ASE American Society of Echocardiography

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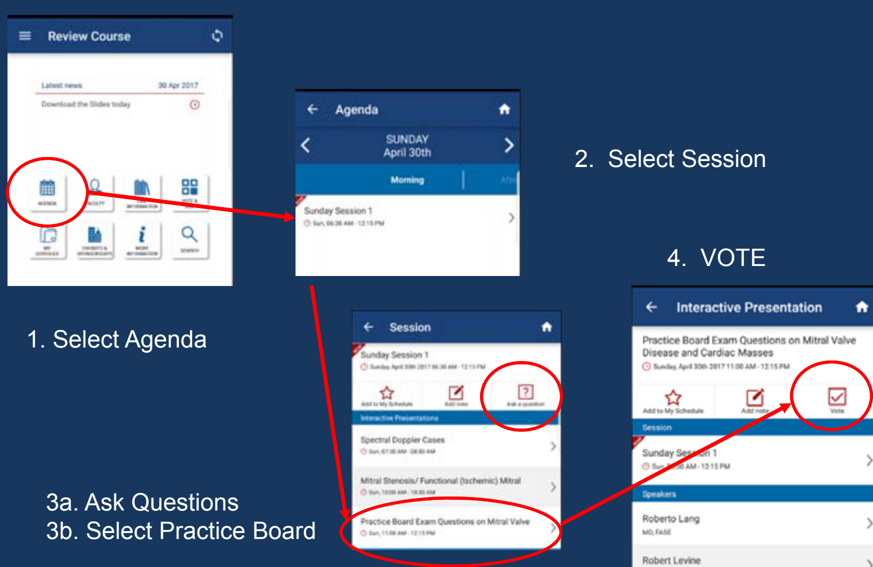
ASCeXAM / ReASCE

Practice Board Exam Questions

Sunday

- **Spectral Doppler**
- **Tissue Doppler and Strain Imaging**
- **Cardiac Masses**
- **Degenerative Mitral Valve Disease**
- **Mitral Stenosis/Functional (Ischemic) Mitral Valve Disease**
- **Mitral Regurgitation**

Participate in Board Questions



1. Select Agenda

2. Select Session

3a. Ask Questions
3b. Select Practice Board

4. VOTE

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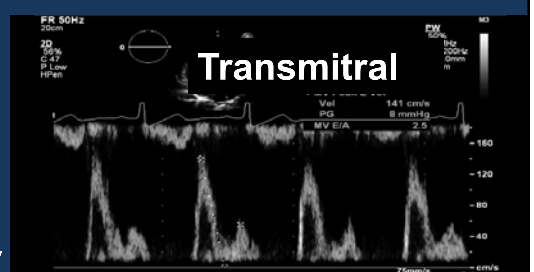
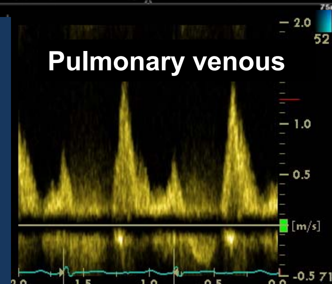
Spectral Doppler and MV Cases

Gerald P. Aurigemma, MD, FASE

A 65 year old with MVP and MR. What do you conclude from these spectral profiles?

1. He has normal diastolic function
2. The MR is probably not very significant
3. The MR is likely to at least moderate to severe
4. Cannot tell with certainty





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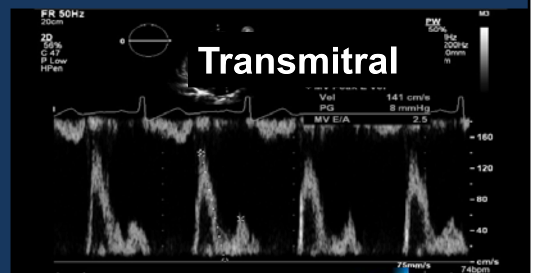

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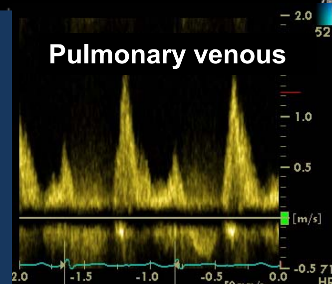
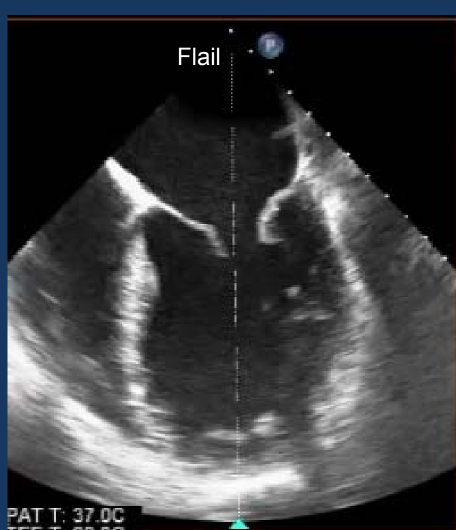
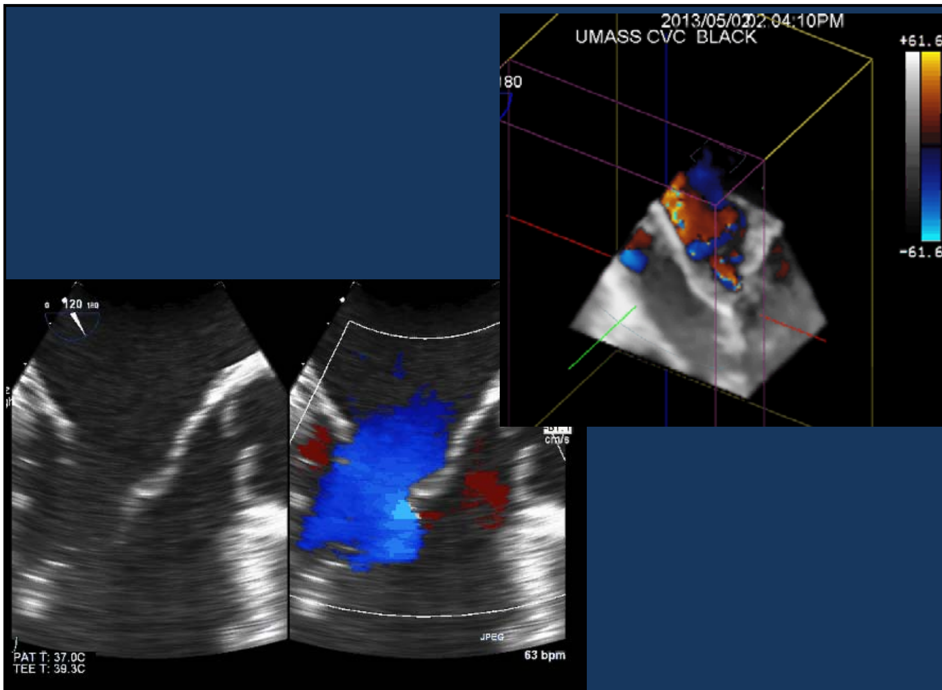
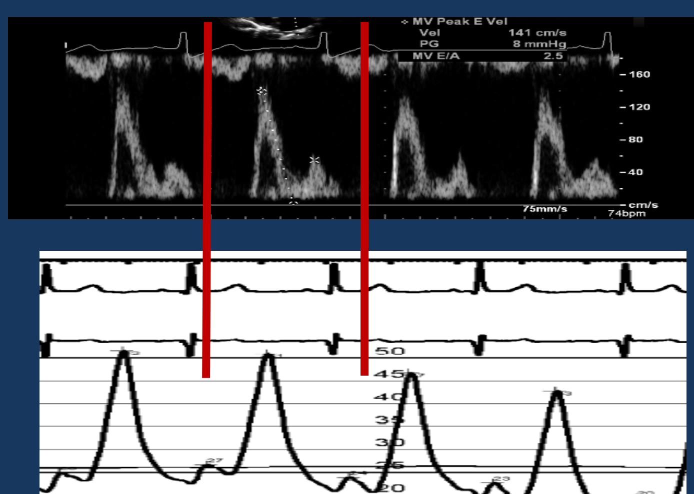


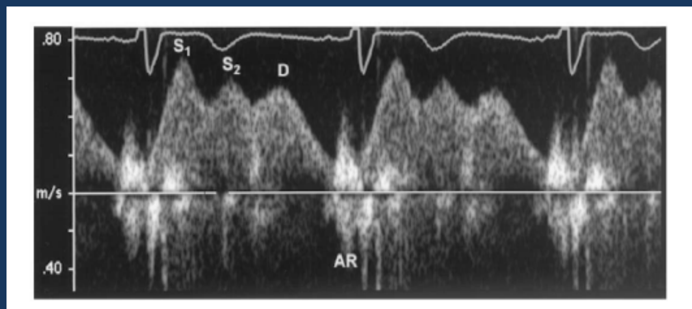
TOE



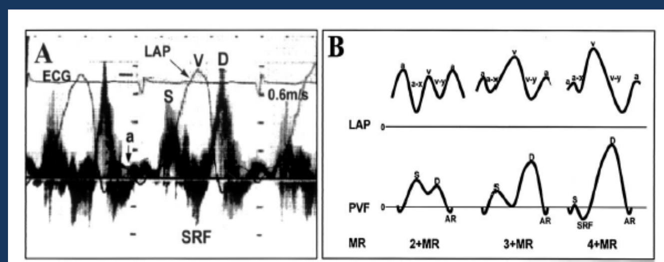


Doppler + Haemodynamics





Normal

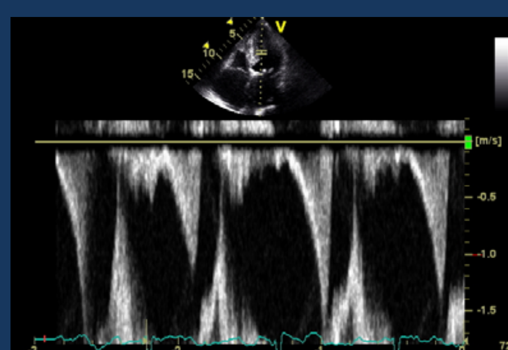


MR

Tabata et al. J Am Coll Cardiol 1992;20:1345

This spectral Doppler profile may be seen in:

1. HCM
2. Hypertensive LVH
3. AS
4. 1-3
5. None of above



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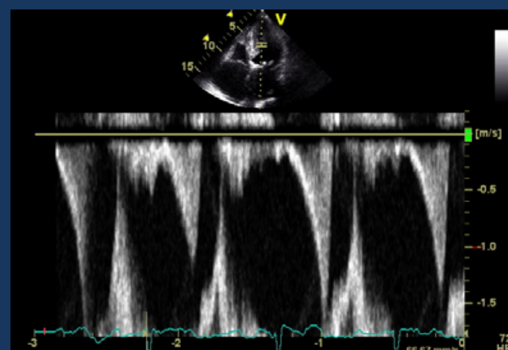
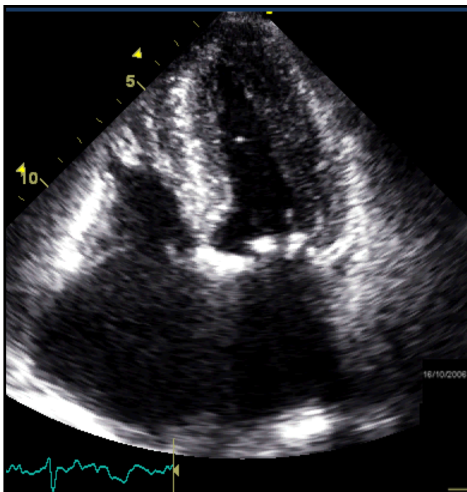
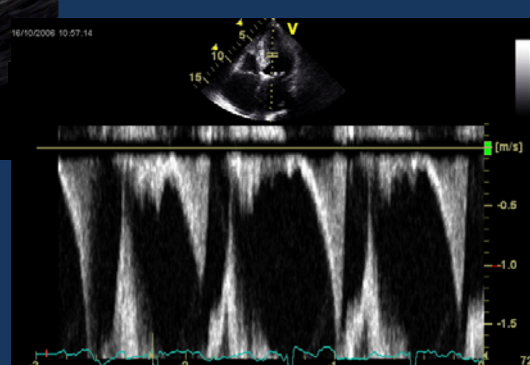
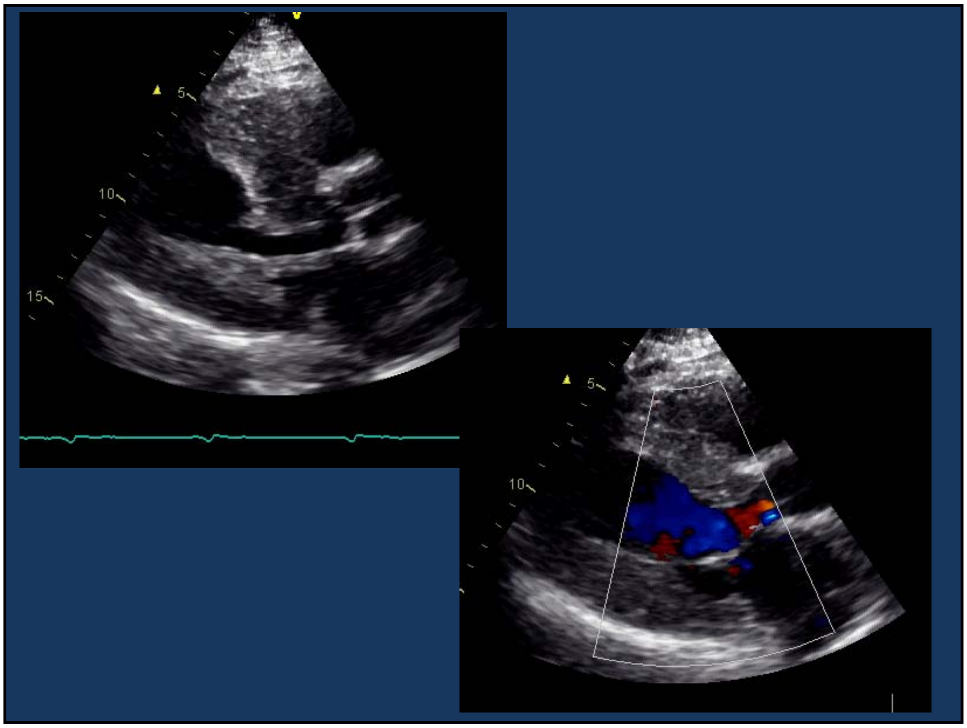
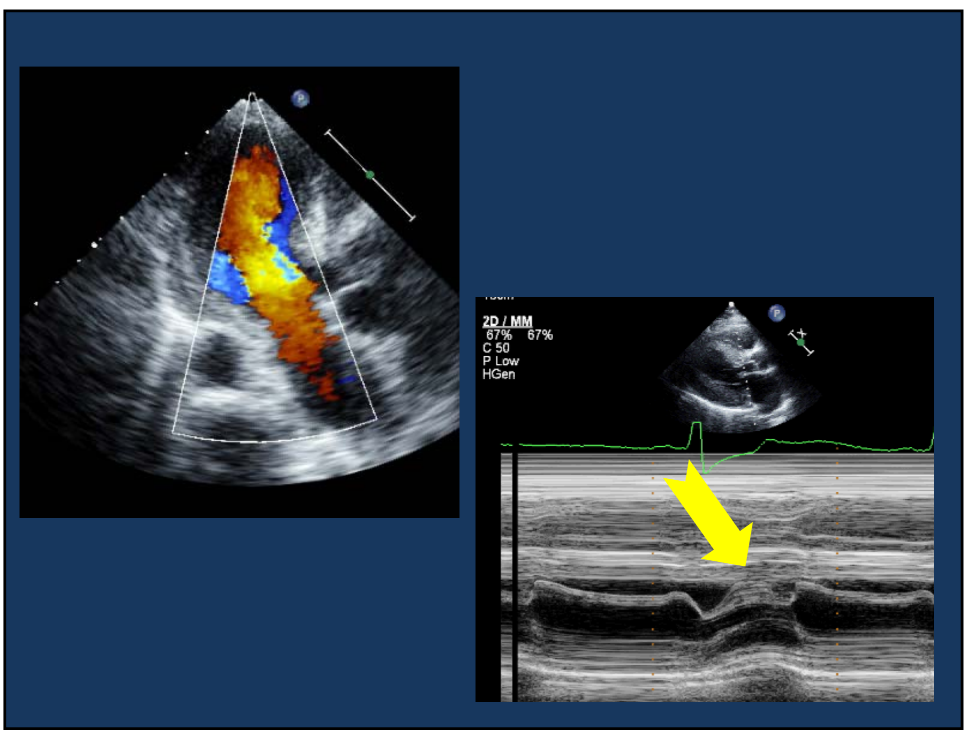
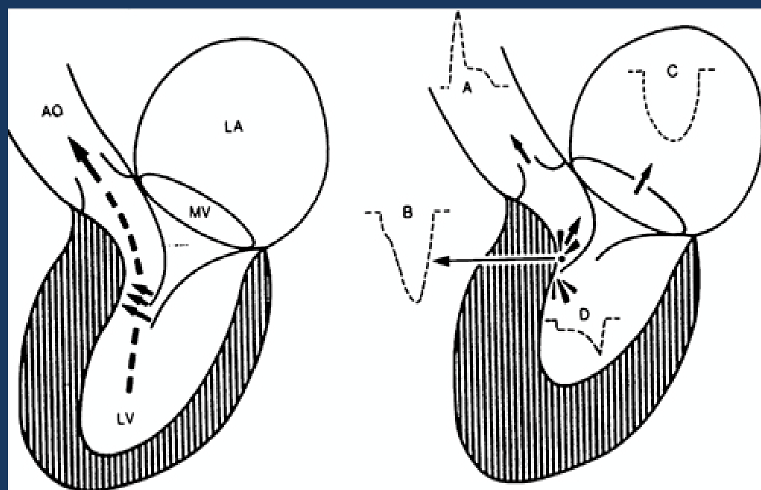




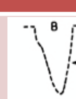
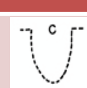


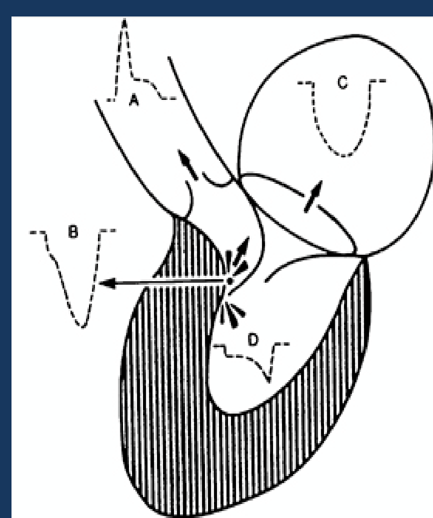


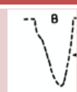
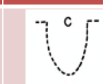

2D / MM
67% 67%
C 50
P Low
HGen

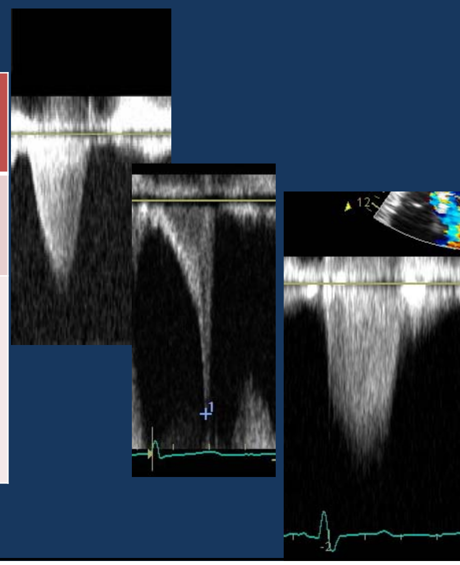


Various Doppler Profiles in HCM

LVOT	Mid cavity	MR
		
Late peaking Gentle slope 4.5 M/s	Late peaking Very sharp Lower velocity than LVOT signal	Starts early Parabolic Can be as high as 8 M/s



LVOT	Mid cavity	MR
		
Late peaking	Late peaking	Starts early
Gentle slope	Very sharp	Parabolic
4.5 M/s	Lower velocity than LVOT signal	Can be as high as 8 M/s



A 44 year old man undergoes echo for positive blood cultures. This echo shows

1. Small AV and MV vegetations
2. Lambl's excresences on the MV and AV
3. MV vegetation
4. None of the above

A 44 year old man undergoes echo for positive blood cultures. This echo shows

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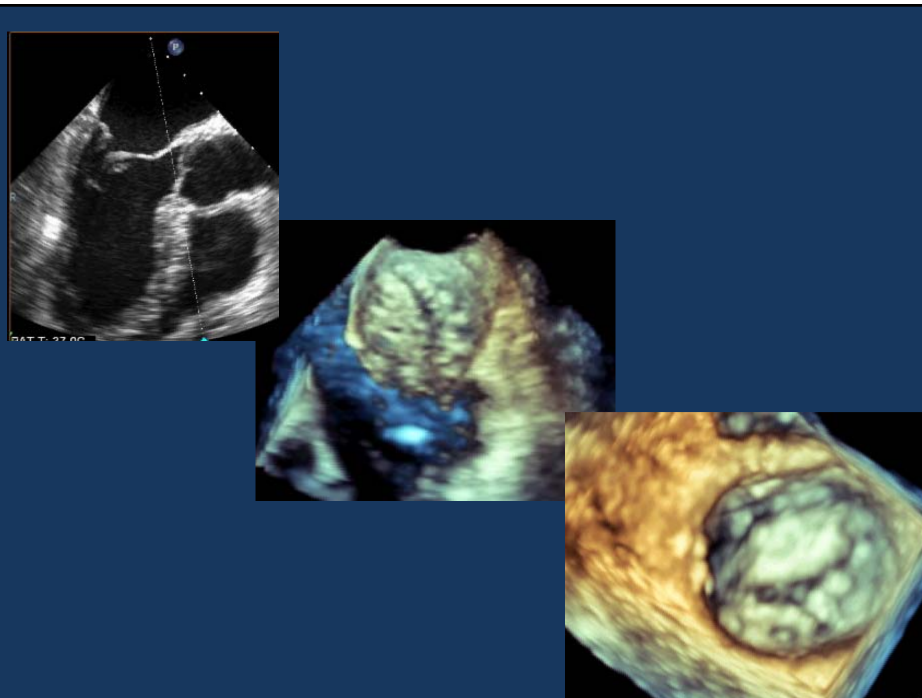
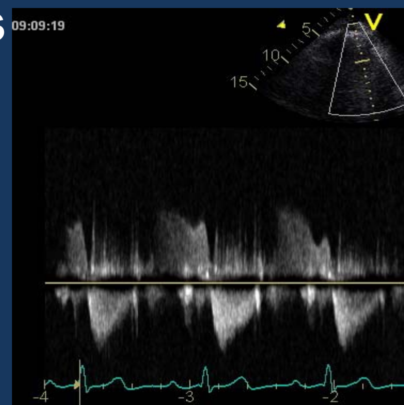


The phenomenon indicated by the arrow indicates the existence of:

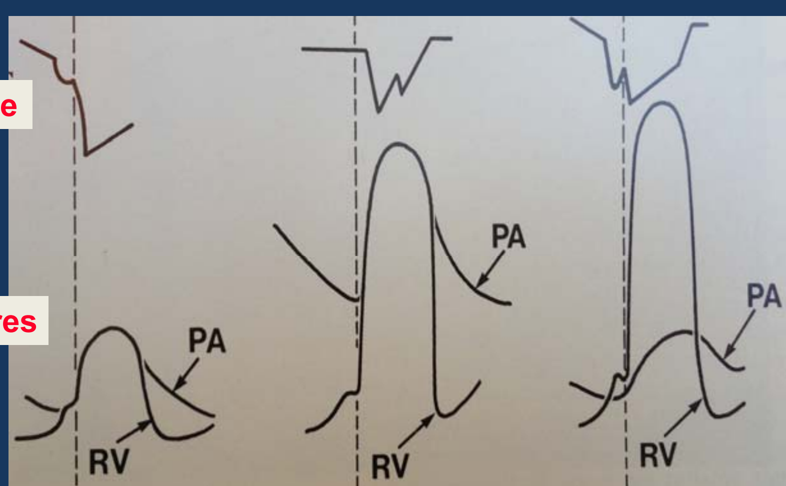
1. High PA pressures
2. A PDA
3. RV systolic dysfunction
4. Severe PR
5. Sinus rhythm



Normal PHTN PS

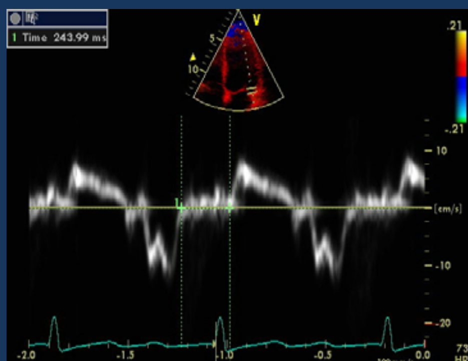
M-mode

Pressures

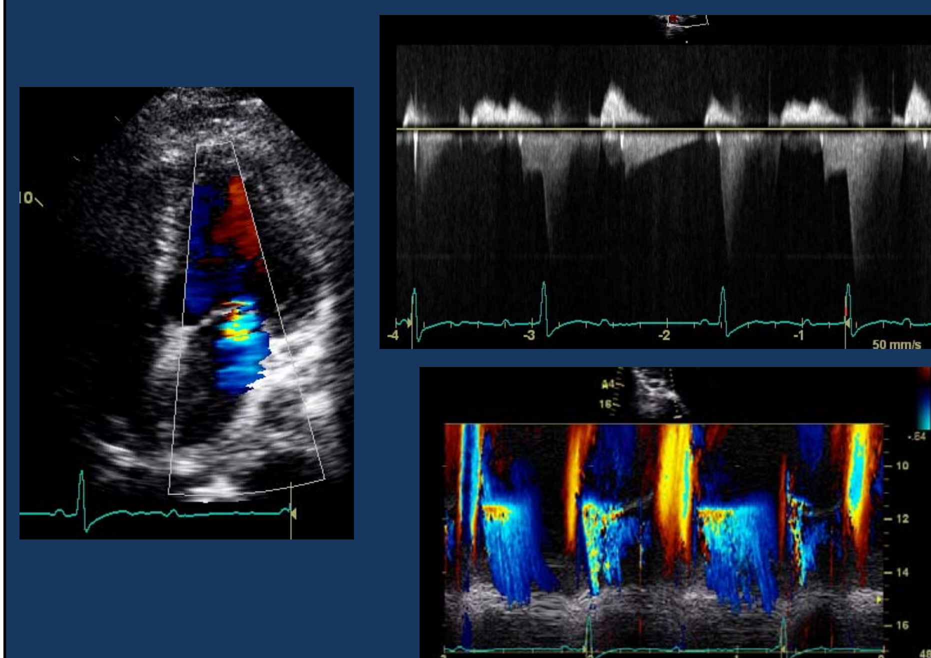


Adapted from : Feigenbaum's Echocardiography
Fourth Edition 1986

What would auscultation reveal in this patient?



1. Loud S1
2. Midsystolic click
3. Soft S1
4. Diastolic rumble



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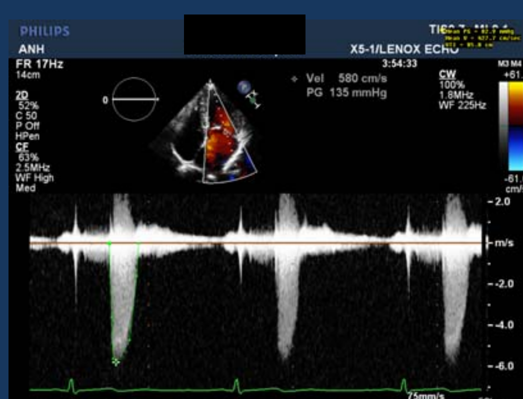
Cases: Mitral Valve Disease and Cardiac Masses

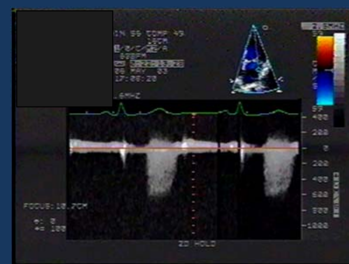
Itzhak Kronzon, MD, FASE

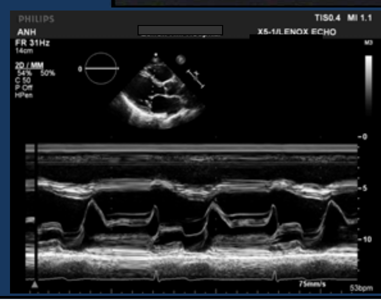
Physical finding?



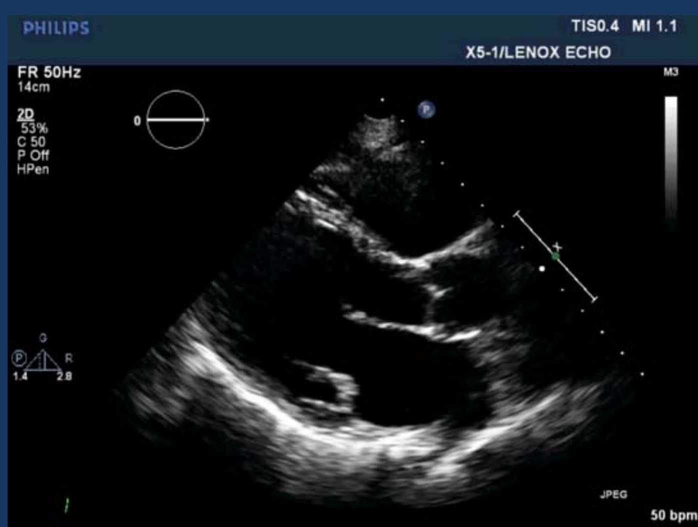
1. Holosystolic m
2. Click
3. Diastolic rumble
4. Gallop

The correct answer is 2 : A click

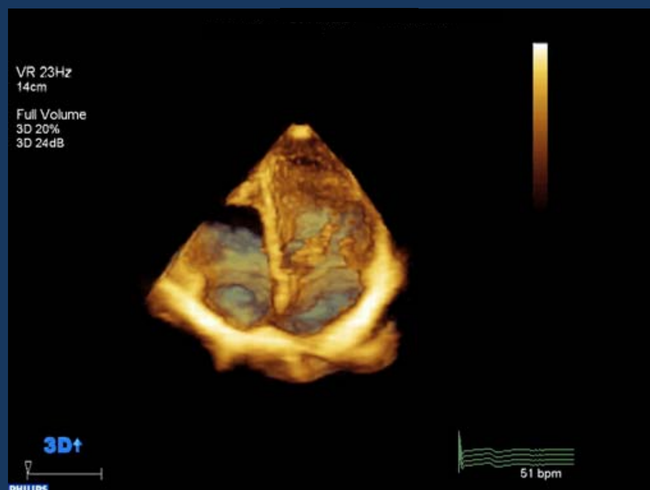




Note:MVP, End Systolic MR

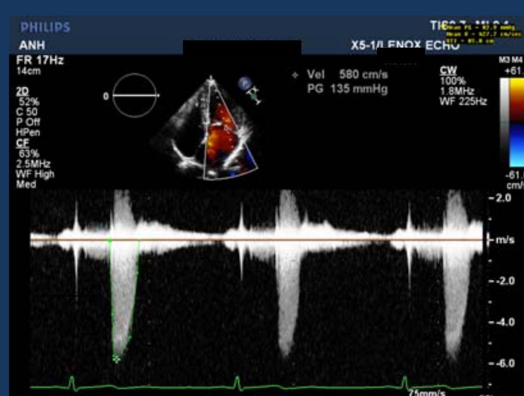


Normal size LA and LV. EF=65%



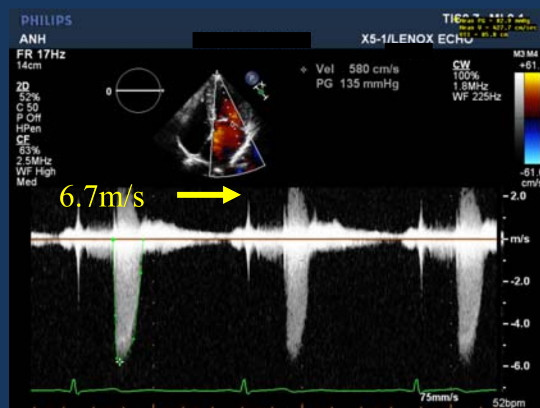
Full volume RT 3D TTE

Based on this Doppler tracing, the patient also has:

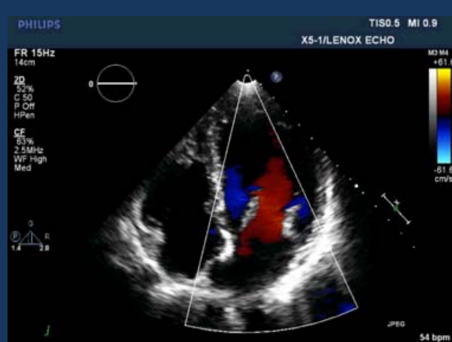


1. Hypertension
2. Aortic Regurgitation
3. Atypical chest pains
4. Paroxysmal AF

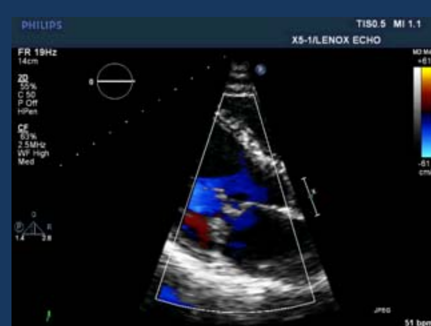
Correct answer: A. Hypertension



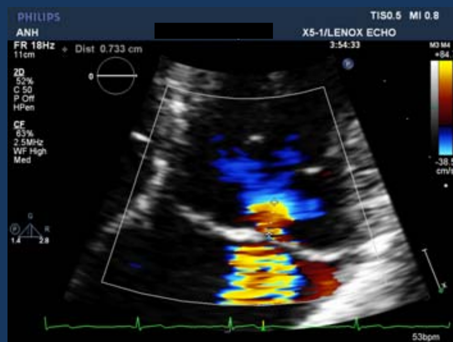
With MR Velocity of 6.0 m/sec, the gradient between LV and LA is 144 mmHg.
The systolic arterial pressure was 160mmHg.



How severe is the MR?

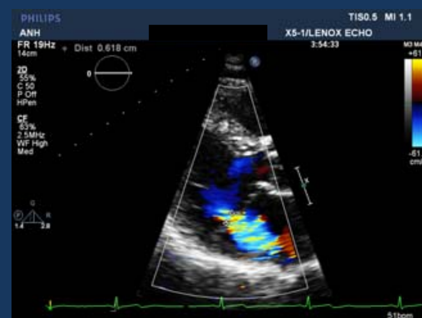


1. Mild
2. Moderate
3. Severe
4. Show me PISA or VC
5. RT 3D TEE



PISA ERO = 38mm sq

MR Vena Contracta=7mm



MR is

1. Mild
2. Moderate
3. Severe
4. Cannot tell

MVP

The severity of the MR determination will best calculated by:

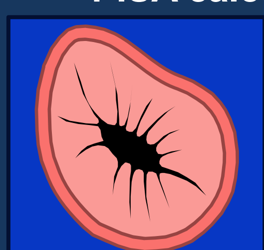
1. Vena Contracta Diameter
2. Regurgitant volume
3. PISA to calculate EROA
4. Percent of MR jet color area in the LA.

MVP

The severity of the MR determination will best calculated by:

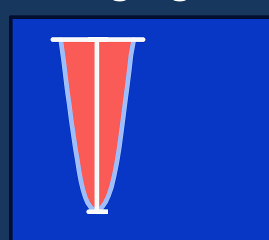
A. Vena Contracta Diameter
→B. Regurgitant volume
C. PISA
D. Percent of MR jet color area in the LA.

PISA calculation of regurgitant volume



ERO

x

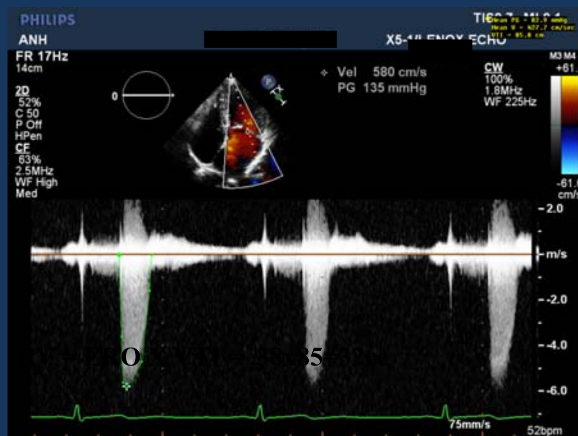


VTI

= Regurg. Volume

Courtesy Dr Jae Oh

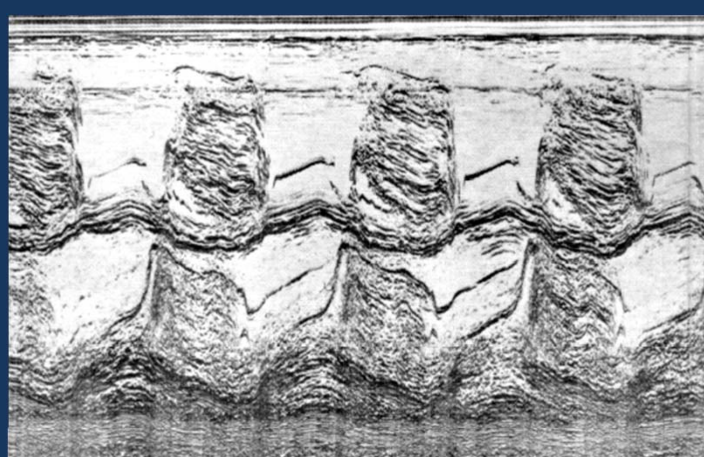
How severe is the MR?
Regurgitant Volume!



ERO=.38cm
VTI=85cc

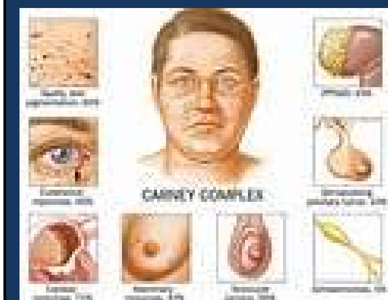
MR is mild-moderate.

Back cover of ECHOCARDIOGRAPHY
Feigenbaum, 3rd edition



A. Lutembacher
B. Shone
C. Carney
D. Williams

CARNEY Complex



Cardiac myxoma	72%
Mammary myxoma	42%
Pituatry tumor GH	10%
Testicular tumor	56%
Schwanoma	5%
Skin spotty pigmentation	65%

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Tissue Doppler And Strain Imaging

Steven J. Lester, MD, FASE

1. When obtaining a pulsed wave tissue Doppler signal you should?

a. Turn the wall filters on and turn down the receiver gain.
b. Turn the wall filters off and turn up the receiver gain.
c. Turn the wall filters off and turn down the receiver gain.
d. Turn the wall filters on and turn up the receiver gain.

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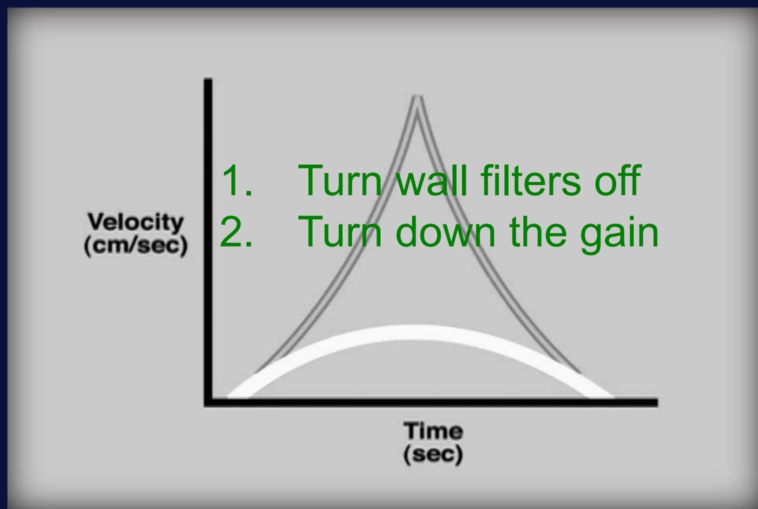
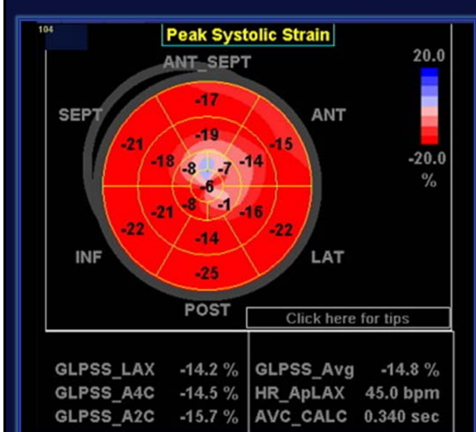
Doppler:
Doppler Tissue Imaging



2. A 46 year old female was referred for evaluation of chest pain. The regional and global longitudinal peak systolic strain values are show in the parametric display. The findings suggest?



A. Cardiac amyloidosis
B. Apical HCM
C. Basal inferior infarction
D. Hypertensive heart disease
E. Renal failure

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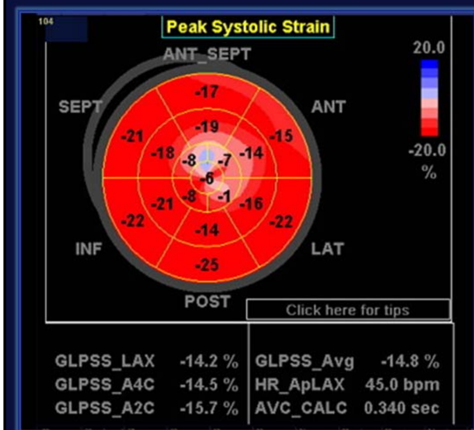

A. Cardiac amyloidosis

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C. Basal inferior infarction

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E. Renal failure

3. An advantage of "speckle tracking" myocardial imaging over Doppler Tissue Imaging is?

a. **Strain values are measured along the axis of the ultrasound beam.**

b. **Velocity and strain values are measured from standard gray-scale images.**

c. **Myocardial velocity measurements are not influenced by translational or tethering motion as they are when obtained by pulsed wave tissue Doppler imaging.**

d. **You can measure longitudinal but not circumferential or radial strain.**

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c. Myocardial velocity measurements are not influenced by translational or tethering motion as they are when obtained by pulsed wave tissue Doppler imaging.
d. You can measure longitudinal but not circumferential or radial strain.

4. Negative strain values are consigned to?

a. Shortening, Thickening and Counterclockwise rotation.
b. Shortening, Thinning and Clockwise rotation.
c. Lengthening, thickening and Clockwise rotation.
d. Shortening, Thinning and Counterclockwise rotation.
e. Shortening, Thinning and Clockwise rotation

4. Negative strain values are consigned to?

a. Shortening, Thickening and Counterclockwise rotation.
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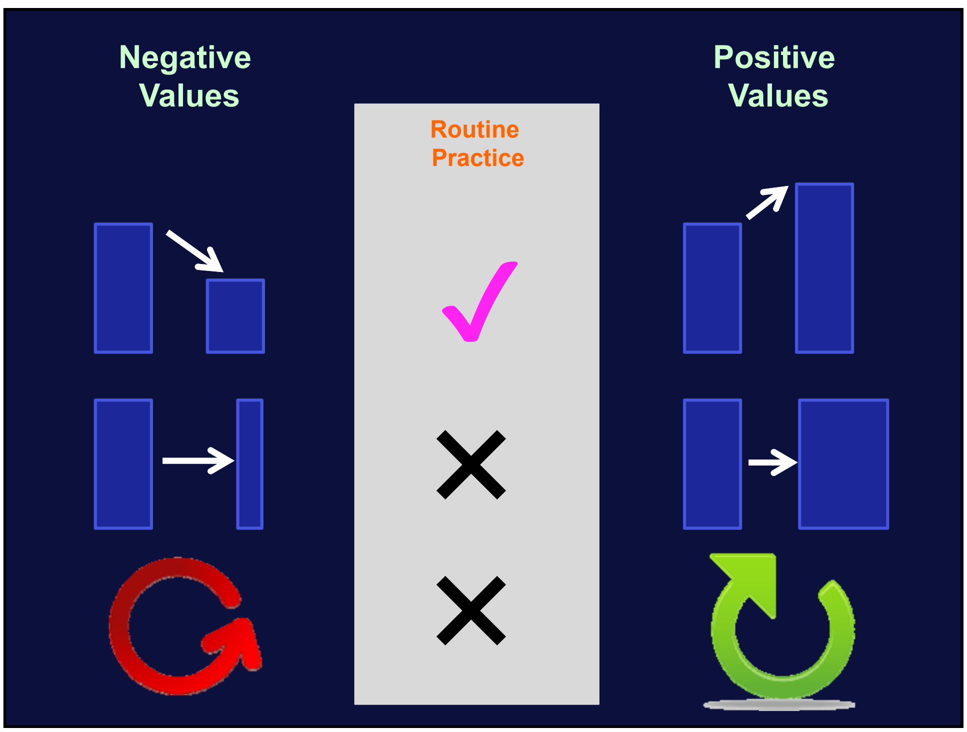
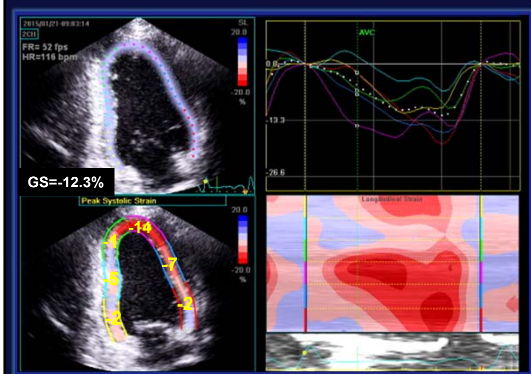


5. A 59 year women with breast cancer being treated with anthracycline based chemotherapy is referred to clinic after the echo reported a reduction in global longitudinal peak systolic strain. The clinician reviewed the echo and requested that the strain values be repeated. Why did the clinician suspect that the strain values were falsely low?



a. Poor tracking
b. The annulus is incorrectly identified and tracking part of the left atrium.
c. The region of interest thickness is set too wide and including the pericardium.
d. End-systole has been Incorrectly identified/marked.

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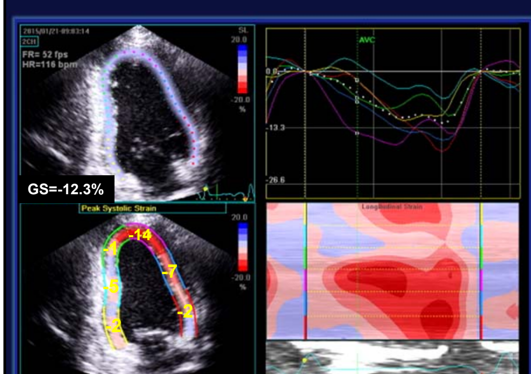

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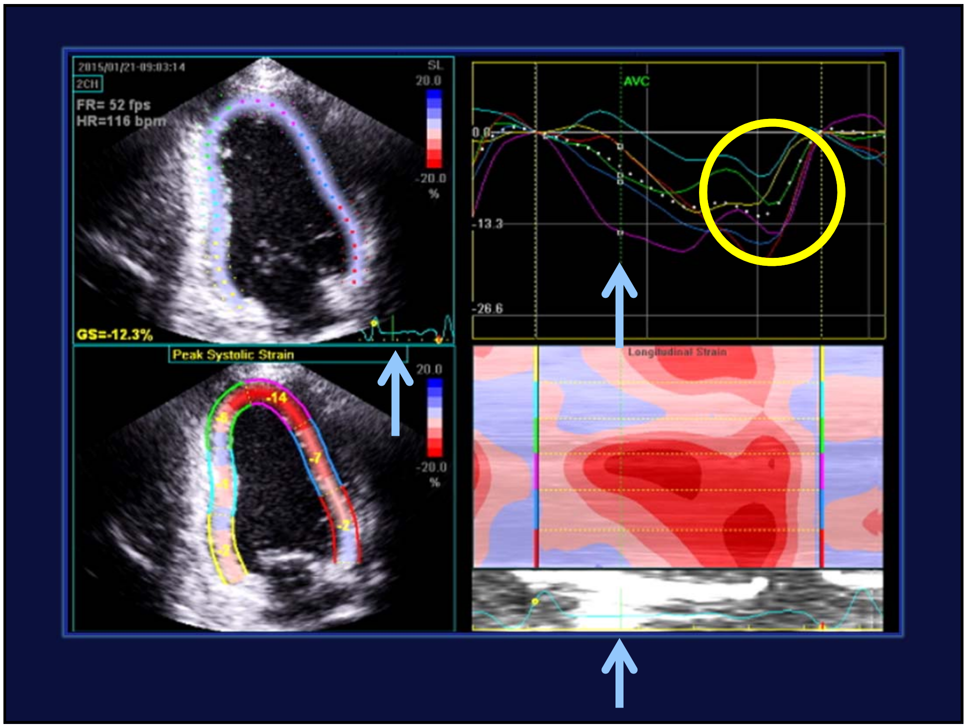
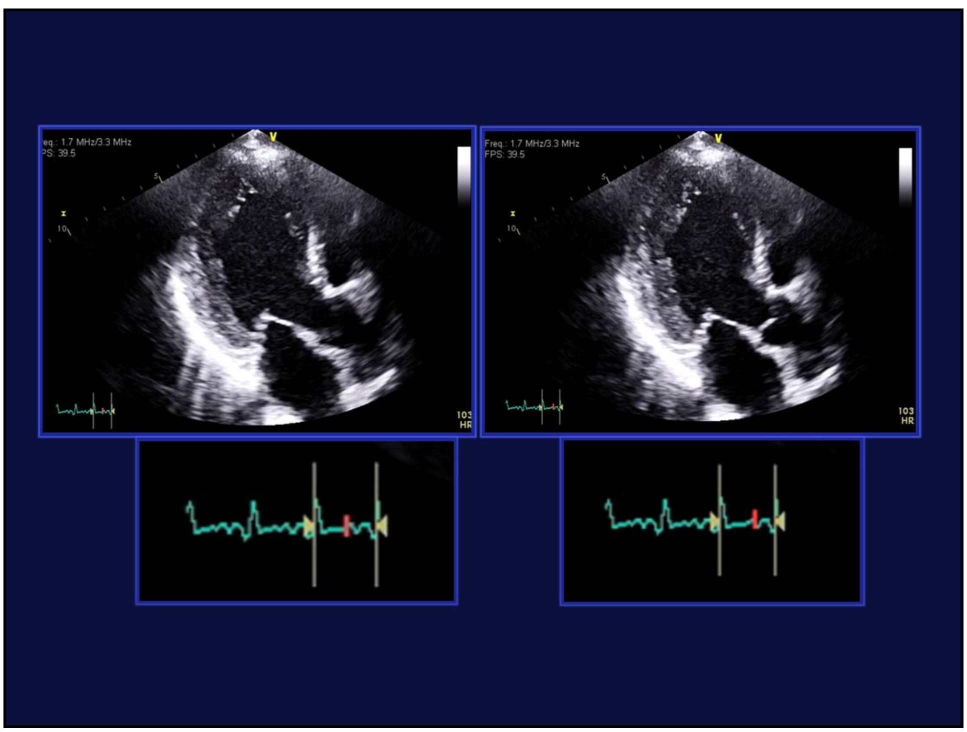
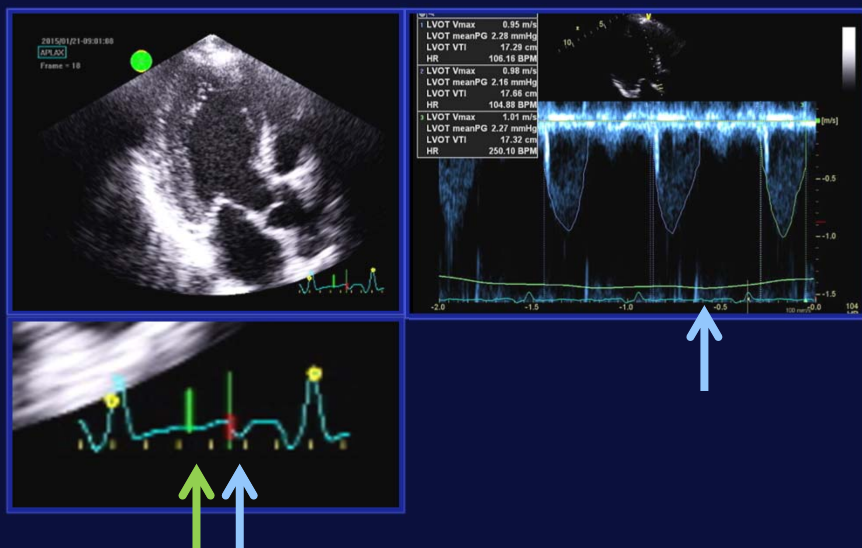

2015/01/21-09:03:14
2CH
FR= 52 fps
HR=116 bpm
GS=-12.3%
Peak Systolic Strain
SL
20.0
-20.0
%
AVC
0.0
-13.3
-26.6
Longitudinal Strain





6. Compared to pulsed wave tissue Doppler the myocardial velocities obtained by color tissue Doppler are?

a. Higher
b. Lower
c. The same

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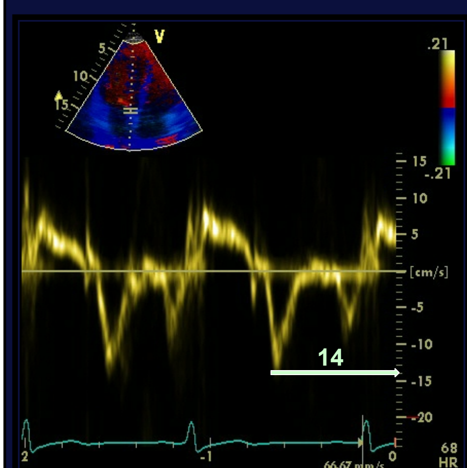
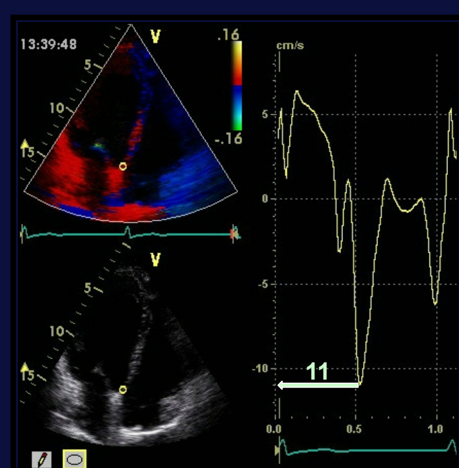
b. Lower
c. The same

Peak Velocities	**Mean Velocities**
Pulsed TD	**Color TD**





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Mitral Valve Disease and Cardiac Masses

Dennis A. Tighe, MD, FASE

Which one of the following is the most commonly encountered cardiac mass lesion?

1. Metastatic (secondary) tumor
2. Atrial myxoma
3. Papillary fibroelastoma
4. Hemangiosarcoma
5. Intra-cardiac thrombus

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5. **Intra-cardiac thrombus****

Which of the following primary cardiac tumors is most likely to involve the cardiac valves ?

1. Myxoma
2. Papillary fibroelastoma
3. Sarcoma
4. Hemangioma
5. Rhabdomyoma

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2. **Papillary fibroelastoma****
3. Sarcoma
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Which of the following tumor types exhibits the highest propensity for cardiac metastasis?

1. Malignant melanoma
2. Osteogenic sarcoma
3. Bronchogenic cancer
4. Breast cancer
5. Hypernephroma

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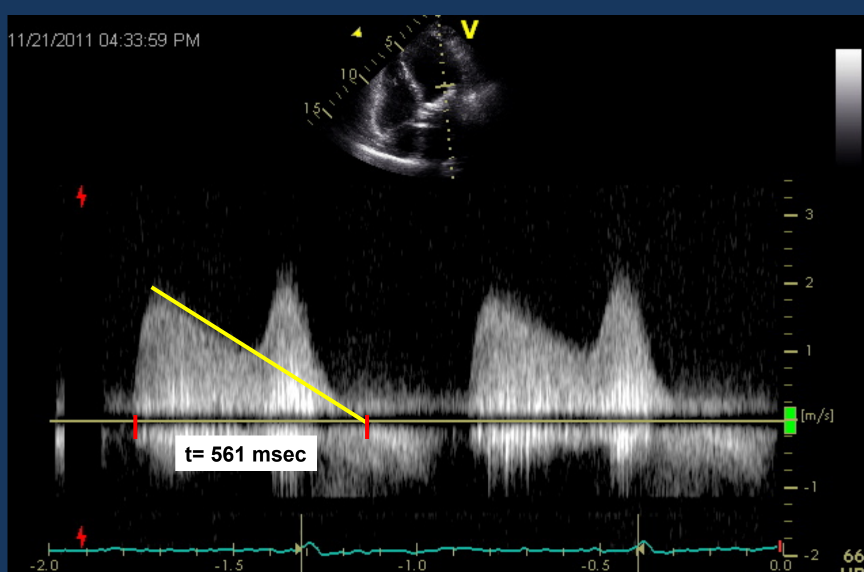

Which of the following values is the best estimate of the mitral orifice area?

A. 0.40 cm^2
B. 0.75 cm^2
C. 1.0 cm^2
D. 1.4 cm^2
E. 2.6 cm^2

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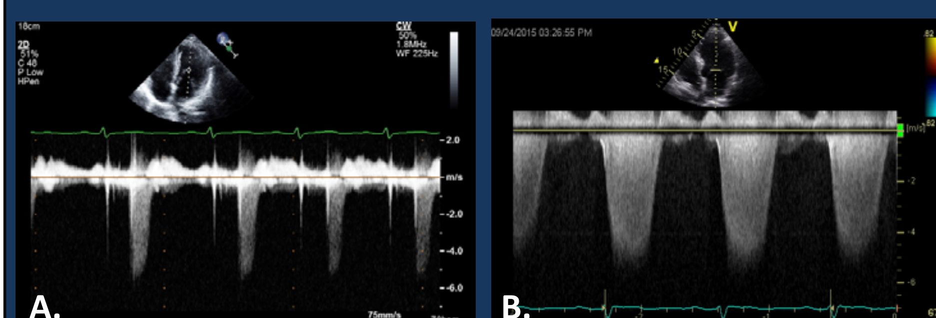
B. 0.75 cm^2
C. 1.0 cm^2
D. 1.4 cm^2 **
E. 2.6 cm^2

Choice Explanations

- D. 1.4 cm^2.
- This continuous wave spectral profile of the mitral valve shows increased trans-valvular velocities and a prolonged deceleration time (measured).
  – Given the known deceleration time, the relationship between deceleration time (DT) and mitral pressure half-time (PHT) is:
    PHT (in msec) = 0.29xDT
  – Once the PHT is known, the Hatle formula (MVA (in cm^2) = 220/PHT) can be used to estimate the mitral orifice area.
    - In this case, the PHT = 163 msec.
- Alternatively, the formula MVA = 759/DT can be utilized.

Two Patients with Mitral Regurgitation due to MVP



CW Doppler

When comparing the patients with MR depicted in panels A and B, which of the following statements is *TRUE*?

- A. Color jet area is often smaller among patients depicted in panel A compared to B.
- B. The peak mitral inflow velocity is consistently lower among patients in panel B versus A.
- C. The ERO area by PISA is consistently smaller among patients depicted in panel A versus B.
- D. Clinical outcomes are often better for patients depicted in panel A versus B.

When comparing the patients with MR depicted in panels A and B, which of the following statements is *TRUE*?

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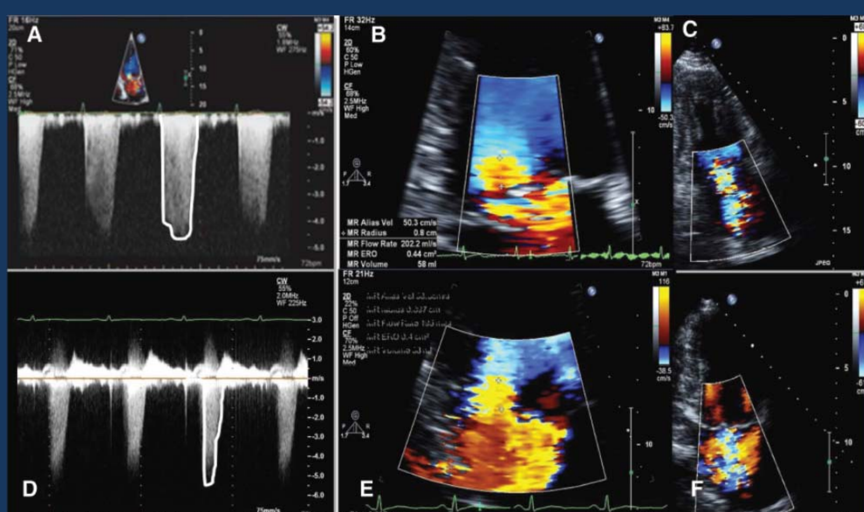
- **D. Clinical outcomes are often better for patients depicted in panel A versus B.****

	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, %	54.9±10.5	99.7±3.1	<0.0001
Regurgitant volume, mL per beat	25.2±13.5	48.5±25.6	<0.0001
LV and LA characteristics			
LVEDD, mm	51.3±6.4	53.9±6.6	0.005
LVESD, mm	32.1±5.1	33.5±5.4	0.06
LA volume index, mL/m^2	39±14	54±21	<0.0001
LV diastolic volume index, mL/m^2	72±22	102±22	<0.0001
LV systolic volume index, mL/m^2	25±10	30±12	0.0005
LV mass index, g/m^2	103±31	112±25	0.02
End-systolic mitral annulus diameter, cm	3.7±0.5	3.8±0.4	0.56

Topilsky Y et al. Circulation 2012;125:1643-1651.



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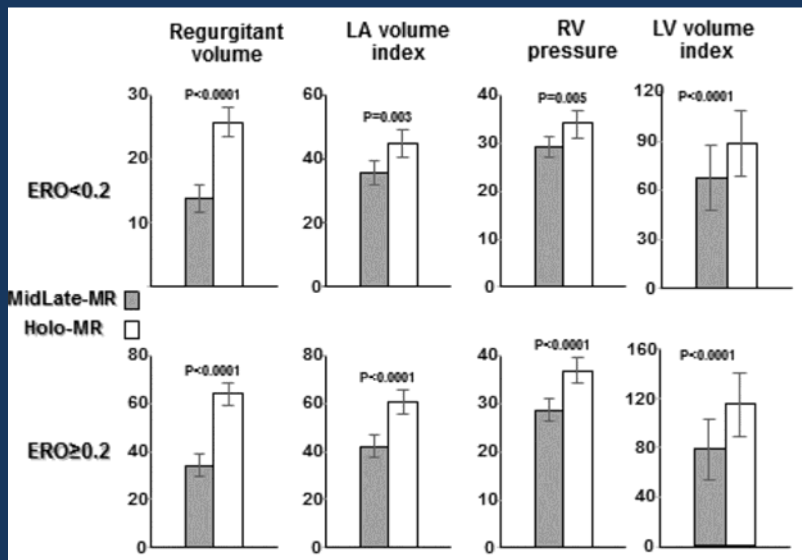

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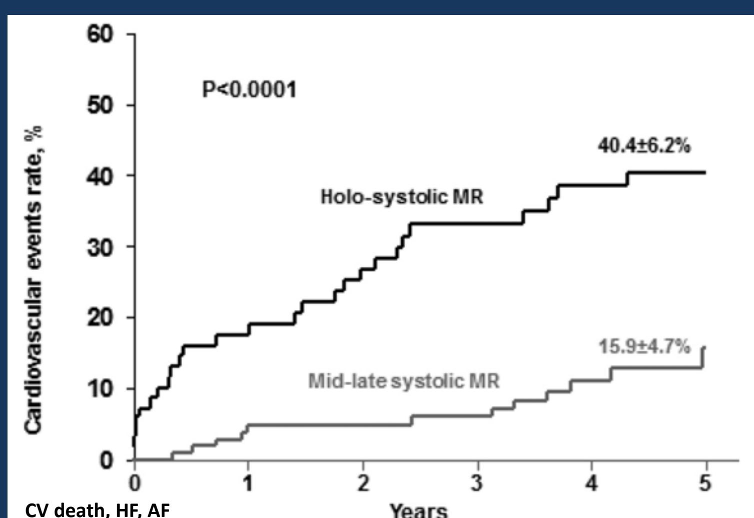


Topilsky Y et al. Circulation 2012;125:1643-1651.

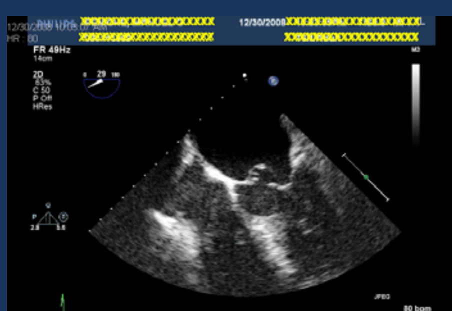
Case 1

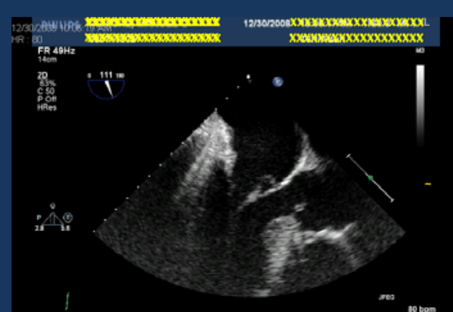
History

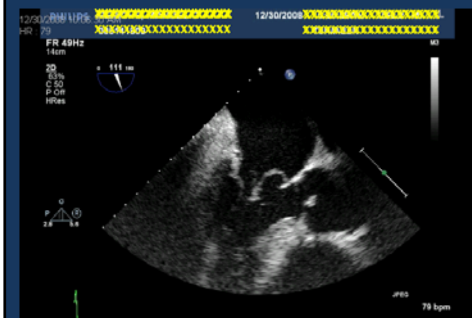
- A 61 year-old man
  - Presents to hospital with worsening shortness of breath, back pain, and a 20-pound weight loss over the past 6-months.
  - Two weeks prior to presentation he developed orthopnea.
  - As an outpatient, an oral antibiotic was prescribed for presumed pneumonia.
  - Transferred from an OSH for further care.

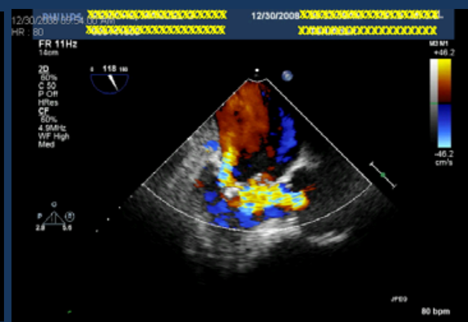
History/Data

- PMH
  - HTN
  - Dyslipidemia
  - CAD
  - Type B aortic dissection 1996
- SH
  - Manual laborer
  - Non-smoker
  - No EtOH
  - No illicit drug use
- Exam
  - Labored breathing (50% FM); HR 80/min, regular
  - JVD
  - Bilateral rales
  - HSM apex, diastolic decresendo murmur LLSB
  - LE edema
- Labs
  - WBC 14, Hgb 9.2
  - SR 1^{o} AVD, IRBBB, LAE
  - Pulm edema, b/l effusions









Based on the history and TEE images, which of the conditions best explains the mitral valve findings?

- A. Myxomatous valve degeneration
- B. Endocarditis involving the aortic valve
- C. Pseudoaneurysm of the mitral-aortic intervalvular fibrosa
- D. Congenital diverticulum
- E. Blood cyst of the mitral valve

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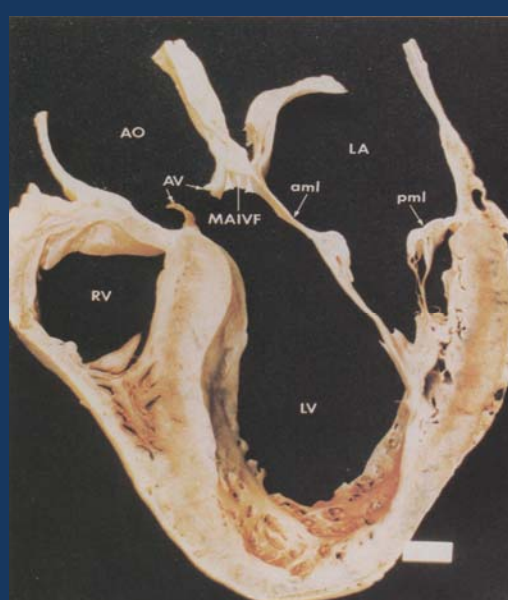
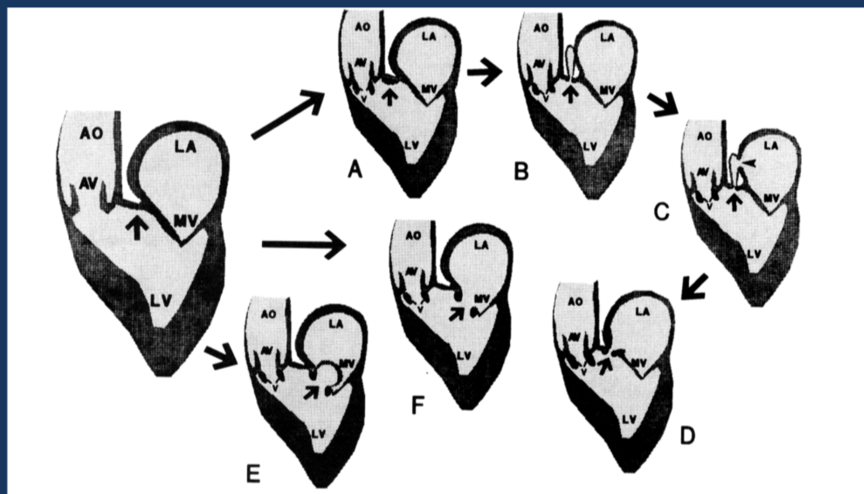
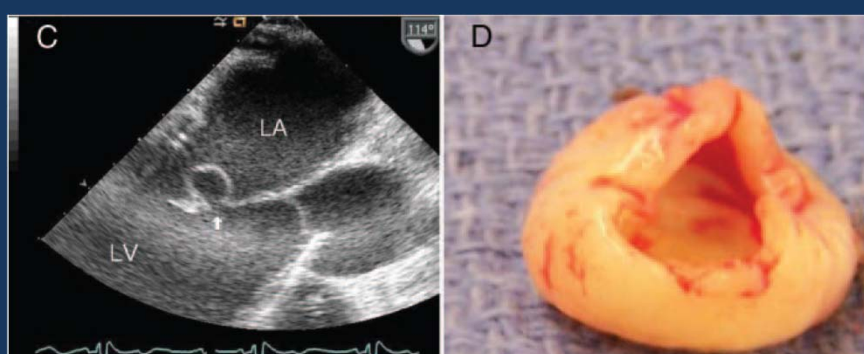


Karalis DG et al. Circulation 1992;86:353.

Sub-aortic Complications of IE



Karalis DG et al. Circulation 1992;86:353.



Stechert MM et al. Anesthesia-Analgesia 2012;114:86.

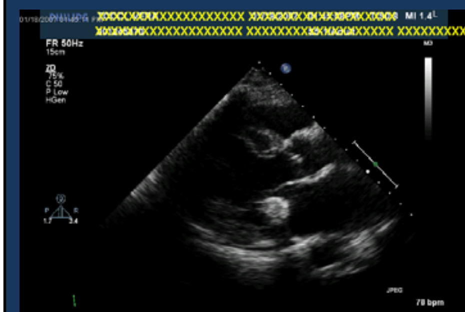
Table 1. Differential Diagnosis of Mitral Valve Aneurysm

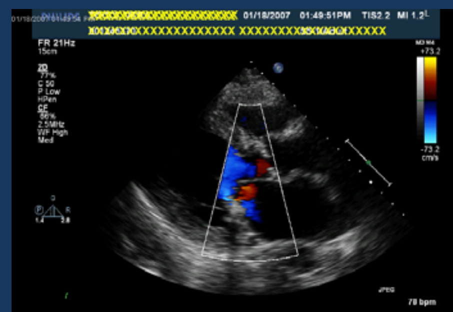
	Mitral valve aneurysm	Mitral valve diverticulum	Mitral valve dissection	Mitral valve prolapse	Cardiac tumors
Appearance	Saccular with distinct mouth and neck	Saccular with distinct mouth and neck	Saccular. Absence of distinct neck and mouth	Myxomatous thickening with redundant tissue. Absence of distinct neck and mouth	Typically solid. Rare cystic changes. Absence of distinct neck and mouth
Location and shape	Mouth facing left ventricle, aneurysmal sac bulging into left atrium	Mouth facing left atrium with diverticulum bulging into left ventricle	Double layer pouch. May resemble flail leaflet	Bowing of mitral leaflet may approximate a semicircle	Shape variable. Myxomas rarely found attached to valves
Changes in appearance during the cardiac cycle	Systolic expansion into left atrium, ↓ size or collapse in diastole	Absence of systolic expansion	Absence of systolic expansion	Leaflet tip bulging into left atrium with systole	Absence of significant changes
Doppler findings	Color flow swirling in sac. Perforation of sac may mimic mitral regurgitation	Color flow swirling in sac. Perforation not reported	Color flow swirling (?). May be associated with mitral regurgitation	Posteriorly directed mitral regurgitant jet may be demonstrated	Absence of color flow swirling in cases of cystic changes

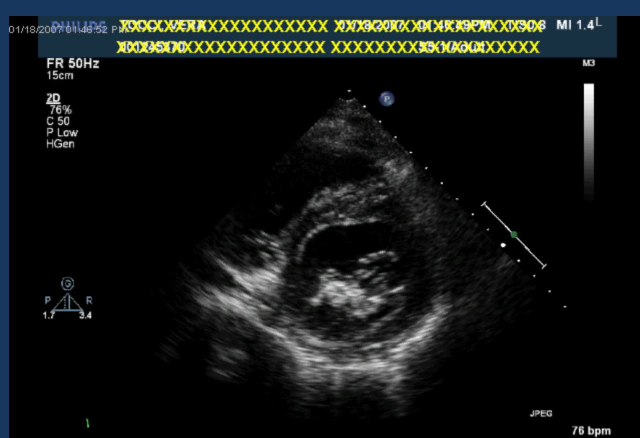
Stechert MM et al. Anesthesia-Analgesia 2012;114:86.

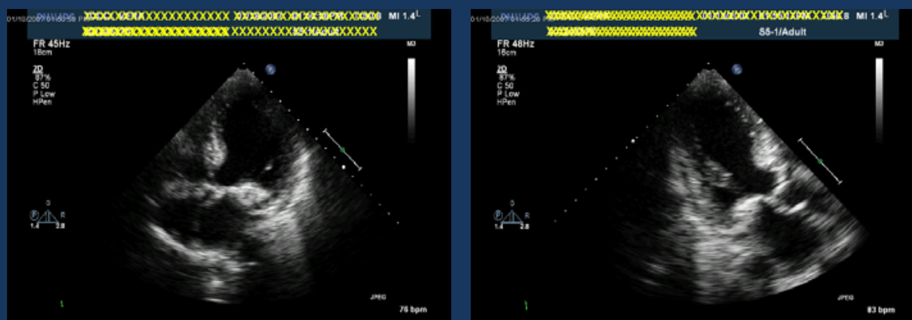
Case 2

- An 84-year old woman with Stage IV chronic kidney disease and systemic hypertension presents to an outside hospital with worsening shortness of breath.
  - Physical examination and chest radiography were consistent with pulmonary edema
    - Diuretics were given
  - Transthoracic echocardiography was performed






MI 1.4
FR 50Hz
15cm
2D
76%
C 50
P Low
HGen
M3
JPEG
76 bpm



Which of the following entities constitutes the most likely etiology for the finding shown?

A. Left atrial myxoma
B. Intracavitary thrombus
C. Infective endocarditis
D. Caseous calcification
E. Papillary fibroelastoma

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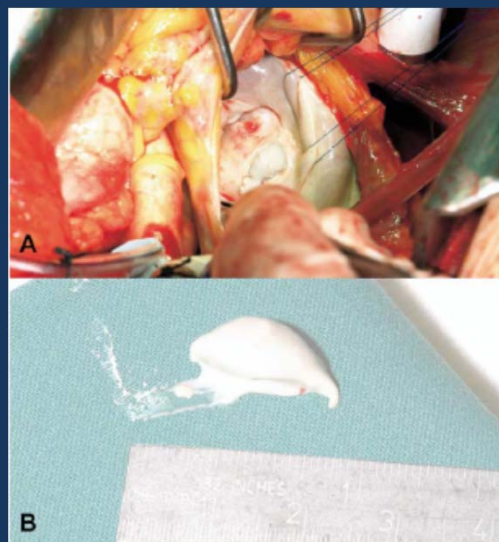
Caseous Calcification of the Mitral Annulus

- Relatively rare
  - Estimated prevalence of 0.07%
- Annular-based mass with echoluscencies
  - Putty-like admixture of fatty acids, cholesterol, and calcium
    - "Toothpaste" tumor
  - Rounded
  - Smooth borders
- Posterior location
- Associated conditions
  - Elderly
  - HTN
  - Women
- Natural history appears benign
  - Some cases may regress spontaneously
- Differential diagnosis
  - Abscess
  - Tumors
  - Thrombus



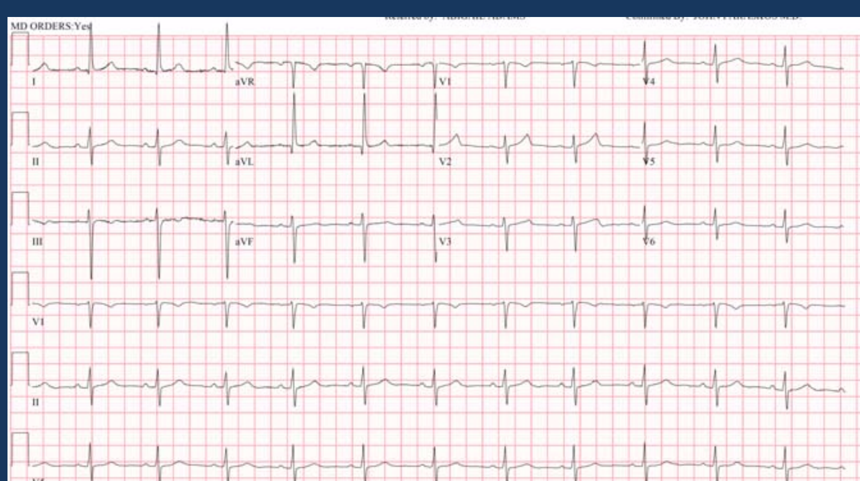
Alkadhi H et al. J Thorac Cardiovasc Surg 2005;129:1438.

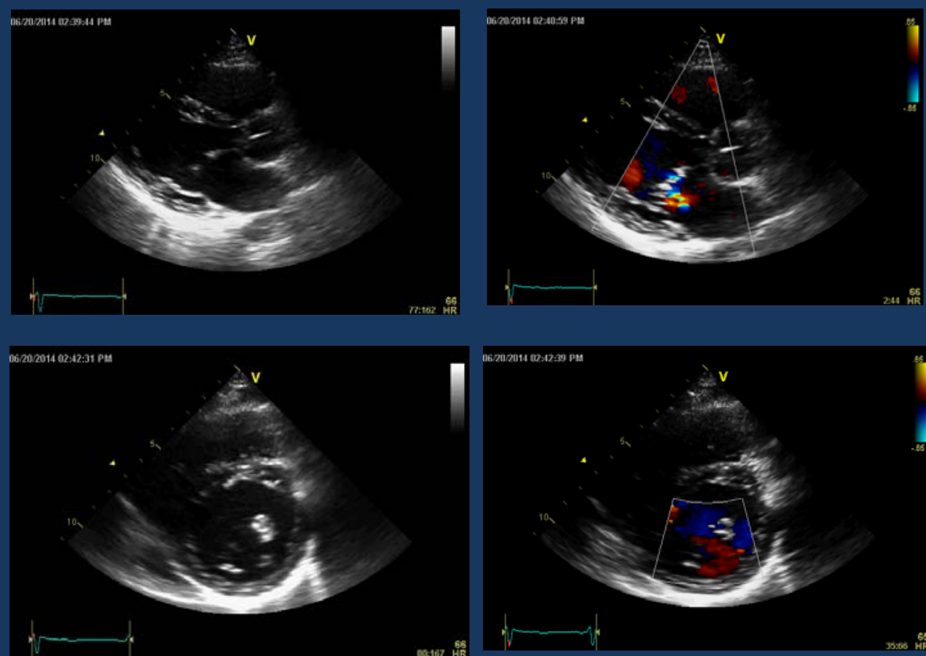
Case 3

Case 2

- An 36-year old woman is referred for echocardiography by her new PCP who heard a heart murmur. She is otherwise asymptomatic. She reports that several years prior she had open heart surgery performed at another institution.
  - An ECG was on-file
  - A transthoracic echocardiogram was performed

ECG

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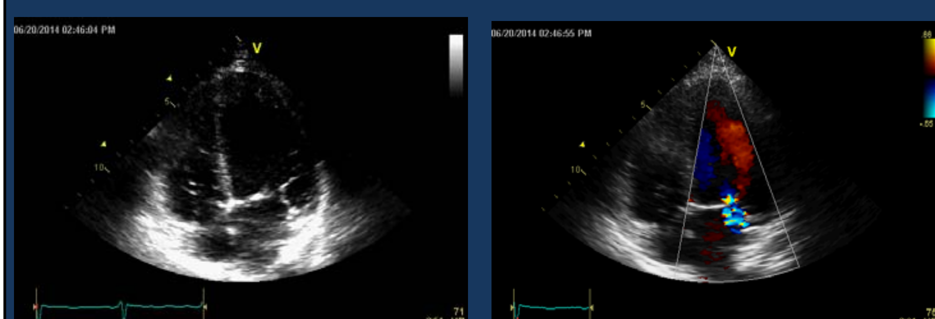
06/20/2014 02:46:04 PM
06/20/2014 02:46:55 PM

Based on the ECG and echocardiography you suspect that the prior surgery was performed for:

A. Infective endocarditis
B. Rheumatic heart disease
C. Atrial septal defect
D. Degenerative valve disease
E. Hypertrophic cardiomyopathy

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Ostium Primum ASD
(partial AV canal defect)

- 15-20% of ASDs
- Primum septum does not fuse with endocardial cushions
  - ASD occurs at base of interatrial septum
- Anomalies of AV valves common
  - Cleft MV most common
- Associations
  - Small inlet VSD (“transitional defect”)
  - LVOT elongated/narrowed (“gooseneck deformity”)
  - Sub-aortic stenosis
- ECG
  - LAD
- Echo
  - Cleft AML with MR (directed posterolateral)
  - AV valves in same plane

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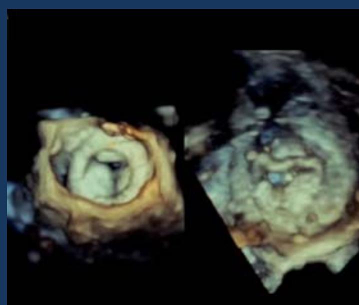
Degenerative Mitral Valve Disease

Roberto M. Lang, MD, FASE

A 27 year old female presents with shortness of breath. The following 3D TEE is obtained What is the most likely diagnosis?



1. Dehisced mechanical aortic prosthesis
2. Stenosed bioprosthetic mitral valve
3. Stenosed bioprosthetic aortic valve
4. Dehisced mechanical mitral valve

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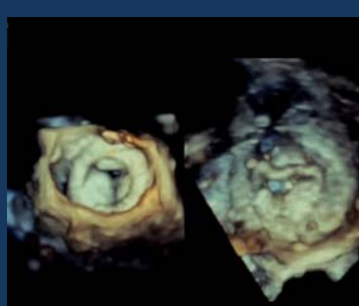
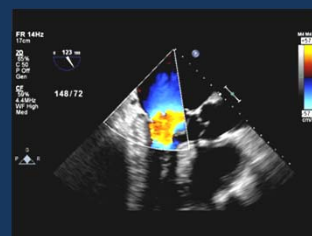


1. Dehisced mechanical aortic prosthesis
2. Stenosed bioprosthetic mitral valve
3. Stenosed bioprosthetic aortic valve
4. Dehisced mechanical mitral valve

A 36 year old patient presents with shortness of breath. A TEE was obtained. What is the most likely blood smear associated with this condition?



1. Eosinophilia
2. Red cell changes with lead poisoning
3. Hemolytic anemia
4. Thrombocytopenia
5. Excess of segmented neutrophils

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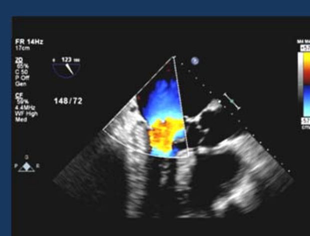

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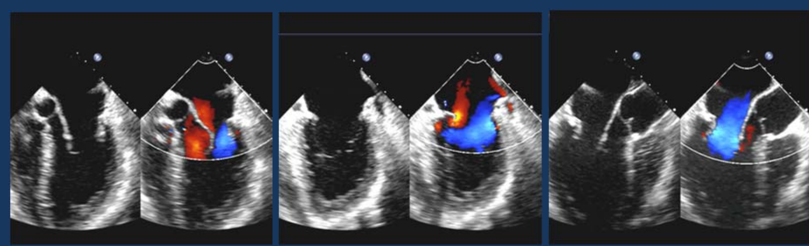
4. Thrombocytopenia
5. Excess of segmented neutrophils

A 31 woman presents with sudden onset of shortness of breath.
A TEE is performed.
Which is the most likely location of the culprit lesion?



1.P2 Flail
2.P1 Flail
3.P3 Flail
4.A2 Flail
5.A3 Flail

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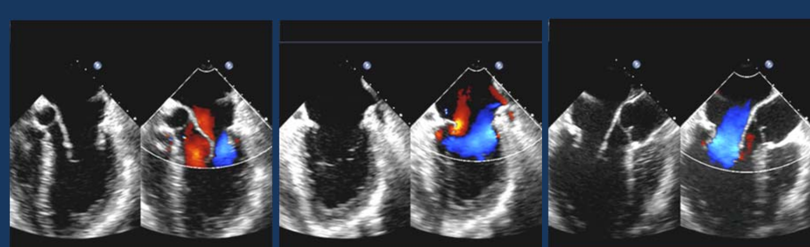

1.P2 Flail
2.P1 Flail
3.P3 Flail
4.A2 Flail
5.A3 Flail

Which of the following is most consistent with a severe grade of mitral insufficiency?

1. A continuous Doppler signal that is an incomplete envelope of low signal intensity.
2. A Peak E wave velocity of less than 1.2 m per second.
3. A maximal jet area as detected with color Doppler of less than 3.0cm^2.
4. A reversed systolic pulmonary venous waveform as detected with pulsed wave Doppler.

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All of the following clinical situations will limit the accuracy of the pressure half-time method for the measurement of mitral valve area with the exception of:

1. Conditions that alter left atrial compliance.
2. Conditions that alter left ventricular compliance.
3. Rapid heart rate
4. Severe aortic insufficiency.
5. Severe degree of mitral stenosis.

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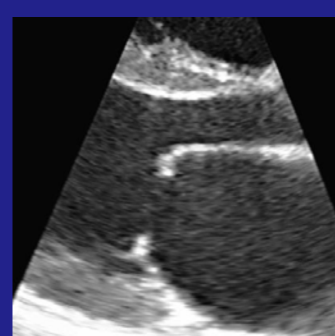
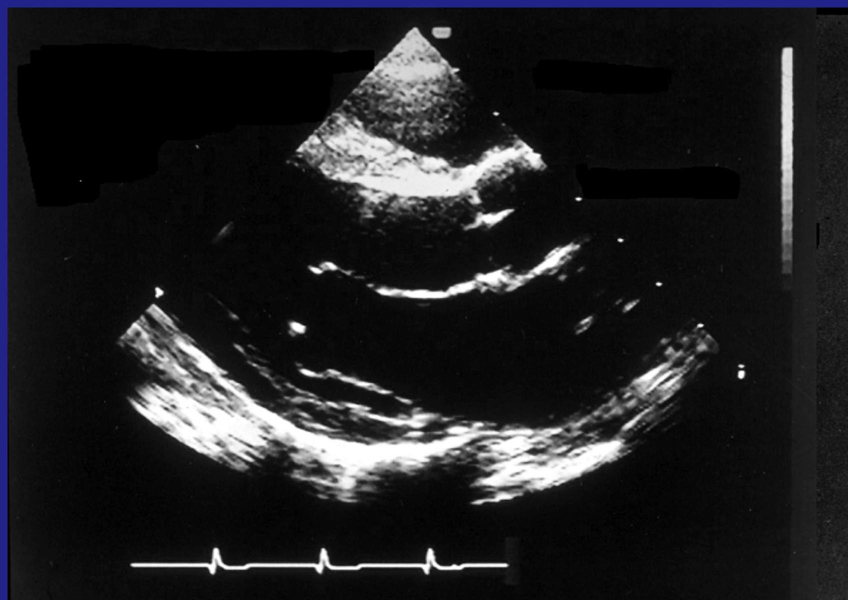
Mitral Stenosis/Functional (Ischemic) Mitral Valve Disease

Robert A. Levine, MD

In what conditions is there diastolic mitral leaflet doming with the leaflet concave toward the LA ?

1. Rheumatic MS
2. Rheumatic and calcific MS
3. Rheumatic and congenital MS
4. Rheumatic MS and AI with flow hitting the mitral valve





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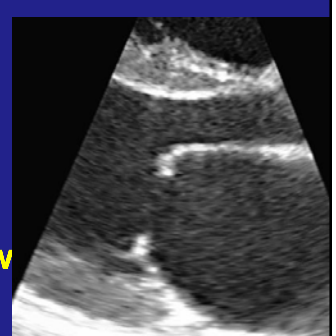
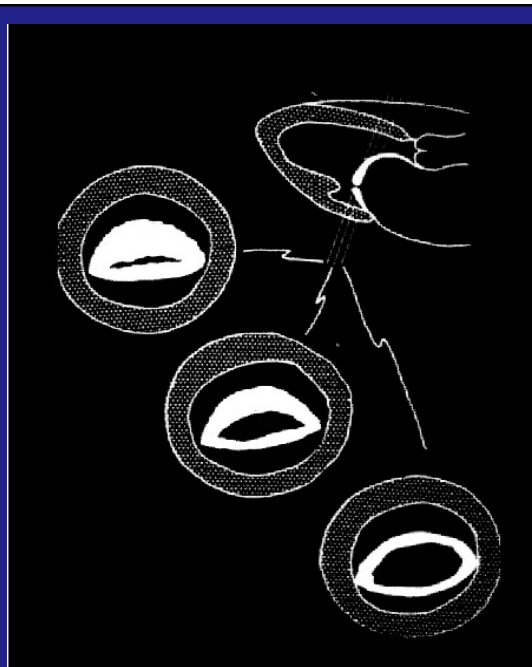


In mitral stenosis, which is the best view to guide placement of the beam to measure the narrowest orifice area?

A. The parasternal long-axis view
B. The parasternal short-axis view
C. The apical 2-chamber view
D. The apical 4-chamber view



Martin and Stamm

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B. The parasternal short-axis view
C. The apical 2-chamber view
D. The apical 4-chamber view

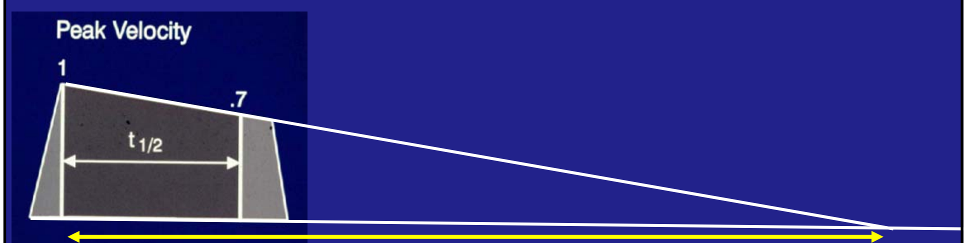
A patient has mitral stenosis with an E-wave deceleration time of 1000 milliseconds. What is the mitral valve area?

1. 0.22 cm^2
2. 0.75 cm^2
3. Depends on cardiac output
4. 1.5 cm^2

PHT = 29% of total deceleration time (DT)

MVA = 220 / Pressure half time

MVA = 750 / Deceleration time



Deceleration time

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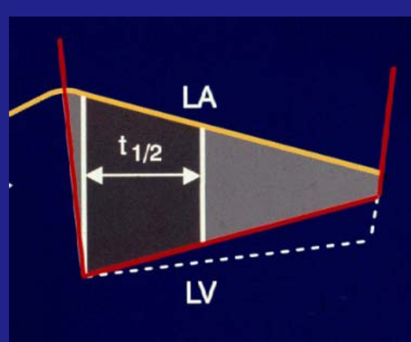
2. ► 0.75 cm^2
3. Depends on cardiac output
4. 1.5 cm^2

How does the mitral pressure half time vary with these parameters?

1. **Directly** with mitral valve area, directly with ventricular stiffness
2. **Directly** with mitral valve area, inversely with ventricular stiffness
3. ***Inversely*** with mitral valve area, directly with ventricular stiffness
4. ***Inversely*** with mitral valve area, inversely with ventricular stiffness

↓ MV area → ↑ Decel time

↑ LV stiffness → ↓ Decel time



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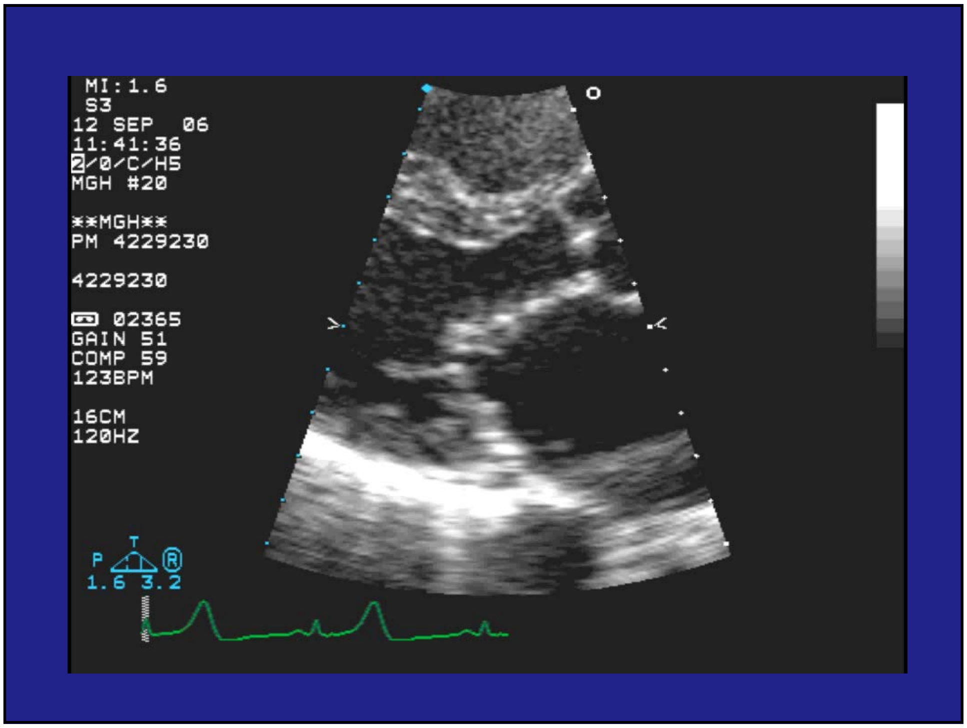
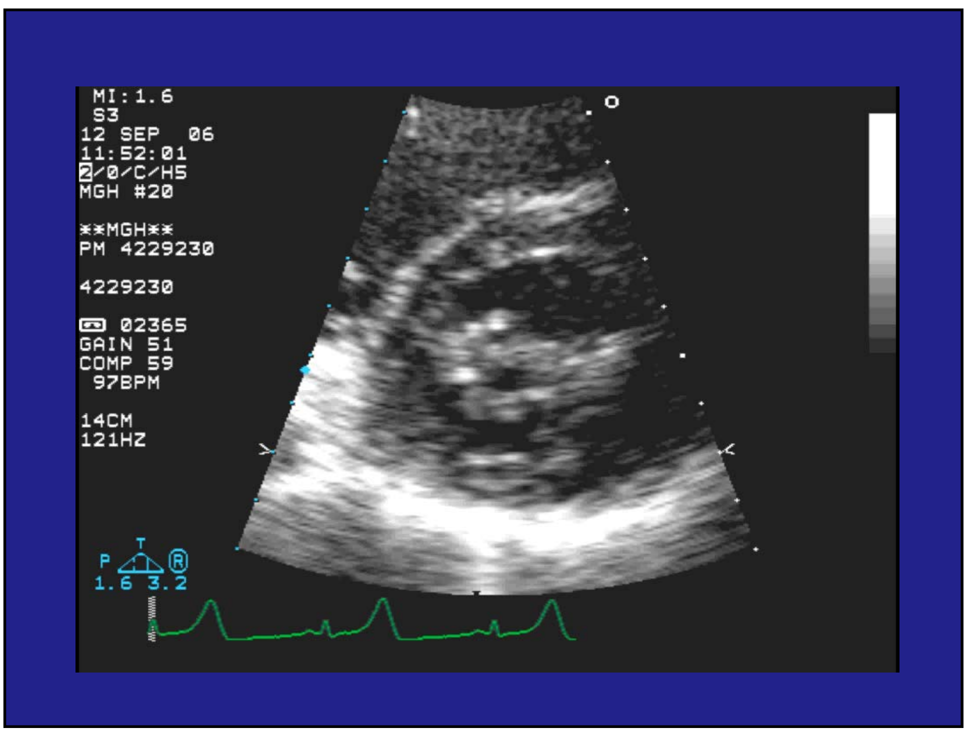
How does the mitral pressure half time vary with these parameters?

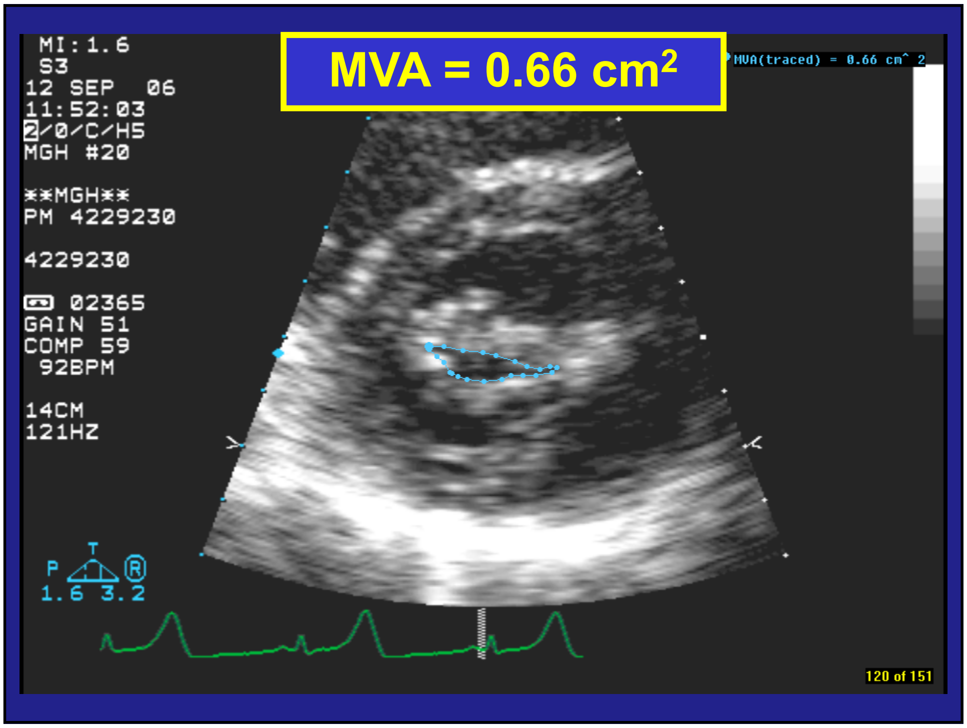
1. **Directly** with mitral valve area, directly with ventricular stiffness
2. **Directly** with mitral valve area, inversely with ventricular stiffness
3. ***Inversely*** with mitral valve area, directly with ventricular stiffness
4. ► ***Inversely*** with mitral valve area, inversely with ventricular stiffness

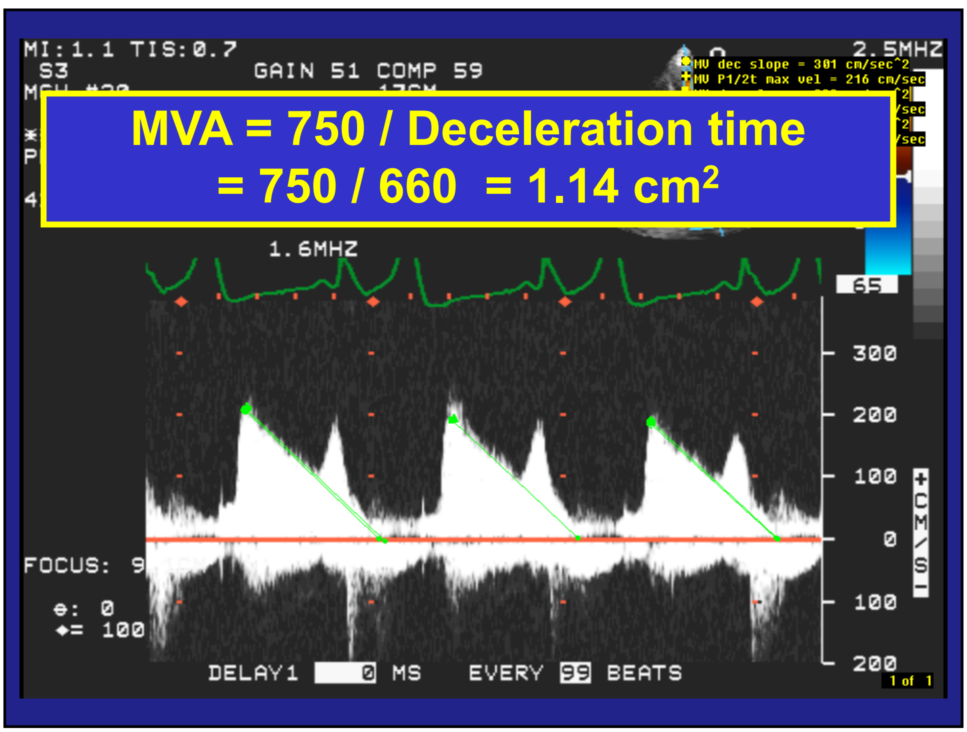
What condition can explain the difference in MV area by planimetry and half time in the following patient?

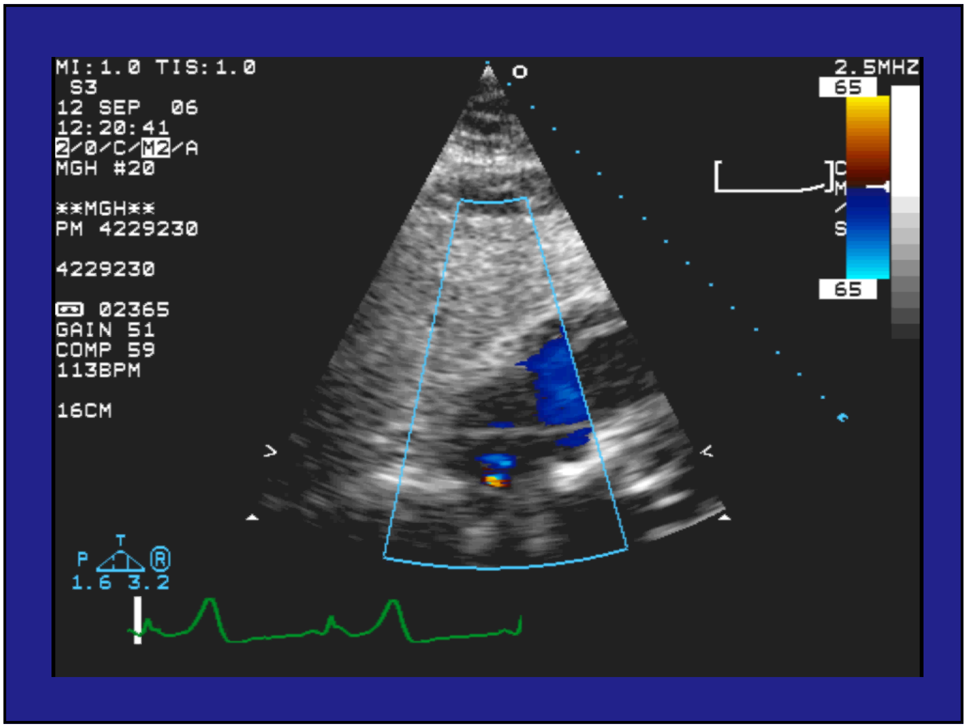
A. Mild aortic insufficiency
B. Post-balloon atrial shunt PFO
C. Moderate mitral regurgitation
D. Left atrial enlargement

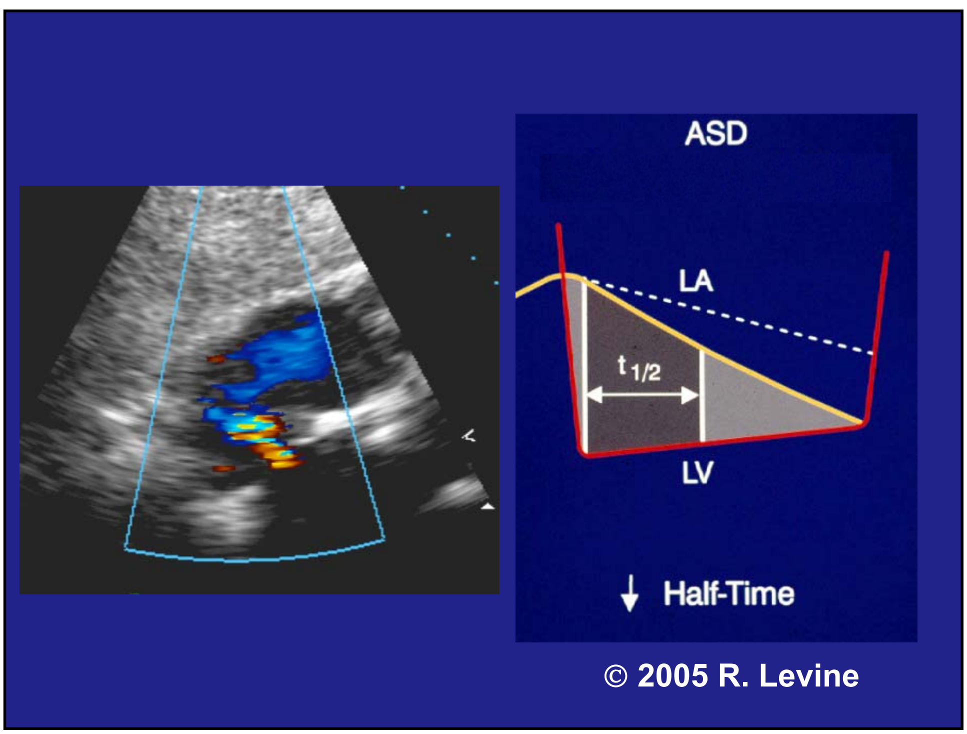

MI:1.6
S3
12 SEP 06
11:41:36
2/0/C/H5
MGH #20
MGH
PM 4229230
4229230
02365
GAIN 51
COMP 59
123BPM
16CM
120HZ
P
T
R
1.6 3.2


MI:1.6
S3
12 SEP 06
11:52:01
2/0/C/H5
MGH #20
MGH
PM 4229230
4229230
02365
GAIN 51
COMP 59
97BPM
14CM
121HZ
P
T
R
1.6 3.2


MVA = 0.66 cm²
MI:1.6
S3
12 SEP 06
11:52:03
MGH #20
MGH
PM 4229230
4229230
02365
GAIN 51
COMP 59
92BPM
14CM
121HZ
1.6 3.2
120 of 151


MVA = 750 / Deceleration time
= 750 / 660 = 1.14 cm²
MI:1.1 TIS:0.7
S3
GAIN 51 COMP 59
2.5MHZ
MV dec slope = 301 cm/sec^2
MV P1/2t max vel = 216 cm/sec
1.6MHZ
65
300
200
100
0
100
200
+CM/S-
FOCUS:
DELAY1 0 MS
EVERY 99 BEATS
1 of 1


MI:1.0 TIS:1.0
S3
12 SEP 06
12:20:41
MGH #20
MGH
PM 4229230
4229230
02365
GAIN 51
COMP 59
113BPM
16CM
2.5MHZ
65
65
1.6 3.2


ASD
LA
t 1/2
LV
↓ Half-Time
© 2005 R. Levine

What condition can explain the difference in MV area by planimetry and half time in this patient?

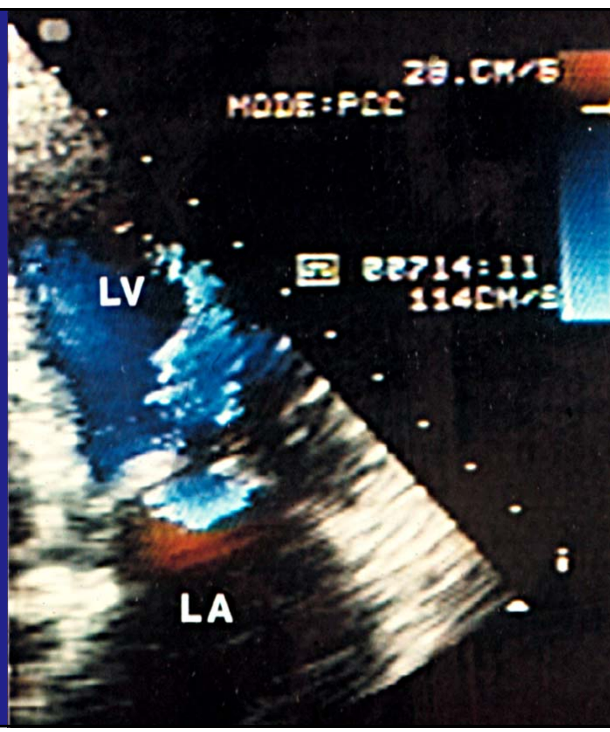
A. Mild aortic insufficiency
B. Post-balloon atrial shunt PFO
C. Moderate mitral regurgitation
D. Left atrial enlargement

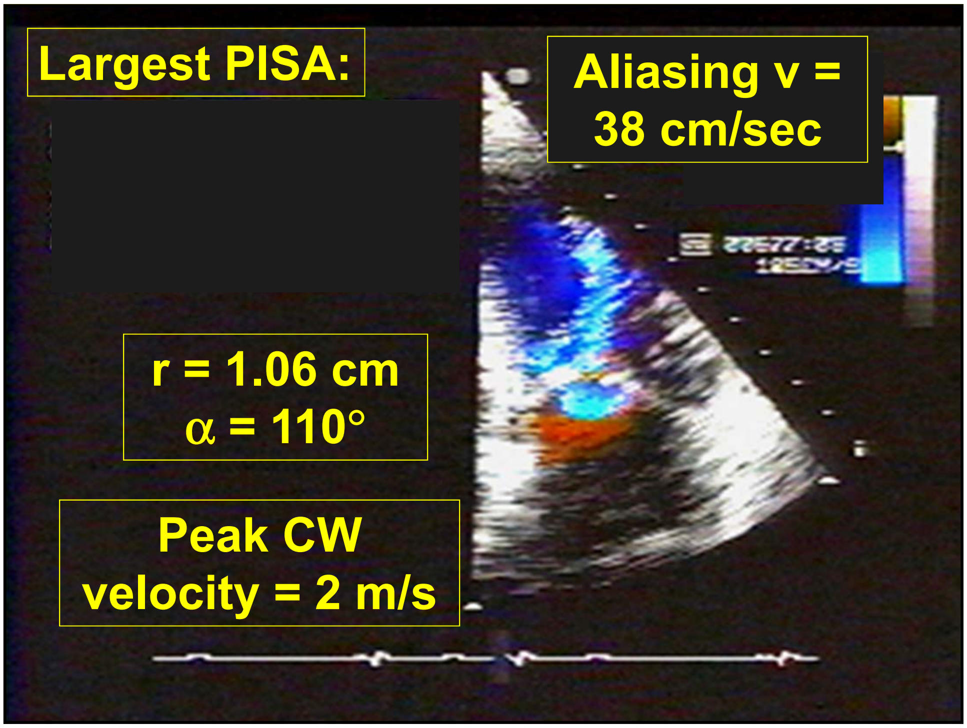
What condition can explain the difference in MV area by planimetry and half time in this patient?

A. Mild aortic insufficiency
► B. Post-balloon atrial shunt PFO
C. Moderate mitral regurgitation
D. Left atrial enlargement

What is the mitral valve area in this patient?

A. 0.82 cm^2
B. 1.34 cm^2
C. 1.0 cm^2
D. Need more data

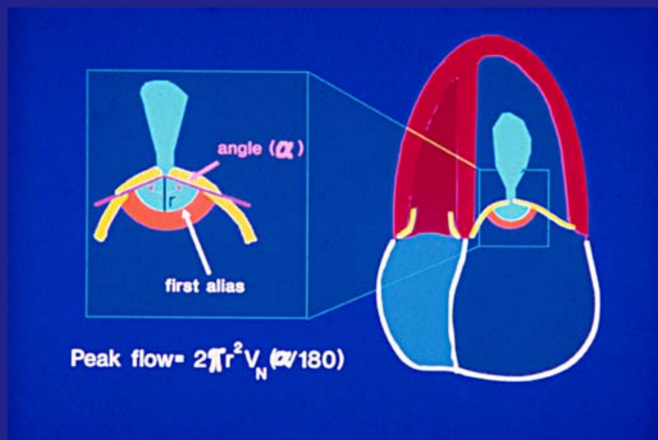




What is the mitral valve area in this patient?

A. $0.82\ cm^2$
B. $1.34\ cm^2$
C. $1.0\ cm^2$
D. Need more data

PISA Method



MVA = Peak Flow/Peak MS velocity

Leonardo Rodriguez

Peak flow rate = $2\pi\, r^2\, v\, (\alpha/180)$

$r = 1.06$ cm

$v = 38$ cm/sec

$\alpha = 110°$

Peak flow rate = 164 cm^3/sec

MVA = Peak flow rate / Peak velocity

= (164 cm^3/sec) / (200 cm/sec)

= 0.82 cm^2

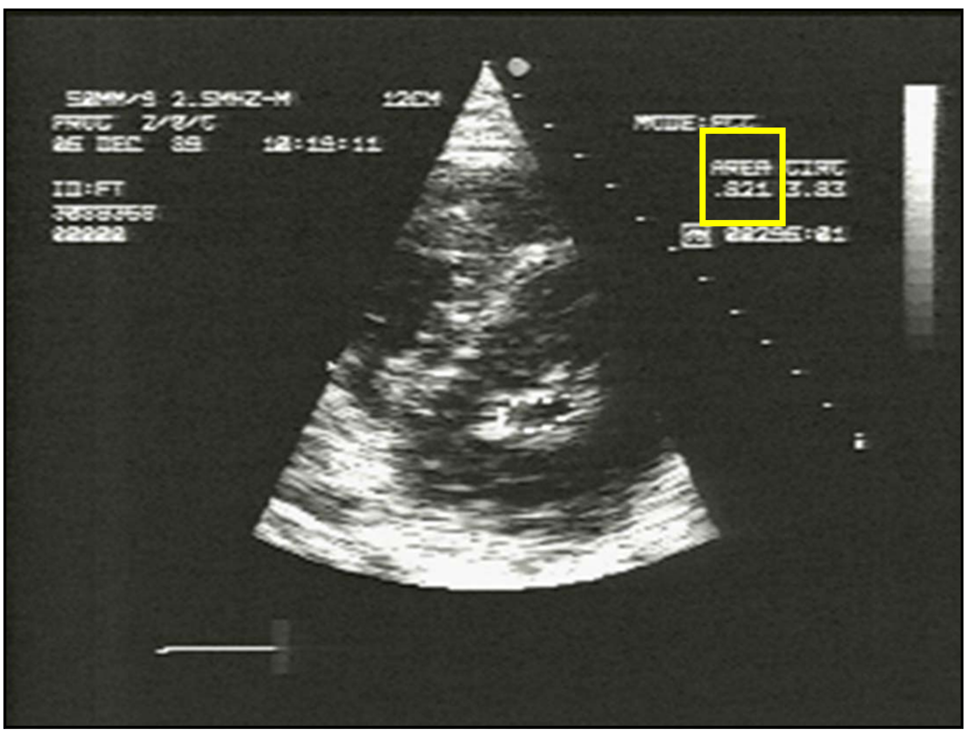
What is the mitral valve area in this patient?

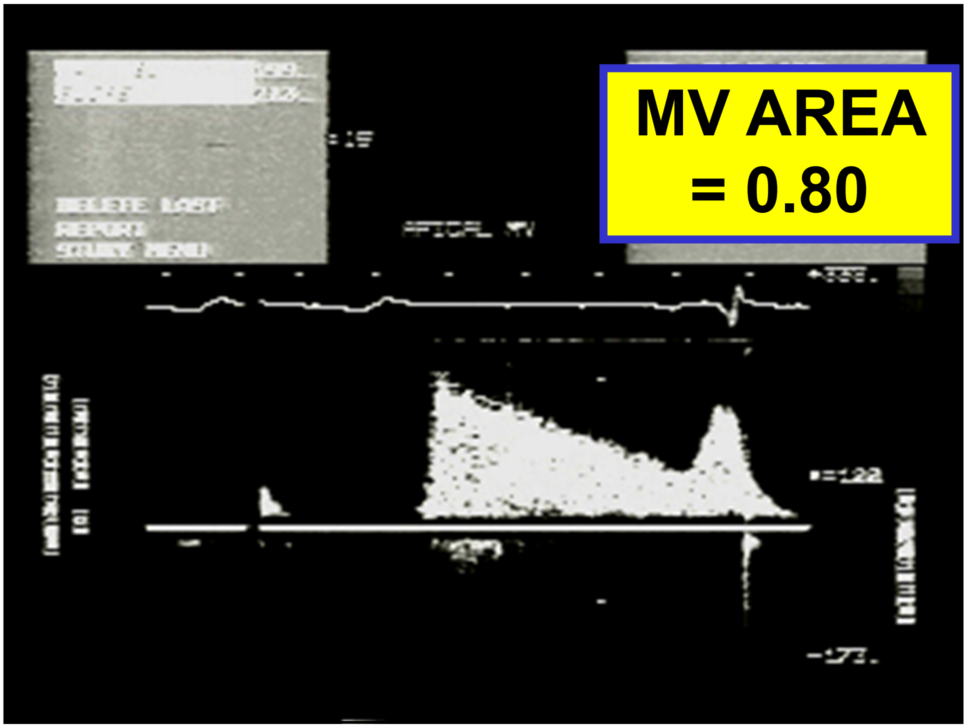
► A. 0.82 cm^2

B. 1.34 cm^2

C. 1.0 cm^2

D. Need more data





In evaluating mitral stenosis, the pressure half time is calculated as:

a. The time taken to drop to 0.7 x the peak pressure gradient
b. The time taken to drop to half the peak pressure gradient
c. The time taken to drop to half the peak velocity
d. The pressure gradient at half the diastolic filling period

In evaluating mitral stenosis, the pressure half time is calculated as:

a. The time taken to drop to 0.7 x the peak pressure gradient

► b. The time taken to drop to half the peak pressure gradient

c. The time taken to drop to half the peak velocity

d. The pressure gradient at half the diastolic filling period

44 yo woman with increasing dyspnea 1 year after difficult childbirth

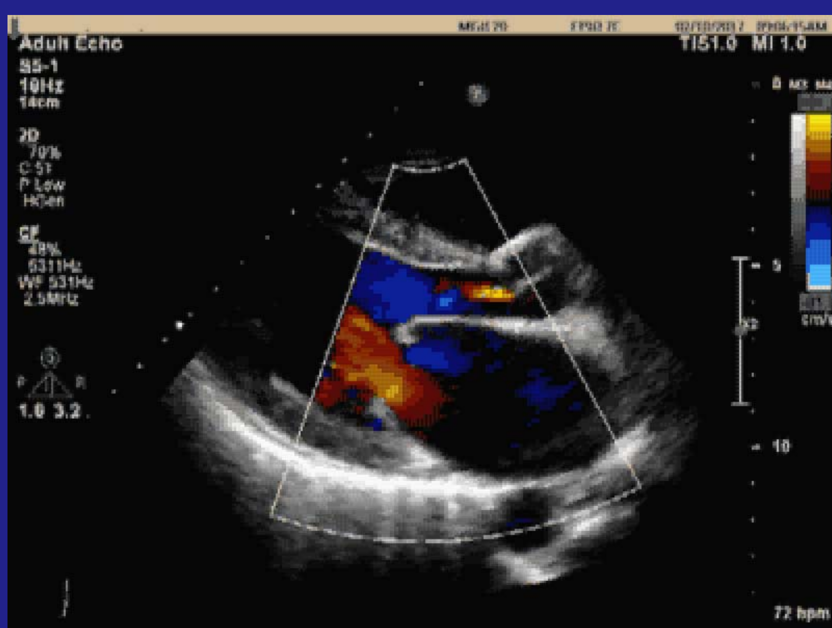
What intervention would you suggest first?

a. Diuretic

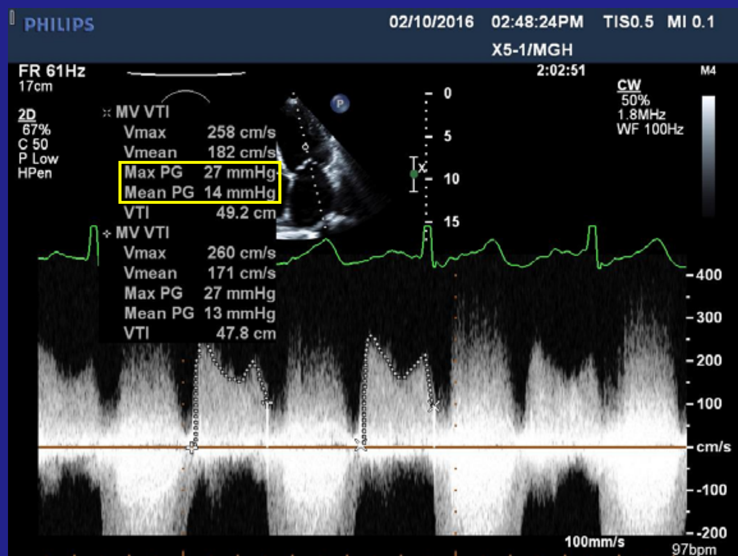
b. Mitral balloon valvuloplasty

c. Surgical mitral valve repair

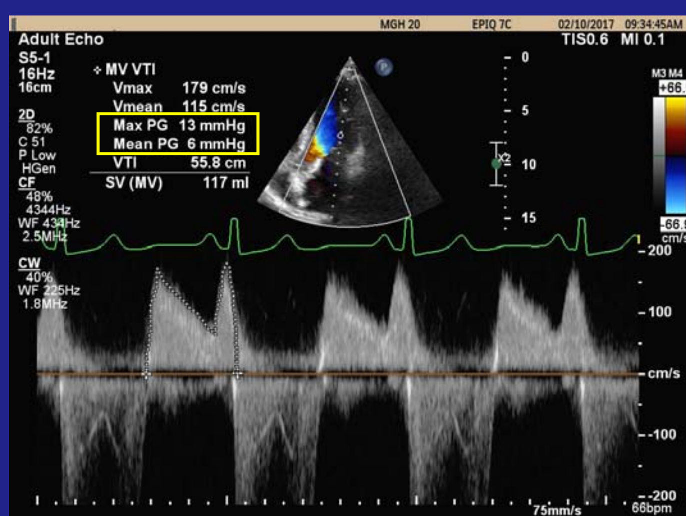
c. Surgical valve replacement



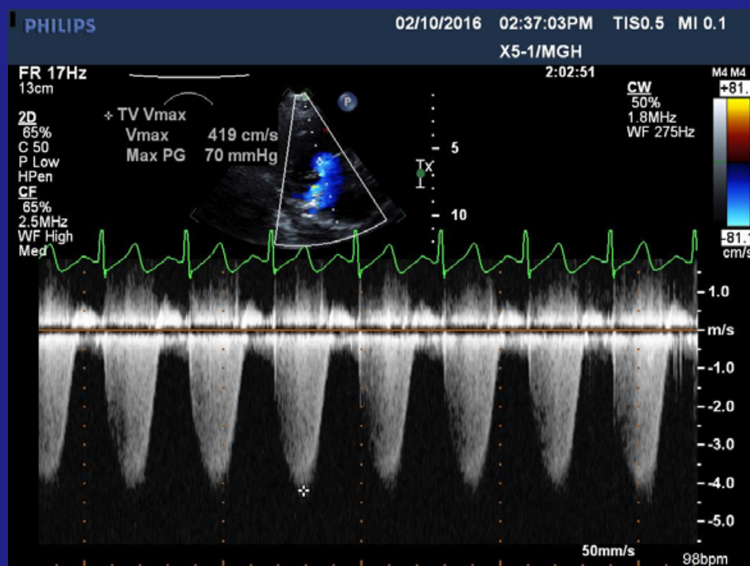
Before diuretic



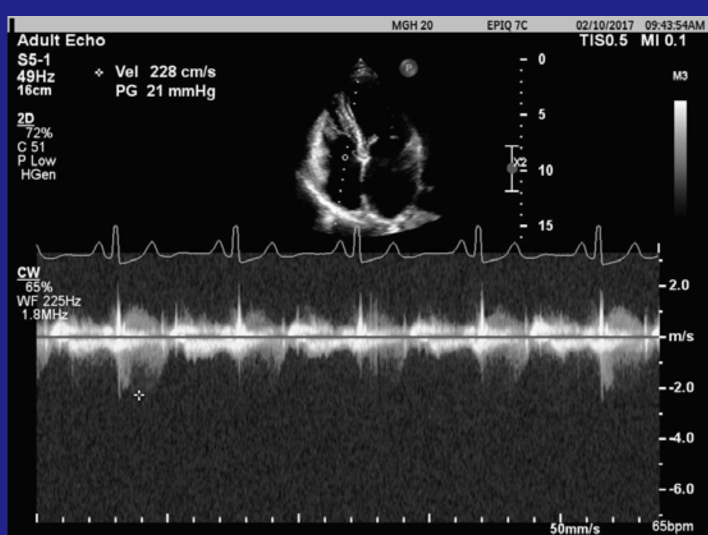
After diuretic



Before diuretic: RVSP 80 mmHg

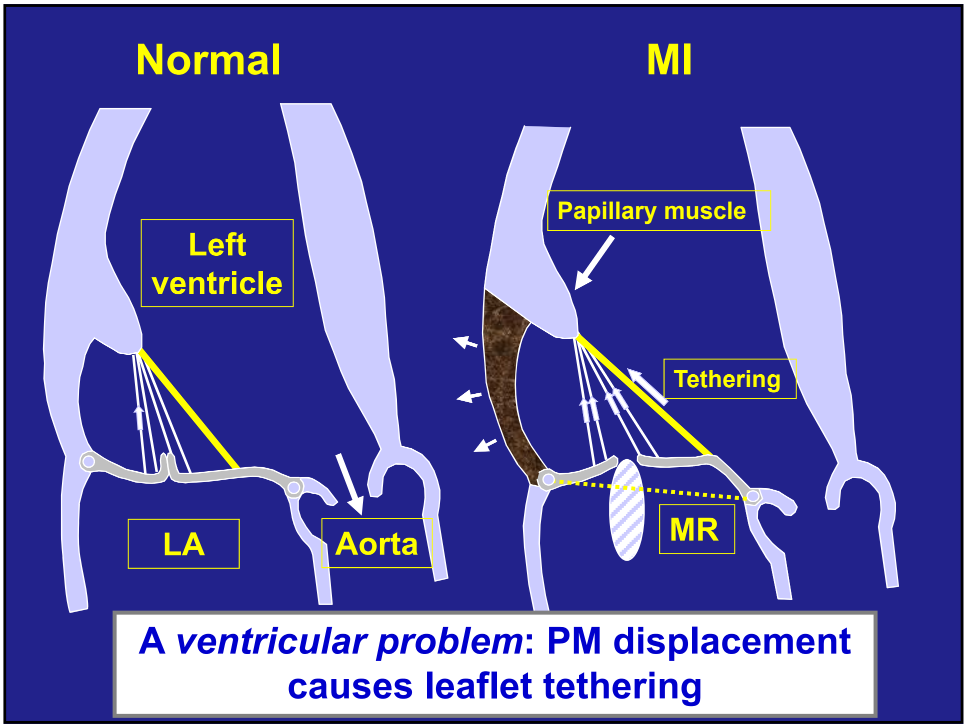


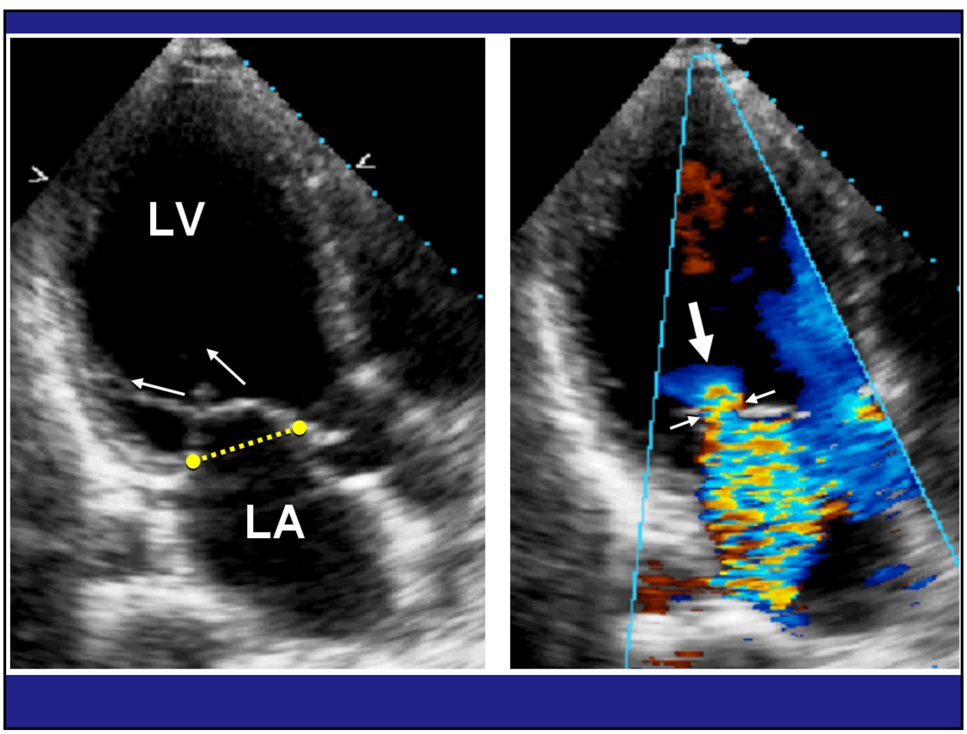
After diuretic: RVSP 31 mmHg



Ischemic MR is caused primarily by which of the following?

1. Coronary ischemia that varies over time
2. Papillary muscle displacement with mitral leaflet tethering
3. Failure of the ischemic papillary muscles to contract
4. Mitral annular dilatation


Normal
MI
Left ventricle
Papillary muscle
Tethering
LA
Aorta
MR
A ventricular problem: PM displacement causes leaflet tethering


LV
LA

Ischemic MR is caused primarily by which of the following?

1. Coronary ischemia that varies over time
2. ▶ Papillary muscle displacement with mitral leaflet tethering
3. Failure of the ischemic papillary muscles to contract
4. Mitral annular dilatation

In the recent echo-based CardioThoracic Surgical Network study of severe ischemic MR, after CABG and mitral annuloplasty:

1. MR remains repaired in 80% of patients after 2 years
2. MR reoccurs in 59% of patients after 2 years without symptoms
3. MR reoccurs in 59% of patients after 2 years with increased heart failure
4. MR remains in 50% of patients at 6 months but then decreases over 1 year

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4. MR remains in 50% of patients at 6 months but then decreases over 1 year

A patient with mild ischemic MR develops pulmonary hypertension and dyspnea at a low exerecise work load. This can best be explained by:

1. New wall motion or non-ischemic increase in functional MR
2. New ischemic wall motion only
3. Primary increase in pulmonary vascular resistance
4. Diffuse microvascular obstruction with hypokinesis

A patient with mild ischemic MR develops pulmonary hypertension and dyspnea at a low exerecise work load. This can best be explained by:

▶ 1. New wall motion or non-ischemic increase in functional MR
2. New ischemic wall motion only
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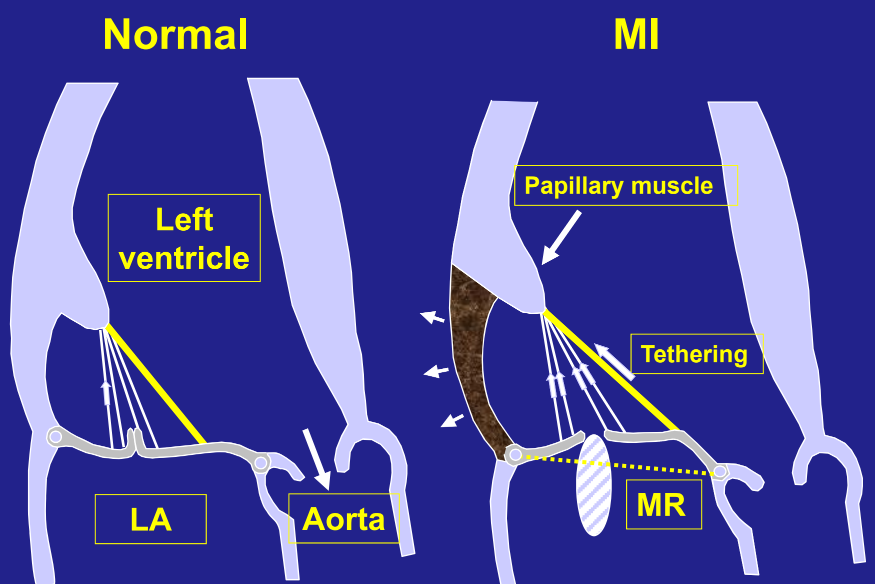
4. Diffuse microvascular obstruction with hypokinesis

A patient with an inferior wall MI and no reversible ischemia showed moderate to severe ischemic MR by preop TTE. After OR anaesthetic induction, MR is mild in the absence of hypotension. The surgeon questions your preoperative MR grading. What course can you take?

1. Agree, noting the limitations of echo assessment of MR
2. Suggest intraop Dobutamine stress
3. Suggest intraop volume loading test
4. Confirm that mitral valve repair will not likely be needed

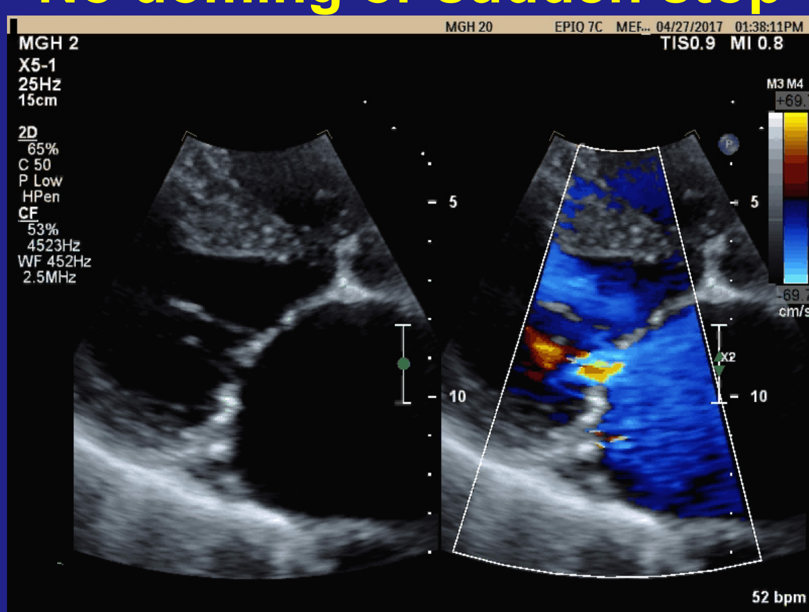


A *ventricular problem*: PM displacement causes leaflet tethering

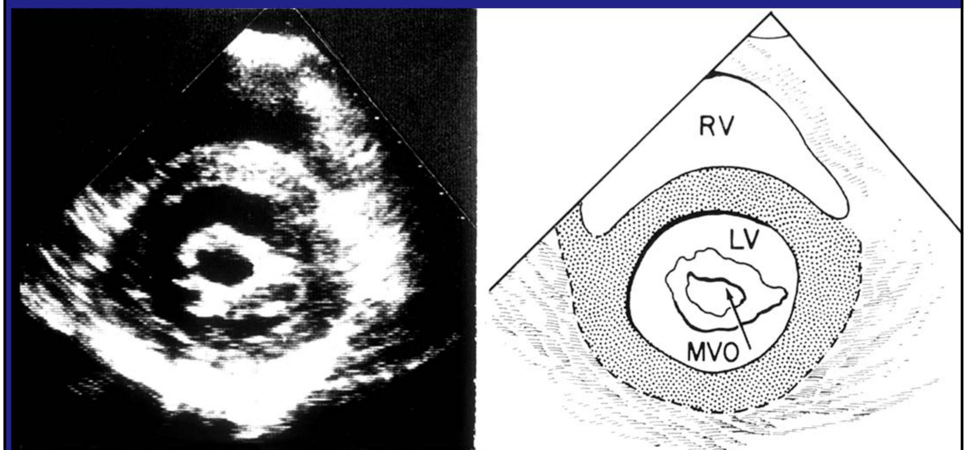
A patient with an inferior wall MI and no reversible ischemia showed moderate to severe ischemic MR by preop TTE. After OR anaesthetic induction, MR is mild in the absence of hypotension. The surgeon questions your preoperative MR grading. What course can you take?

1. **Agree, noting the limitations of echo assessment of MR**
2. **Suggest intraop Dobutamine stress**
3. ▶ **Suggest intraop volume loading test**
4. **Confirm that mitral valve repair will not likely be needed**

No doming or sudden stop



Commissural fusion: Rheumatic



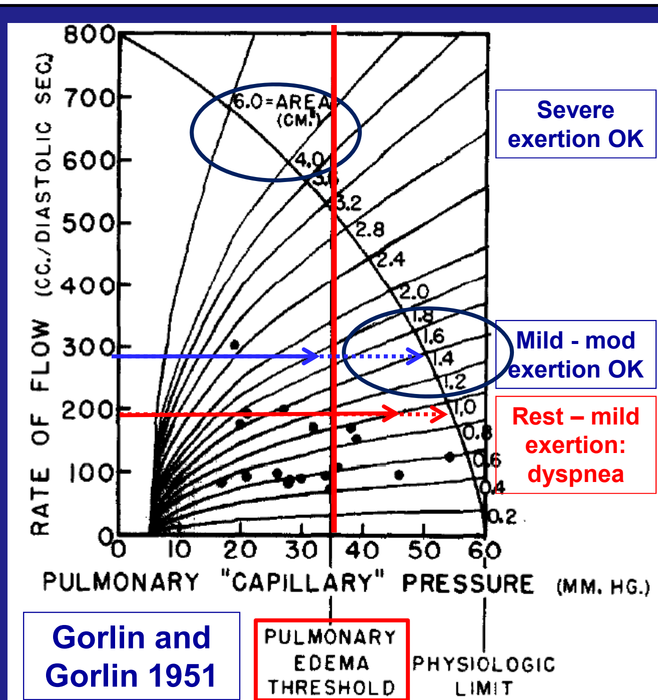
No commissural fusion

2014 AHA/ACC Guideline for the Management of Patients With Valvular Disease (Nishimura)

- > 1.5 cm^2 – "Progressive"
- 1.1 to 1.5 cm^2 – "Severe"
- ≤ 1.0 cm^2 – "Very severe"

Based on symptoms and improvement with intervention

But MVA ≤ 1.5 cm^2 may be as'xic!



Echo and Hydrodynamic Assessment of Mitral Stenosis

- **Mitral valve area measurement**
  - > 1.5 cm^2 - Mild
  - 1.1 to 1.5 cm^2 - Moderate
  - < or = 1.0 cm^2 - Severe

ASE American Society of Echocardiography

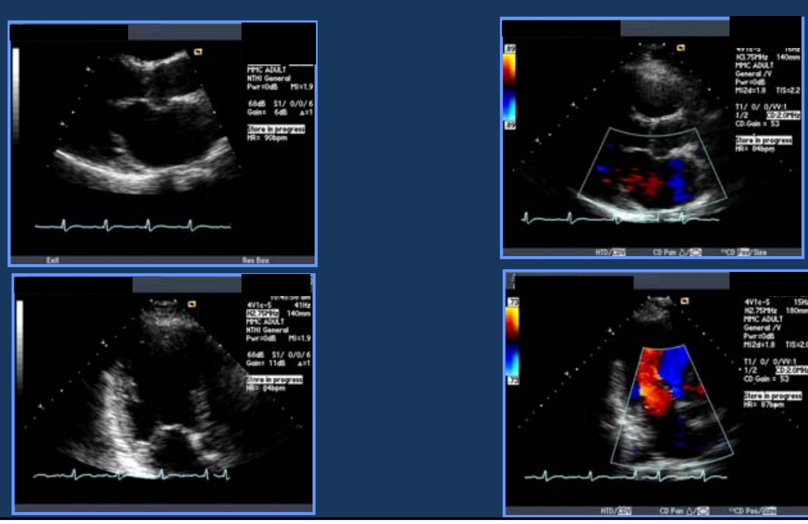
Committed to excellence in cardiovascular ultrasound and its application to patient care.

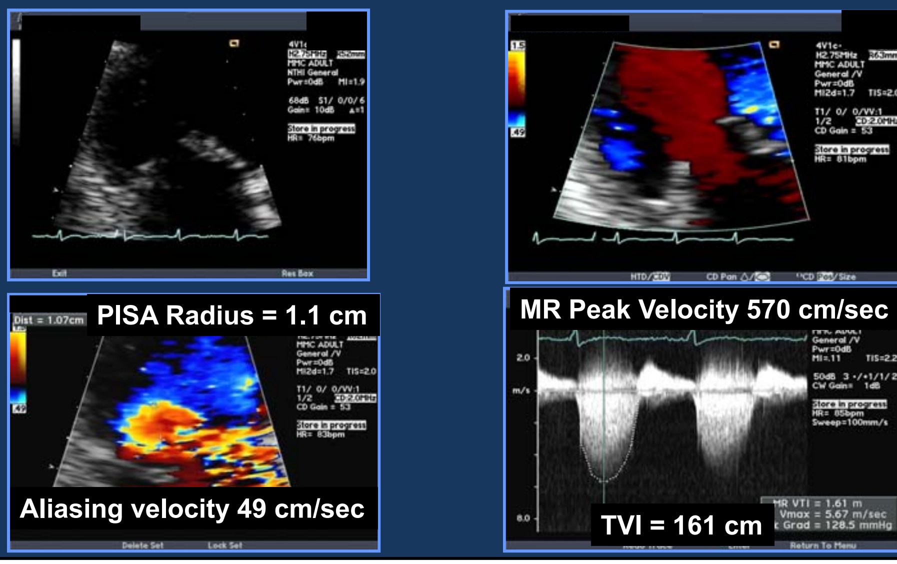
Quantification of Mitral Regurgitation

Sunil Mankad, MD, FASE

Question 1

41 y/o woman: Dyspnea on exertion





What is the calculated ERO?

1. 0.45 cm^2
2. 0.55 cm^2
3. 0.35 cm^2
4. 0.65 cm^2
5. 0.75 cm^2

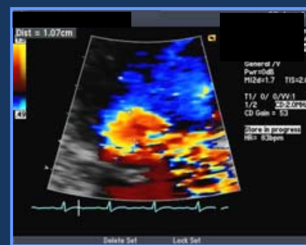
PISA Radius = 1.1 cm

Aliasing velocity 49 cm/sec

MR Peak Velocity 570 cm/sec

TVI = 161 cm

Step 1: Calculate proximal MR flow



$Flow_{MR}$ = $Area_{PISA}$ x $Velocity_{Alias}$

= 2π x R^2 x V_{Alias}

= 6.28 x $(1.1 cm)^2$ x 49 cm/sec

$Flow_{MR}$ = 372 cm^3/sec

Step 2: Calculate the mitral ERO

$$ERO = \frac{Flow_{MR}}{Velocity_{MR}}$$

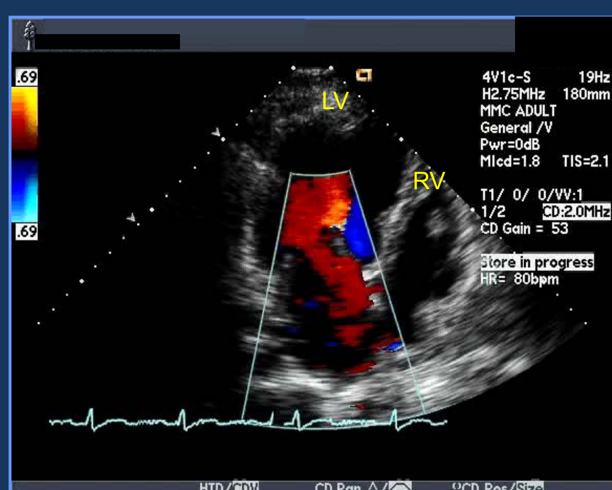
$$= \frac{372\ cm^3/sec}{570\ cm/sec}$$

$Velocity_{MR}$ = 570 cm/sec

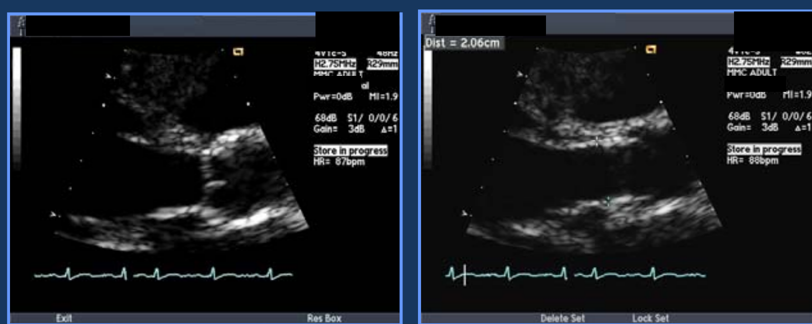
= 0.65 cm^2

Question 2

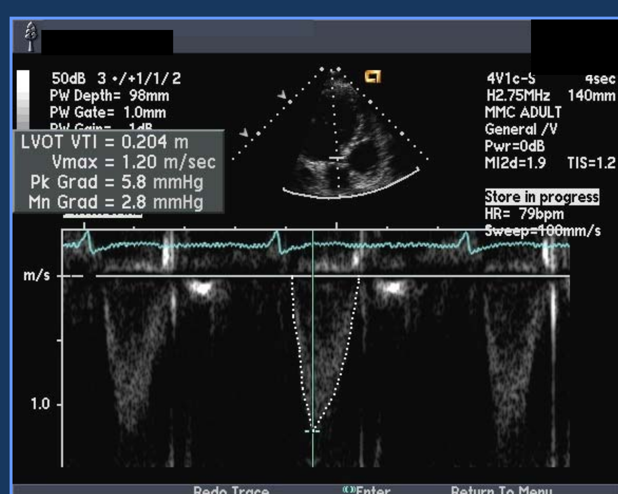
44 year old female with dyspnea



LVOT 2.1 cm
(no aortic regurgitation)

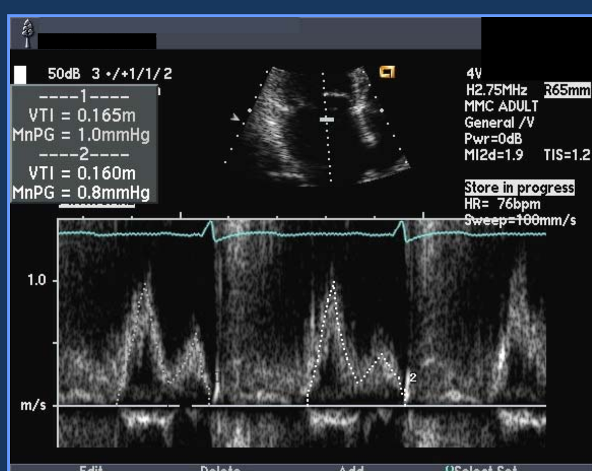


LVOT TVI = 20 cm



MV Annulus = 3.9 cm

MV Annulus TVI = 16 cm



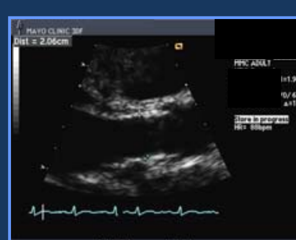
79

What is Mitral Regurgitant Fraction?

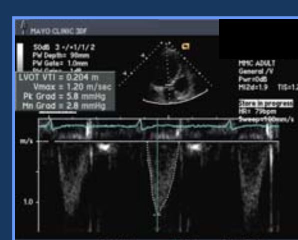
A. 54%
B. 64%
C. 74%
D. 44%

- LVOT 2.1 CM
- LVOT TVI 20 CM
- MV ANNULUS DIAMETER 3.9 CM
- MV ANNULUS TVI 16 CM

Step 1: Calculate LVOT Stroke Volume



LVOT Diameter = 2.1 cm



LVOT TVI = 20 cm

LVOT Stroke Volume = $0.785\,(2.1\text{ cm})^2$ X 20 cm

= 69 cm^3

Step 2: Calculate MV Stroke Volume

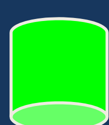
MV Annulus = 3.9 cm

MV Annulus TVI = 16 cm

MV Stroke Volume $= 0.785\ (3.9\ \text{cm})^2 \times 16\ \text{cm}$

$= 191\ \text{cm}^3$

Step 3: Calculate MR Volume



MV Stroke Volume

\-

LVOT Stroke Volume

=

MR Volume

$$191\ \text{cm}^3 - 69\ \text{cm}^3 = 122\ \text{cm}^3$$

Step 4: Calculate Regurgitant Fraction (RF)

Mitral RF = MR Volume / MV Stroke Volume = $\frac{122\ cm^3}{191\ cm^3}$ = 64%

Step 5: Calculate MR ERO

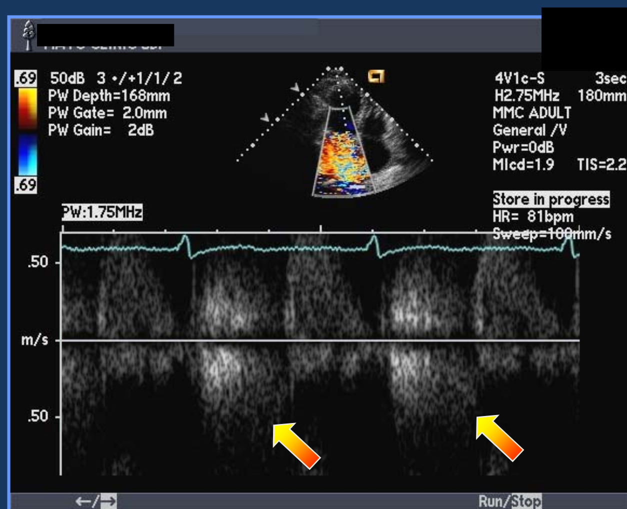
Effective Regurgitant Orifice = MR Volume / MR TVI

MR Volume: $122\ cm^3$

MR TVI (161 cm)

ERO = $\frac{122\ cm^3}{161\ cm}$ = $0.76\ cm^2$

Pulmonary Vein: Systolic Flow Reversal



89

Question 3

- A 66-year-old patient presents with angina, but no symptoms of heart failure. He has a history of hypertension, smoking, type 2 diabetes mellitus, and hyperlipidemia.
- He has a strong family history of coronary artery disease.
- A stress echocardiogram is positive with evidence of cavity dilatation.
- He undergoes cardiac catheterization and left main coronary artery disease is found.
- His echocardiogram reveals an ejection fraction (ef) of 59% and evidence for degenerative (primary) mitral regurgitation.

Which of the following mitral valve echocardiographic parameters should prompt repair of the mitral valve in the setting of concomitant coronary artery bypass grafting?

A. Mitral valve ERO = 41 mm^2

B. MR vena contracta = 0.5 cm

C. MR regurgitant fraction = 43%

D. MR regurgitant volume = 48 cc

Chronic *Primary* Mitral Regurgitation: Intervention (cont.)

Recommendations	COR	LOE
Concomitant MV repair or replacement is indicated in patients with chronic severe primary MR undergoing other cardiac surgery	I	B

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease
Nishimura RA et al. Circulation. 2014 Jun 10;129(23):e521-643

Quantitation of Mitral Regurgitation

	Mild	Moderate		Severe
MR Volume (cm^3/beat)	<30	30 - 44	45 - 59	≥ 60
Regurgitant Fraction (%)	<30	30 - 39	40 - 49	≥ 50
ERO (cm^2)	<0.20	0.20-0.29	0.30-0.39	≥ 0.40
Vena Contracta Width (cm)	< 0.3	0.3 - 0.69		≥ 0.7

Zoghbi WA, et al. J Am Soc Echocardiogr 2017

Question 4

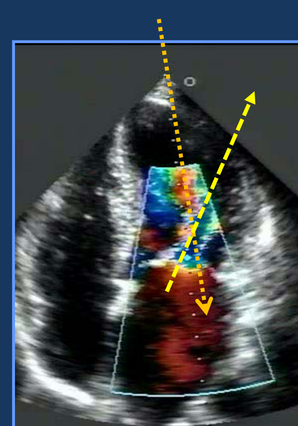
42 year old female with mitral stenosis. The Doppler angle of interrogation was sub-optimal

What will this do to the pressure half-time (PHT)?

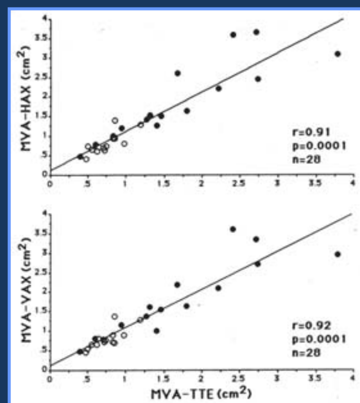
A. This will overestimate the MVA by PHT

B. This will underestimate the MVA by PHT

C. This will not effect the MVA calculation by PHT



Doppler Angle of Incidence Does Not Influence MVA by PHT



Stoddard MF, Prince CR, Tuman WL, Wagner SG. *Am Heart J* 1994. 27:1562

Question 5

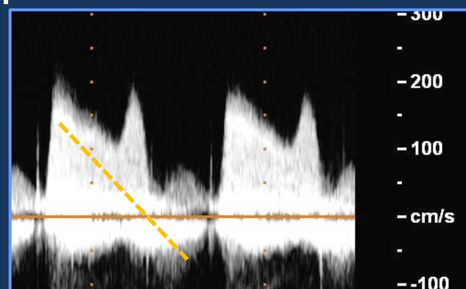
54 year old female with mitral stenosis

Mean mitral diastolic mitral gradient = 8 mmHg

Deceleration time = 420 ms

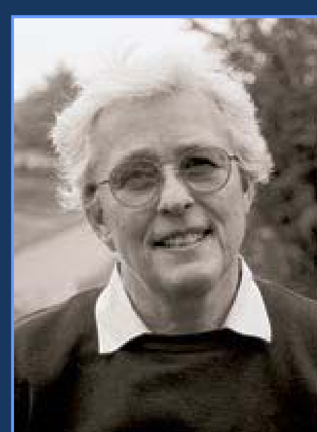
What is the mitral valve area?

1. 1.8 cm^2
2. 1.5 cm^2
3. 1.2 cm^2
4. 1.0 cm^2



Doppler Pressure Half-Time

- Hatle L et al. Noninvasive assessment of pressure drop in mitral stenosis by doppler ultrasound. ***Br med J*** 1978
- Concept first described by libanoff and rodbard in 1966

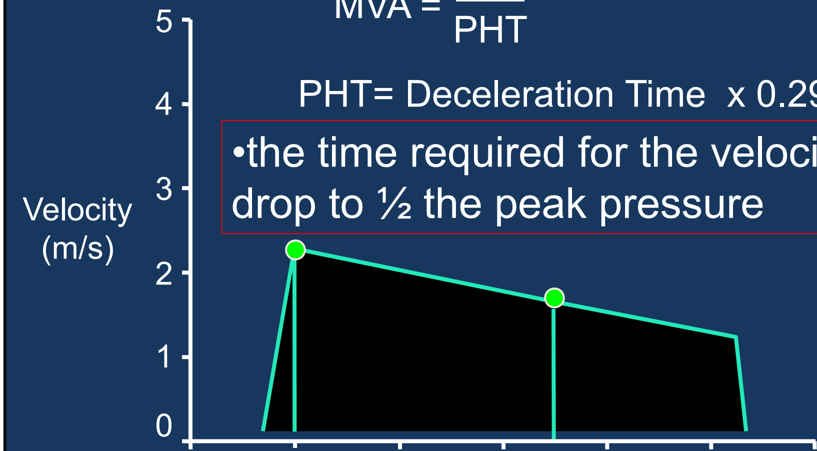


Pressure Half-time

$$MVA = \frac{220}{PHT}$$

PHT= Deceleration Time x 0.29

•the time required for the velocity to drop to ½ the peak pressure



Mitral Valve Area Calculation

- PHT = DT X 0.29
  - 420 ms X 0.29 = 121.8 ms
- MVA = PHT/220
  - 220/121.8 = 1.8 cm^2