Mitral Valve Stenosis: What do I need to know?

ACC Latin American Conference 2017

Athena Poppas, MD FACC FASE

Past ACC Scientific Sessions Chair, ACC Board of Trustee

Professor of Medicine, Brown University School of Medicine

Director, Lifespan Cardiovascular Institute

Rhode Island, Miriam and Newport Hospitals

Disclosures: GE stock, Philips research grant-in-kind

Severity of MS

Table 13. Stages of MS

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
A	At risk of MS	• Mild valve doming during diastole	• Normal transmitral flow velocity	• None	• None
B	Progressive MS	• Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets • Planimetered MVA >1.5 cm^2	• Increased transmitral flow velocities • MVA >1.5 cm^2 • Diastolic pressure half-time <150 ms	• Mild-to-moderate LA enlargement • Normal pulmonary pressure at rest	• None
C	Asymptomatic severe MS	• Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets • Planimetered MVA ≤1.5 cm^2 • (MVA ≤1.0 cm^2 with very severe MS)	• MVA ≤1.5 cm^2 • (MVA ≤1.0 cm^2 with very severe MS) • Diastolic pressure half-time ≥150 ms • (Diastolic pressure half-time ≥220 ms with very severe MS)	• Severe LA enlargement • Elevated PASP >30 mm Hg	• None
D	Symptomatic severe MS	• Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets • Planimetered MVA ≤1.5 cm^2	• MVA ≤1.5 cm^2 • (MVA ≤1.0 cm^2 with very severe MS) • Diastolic pressure half-time ≥150 ms • (Diastolic pressure half-time ≥220 ms with very severe MS)	• Severe LA enlargement • Elevated PASP >30 mm Hg	• Decreased exercise tolerance • Exertional dyspnea

The transmitral mean pressure gradient should be obtained to further determine the hemodynamic effect of the MS and is usually >5 mm Hg to 10 mm Hg in severe MS; however, due to the variability of the mean pressure gradient with heart rate and forward flow, it has not been included in the criteria for severity.

LA indicates left atrial; LV, left ventricular; MS, mitral stenosis; MVA, mitral valve area; and PASP, pulmonary artery systolic pressure.

Nishimura RA. JACC 2014:63(22): 2438

Severity of MS

	MVA cm^2	PASP rest mmHg	Mean Grad mmHg*
Mild	> 1.5	<30	< 5
Moderate	1.0-1.5	30-50	5-10
Severe (very severe)	< 1.0	>50	> 10

***Sinus rhythm and HR 60-80**

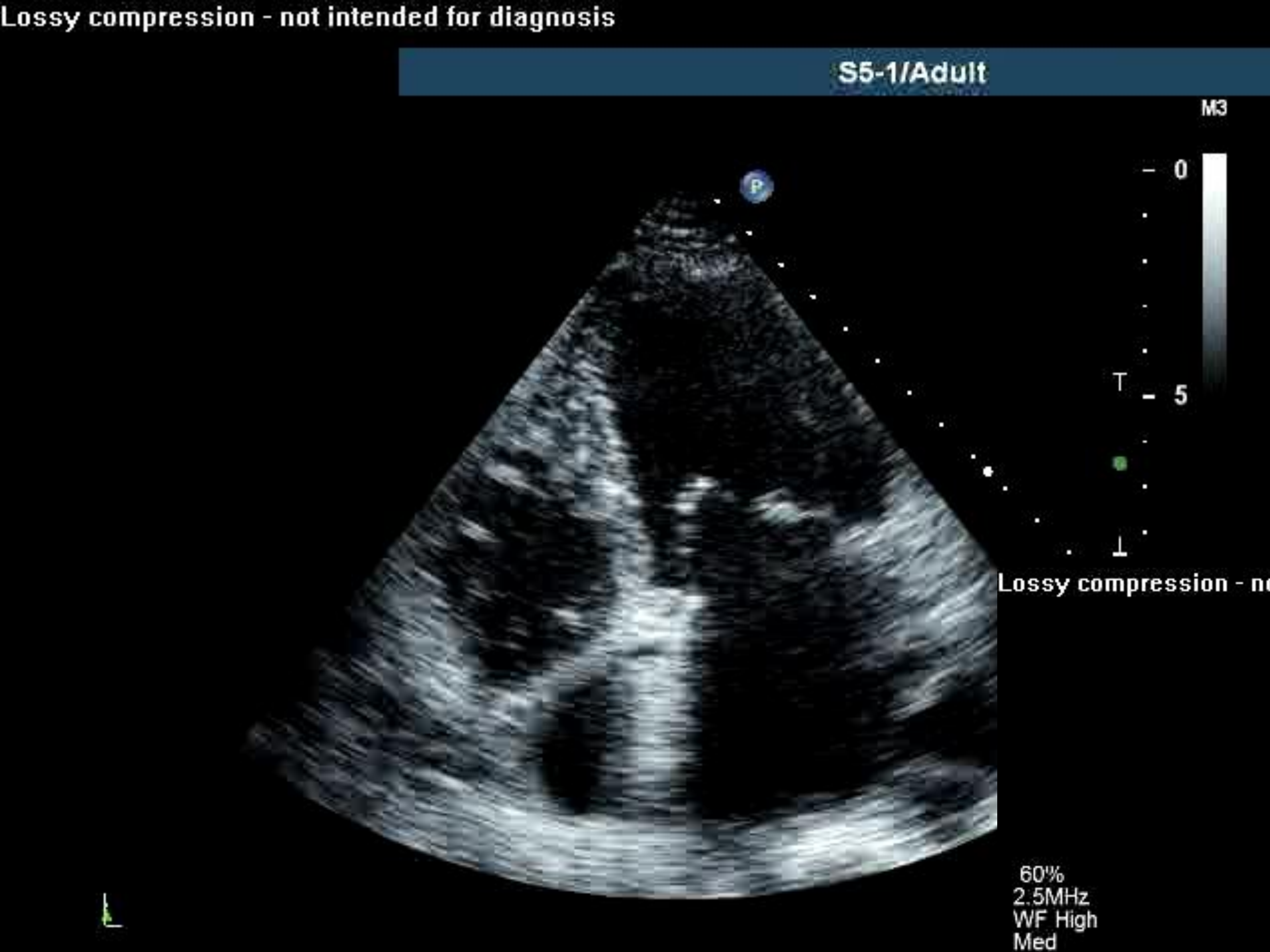
EAE/ASE Guidelines.JASE 2009;22:1.

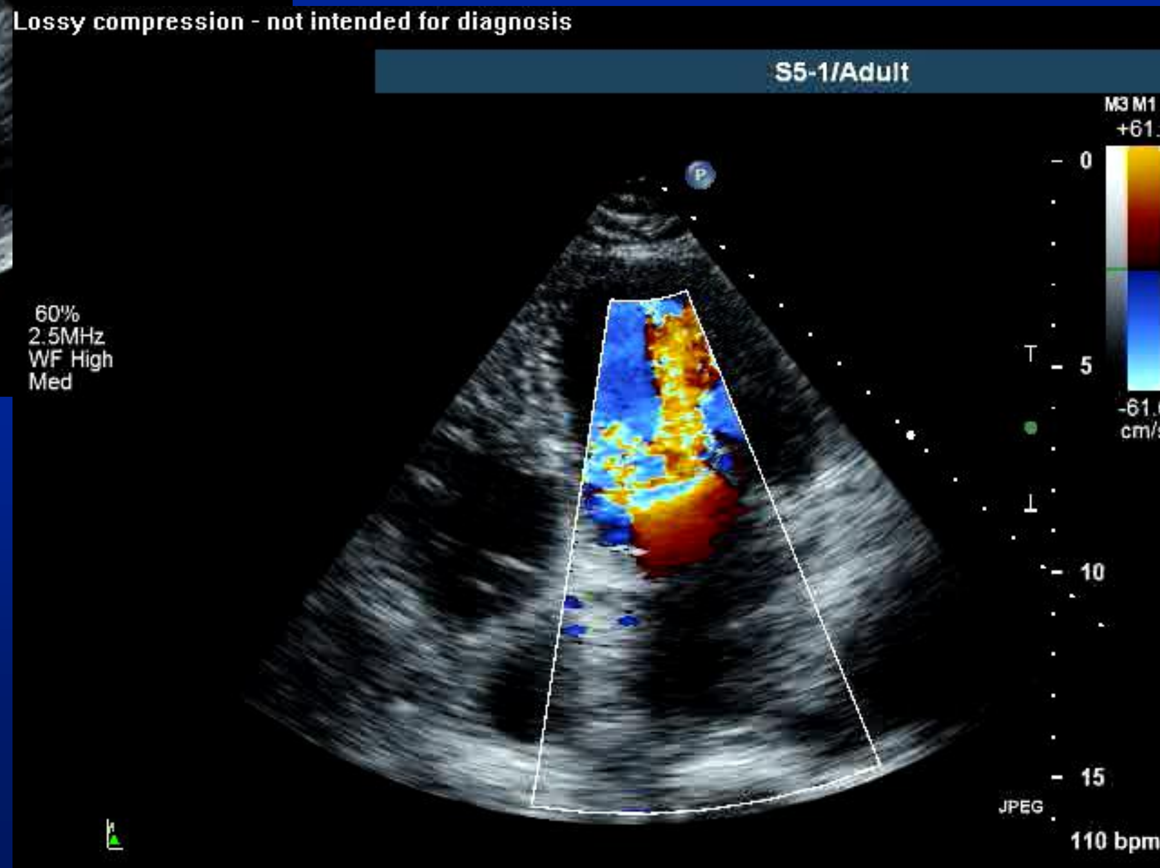
Case presentation

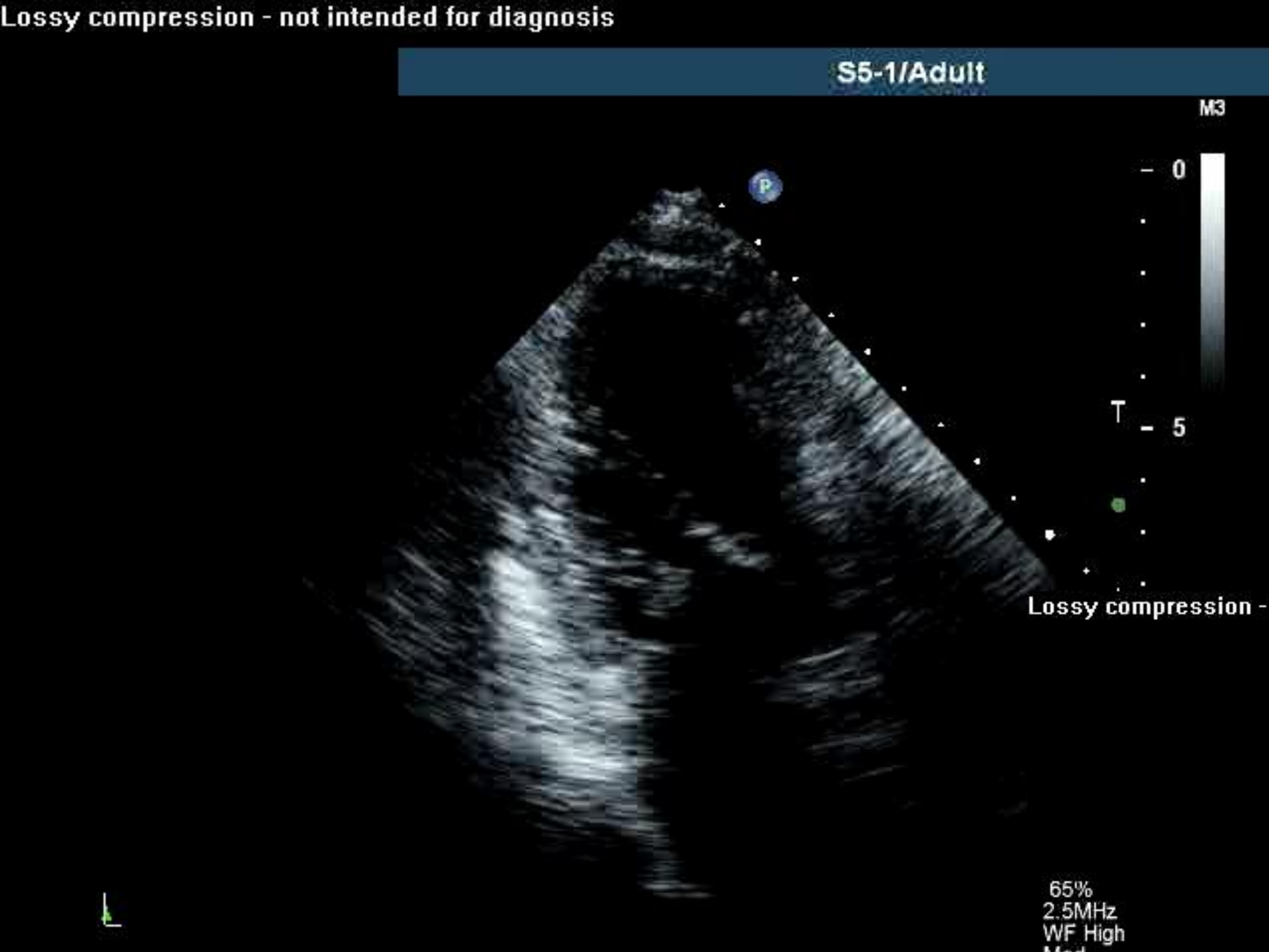
- 26 yo woman presents at 32 weeks gestation with progressive fatigue, SOB and new PND/orthopnea.
- PMHx: heart murmur as a child
- SHx/FHx: negative
- PE: 100/62, 108, 18, afebrile, O2 sat=84%
  - 3/6 HSM apex, PMI laterally displaced, -S3
  - JVP-6cm, carotids 2+
  - Lungs: diffuse rales, Ext: no CCE
- CXR: pulmonary edema vs patchy airspace disease

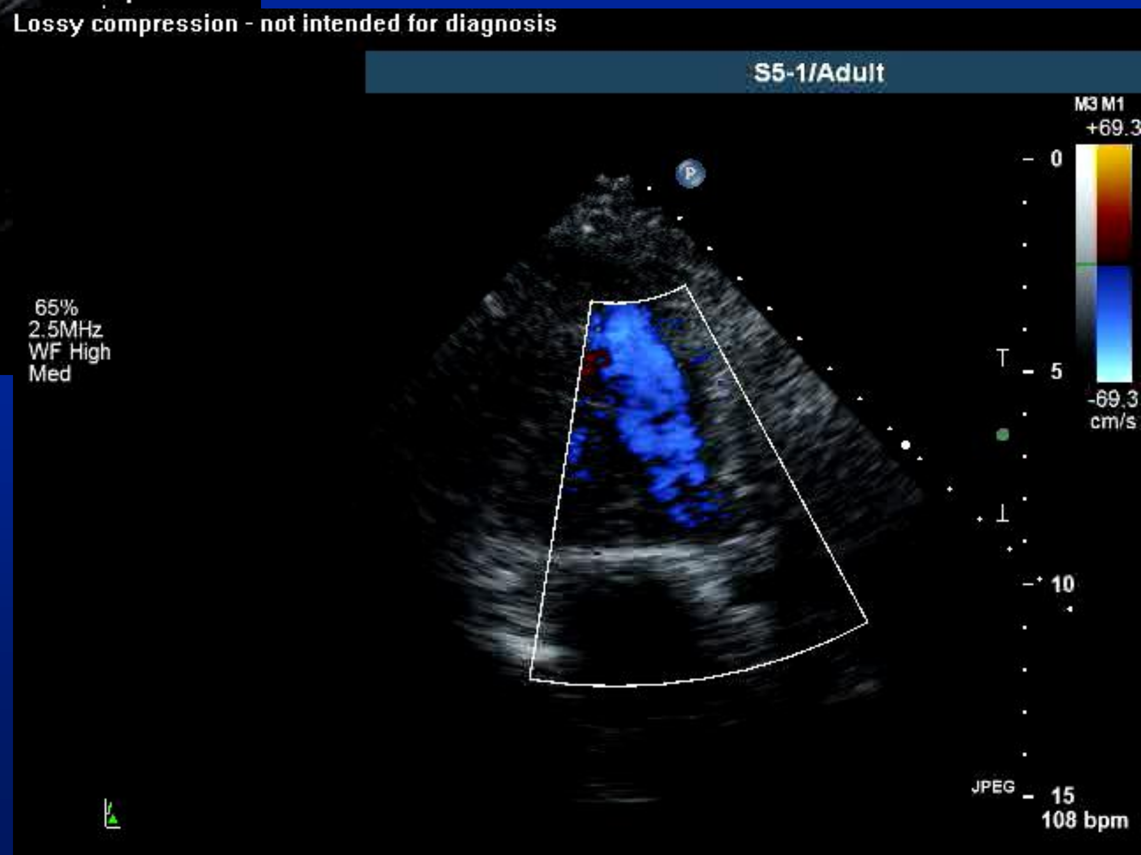

Lossy compression - not intended for diagnosis
S5-1/Adult
M3
0
5


Lossy compression - not intended for diagnosis
S5-1/Adult
M3
5
10
JPEG
111 bpm


Lossy compression - not intended for diagnosis
S5-1/Adult
M3
0
5


Lossy compression - not intended for diagnosis
S5-1/Adult
M3 M1
+61.6
0
5
-61.6
cm/s
60%
2.5MHz
WF High
Med
10
15
JPEG
110 bpm


Lossy compression - not intended for diagnosis
S5-1/Adult
M3
0
5

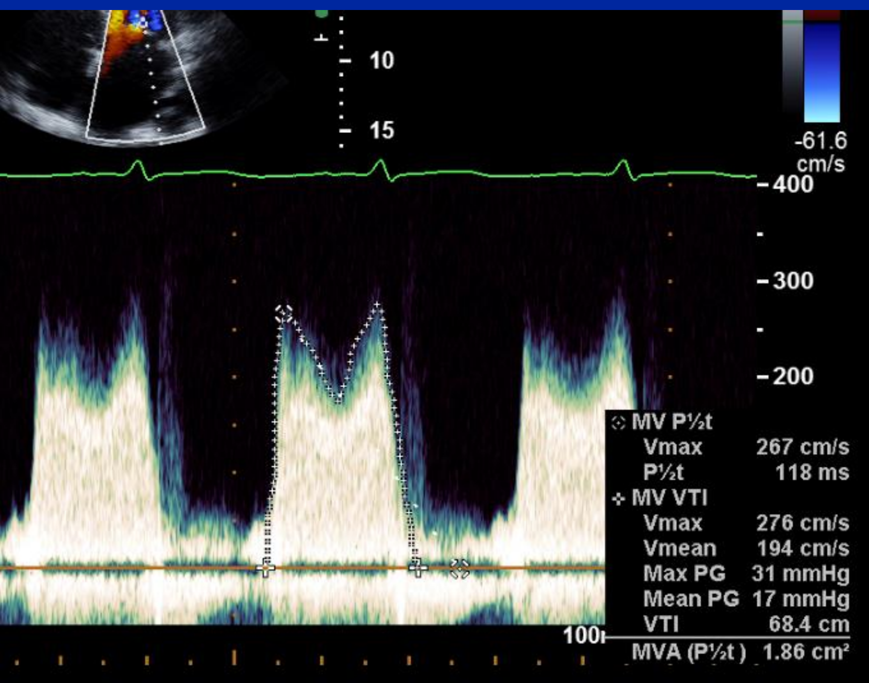

Lossy compression - not intended for diagnosis
S5-1/Adult
M3 M1
+69.3
0
5
-69.3
cm/s
10
15
65%
2.5MHz
WF High
Med
JPEG
108 bpm

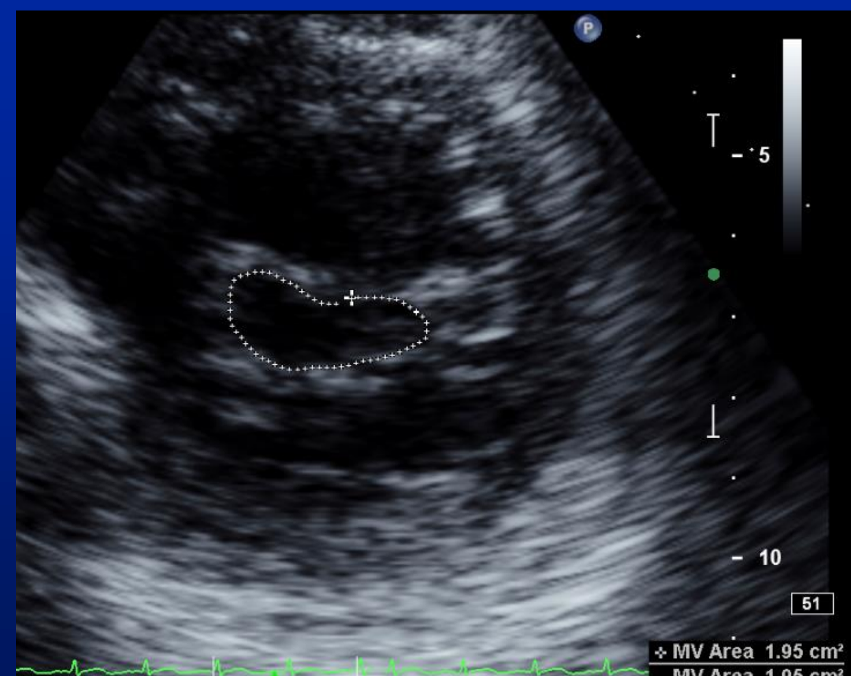
LAVi= 45ml/M^2

PASP= 48mmHg

Mean MVG=17mmHg

MVA plan= 1.9 cm^2
MVA PHT=1.9 cm^2

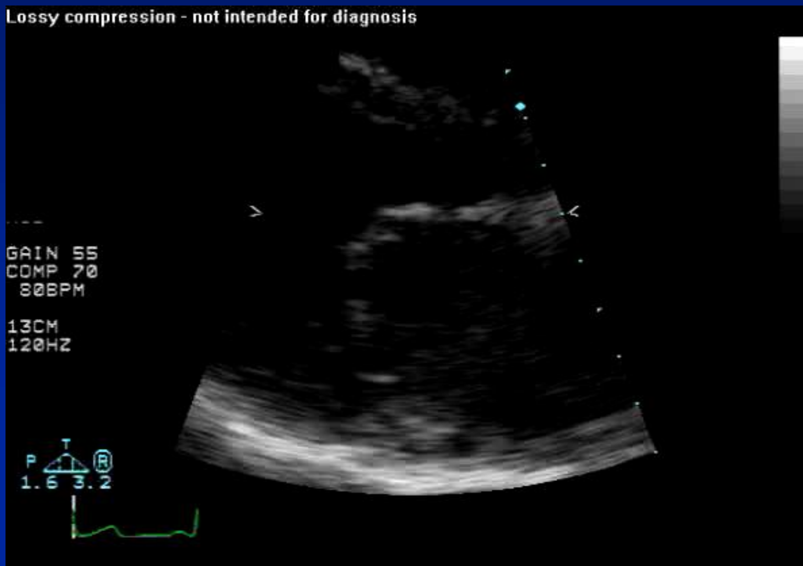


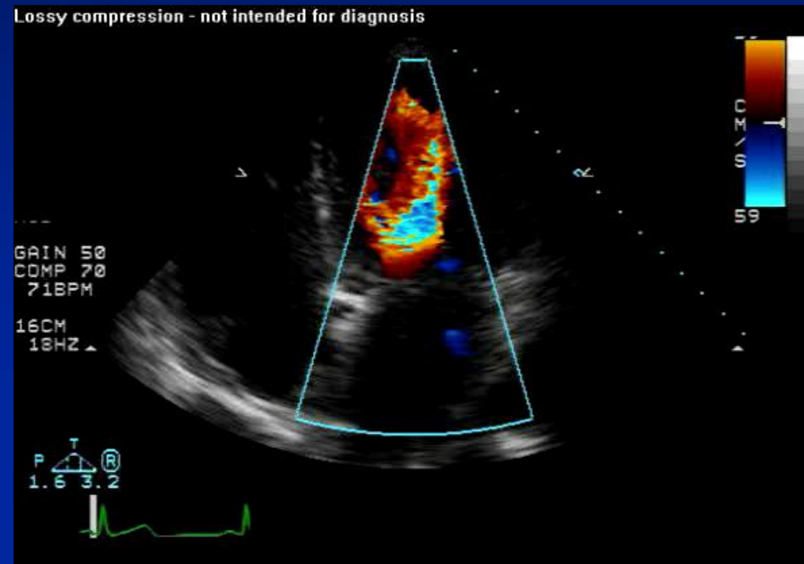


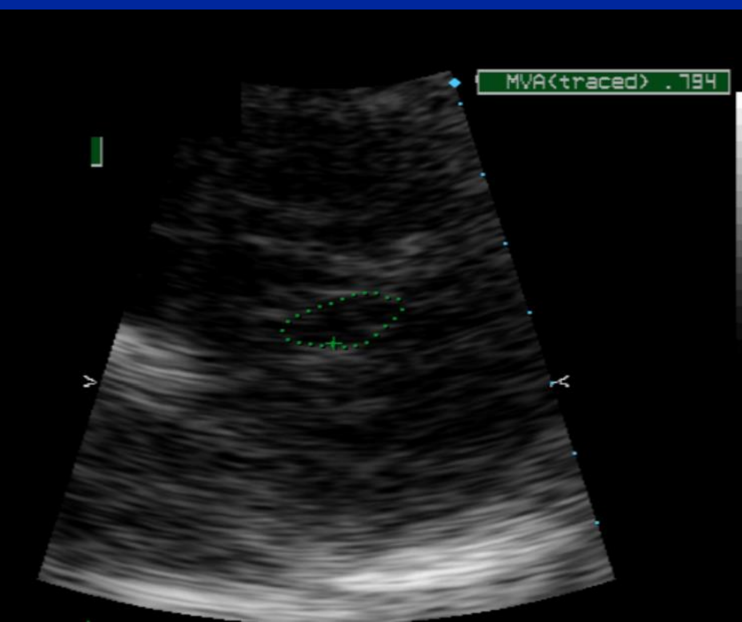
What is the real MVA?

1. Mild mitral stenosis
2. Severe mitral stenosis
3. Mixed moderate regurgitation and stenosis
4. Normal variant of pregnancy

Repeat TTE after betablockers and diuretics

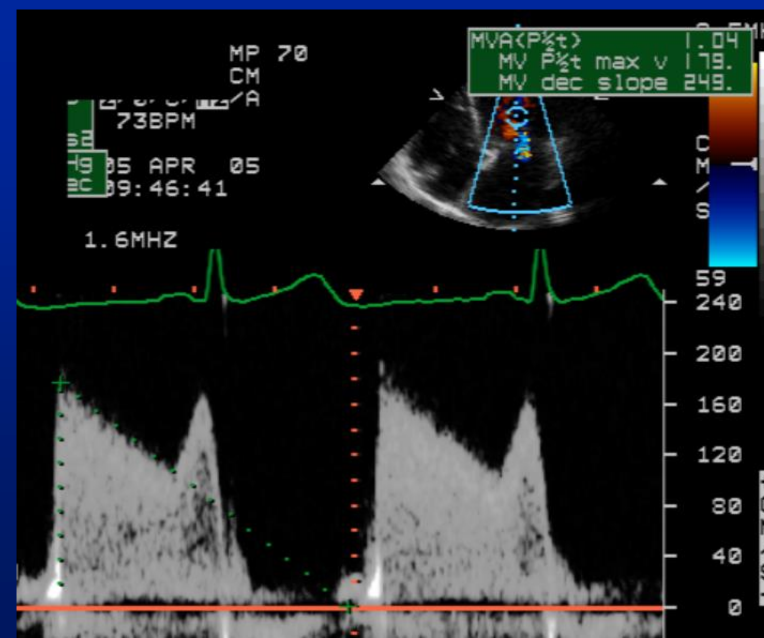




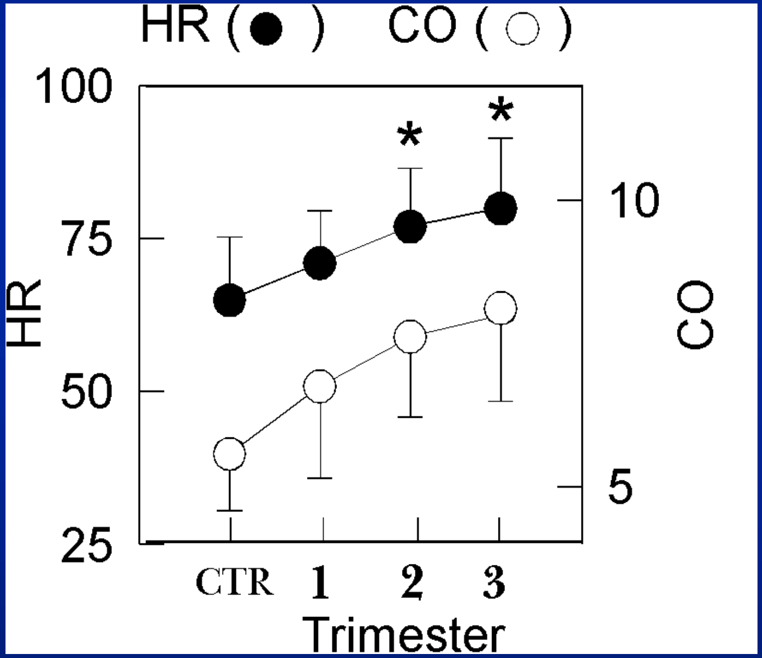


Mean MVG=10mmHg

MVA plan= 0.8cm^2
MVA PHT=1.04



What happened?
Physiology of pregnancy and MVA



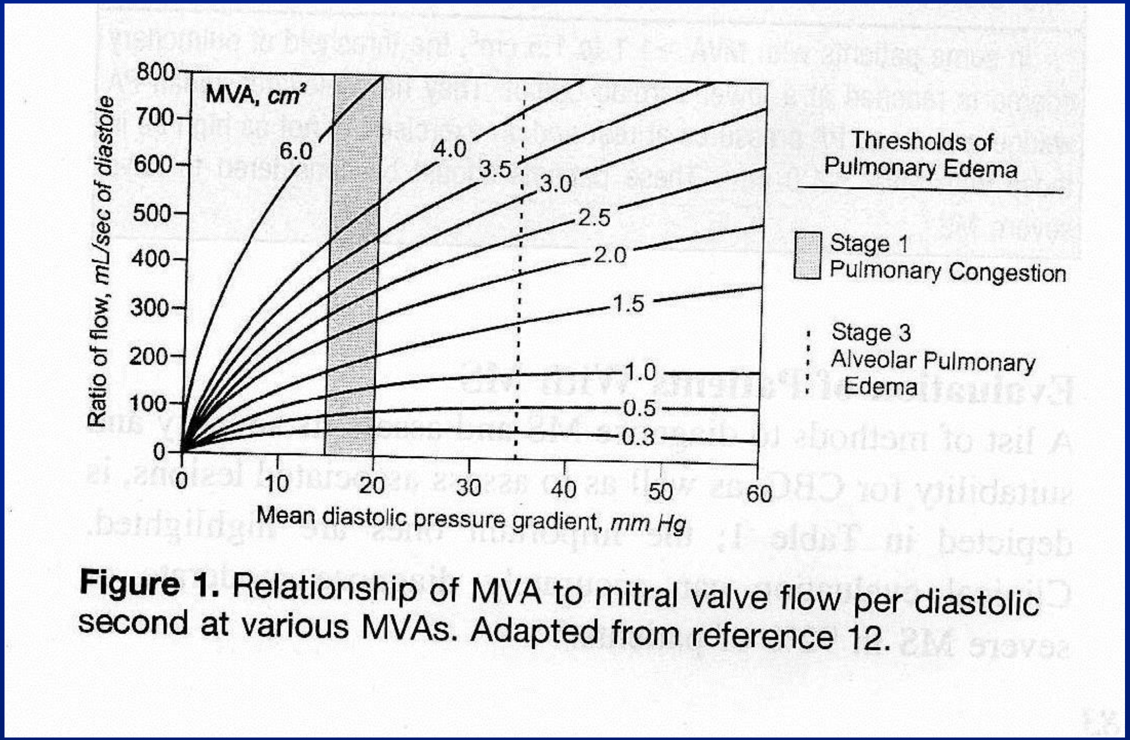


Figure 1. Relationship of MVA to mitral valve flow per diastolic second at various MVAs. Adapted from reference 12.

Poppas Circ 1997.

Rahimtoola.Circ. 2005

PHT is less flow dependent than gradients

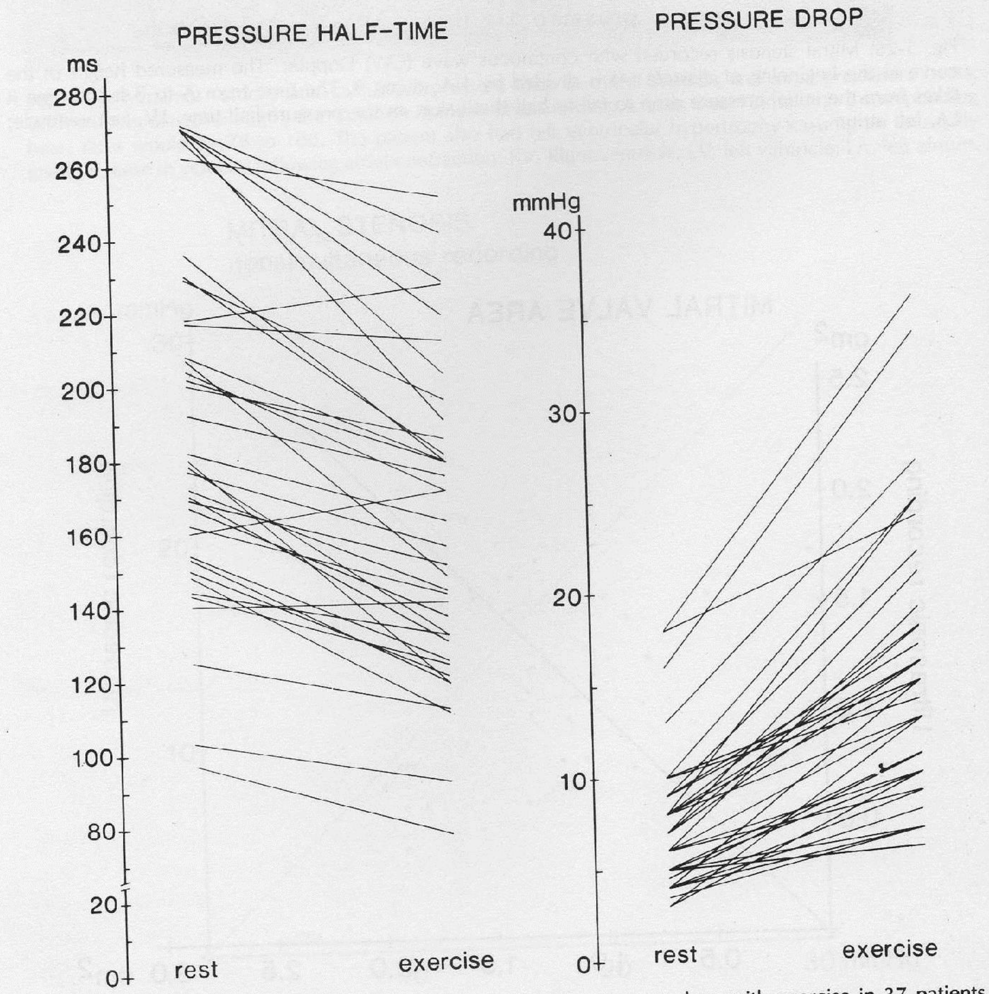


Fig. 5-28. Changes in pressure half-time and mean diastolic pressure drop with exercise in 37 patients with mitral stenosis or combined stenosis and regurgitation. A moderate decrease, in pressure half-time occurs with exercise (from 190 to 160 ms, $P < 0.001$), whereas the simultaneous increase in pressure drop is more pronounced (from 7.6 to 16 mm Hg).

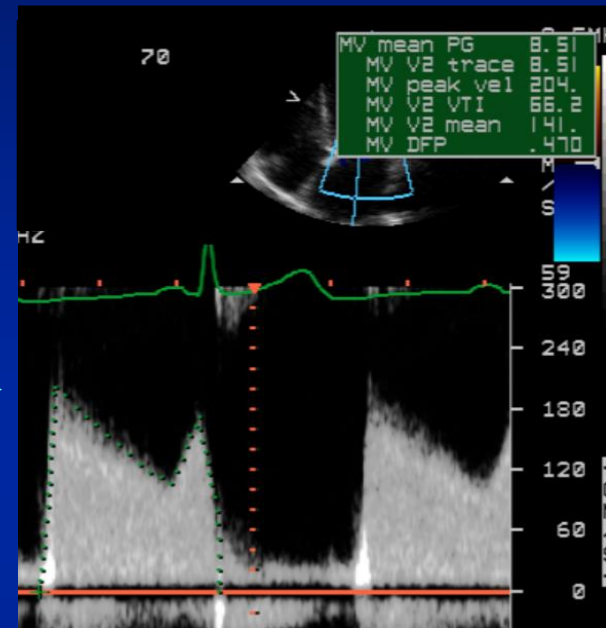
Hatle L.Doppler 1983

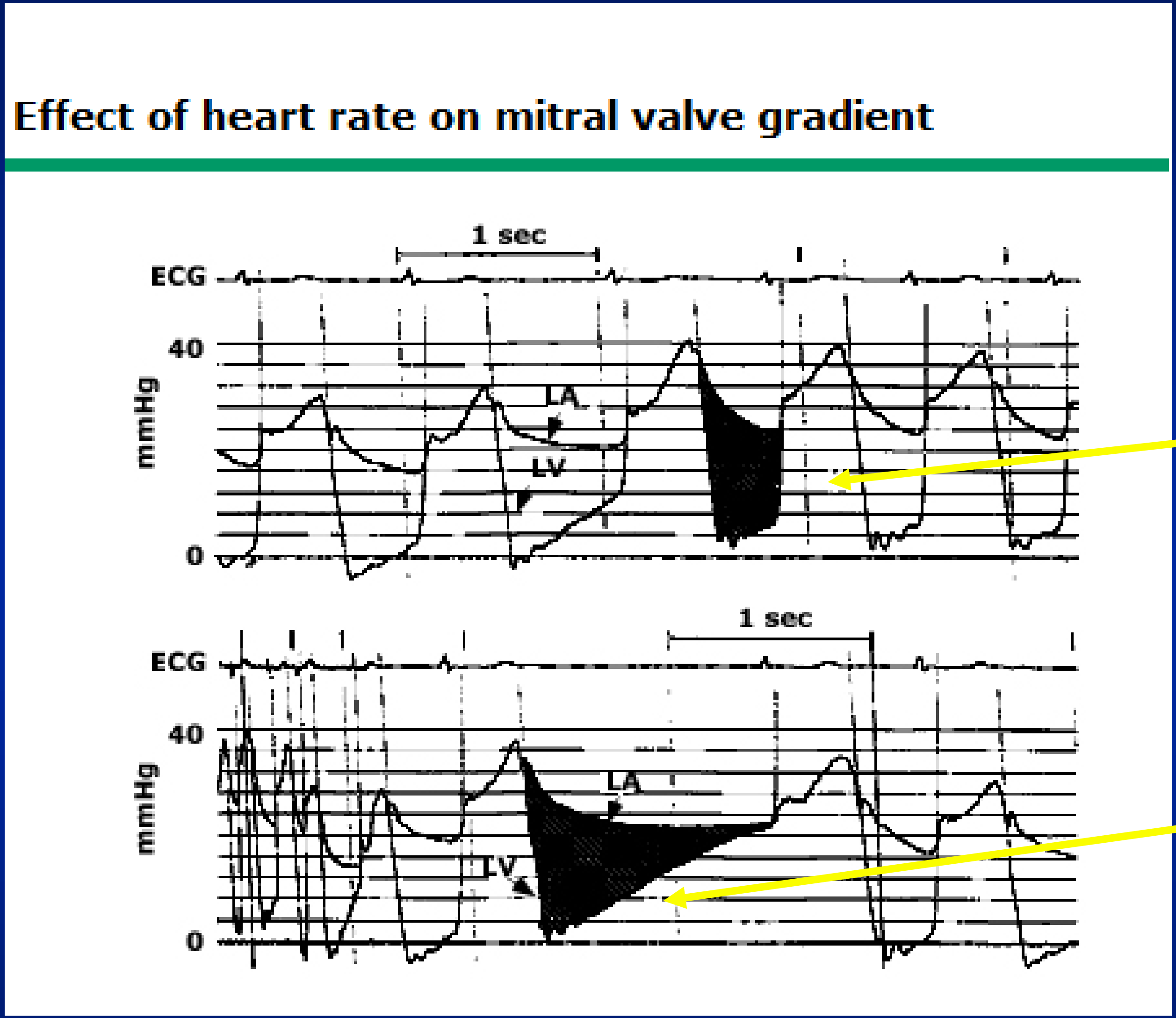
MVA: EAE/ASE recommendations

- INTEGRATED or COMBINED assessment
  - Mean gradients
  - Pressure half time MVA
  - Planimetry MVA
- Secondary assessment
  - Continuity equation
  - Pisa
- Supporting data
  - PASP and LA size
  - Anatomy and structure

Mitral Valve Gradients

- Easy to obtain
  - Tips: trace outer edge
  - grey scale
- Mean not peak gradients
  - Peak, driving pressure
  - Coorelate with invasive
    - Nishimura JACC 1994.
- Dependent upon flow:
  - Heart rate
  - Cardiac output
  - Regurgitation





Simultaneous LA and LV pressure tracings

Short RR interval
Higher gradient

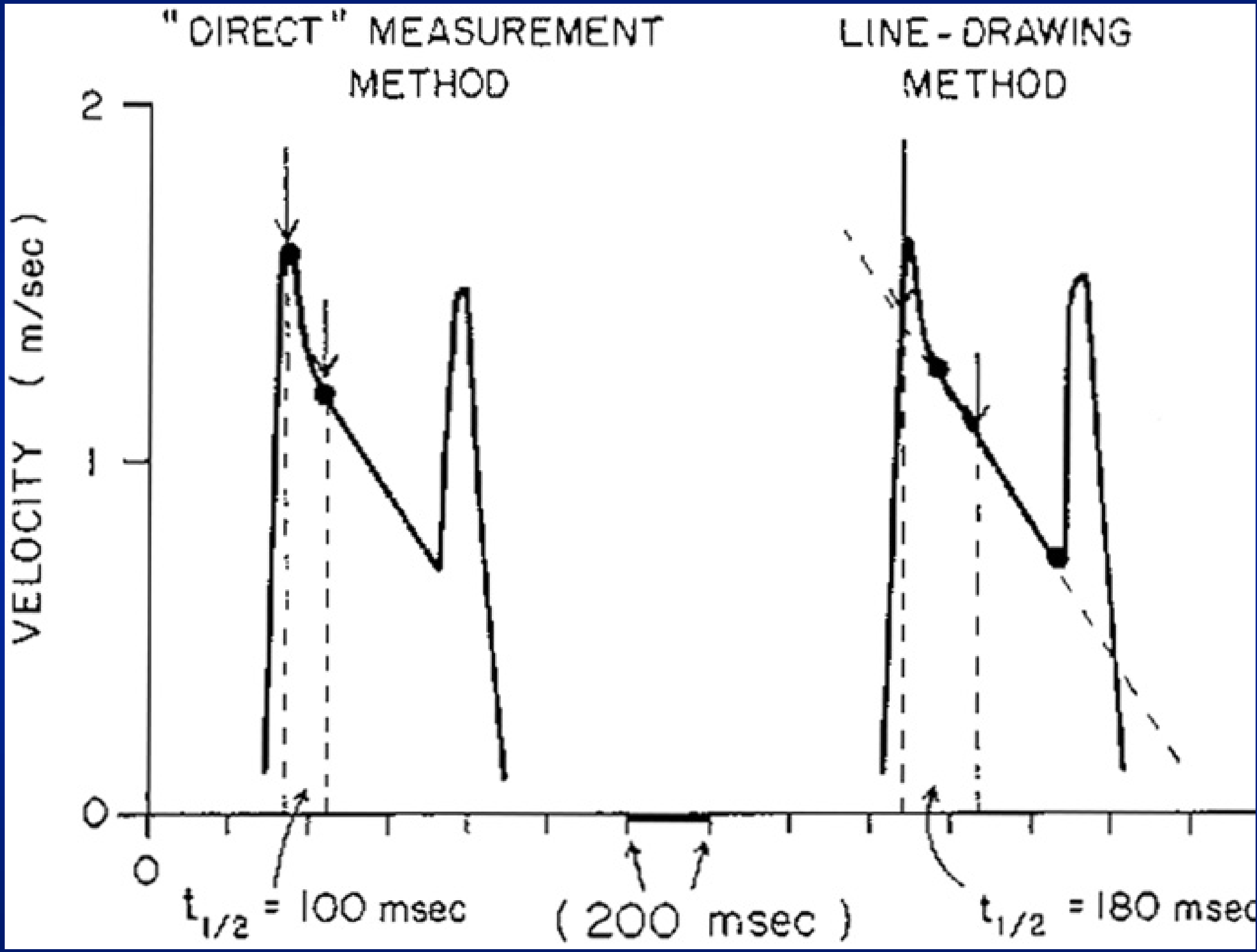
Longer RR interval
Lower gradient

Kern, Hemodyanmic Rounds. 1993 Uptodate

Pressure half time

- Easy and reproducible
  - Tips: linear slope
  - Longer RR interval

- MVA=220/PHT
  - Derived from Gorlin eq
  - Correlates with anatomic MVA

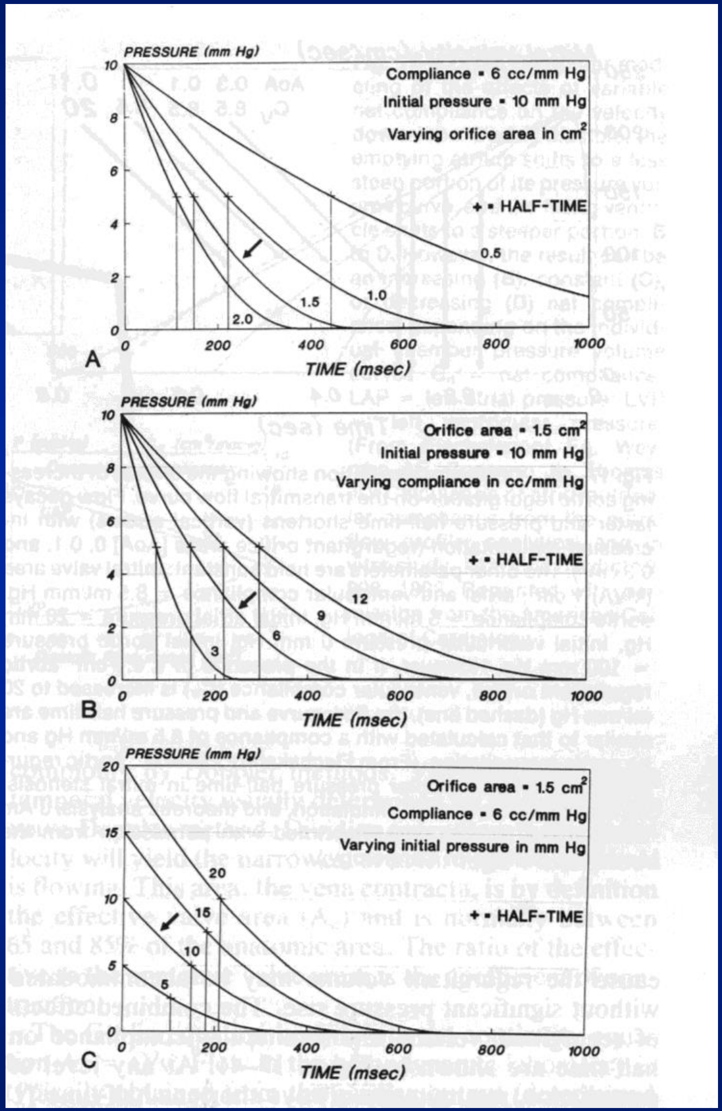


EAE/ASE JASE 2009

MVA in MS: pressure half time

- Dependent on other factors
  - Net LV-LA compliance

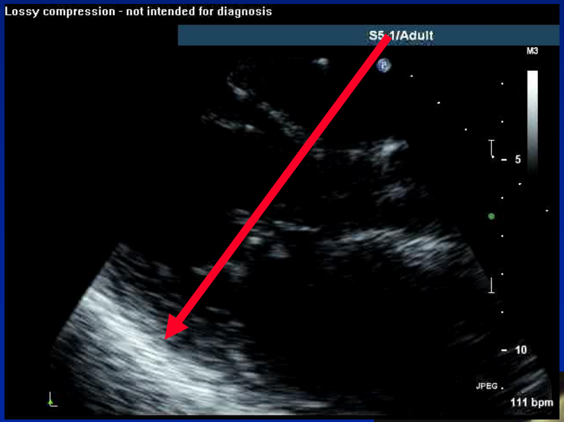
    $$MVA = \frac{11.6 * Cnet * \sqrt{MGp}}{PHT}$$
  - chronic increase in pressure, decrease in compliance
  - \>2-3+AR
    - Shortens PHT, overest MVA
  - ASD
    - Shortens PHT, overest MVA
  - Diastolic dysfunction
    - *elderly

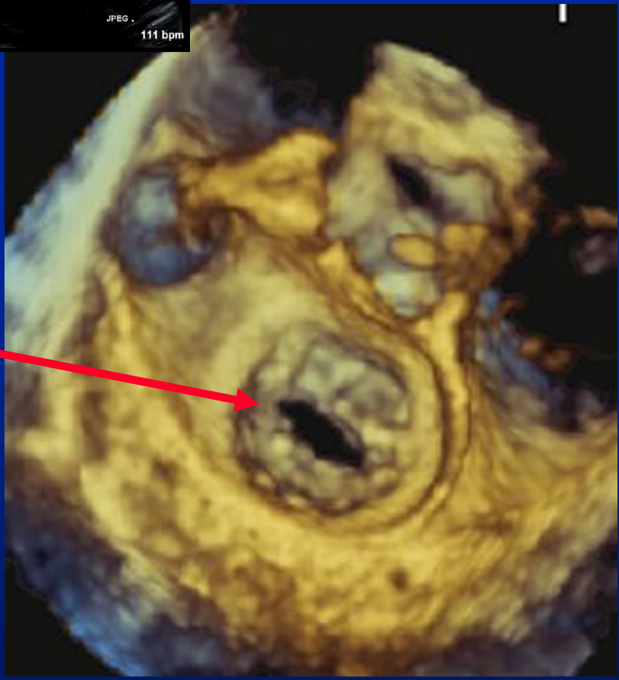


Thomas JD Weyman AE. JACC 1987

MVA in MS: planimetry

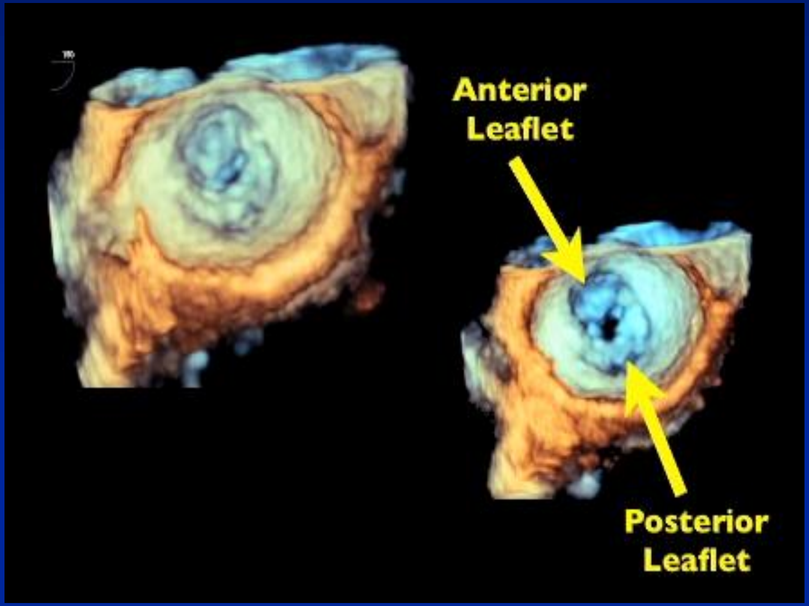
- Anatomic MVA
  - Gold standard
- Independent of conditions
  - Tips: scan plax to find smallest orifice
  - Zoom, mid diastole
  - Biplane & 3D
    - Fusion of commissures
    - Zamorano JACC 2004
    - Sebag AJC 2005
- Limitations:
  - Calcified valves
  - Windows & experience

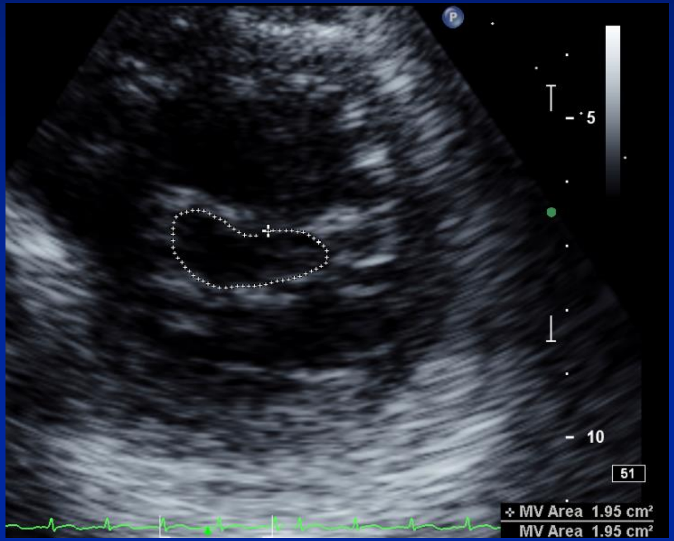


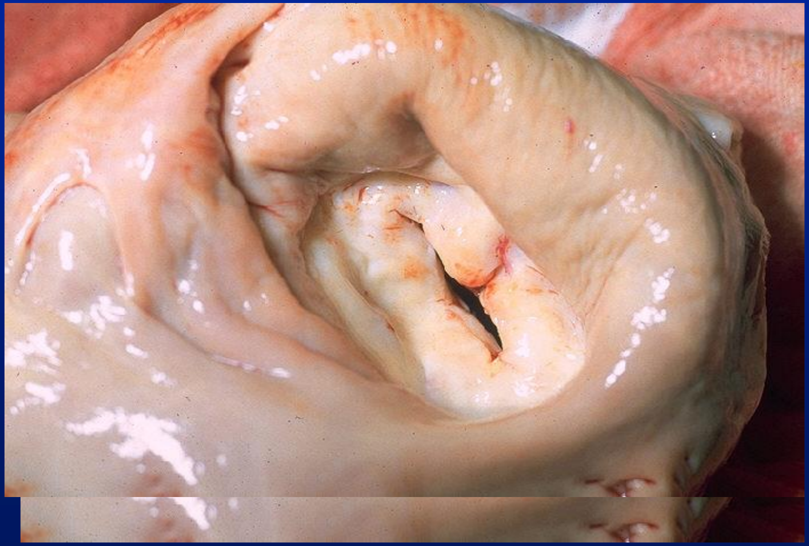


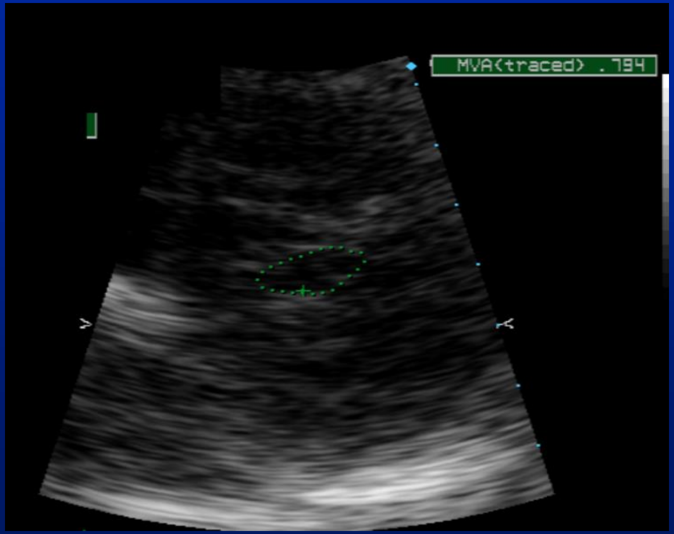
SalcedoJASE 2009

MVA: planimetry



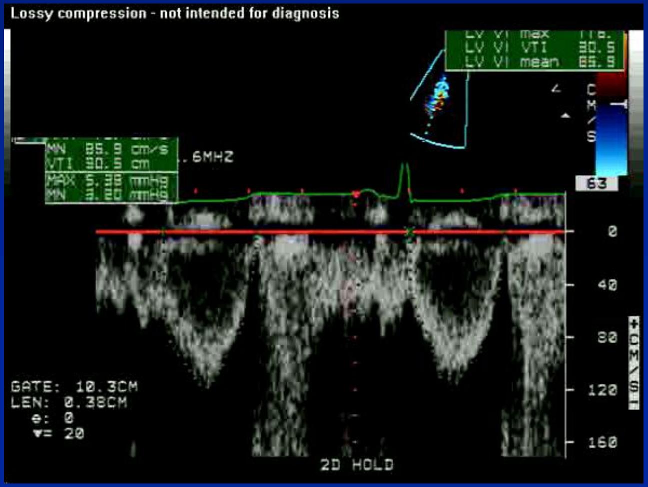




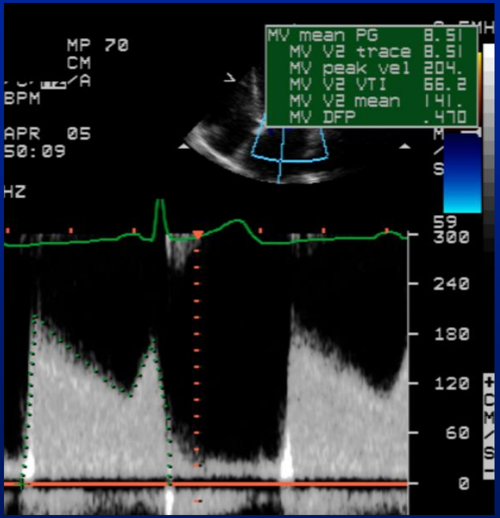


MVA in MS: continuity equation level 2 recommendation

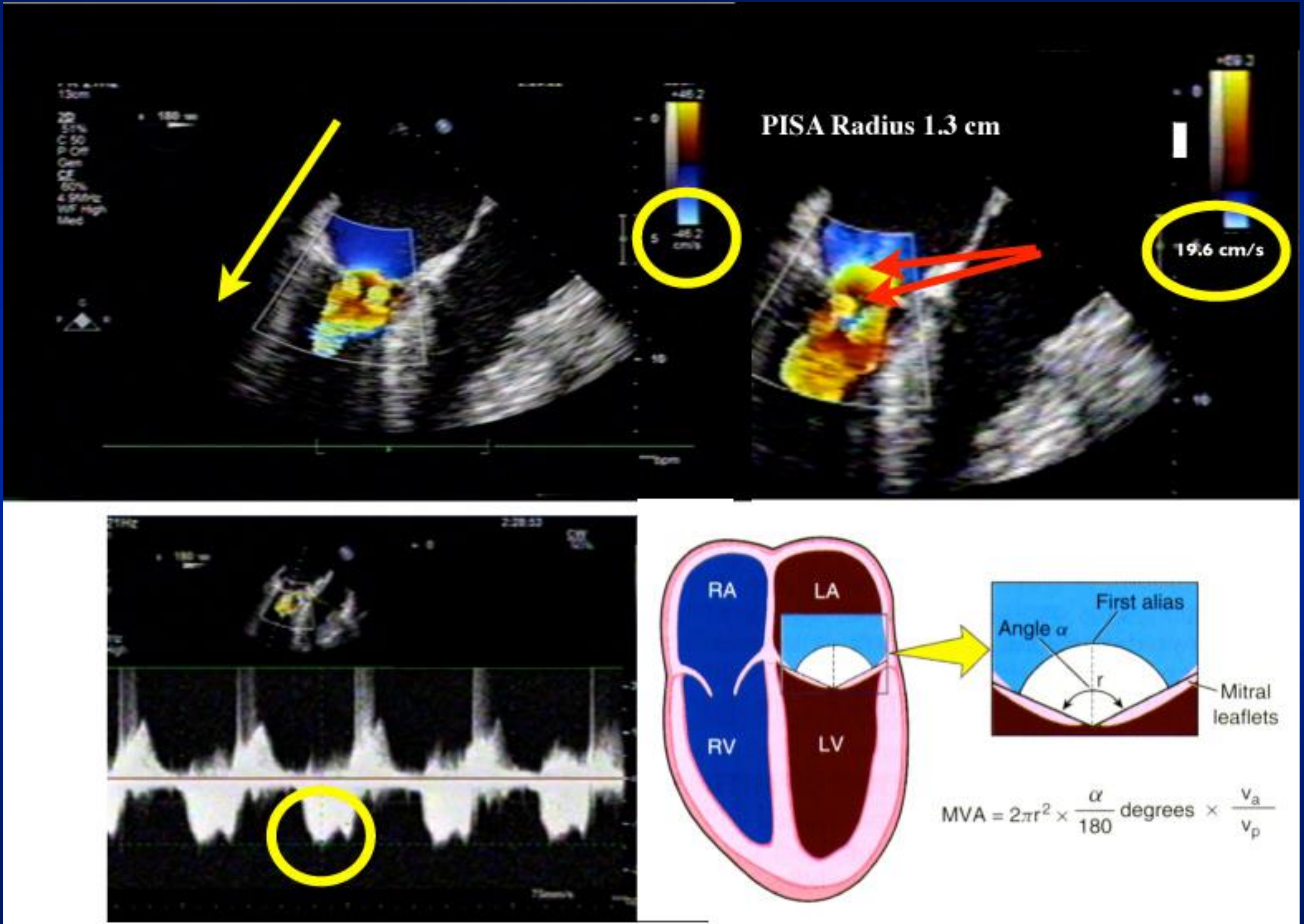
- MVA=∏ r^2 (VTIao/VTImv)
- Conservation of mass
  - SV across LVOT



- Caveats:
  - Cannot use in AI/MR
  - *Effective MVA,* 15% smaller than anatomic
  - Coefficient of discharge

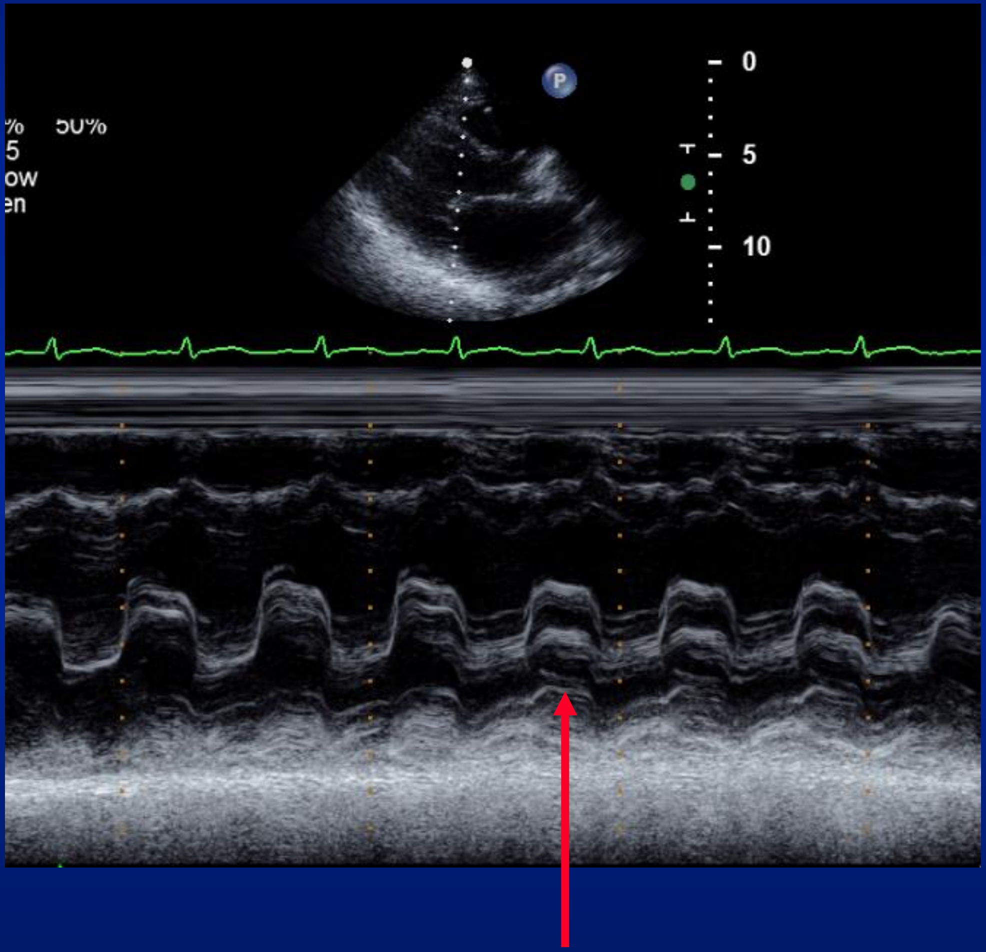


MVA in MS: PISA



MVA in MS: Supportive Data

- Pulmonary pressures
  - <30 mild
  - 30-50 mod
  - > 50 severe
- LA size
- Anatomy
  - 3D commissural fusion
  - M-mode
  - Block Weyman score
- AV and TV involvement



MVA in specific situations

- ASD and AI
  - MVA PHT is overestimated, graded fashion
- After PBMV
  - PHT unreliable
- Congenital/parachute valve
- After MV repair
- Mixed valvular disease

MVA after MV repair: PHT intraop TEE correlated with postop TTE

Table 4B. Agreement between methods of mitral valve area (MVA) measurement for each method and between time periods. Data include mean bias and standard deviations. Data are presented as cm^2.

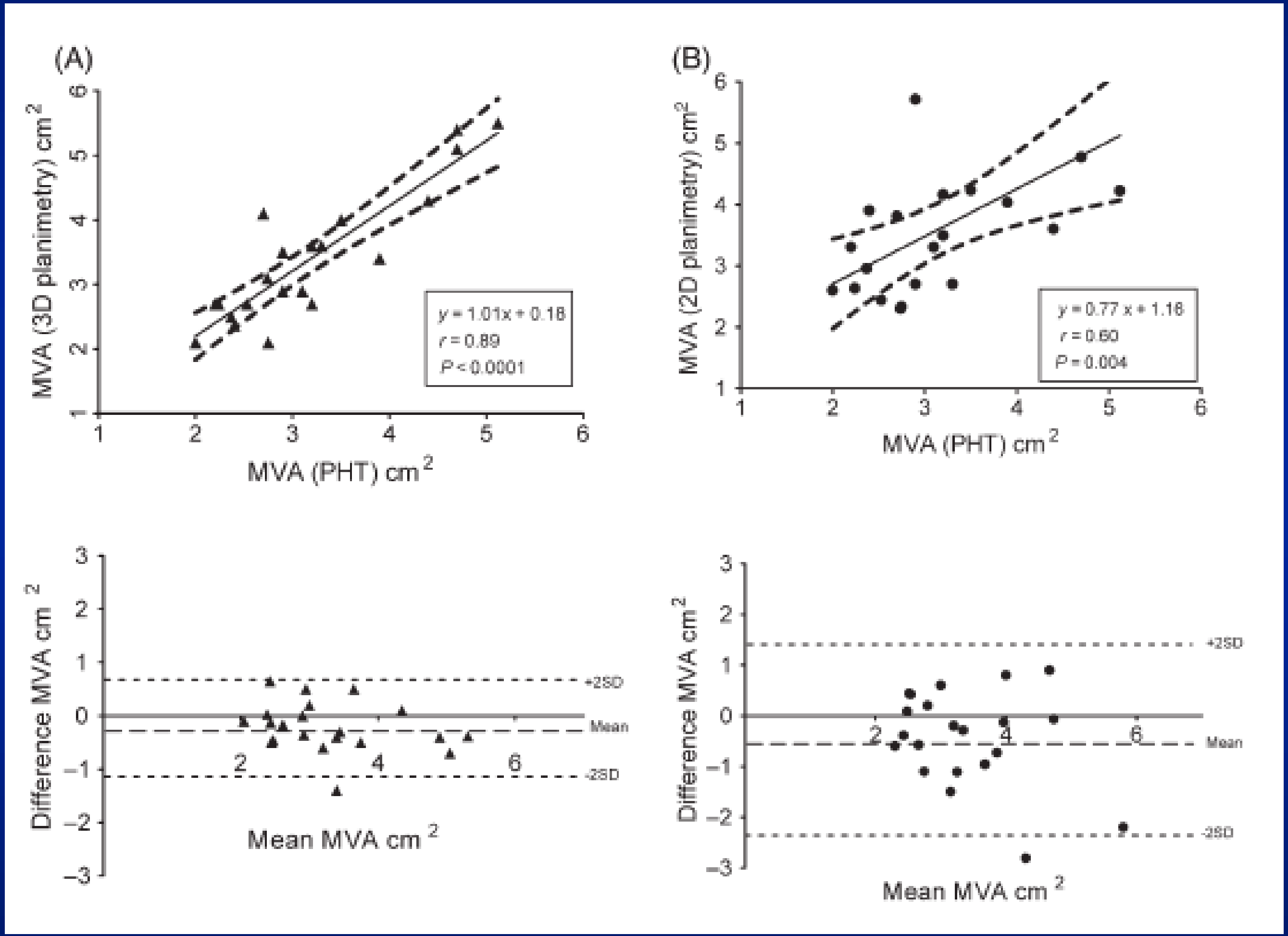
	Pressure Half Time			Planimetry			Continuity Equation		
	OR and TTE-1	OR and TTE 2	TTE 1 and TTE 2	OR and TTE-1	OR and TTE 2	TTE 1 and TTE 2	OR and TTE-1	OR and TTE 2	TTE 1 and TTE 2
Mean MVA	2.98 (0.53	3.01 (0.47)	3.03 (0.55)	3.00 (0.48)	3.12 (0.36)	3.08 (0.36)	2.50 (0.53	2.52 (0.65)	2.31 (0.48)
Bias	0.03 (0.53)	-0.03 (0.24)	-0.05 (0.48)	0.19 (0.36)	0.12 (0.35)	-0.11 (0.31)	0.32 (0.67)	0.32 (0.48)	-0.06 (0.86)

Table 4C. Agreement between intraoperative mitral valve area (MVA) measurement obtained with the pressure half time (PHT) and two-dimensional planimetry (2D-PLAN) obtained during the early (TTE-1) and late (TTE-2) echocardiographic followup. Data are presented as cm^2.

	OR PHT and TTE-1 PLAN	OR PHT and TTE-2 PLAN
Mean MVA	2.98 (0.46)	3.07 (0.39)
Bias	0.15 (0.37)	-0.01 (0.37)

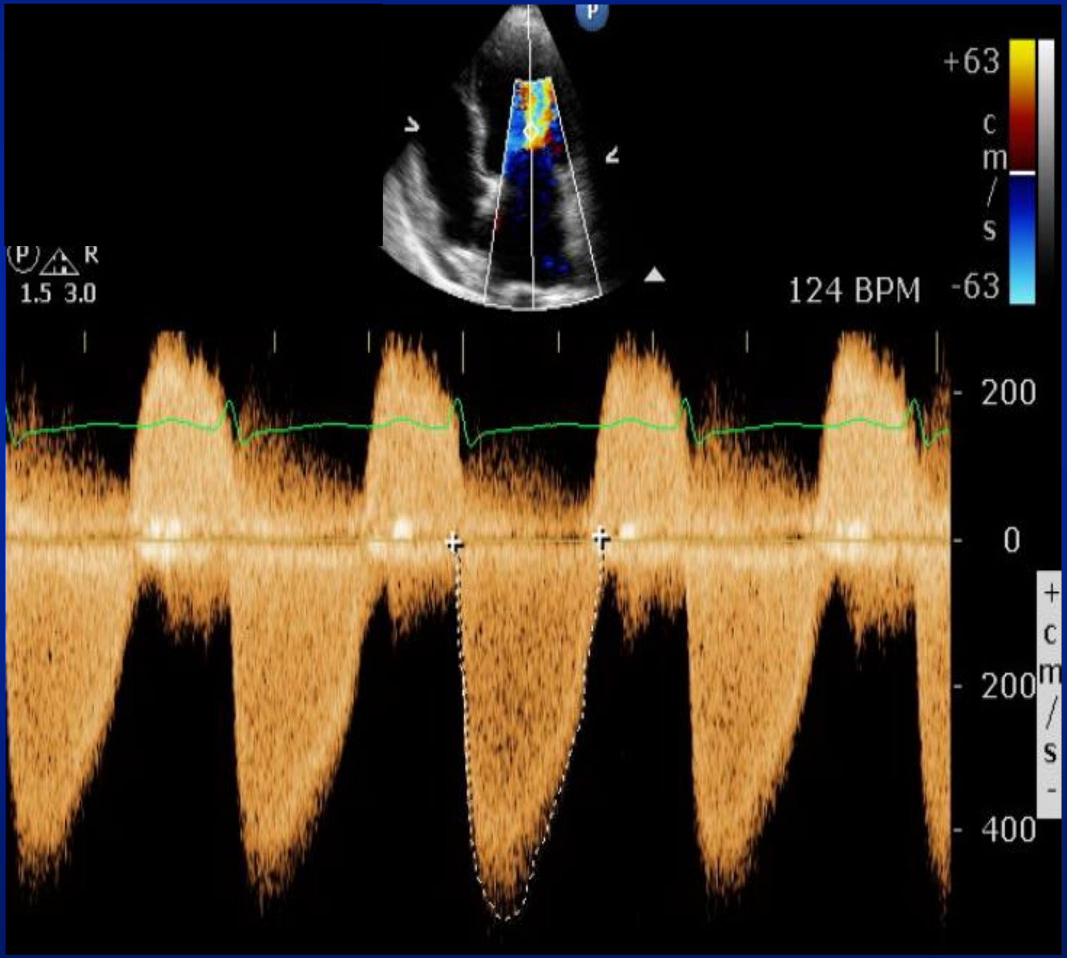
25 MVR patients. Maslow JCTVA 2010

MVA after MV repair: 3D and PHT



Hoole EJE 2008

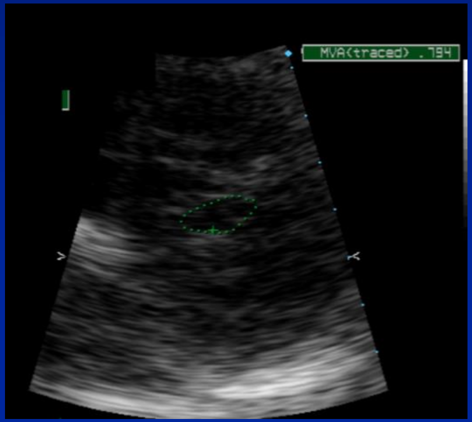
MVA in combined MS and MR

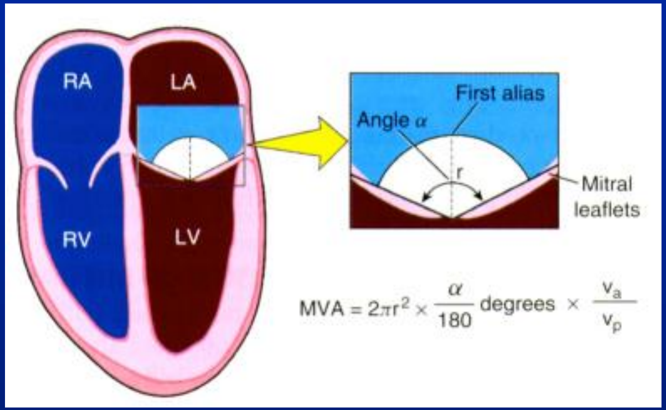


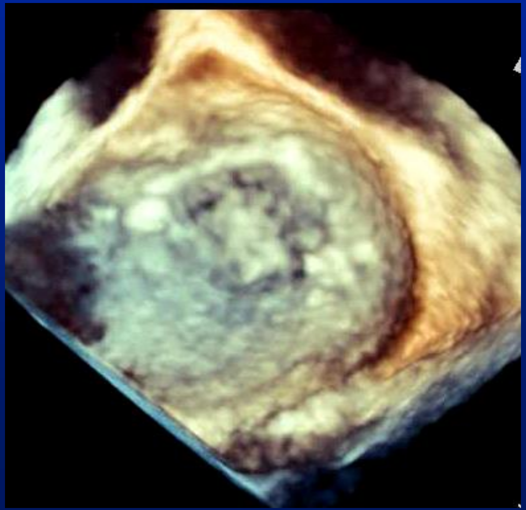
- Mean mitral diastolic gradient 10mmHg
- NOT MS
- High forward stroke volume due to 4+ MR
- Moderate MR and MS
  - Severe symptoms

MVA in Mitral Stenosis:
This is what I need to know!

- INTEGRATED assessment
  - Planimetry 2D & 3D
  - PHT
  - Mean gradients
- Secondary assessment
  - CE or PISA
- Supporting data
  - PASP and LA size
- Special situations
  - PMBV, MV repair

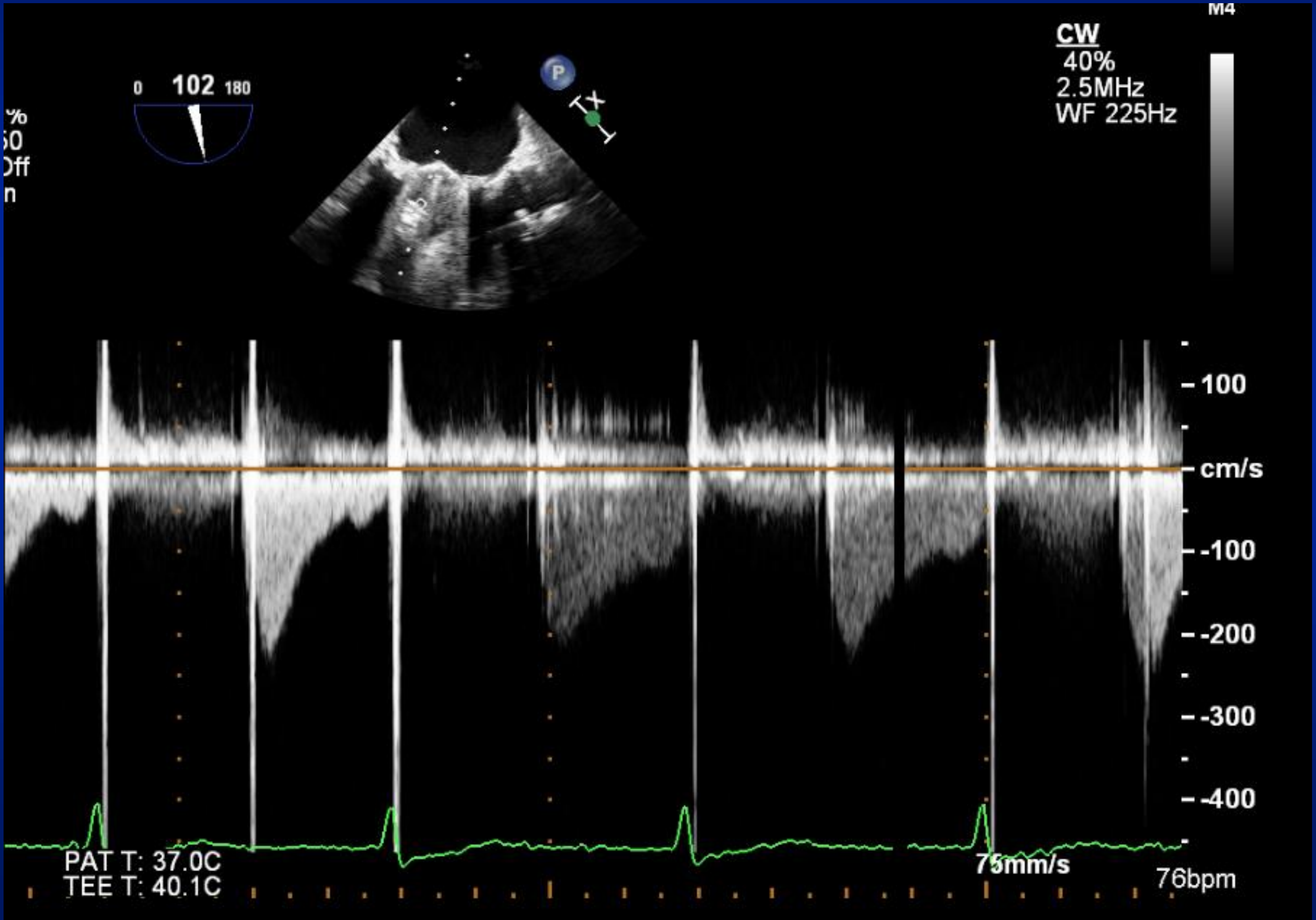




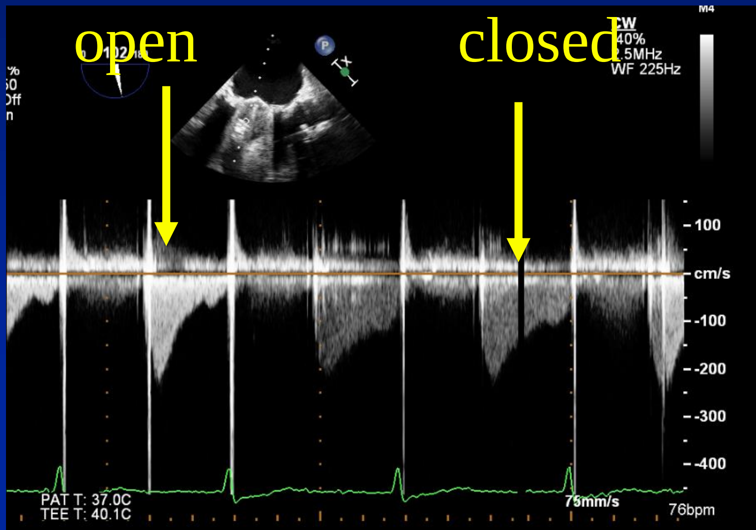


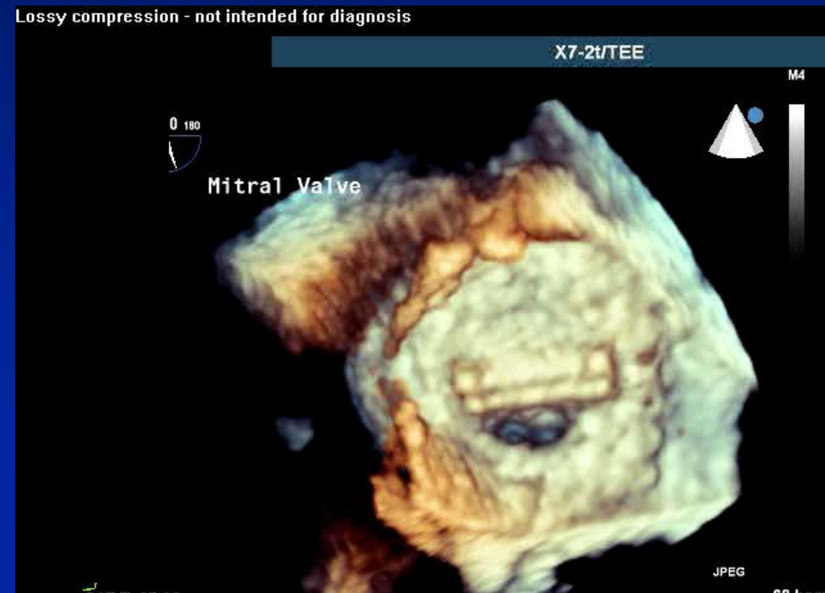
Thank you for you attention!

Case 2:
What is wrong with this valve?

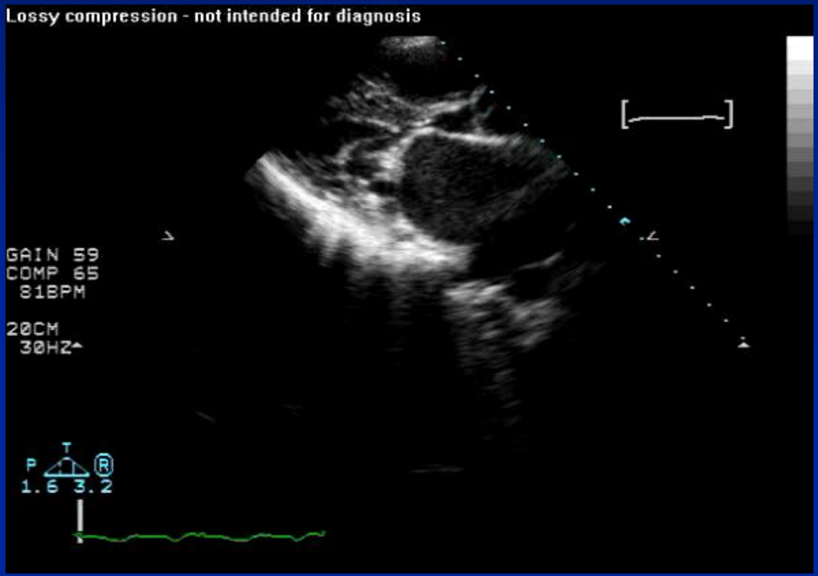


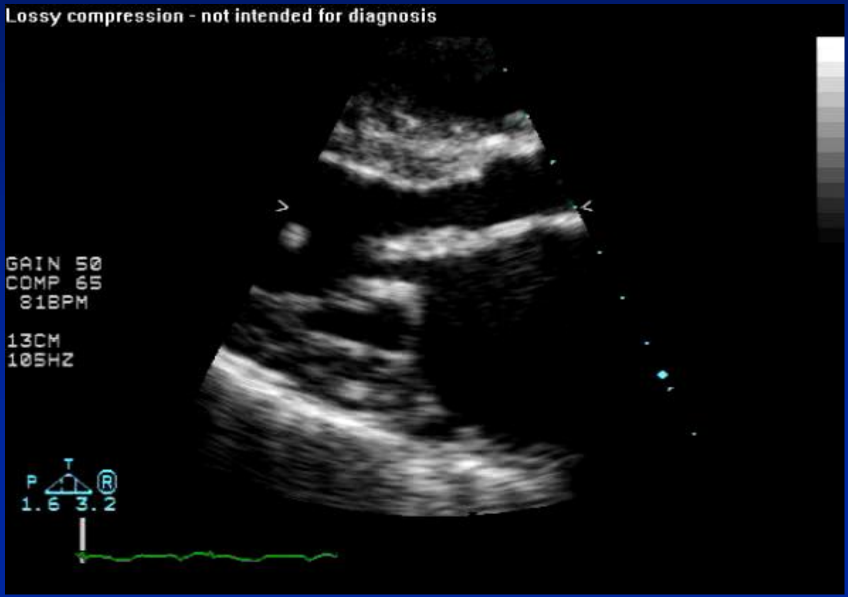
St Jude MVR with intermittent obstruction

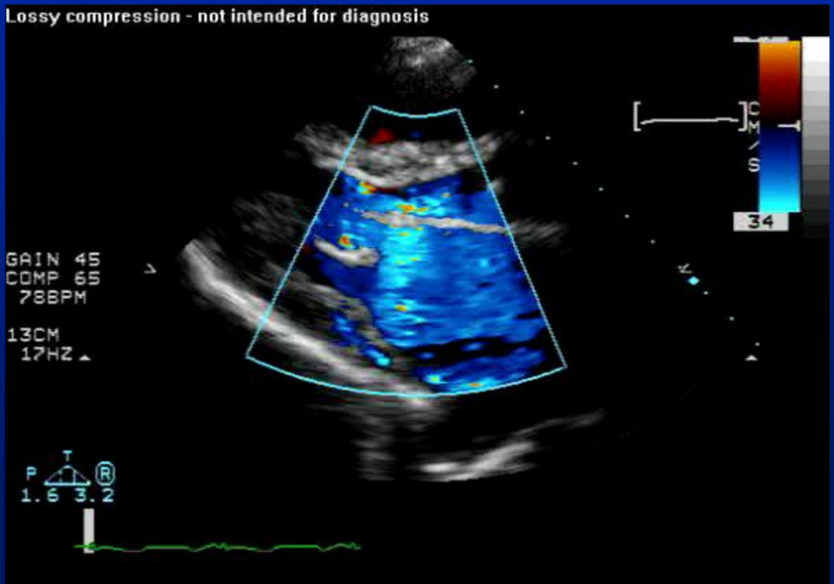


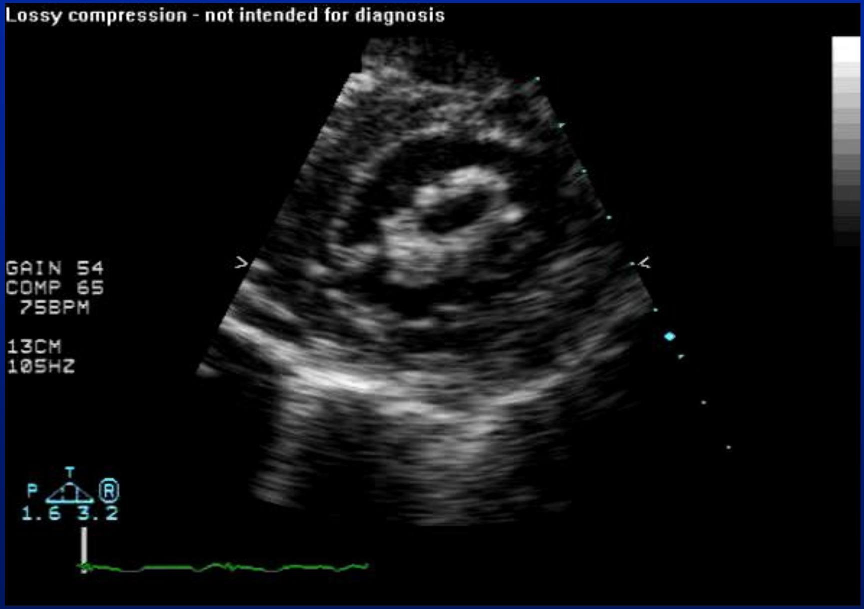


Congenital MS "parachute" MV

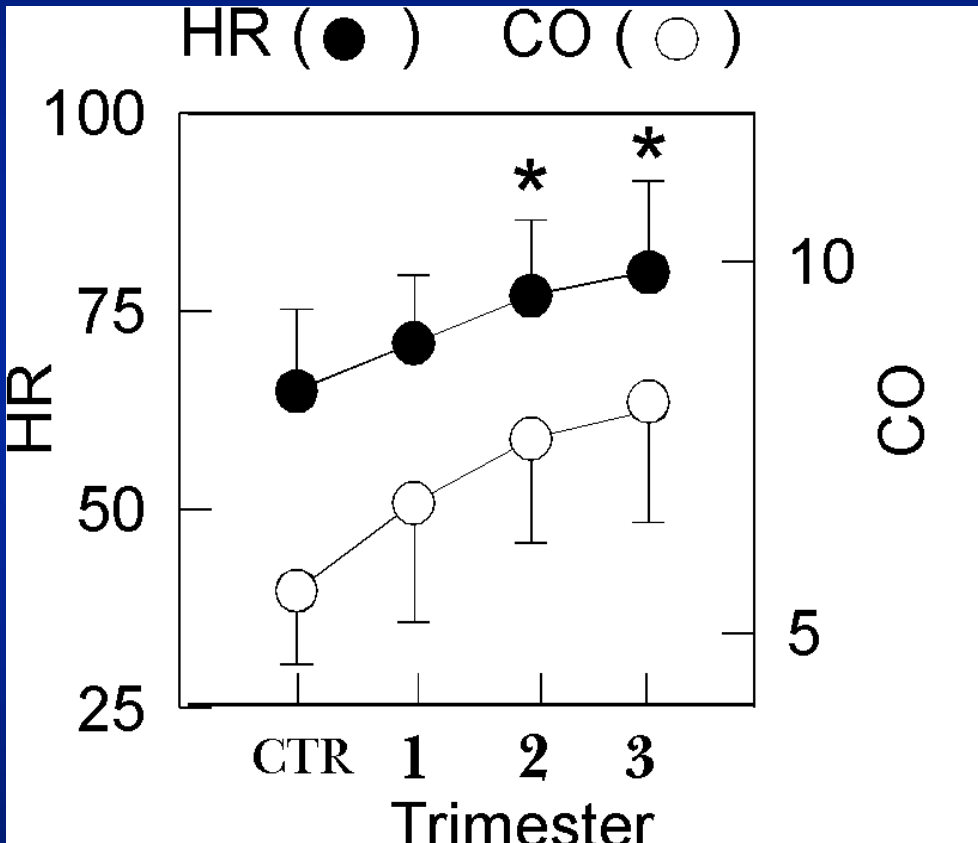


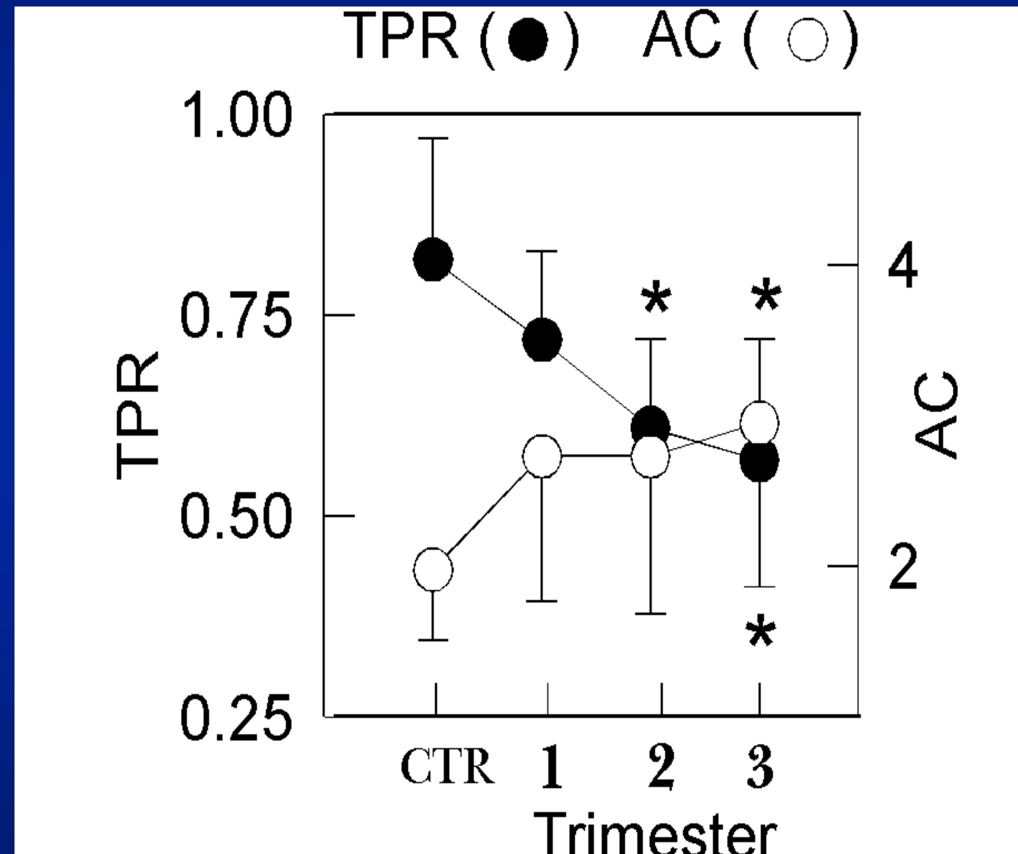






CO, HR and TPR in Pregnancy





30-50% ⇑ in cardiac output
10-20% ⇑ in heart rate

30-50% ⇓ in peripheral resistance

Poppas A.Circ.1997;95:2407