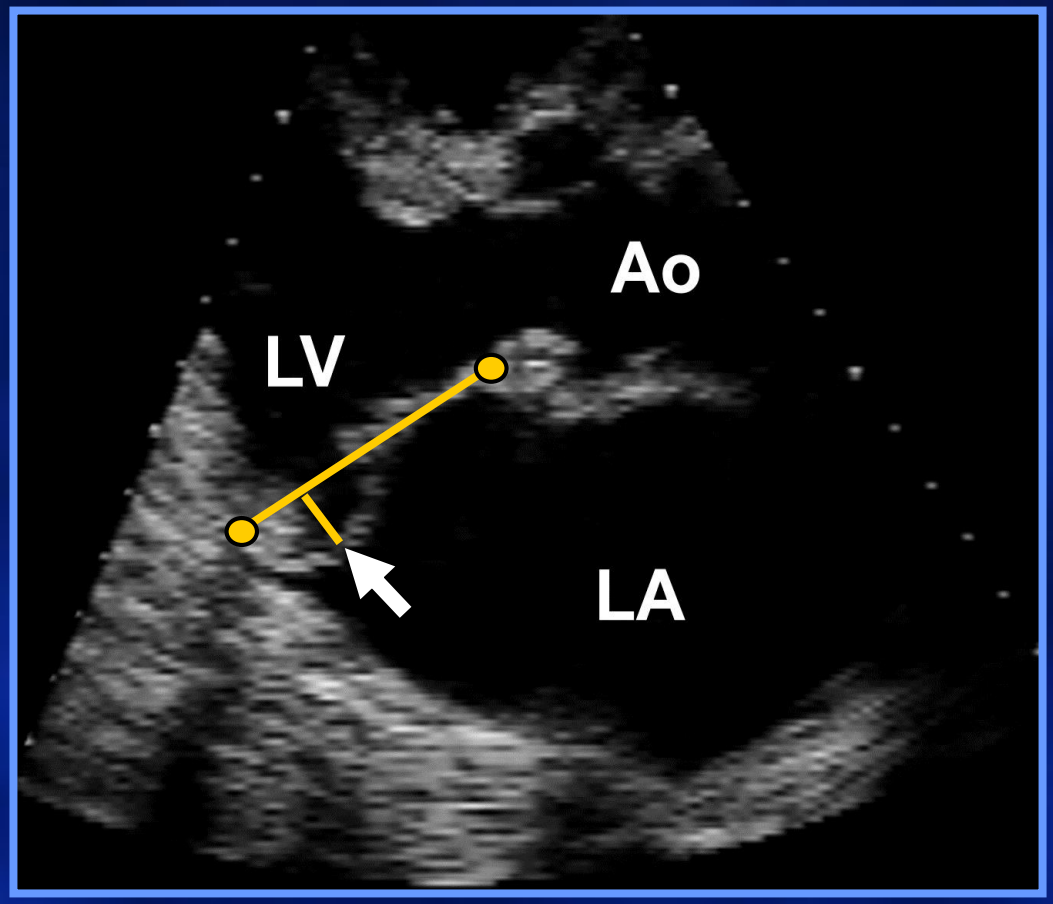




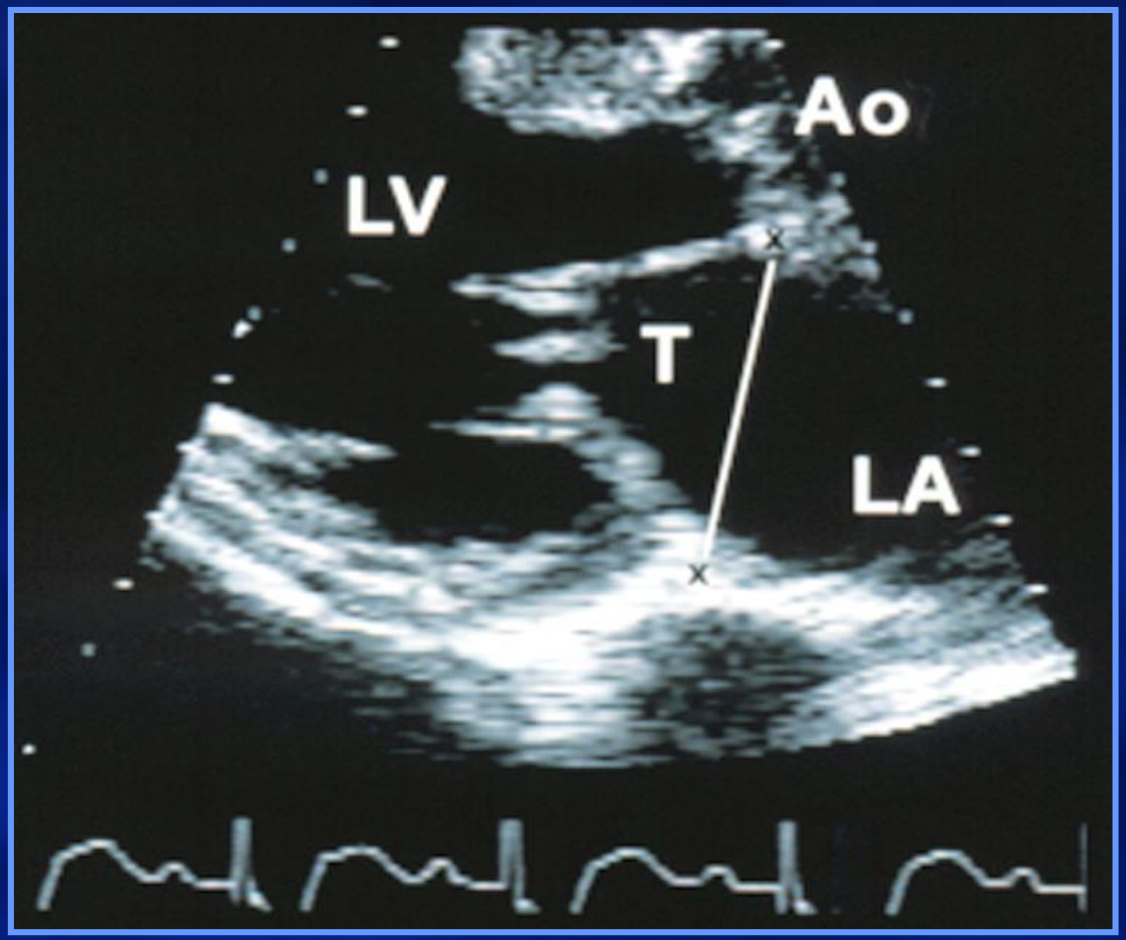
Mitral Valve Prolapse
Echo Diagnosis

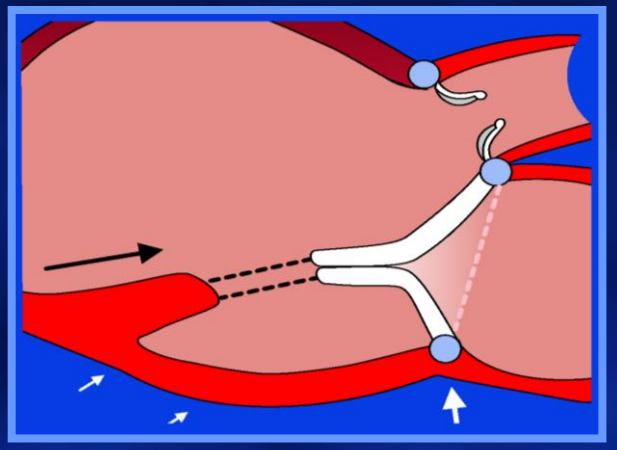
- PLAX view
- > 2mm systolic displacement of one / both leaflets into LA below plane of mitral annulus
- More specific if leaflets are thickened > 5mm (myxomatous)

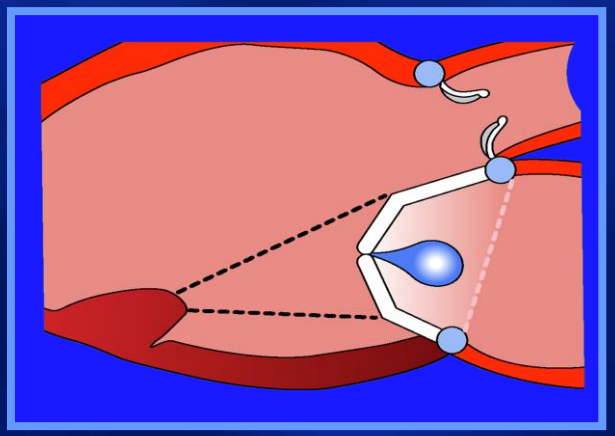
Mitral Valve Prolapse
Echo Diagnosis



Mitral Regurgitation
Tenting Area



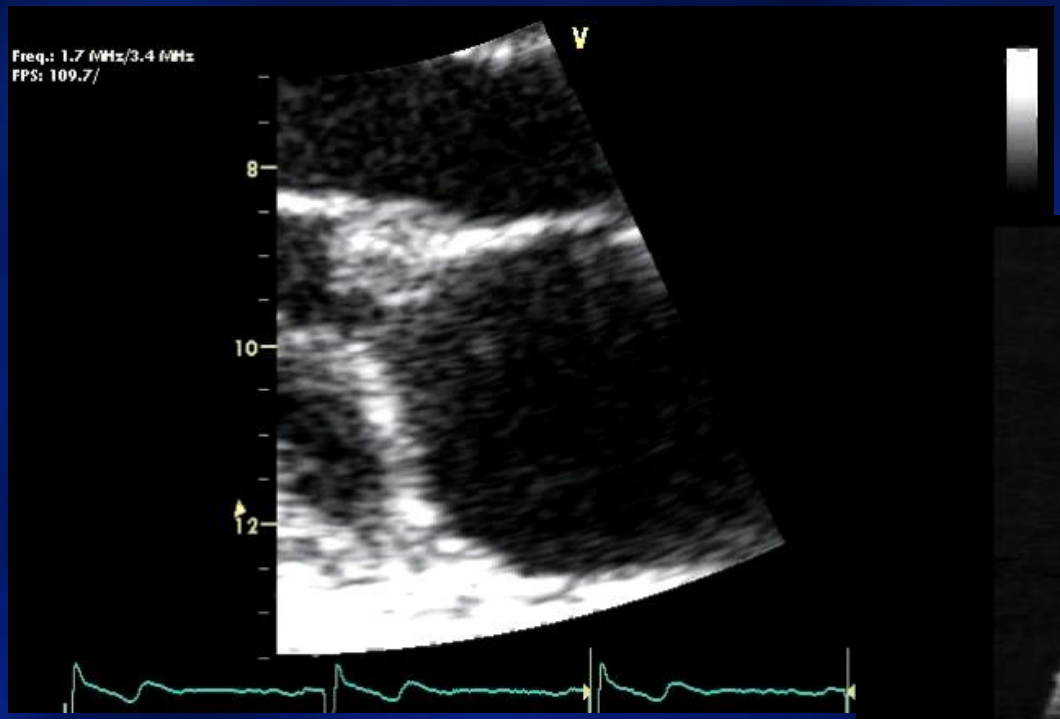


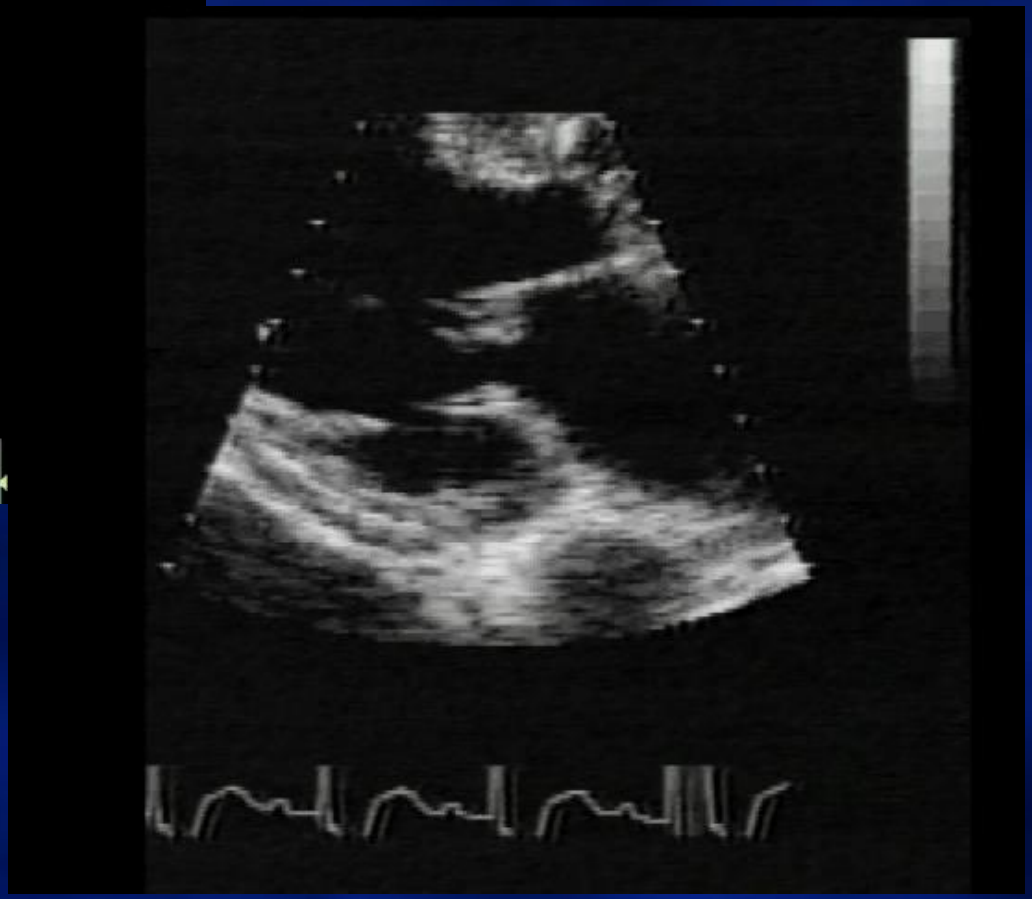


Tenting area ≥ 6 cm2 ~ ≥ mod-severe MR

Mitral Valve Mechanisms

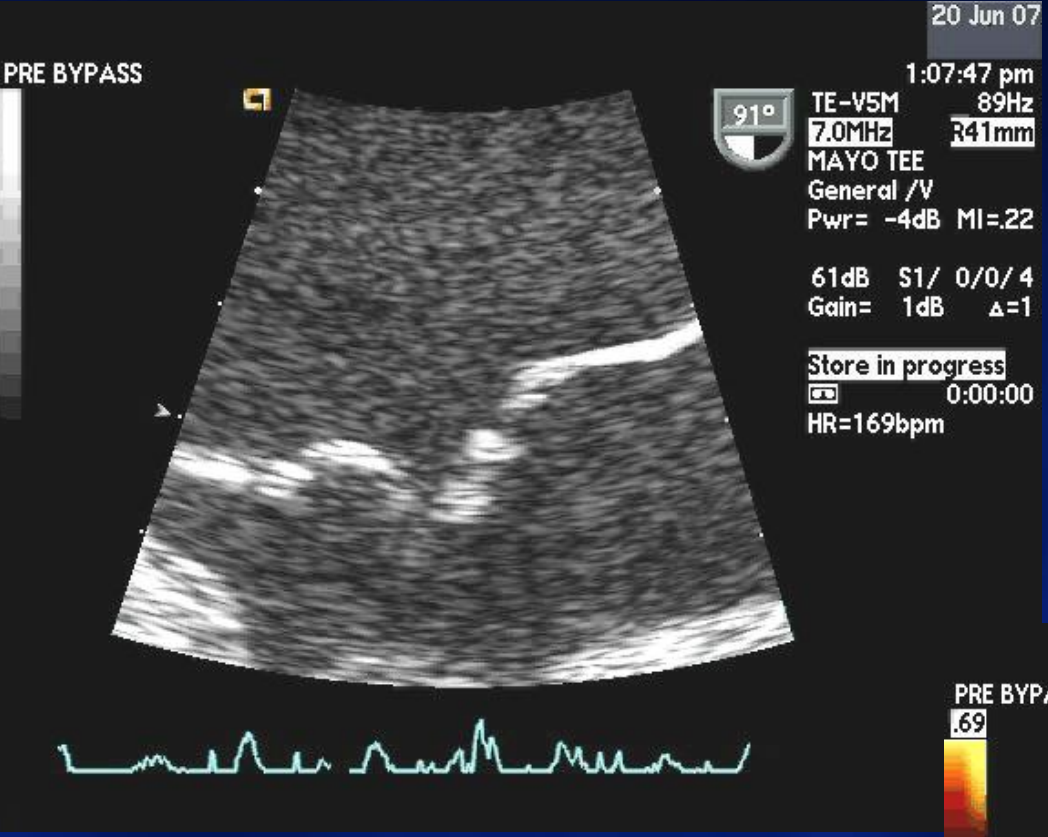
Organic

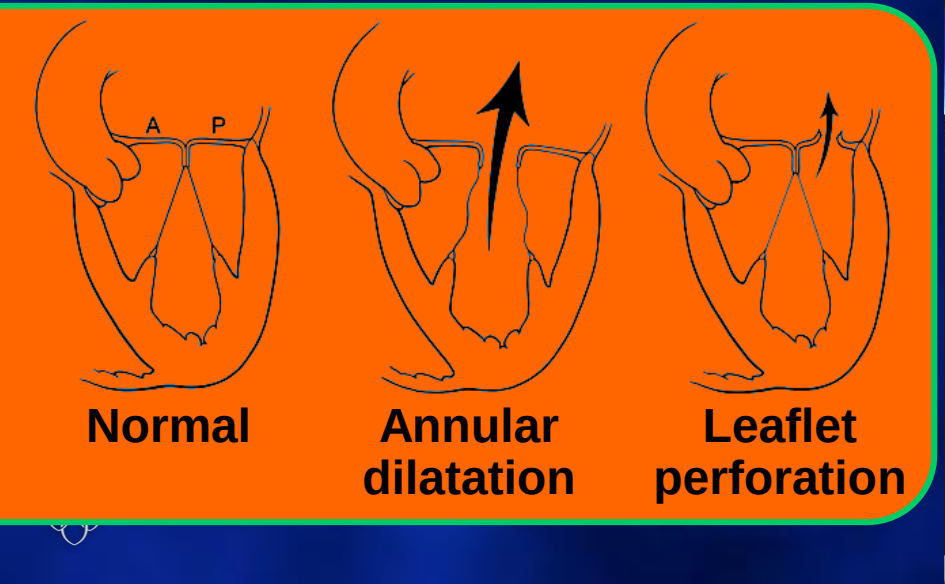


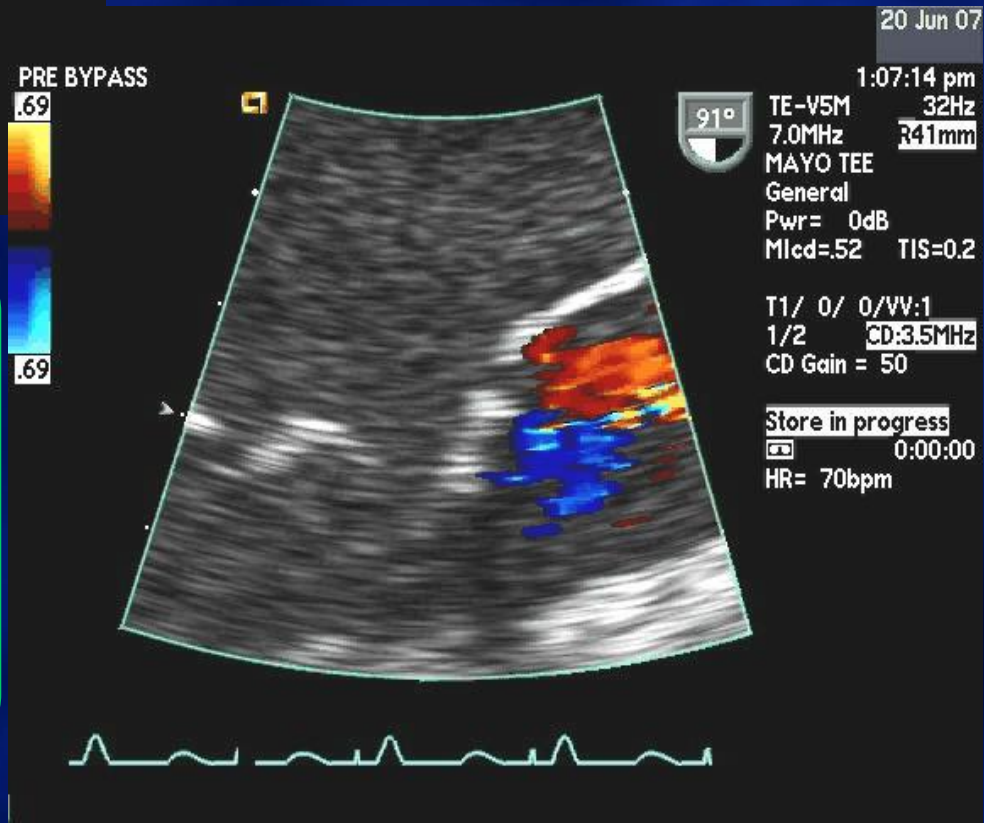


Functional

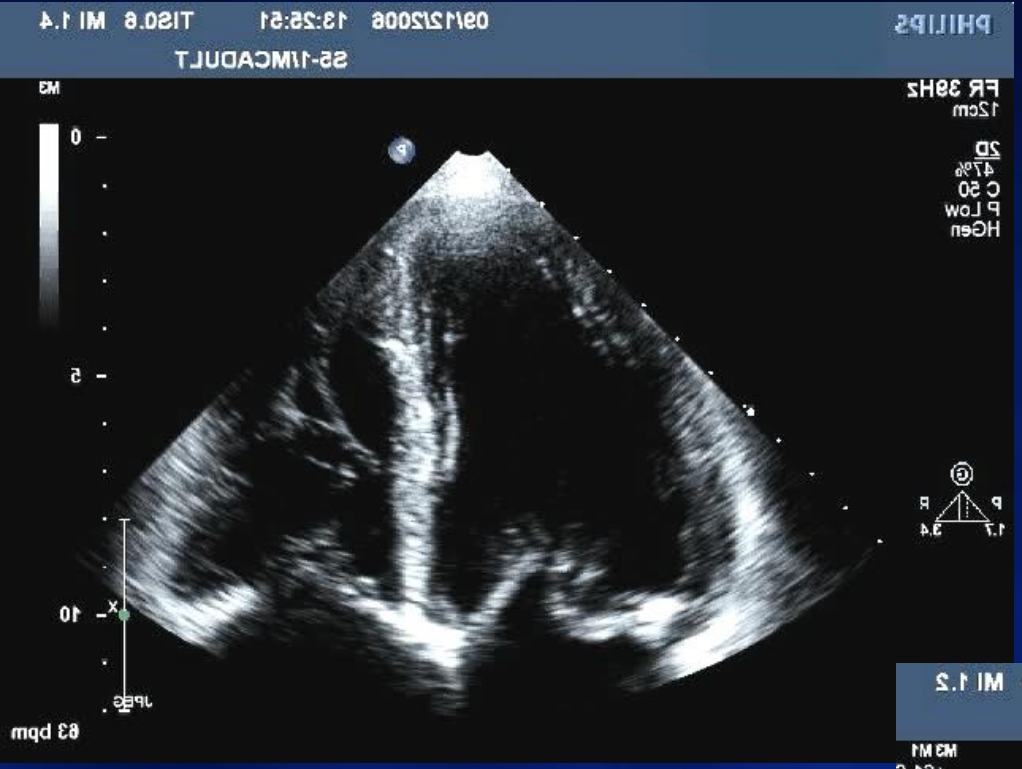
MR Mechanism I

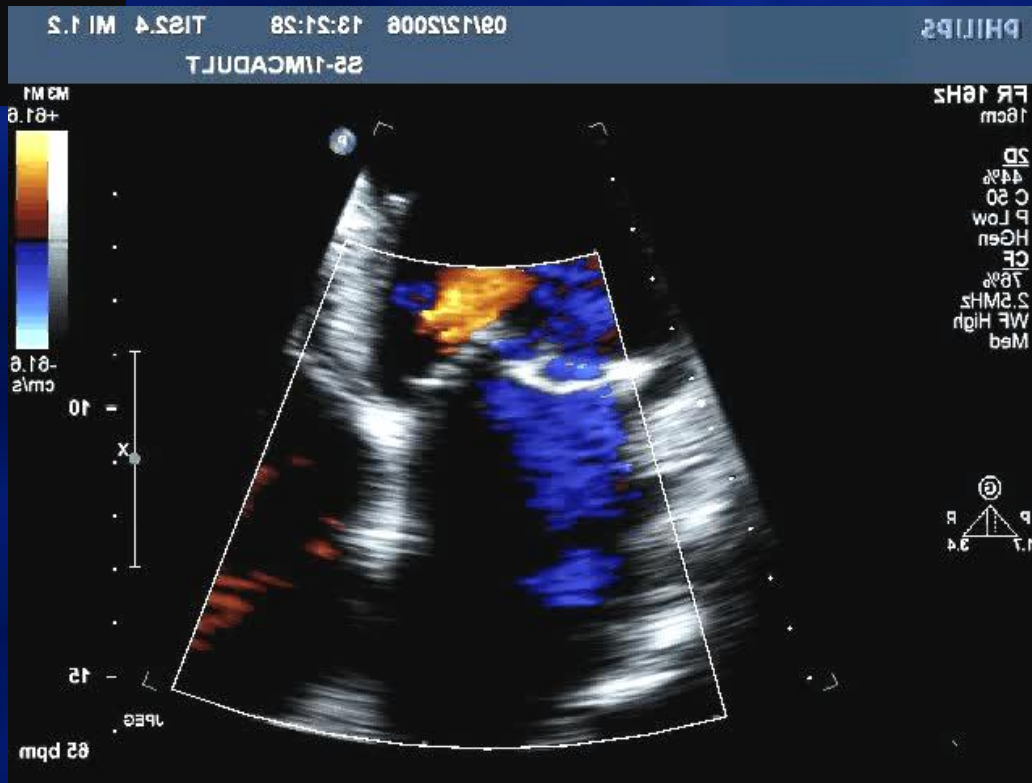




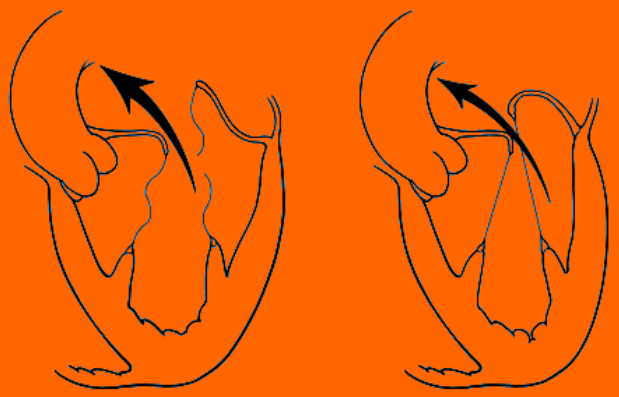


MR Mechanism II





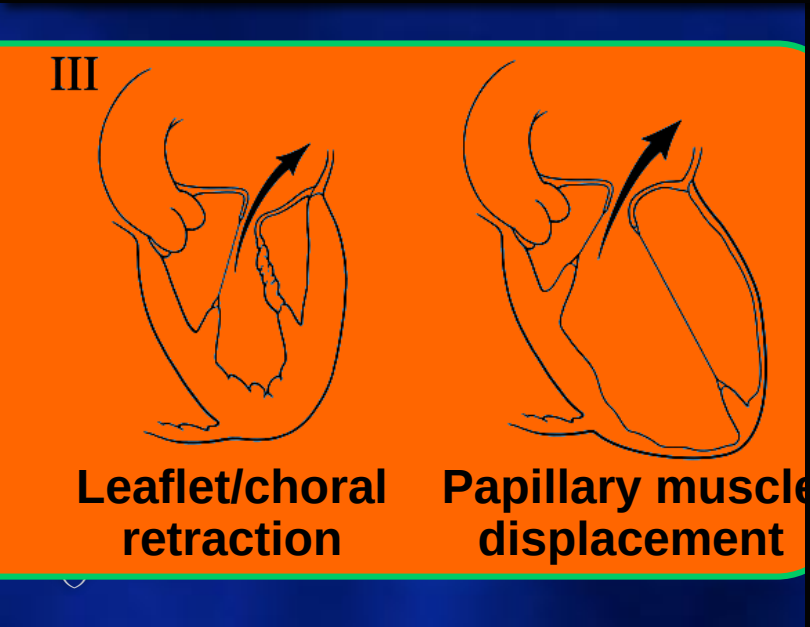
II



Flail leaflet

Leaflet prolapse/ chordal elongation

MR Mechanism III



Regurgitation Severity Assessment

Perform a comprehensive assessment

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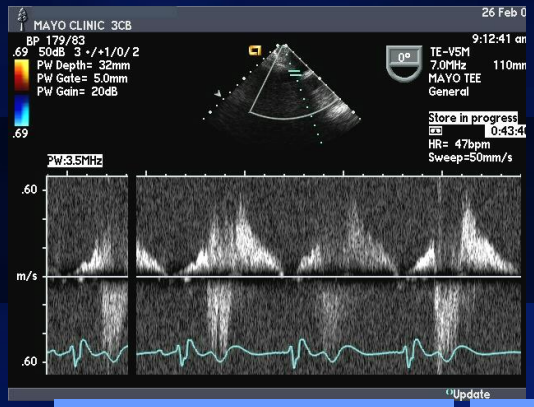
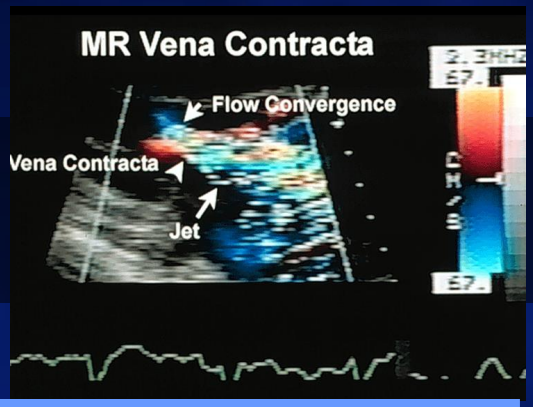
Use all the information available

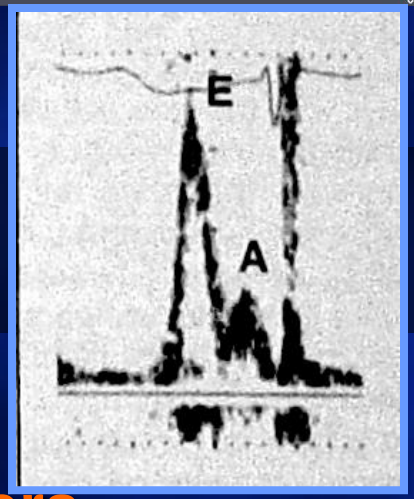
What Type of Information

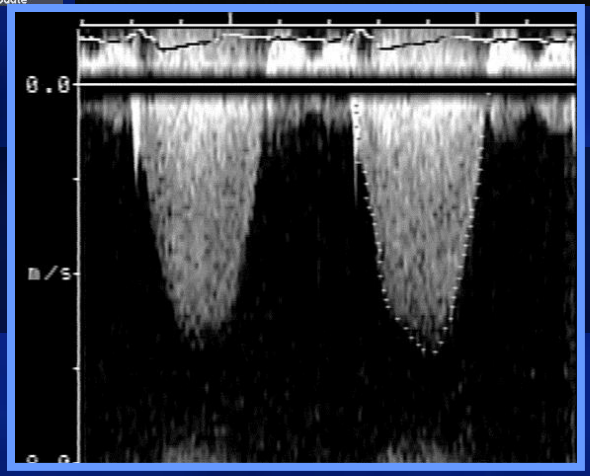
- Specific signs





- Supportive signs





- Quantitative parameters
  - **ERO:** Severity of the lesion itself
  - **RVol:** Severity of the volume overload
  - **RF:** Severity of volume overload relative to the size of the ventricle

MR Severity Assessment

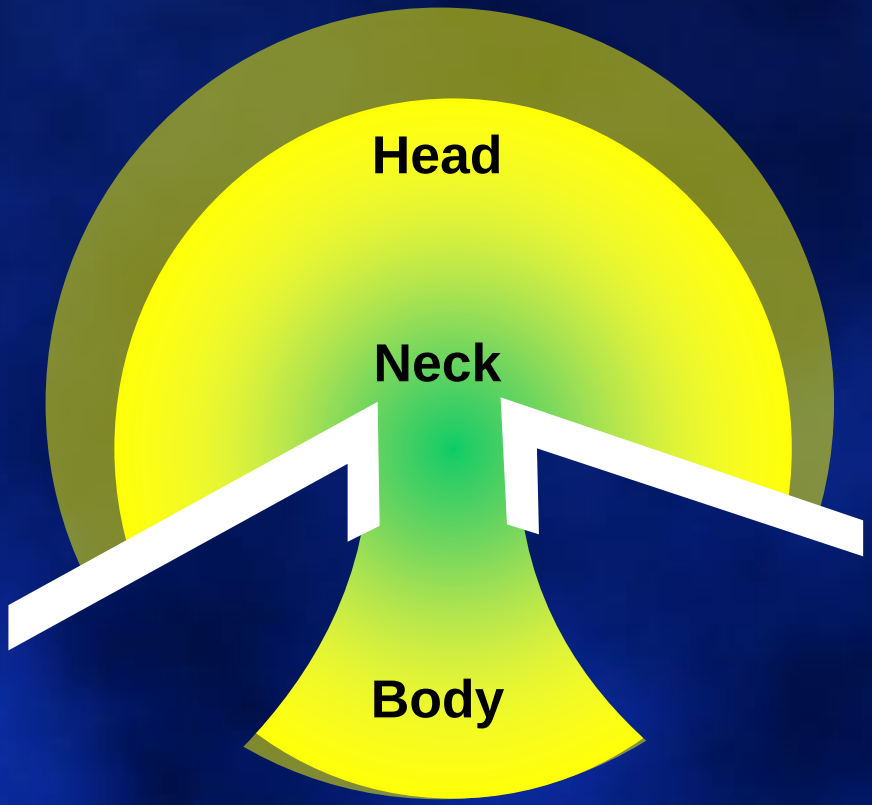
Application of specific and supportive signs, and quantitative parameters in the grading of mitral regurgitation severity

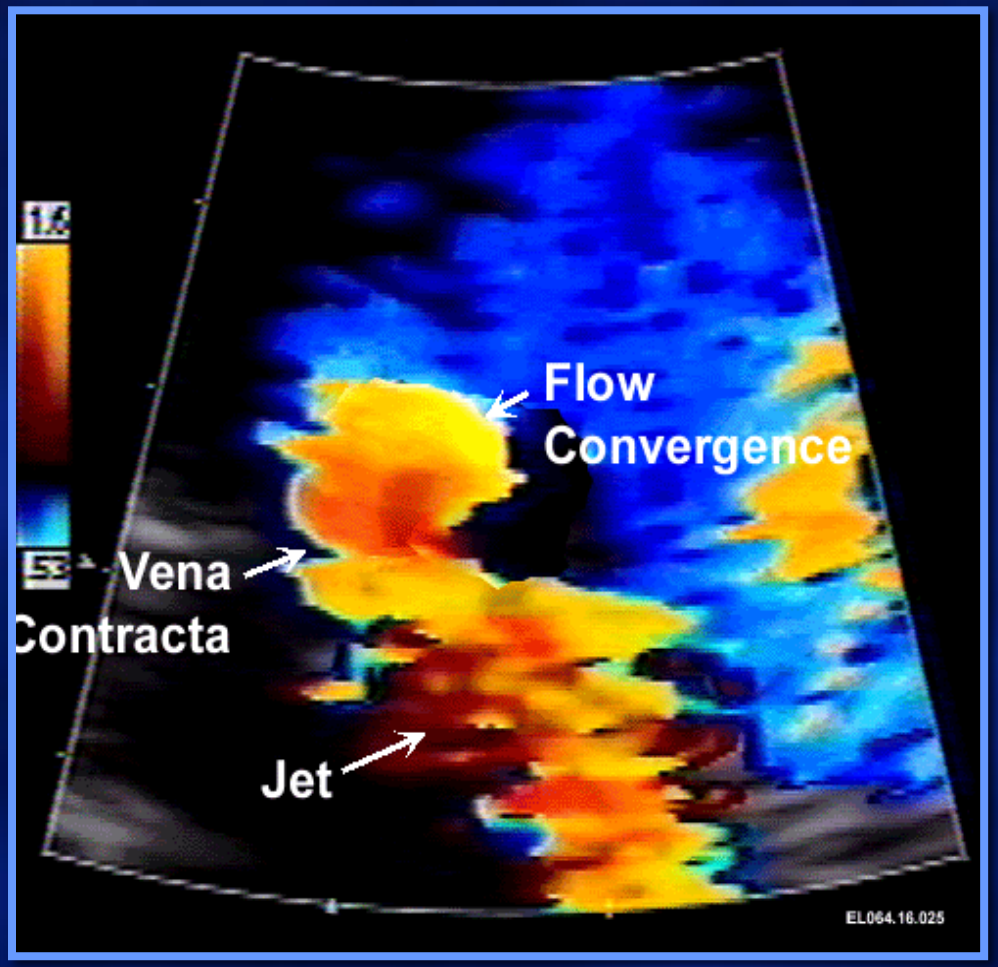
	Mild	Moderate	Severe
Specific signs for MR severity	Small central jet <4 cm^2 or <20% of LA area Vena contracta <0.3 cm No or minimal flow convergence	Signs of MR > mild present but no criteria for severe AR	Vena contracta width >>0.7 cm with large central MR jet (area >40% of LA) or with a wall-impinging jet of any size, swirling in LA Large flow convergence Systolic reversal in pulmonary veins Prominent flail MV leaflet or ruptured papillary muscle
Supportive signs	Systolic dominant flow in pulmonary veins A-wave dominant mitral inflow Soft density, parabolic CW Doppler MR signal Normal LV size	Intermediate signs/ findings	Dense, triangular CW Doppler MR jet E-wave dominant mitral inflow (E >1.2 m/s) Enlarged LV and LA size

Quantitative parameters				
R vol (mL/beat)	<30	30-44	45-59	≥60
RF (%)	<30	30-39	40-49	≥50
EROA (cm^2)	<0.20	0.20-0.29	0.30-0.39	≥0.40

Anatomy of Regurgitant Jet

Head, Neck and Body

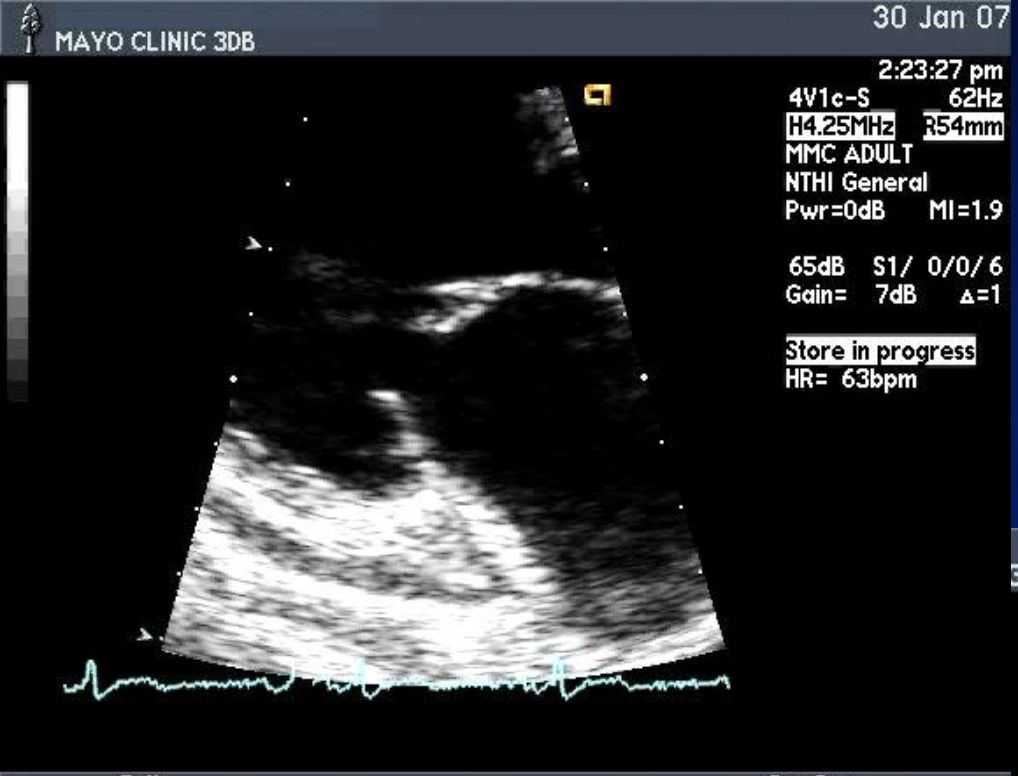


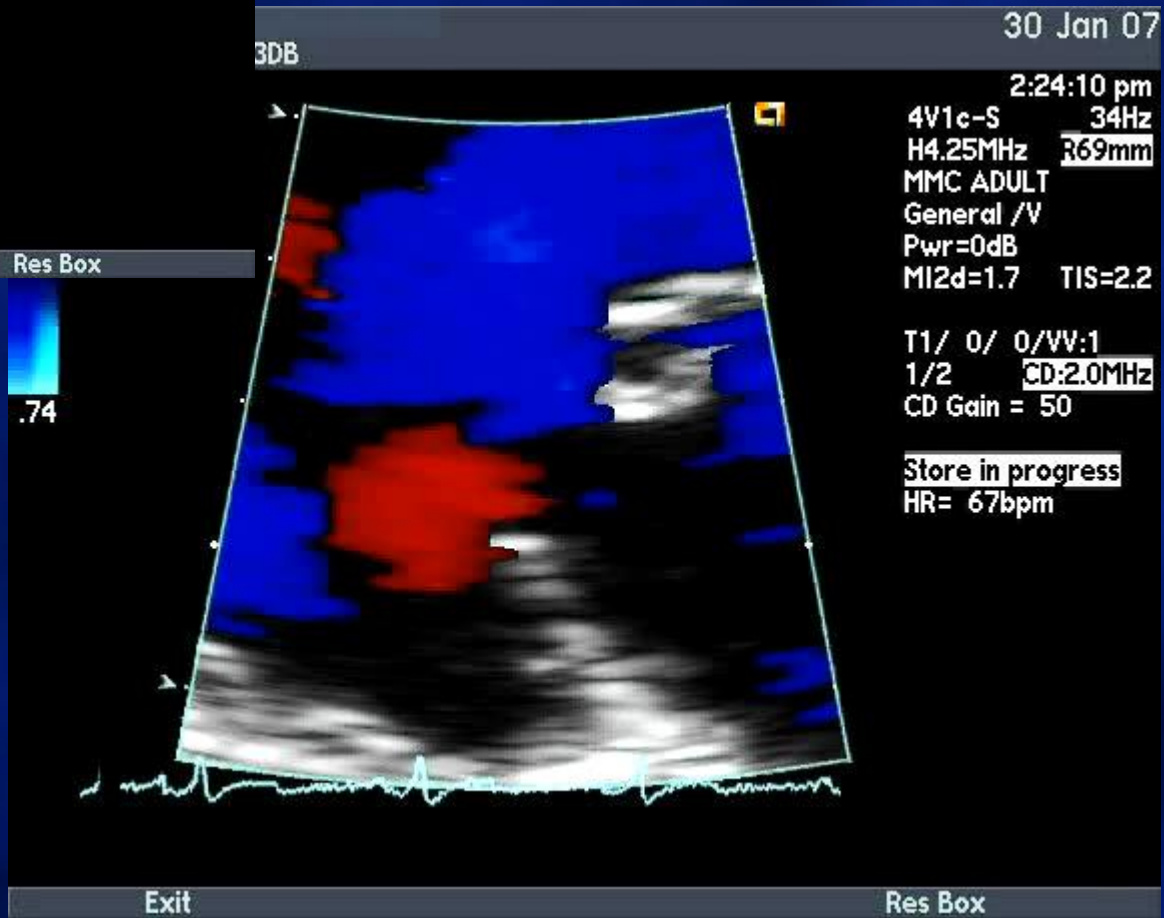


Define the 3 components of the regurgitant jet!

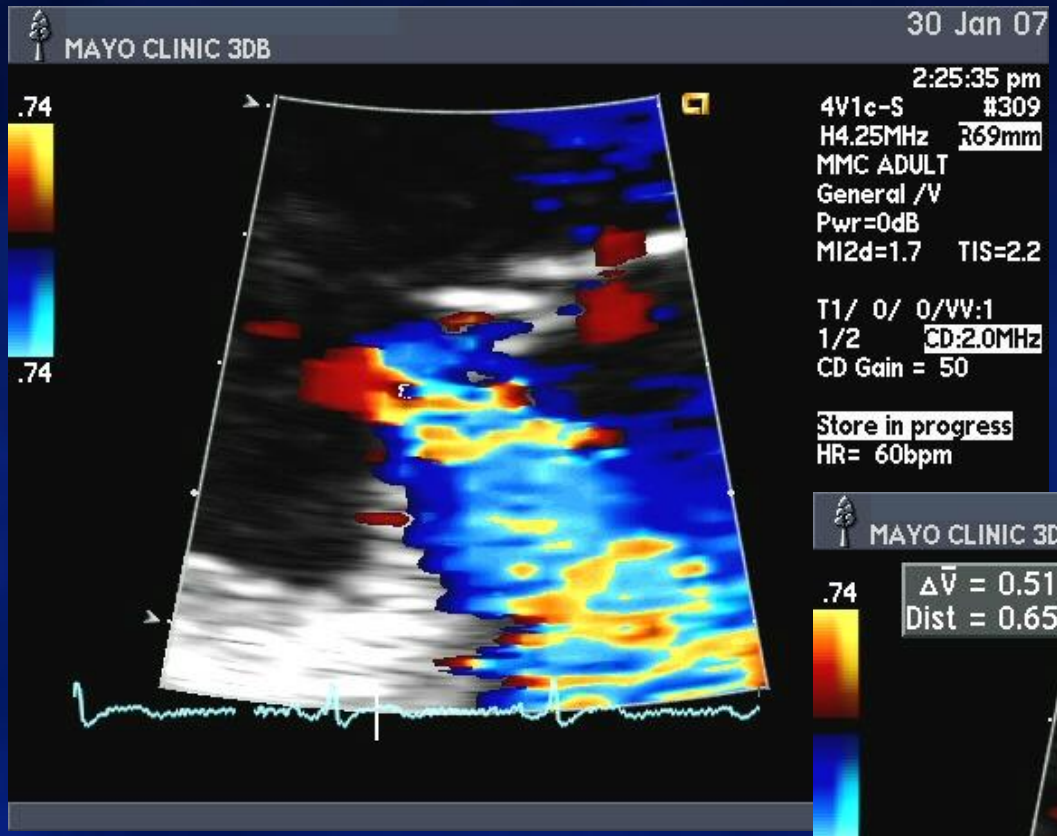
Mitral Regurgitation

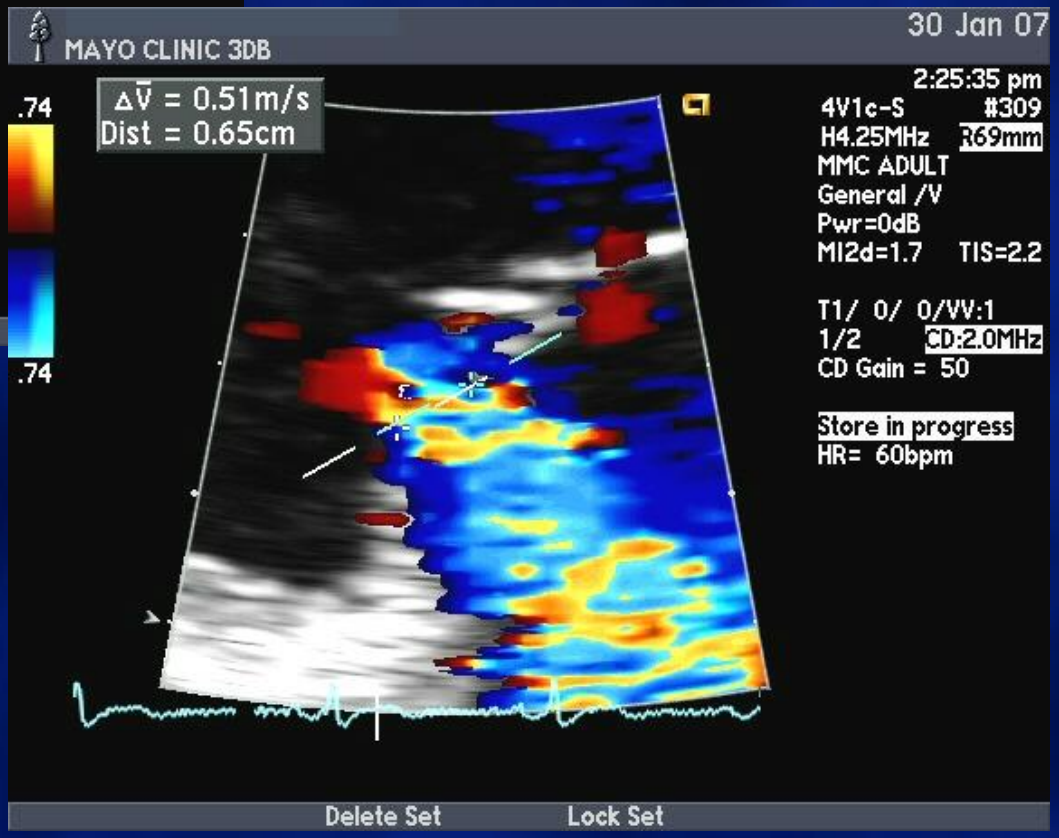
Vena Contracta





Vena Contracta





Vena Contracta
ASE Guidelines

- < 0.3cm mild MR
- ≥ 0.7cm severe MR
- Values in-between quantify!

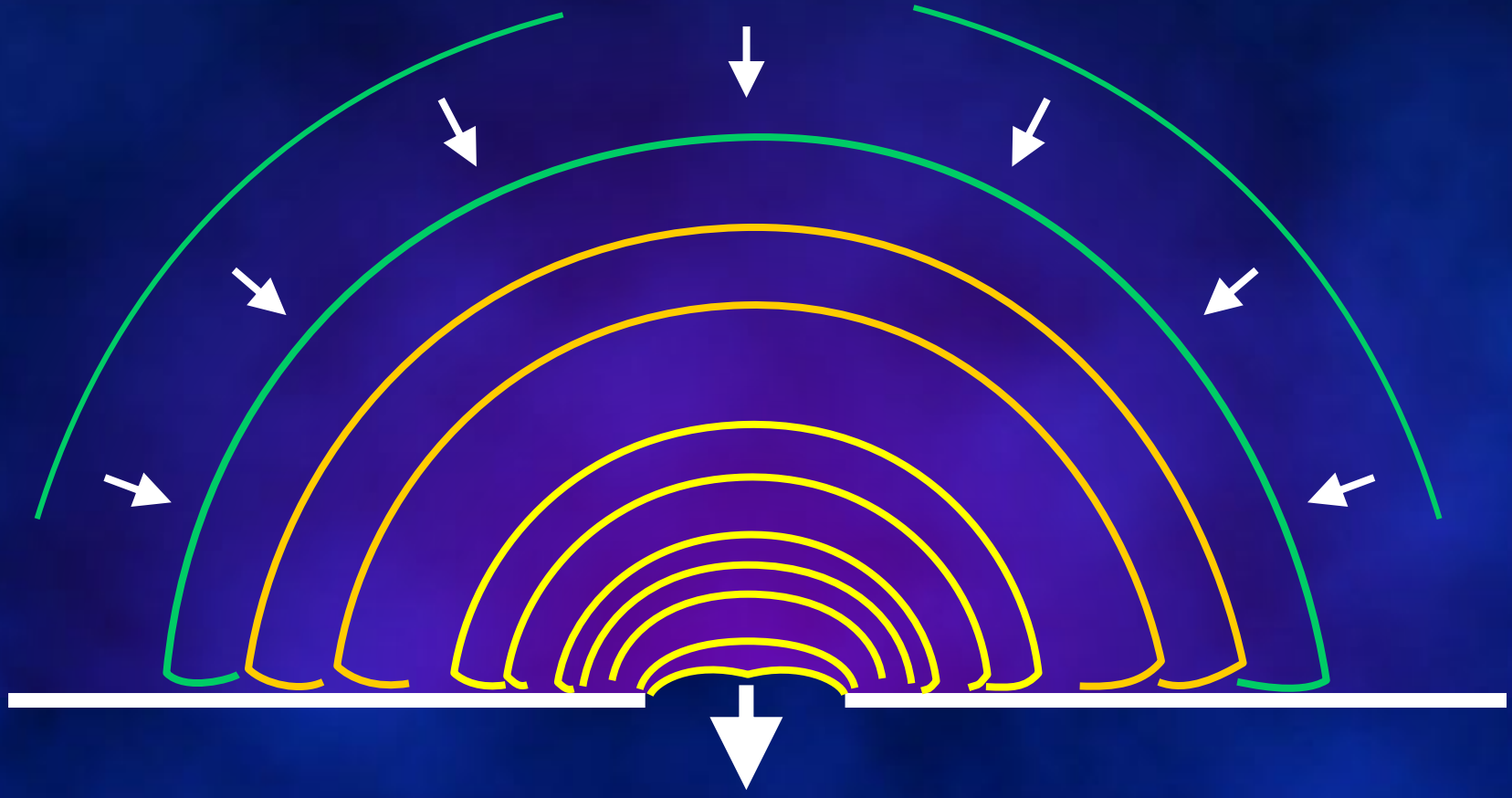
Proximal

I sovelocity

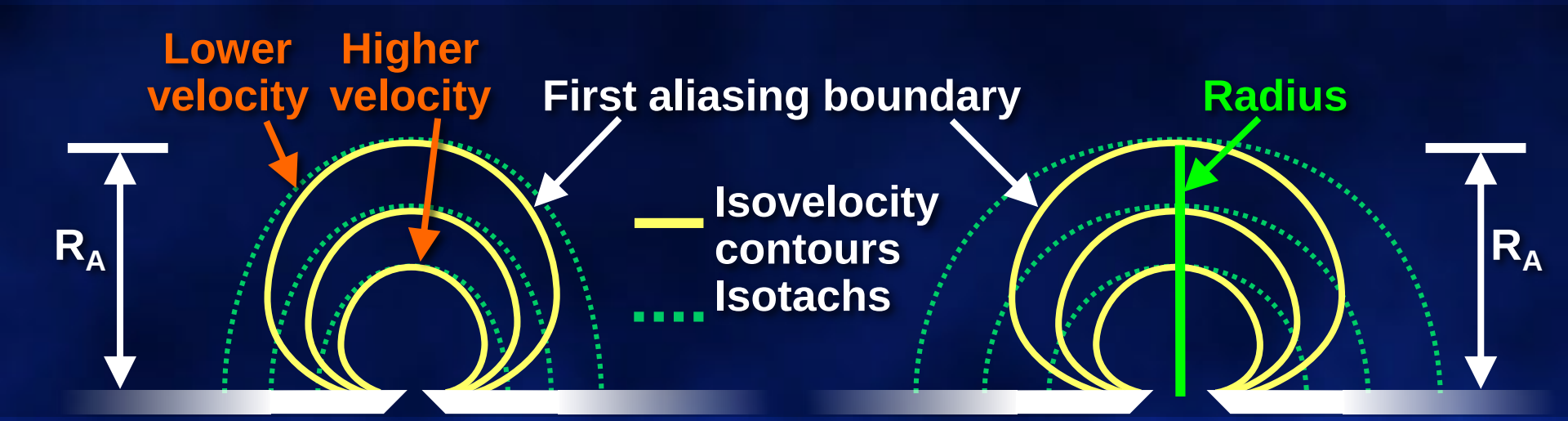
Surface

Area

Behavior of Noncompressible Fluid Approaching Hole



Hemisphere That Looks More Like a Circle

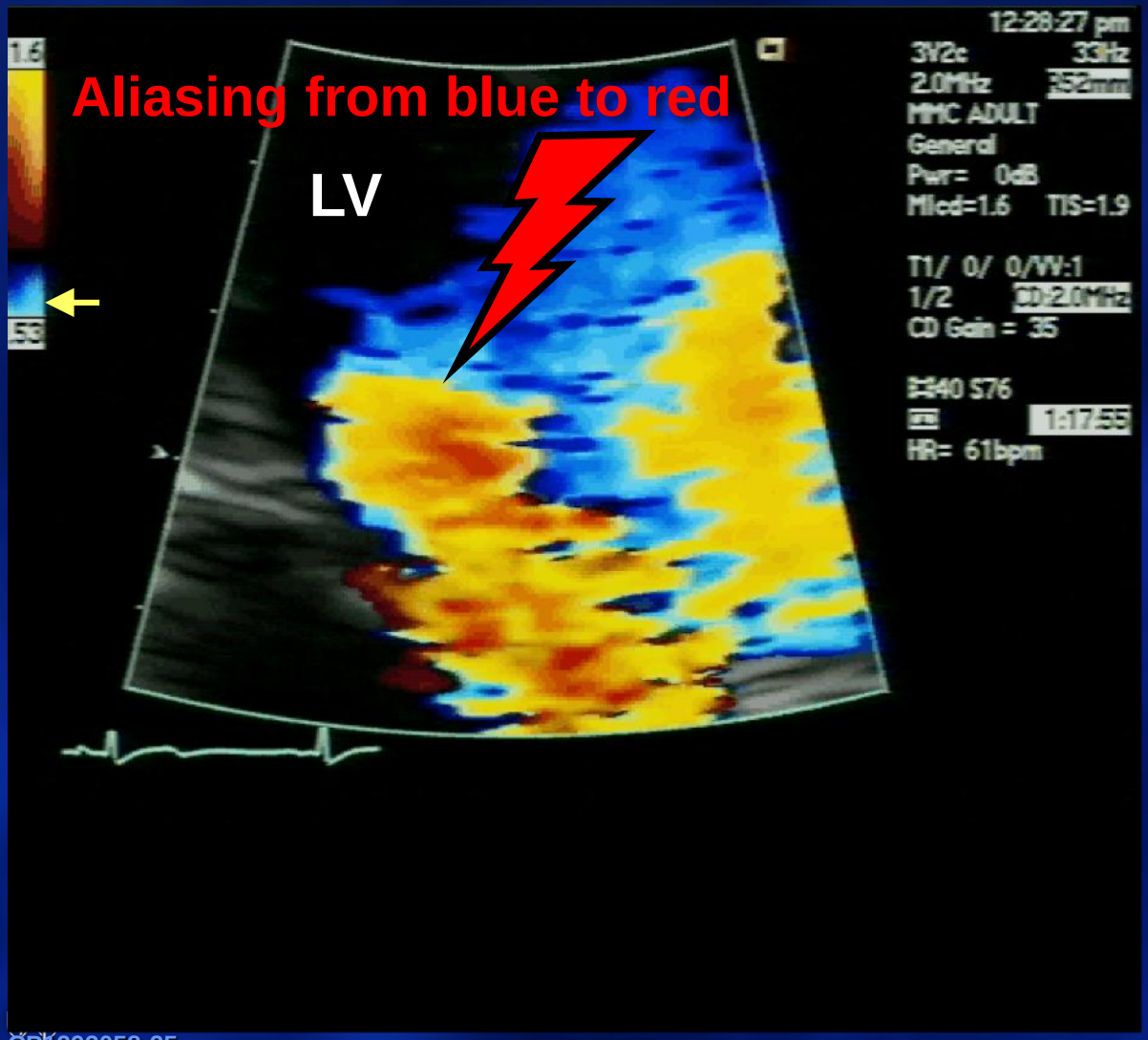


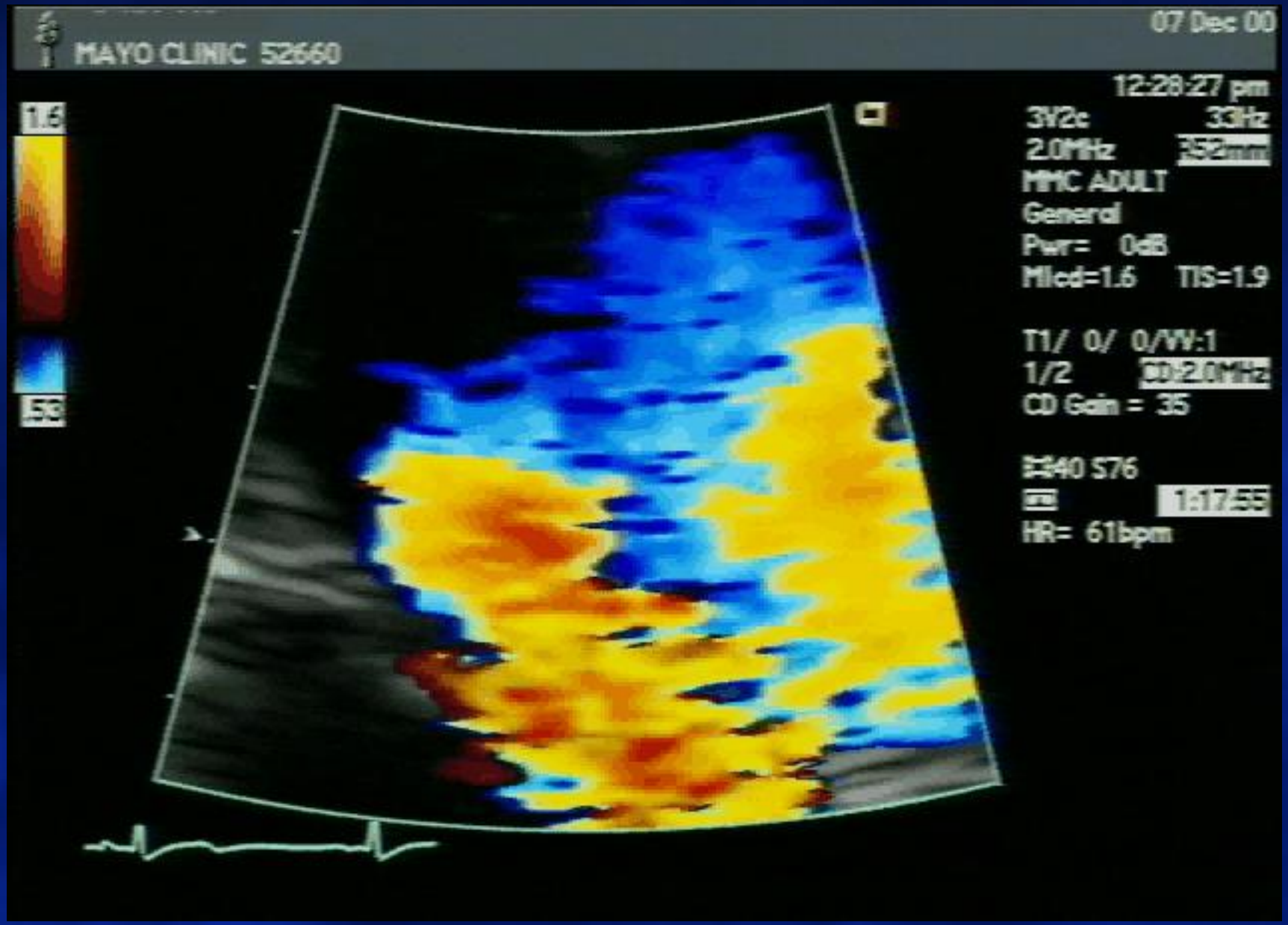
Hemisphere $\Delta = 2\Pi r^2$
X
Velocity (aliasing V)

Flow before the hole

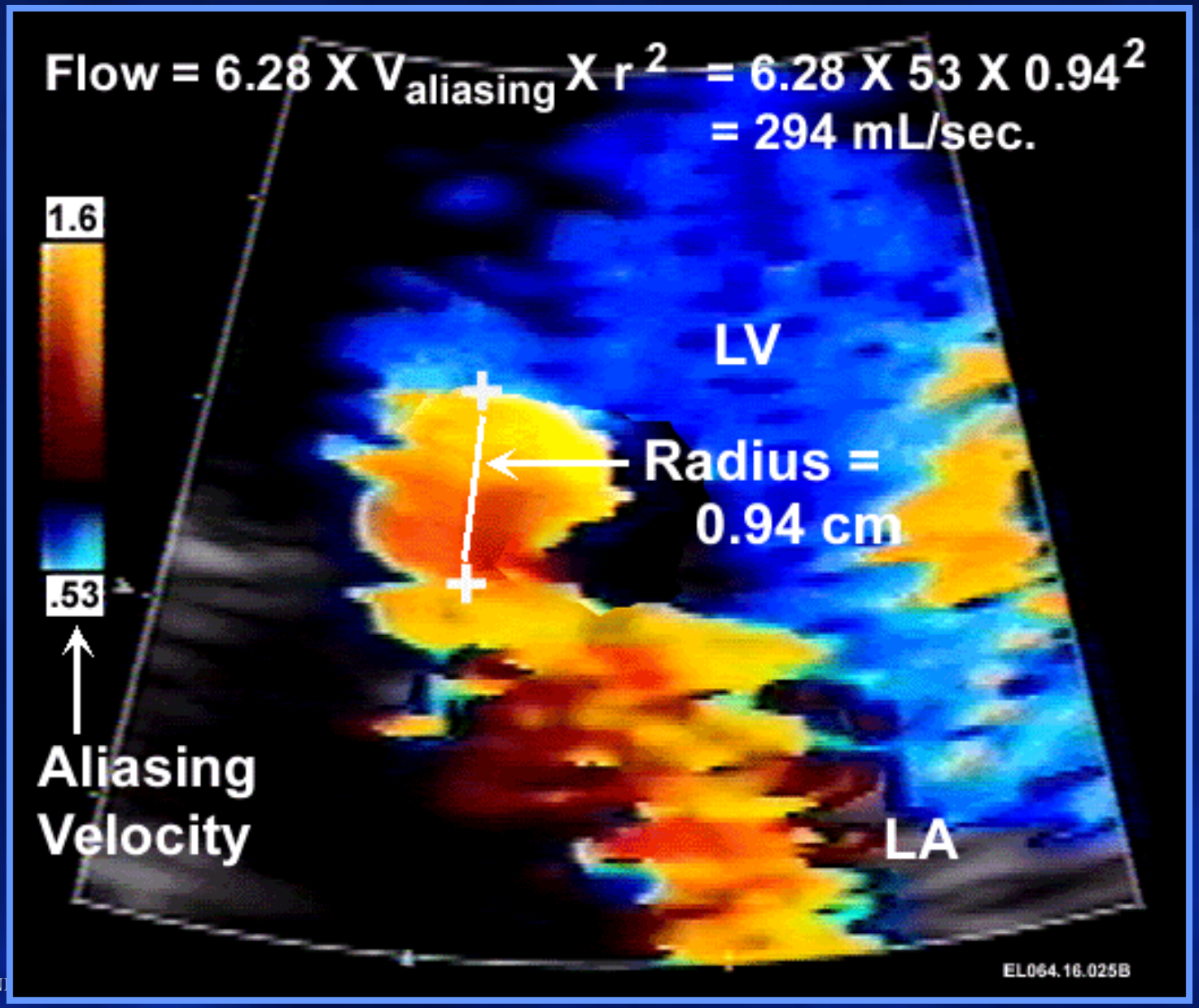
Eliciting a PISA Shell

MR Apical 4-C

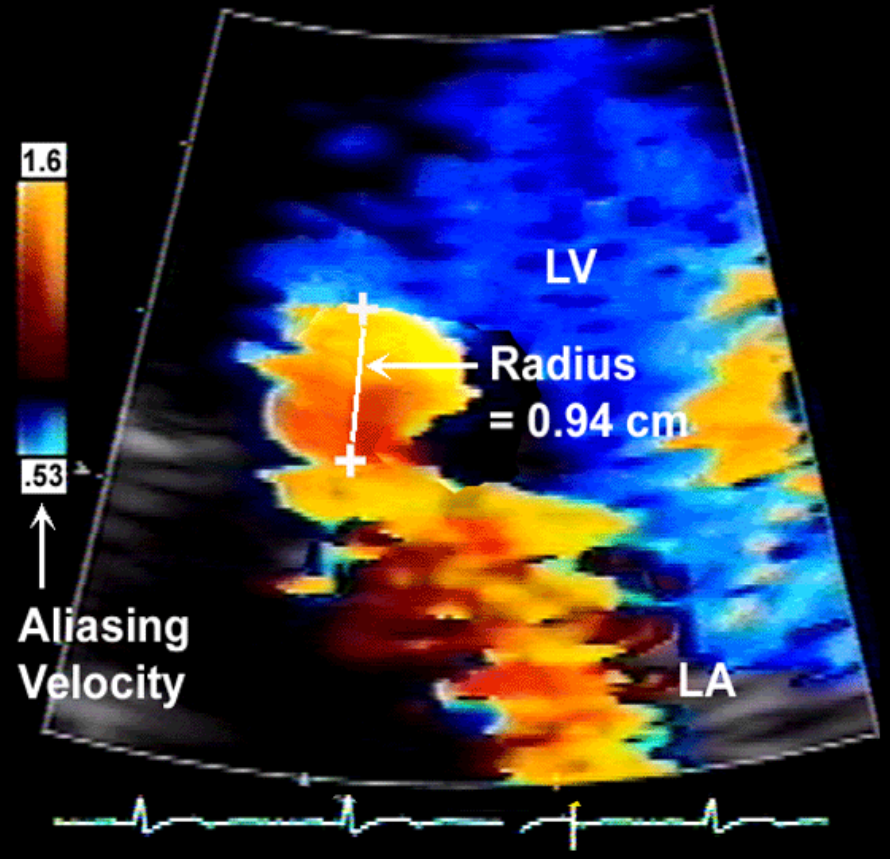


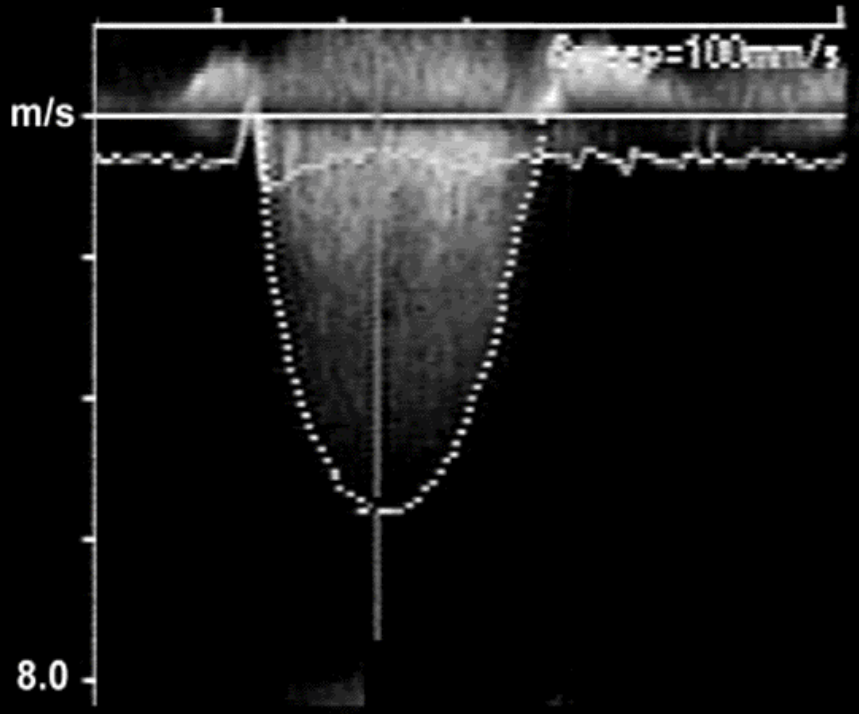

MAYO CLINIC 52660
07 Dec 00
12:28:27 pm
3V2c
3.3Hz
2.0MHz
MMC ADULT
General
Pwr= 0dB
MIed=1.6 TIS=1.9
T1/ 0/ 0/VV:1
1/2
CD Gain = 35
640 576
HR= 61bpm

Flow Before the Hole Calculation



Instantaneous ERO Calculation





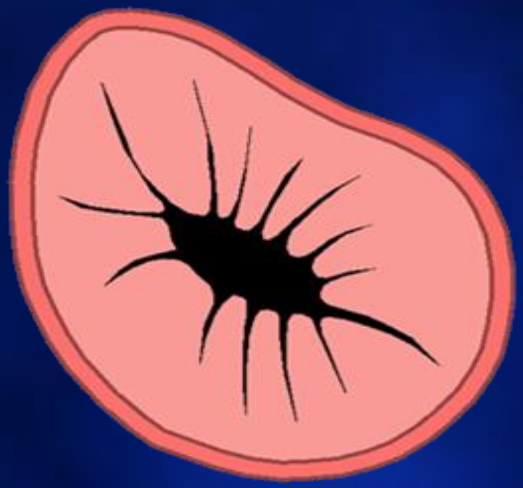
Flow = 294 mL/sec

MR velocity = 557 cm/sec

ERO = flow/velocity = 0.53 cm^2 or 53 mm^2

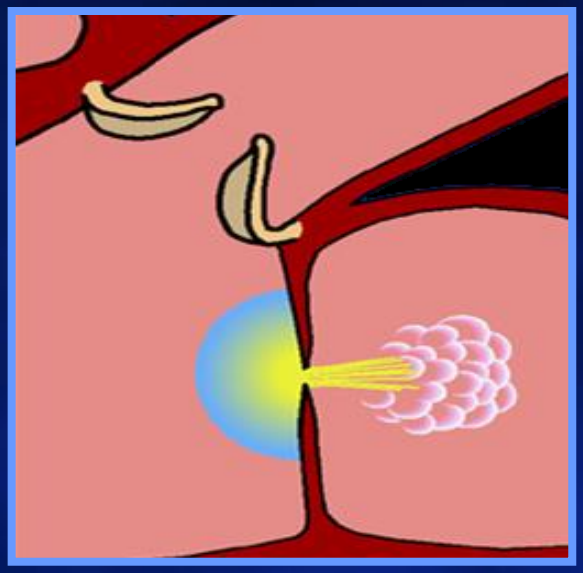
Mitral Regurgitation and PISA

Flow before the hole



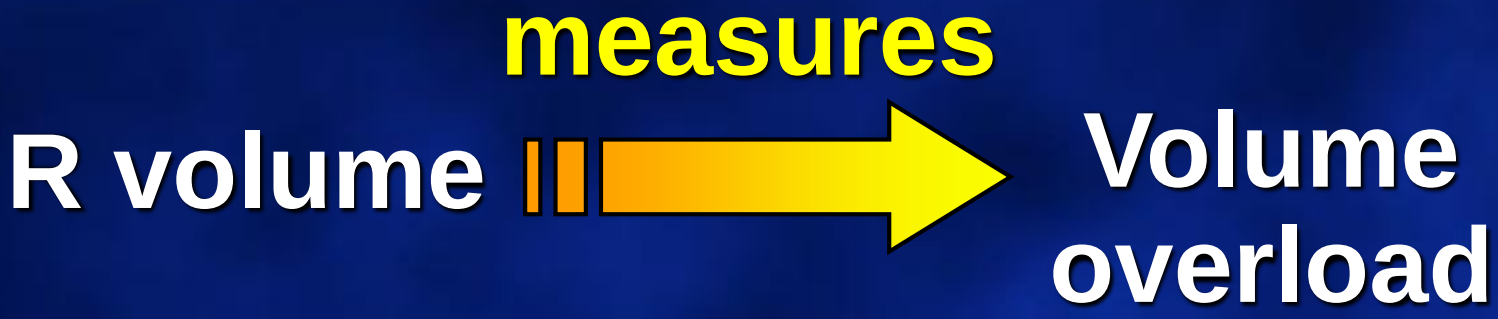
ERO

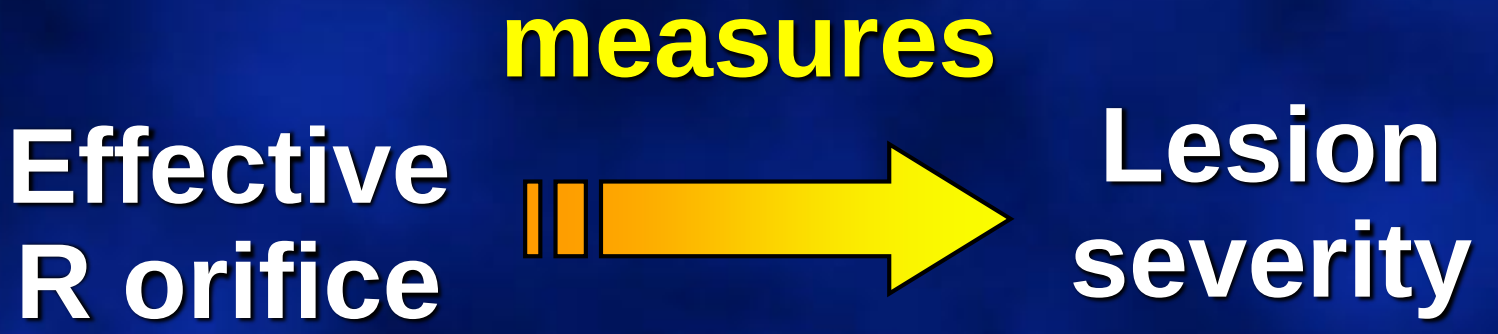
=



MR velocity

Quantitation of Regurgitation Concepts





MR severity evaluation principles

- Hemodynamics regur lesions = TTE
- Confirmed before OR
- Determination hemodynamic consequence of regur lesions can be complex---no method is perfect---so use many

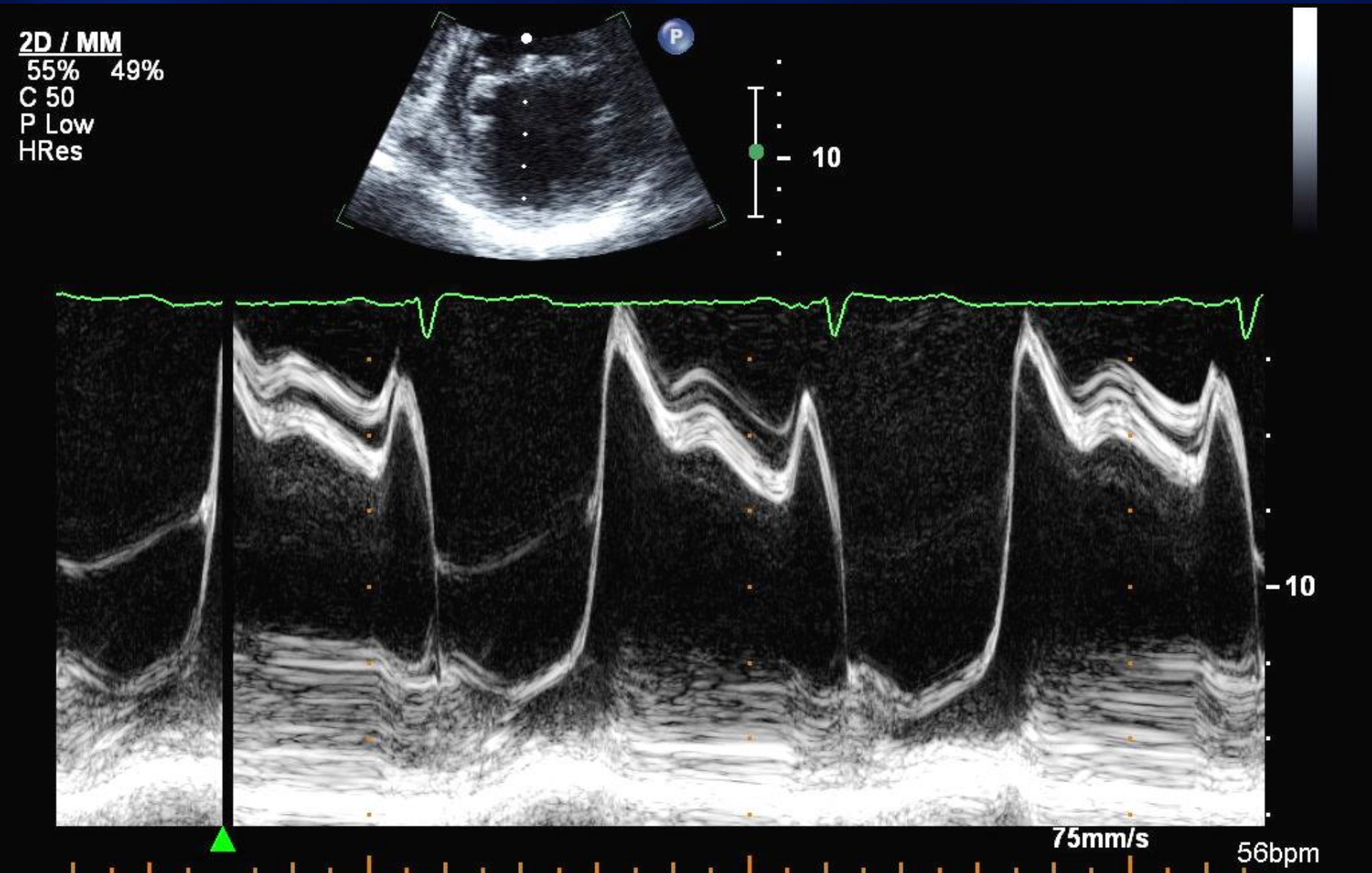
Real life case--
61 yo male, very active, lawyer, anxious

- Marfanoid habitus
- S/P BAV repair severe AR 2007
- Persistent LV enlargement
- PAF, multiple PVCs
- MVP

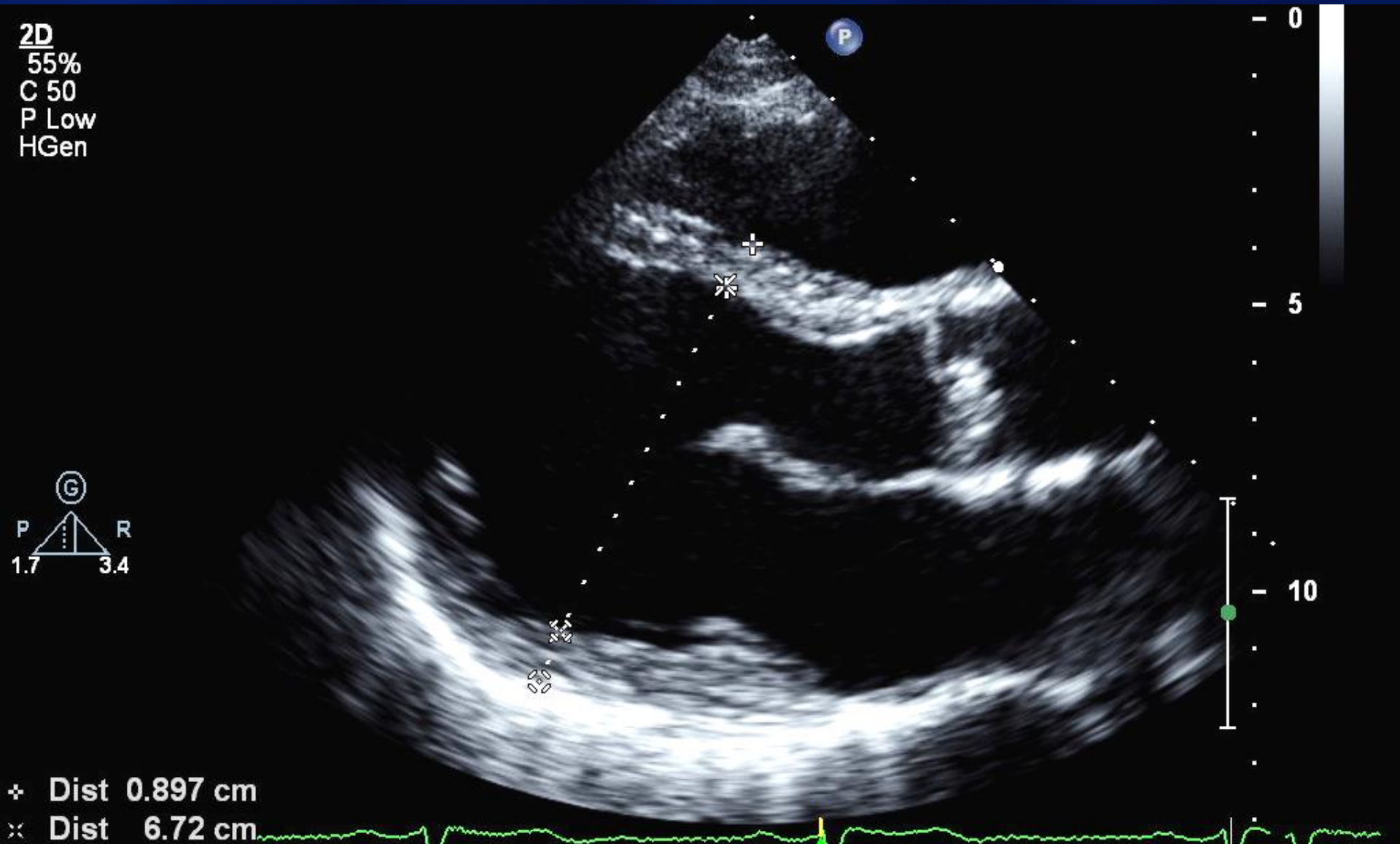
- Yearly check-ups since 2008

Parasternal long 2010
Ocasional SOB/palps running

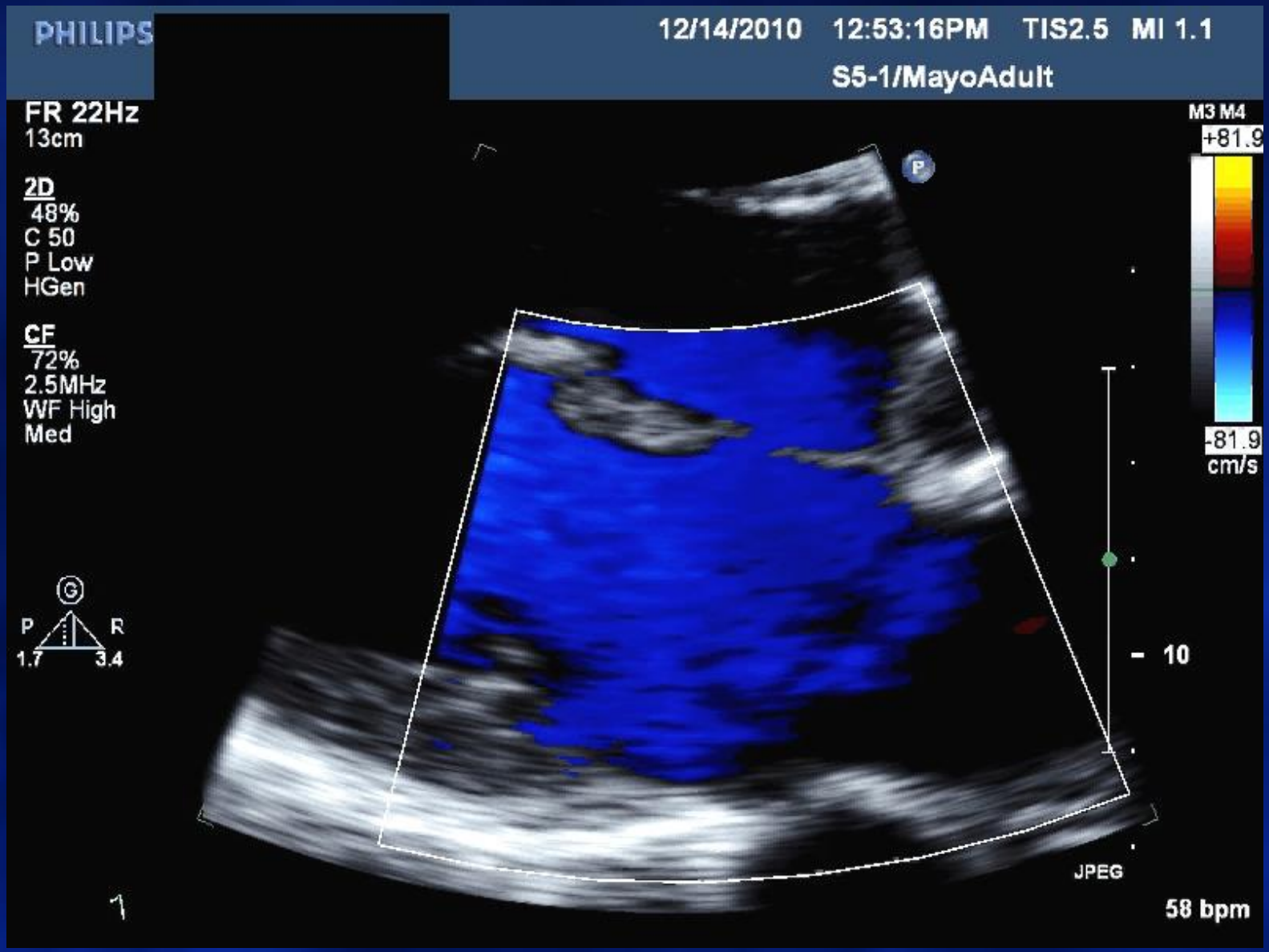
M-MODE



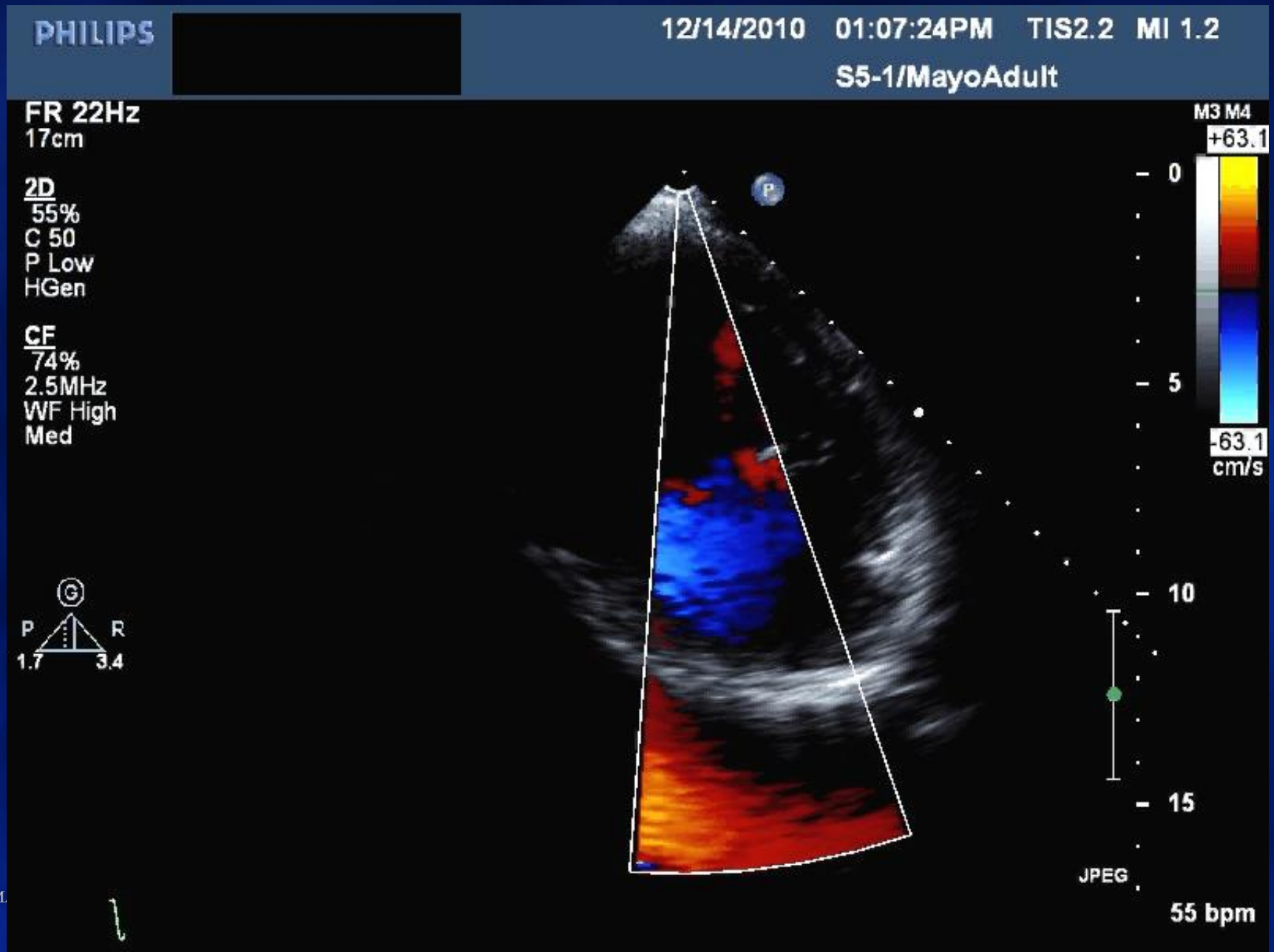
LARGE LV



Color-Doppler



Apical 2-C Color-Doppler



Severity?!?!?!
The magic eye of the doctor

The magic eye of the doctor

1. Mild
2. Mild-moderate
3. Moderate
4. Moderate-severe
5. Severe

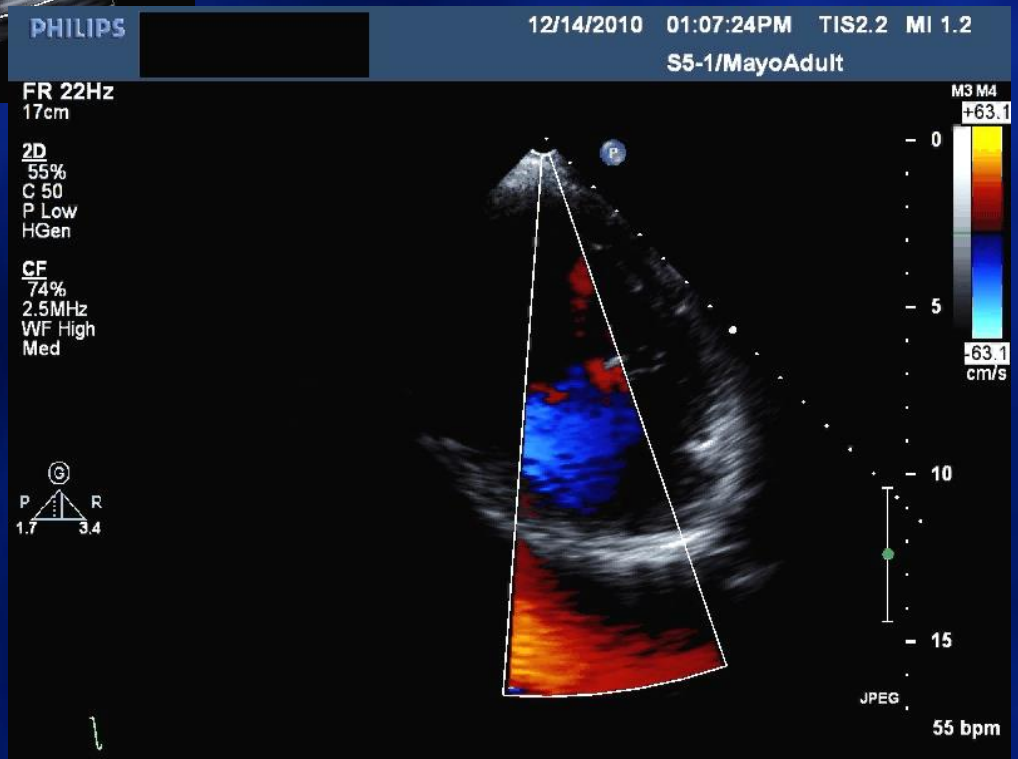
Whenever you can,
count.
— Sir Francis Galton

If you cannot measure it you cannot
control it.
— John Grebe

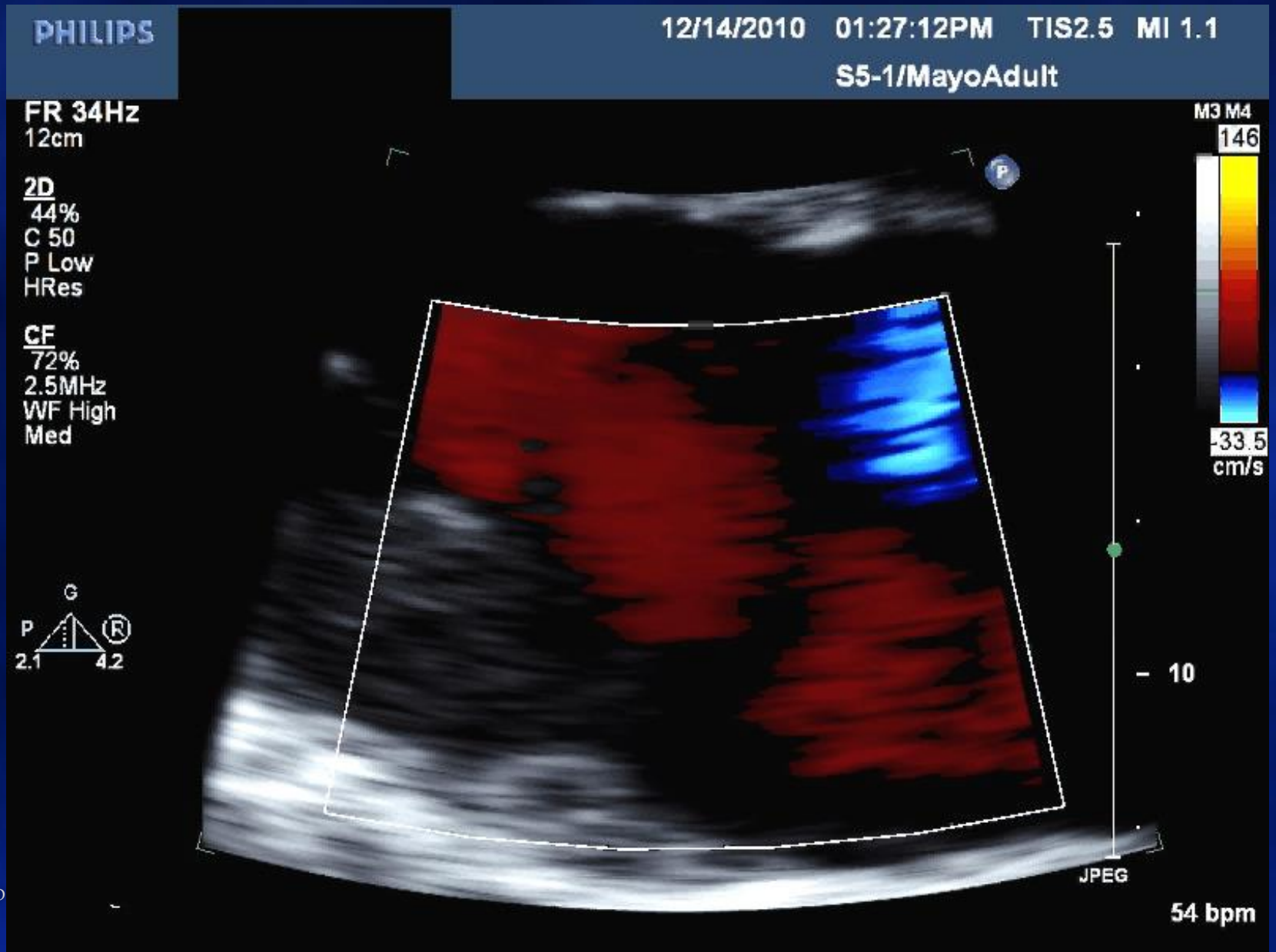
FURTHER EVAL >>>>

PISA

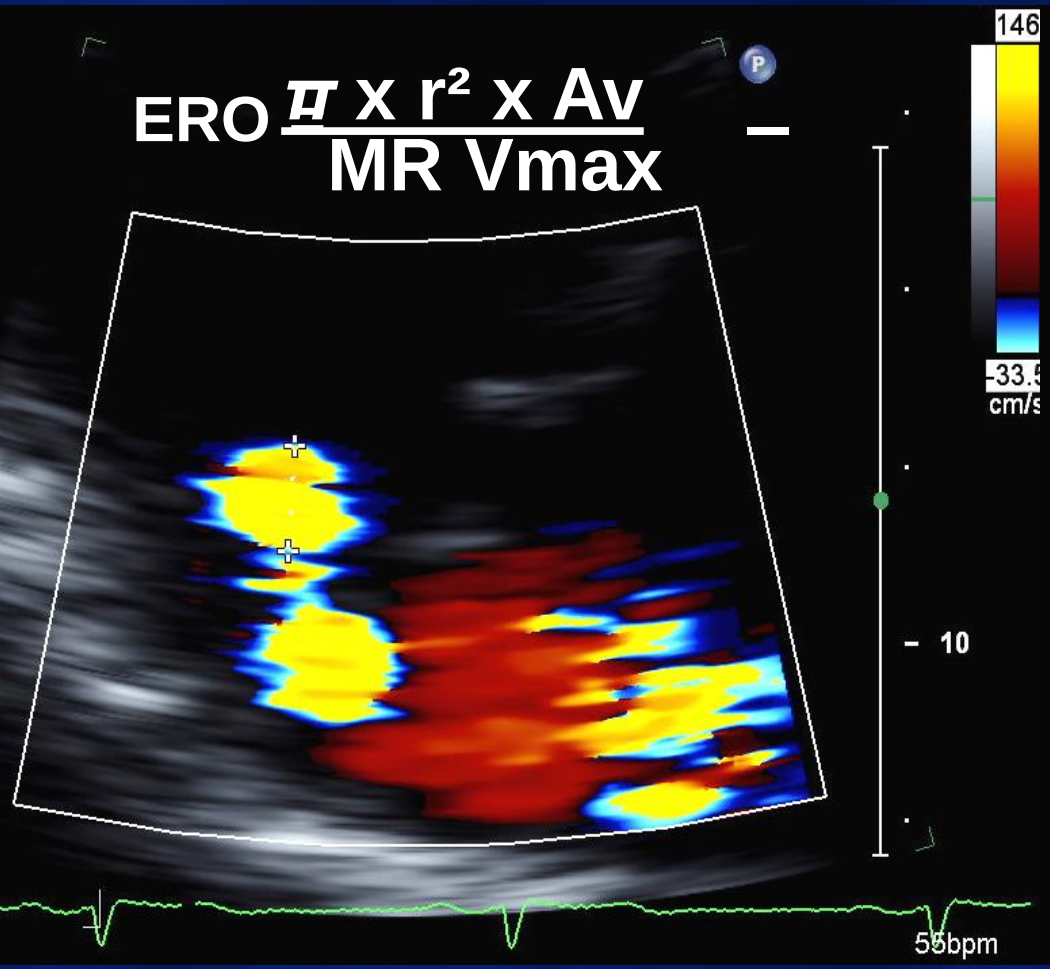

PHILIPS
12/14/2010 12:53:16PM TIS2.5 MI 1.1
S5-1/MayoAdult
FR 22Hz
13cm
2D
48%
C 50
P Low
HGen
CF
72%
2.5MHz
WF High
Med
M3 M4
+81.9
-81.9
cm/s
10

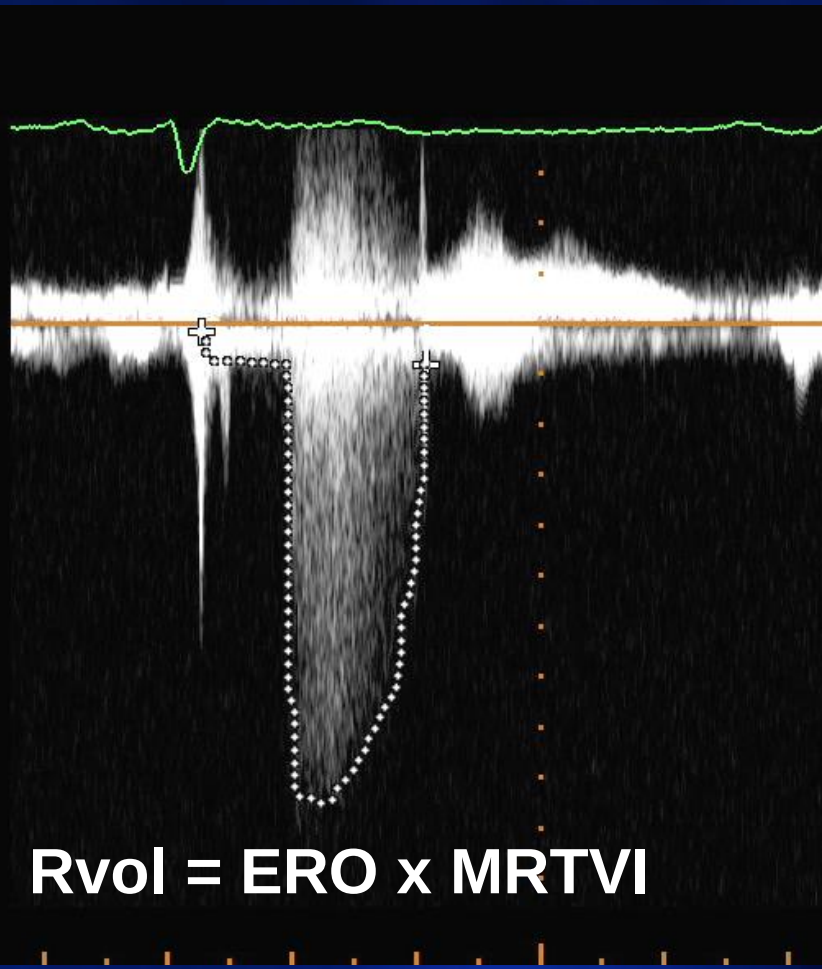

PHILIPS
12/14/2010 01:07:24PM TIS2.2 MI 1.2
S5-1/MayoAdult
FR 22Hz
17cm
2D
55%
C 50
P Low
HGen
CF
74%
2.5MHz
WF High
Med
M3 M4
+63.1
-63.1
cm/s
0
5
10
15
JPEG
55 bpm

PISA...


PHILIPS
12/14/2010 01:27:12PM TIS2.5 MI 1.1
S5-1/MayoAdult
FR 34Hz
12cm
2D
44%
C 50
P Low
HRes
CF
72%
2.5MHz
WF High
Med
G
P
R
2.1
4.2
M3 M4
146
-33.5
cm/s
10
JPEG
54 bpm

PISA and spectral Doppler Doppler End-systolic MR





ERO=0.32 cm2 / Rvol=26cc

What do we do?

1. Mitral repair
2. Mitral replacement
3. Observation
4. something else?

Oxygen consumption stress test
Normal VO2
Satisfactory exercise capacity
No evidence of CO limitation

Mitral Valve Prolapse With Mid-Late Systolic Mitral Regurgitation : Pitfalls of Evaluation and Clinical Outcome Compared With Holosystolic Regurgitation

Yan Topilsky, Hector Michelena, Valentina Bichara, Joseph Maalouf, Douglas W. Mahoney and Maurice Enriquez-Sarano

Circulation. 2012;125:1643

	Mid-Late Systolic MR (n=111)	Holosystolic MR (n=90)	*P*
MR characteristics			
ERO, mm^2	0.25±0.15	0.25±0.15	0.53
Jet area, 4-chamber view, cm^2	8.3±3.6	8.0±5.2	0.63
Jet area, 2-chamber view, cm^2	8.2±4.0	8.3±5.1	0.93
Aliasing velocity, cm/s	37.7±7.6	35.6±9.5	0.08
Flow convergence radius, cm	0.74±0.2	0.78±0.2	0.20
Regurgitant flow rate, mL/s	139.4±80.1	148.6±80.4	0.42
Regurgitant peak velocity, m/s	5.7±0.6	5.7±0.5	0.96
Regurgitant TVI, cm	105.5±21	190.2±29.5	<0.0001
MR duration, ms	233±56	426±50	<0.0001
MR duration/systolic time ratio, %	54.6±10.5	99.7±3.1	<0.0001
Regurgitant volume, mL per beat	25.2±13.5	48.5±25.6	<0.0001

MAYO CLINIC

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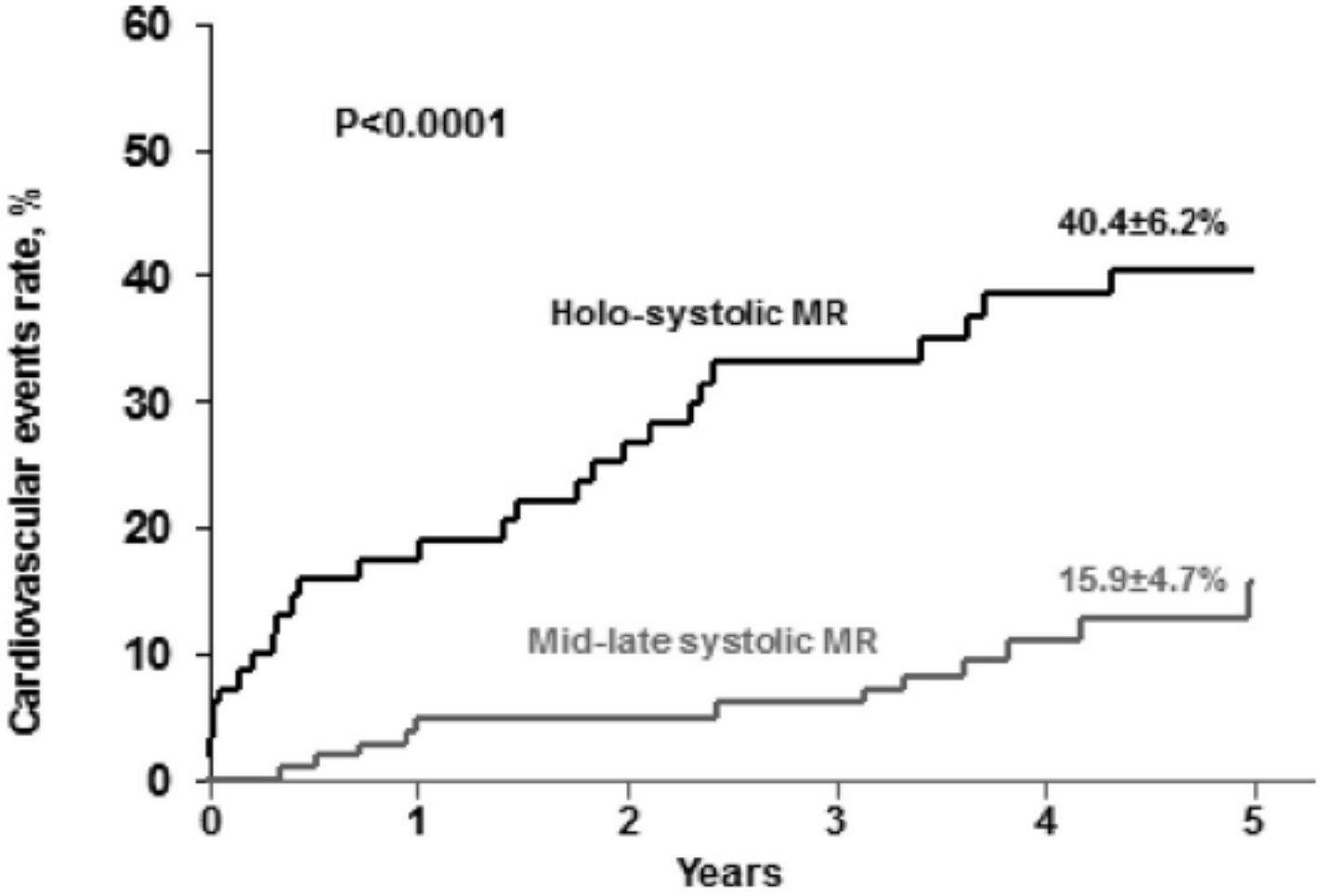
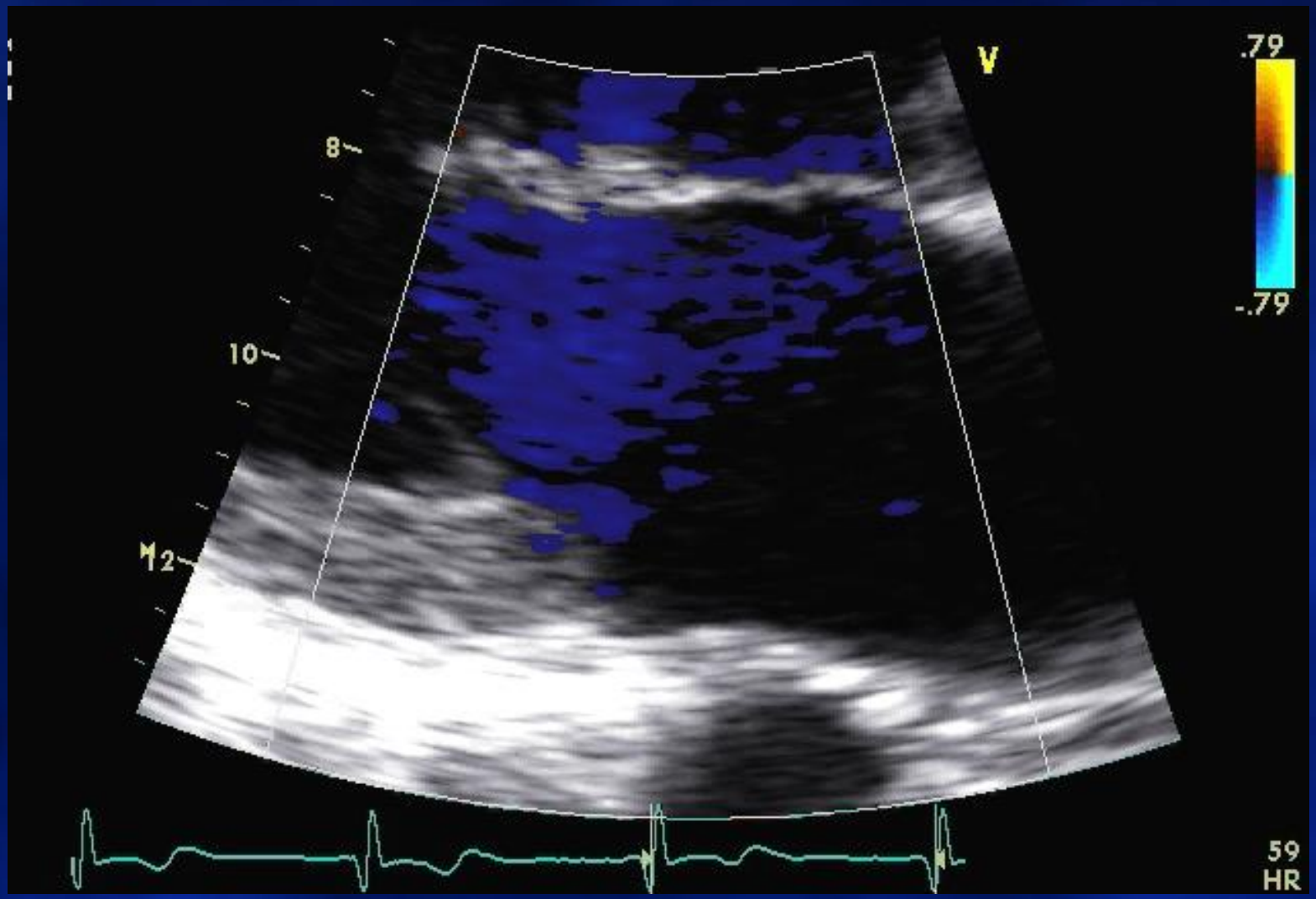
Yan Topilsky, Hector Michelena, Valentina Bichara, Joseph Maalouf, Douglas W. Mahoney and Maurice Enriquez-Sarano

Circulation. 2012;125:1643



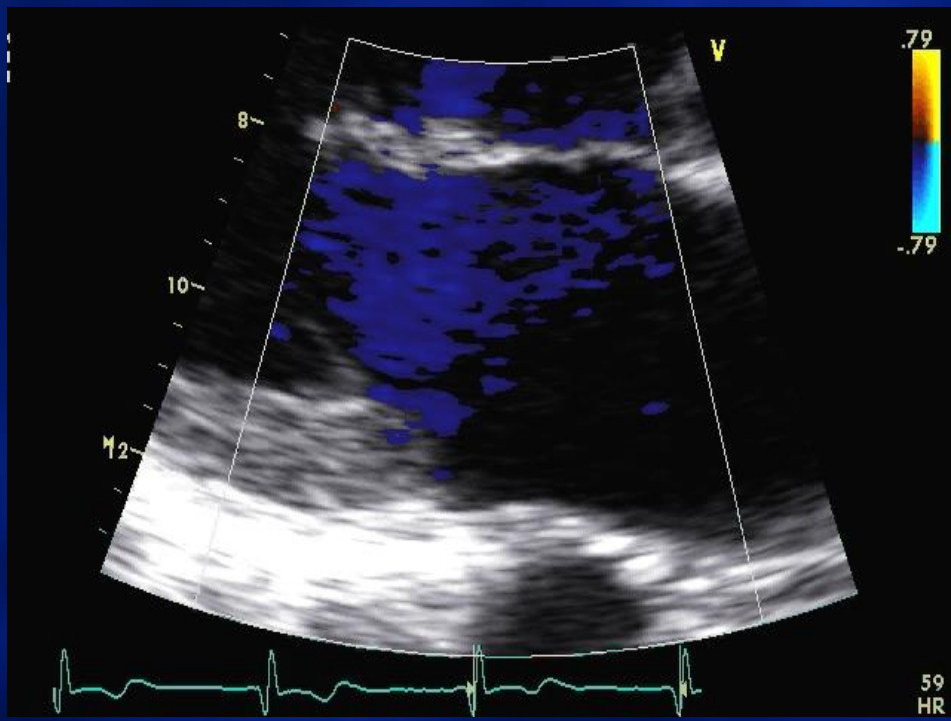
Late 2011…yearly followup
"I stopped running all together"



Compare

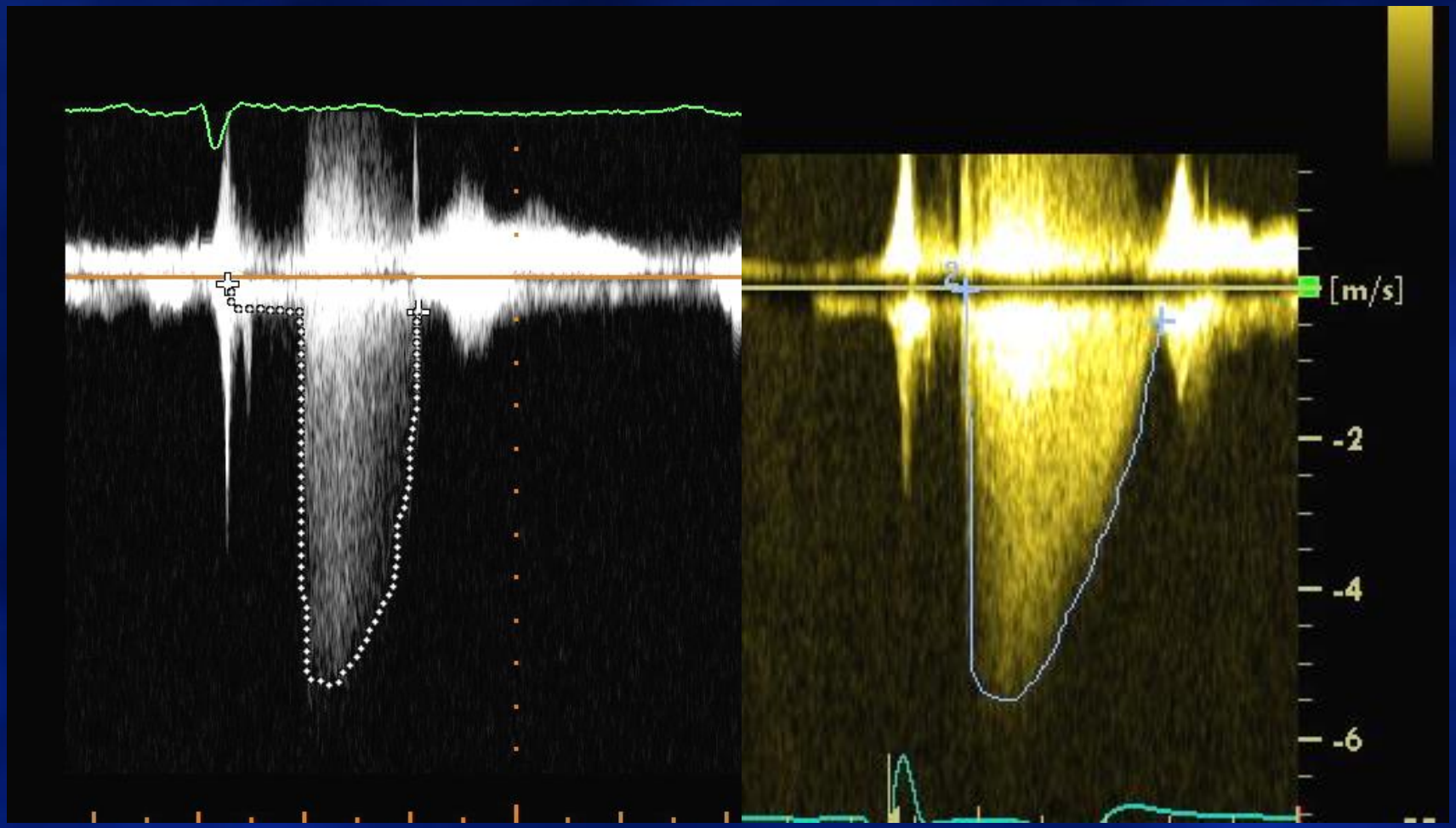
2010

2011



MAYO CLINIC

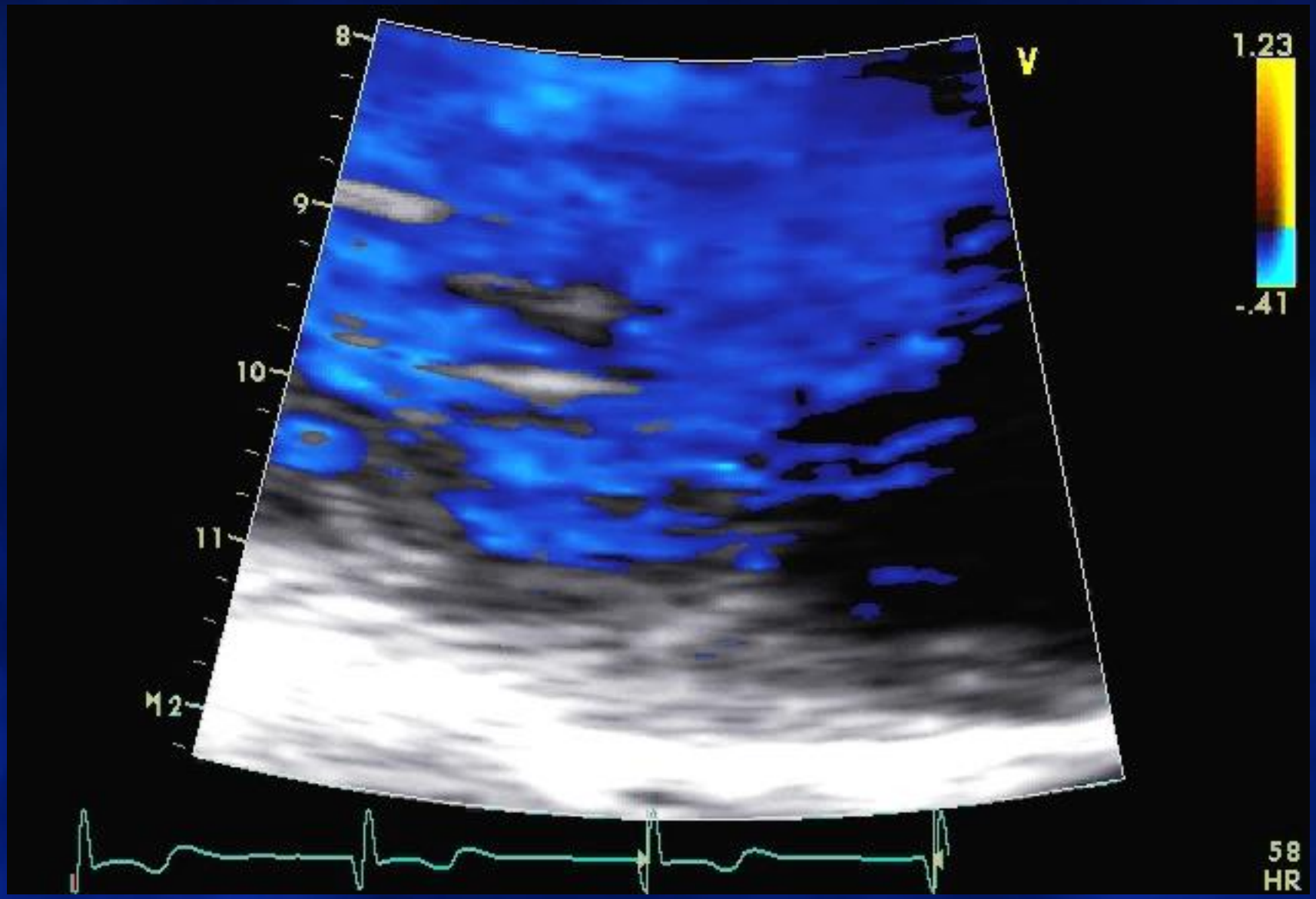
Compare



2010

2011

PISA...



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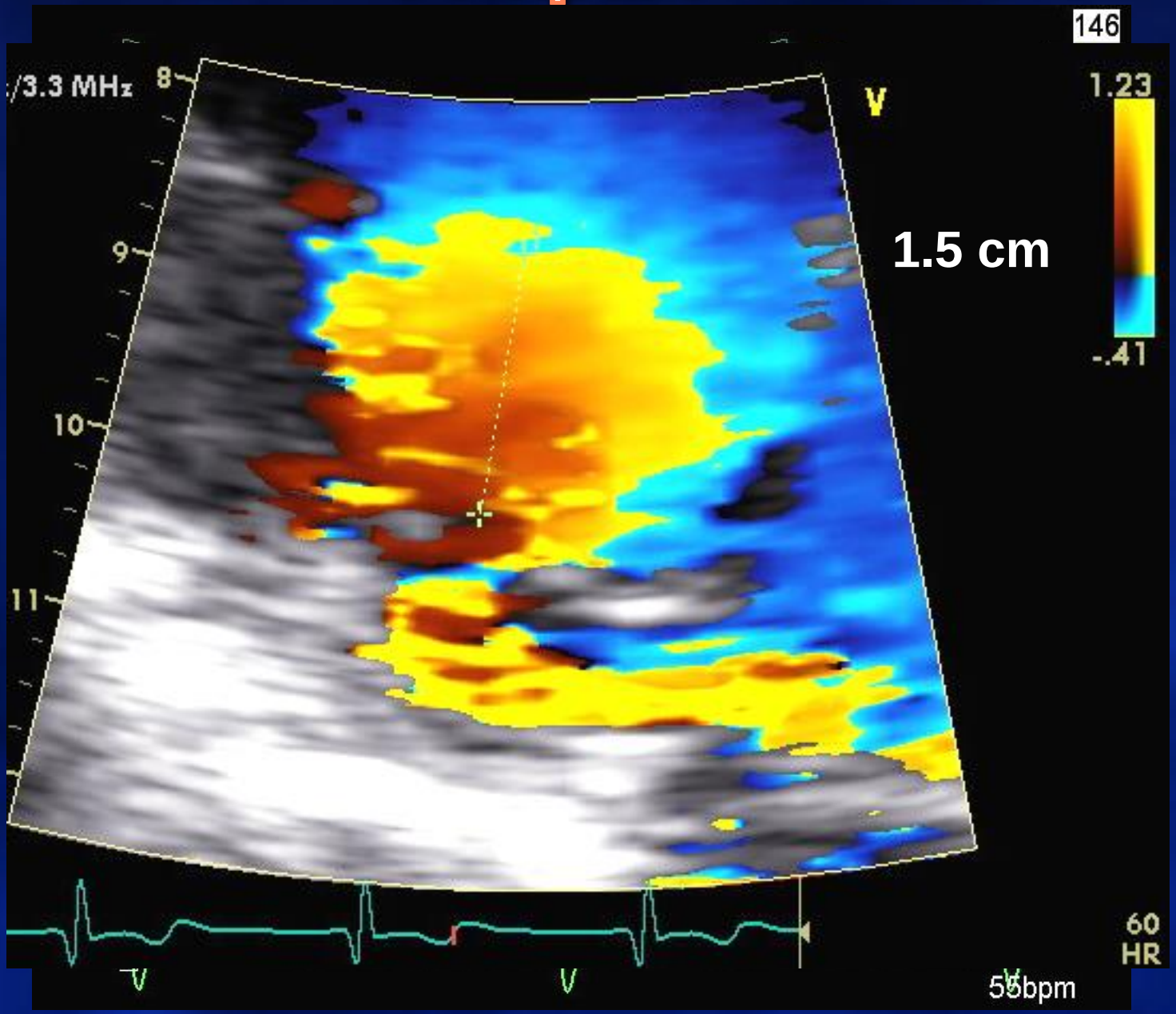
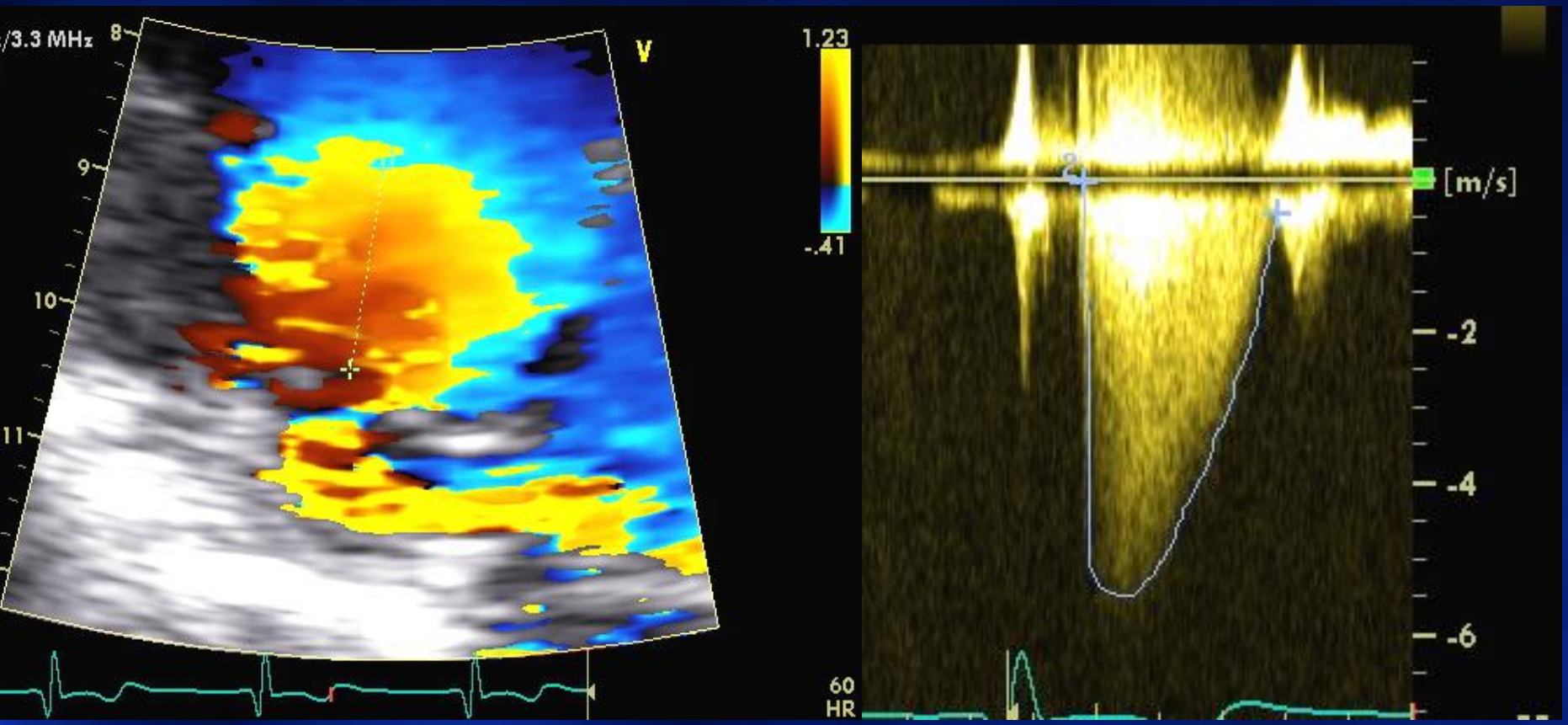
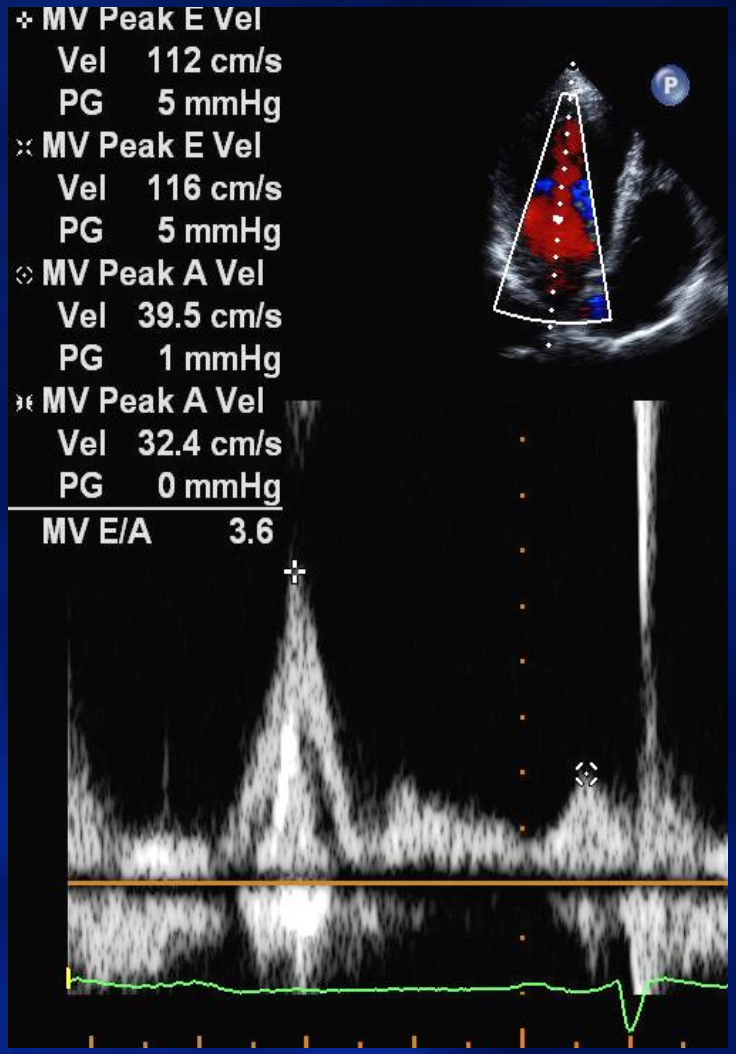
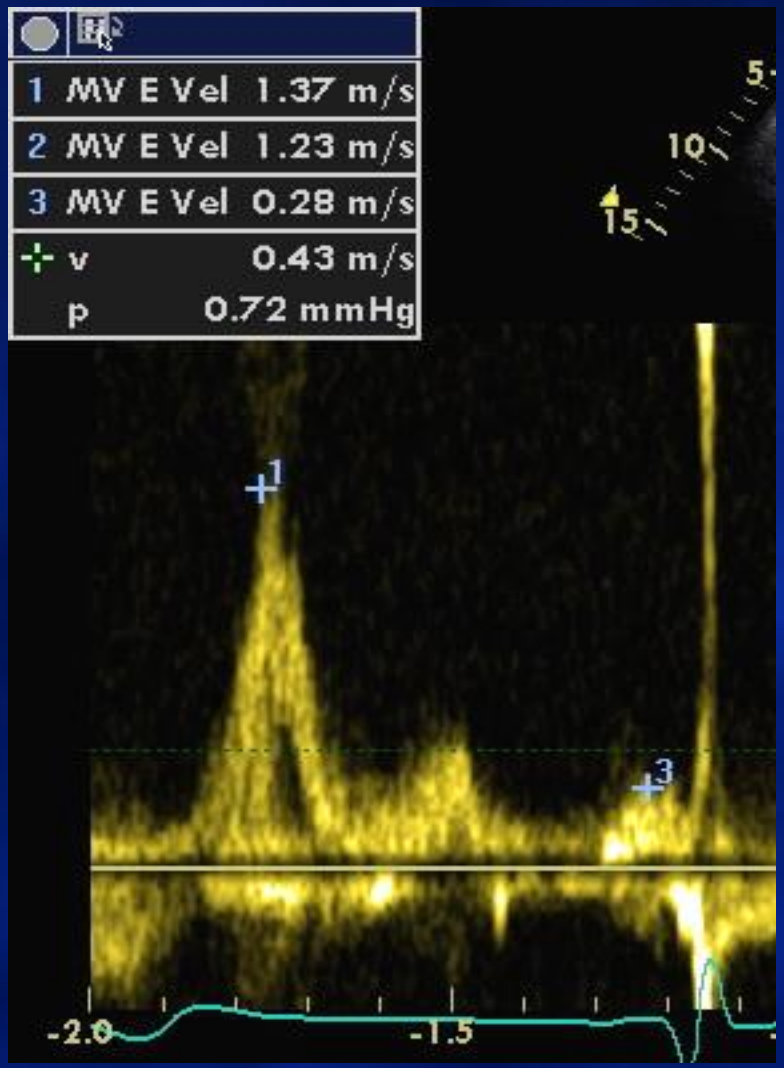




ERO=0.64 cm2 / Rvol=78cc

Still have doubts…





Murmur 5/6
LV larger
BNP elevated

Mitral Valve repair ASAP

TAKE HOME POINTS

- Diagnose severity with TTE, confirmed before OR
- End-systolic MR (MVP) can be tricky, Rvol is more important than ERO

Moral responsibility to patients and colleagues to produce an echocardiographic report closest to the truth