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Stress Testing in Valvular Disease

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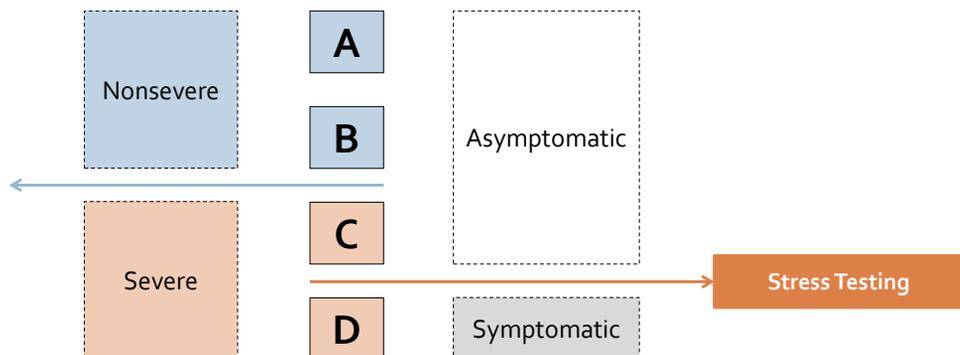
Disclosures

Speakers Bureau (Philips, Medtronic)
Advisory Board (Siemens)

Case #1: Stress in Aortic Regurgitation

Stages of Valvular Heart Disease

2014 ACC/AHA Valvular Guidelines



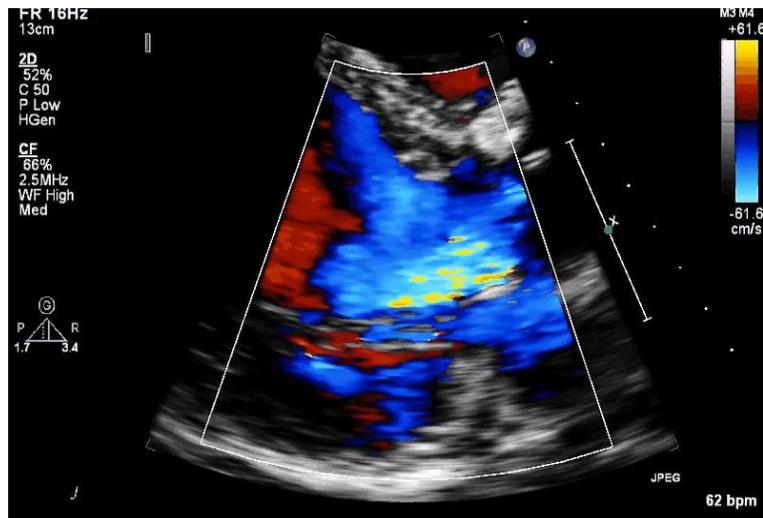
Valvular disease is typically NOT symptomatic unless SEVERE!

Case Presentation

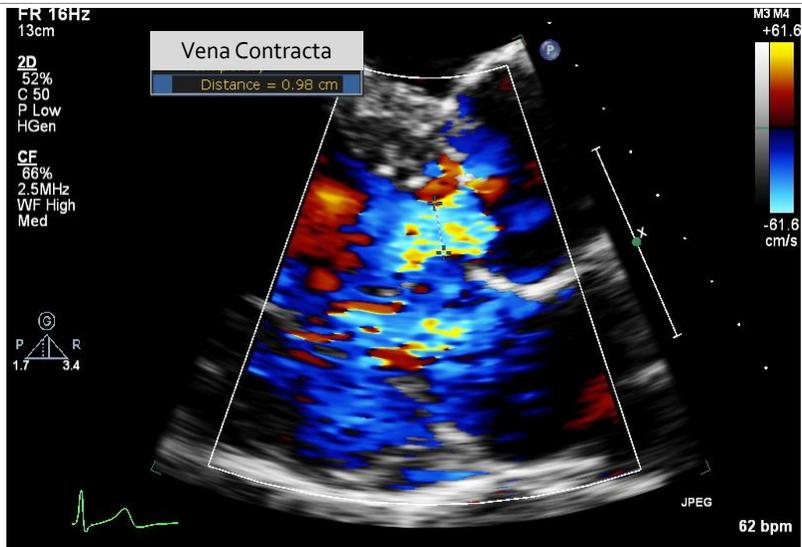
- 48-year-old man with
- Severe aortic regurgitation
 - Bicuspid aortic valve and aortic root dilatation
 - Reports occasional exertional dyspnea which he attributes to recent weigh gain

Referred for **exercise** stress echo

Resting TTE



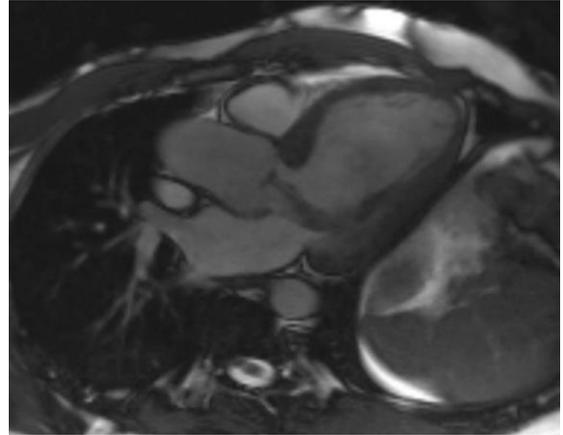
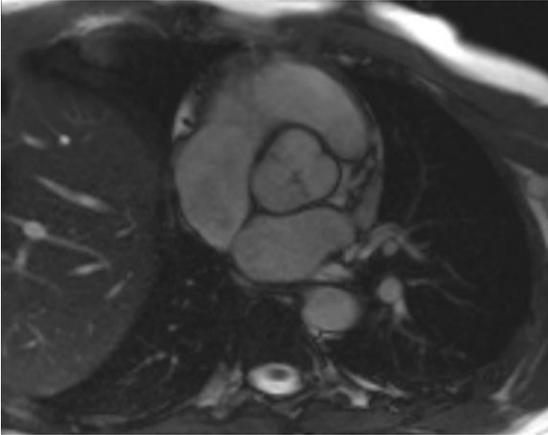
Resting TTE



Resting TTE

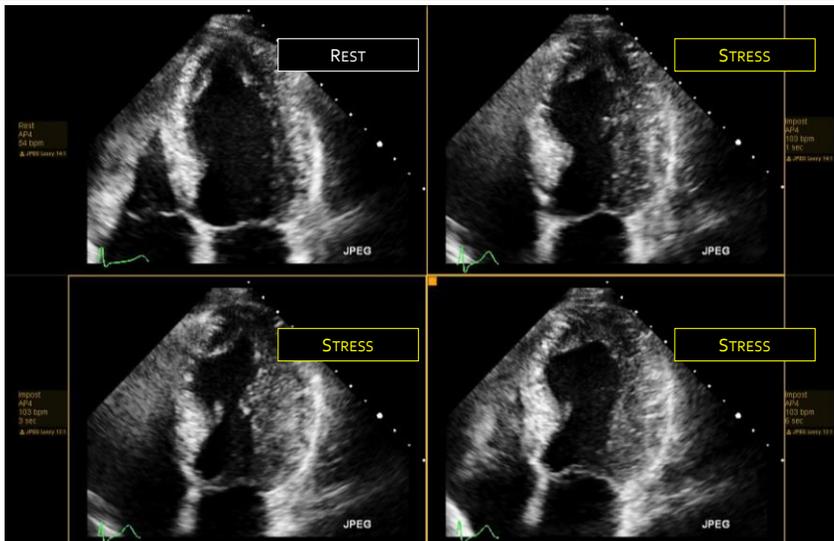


Resting MRI

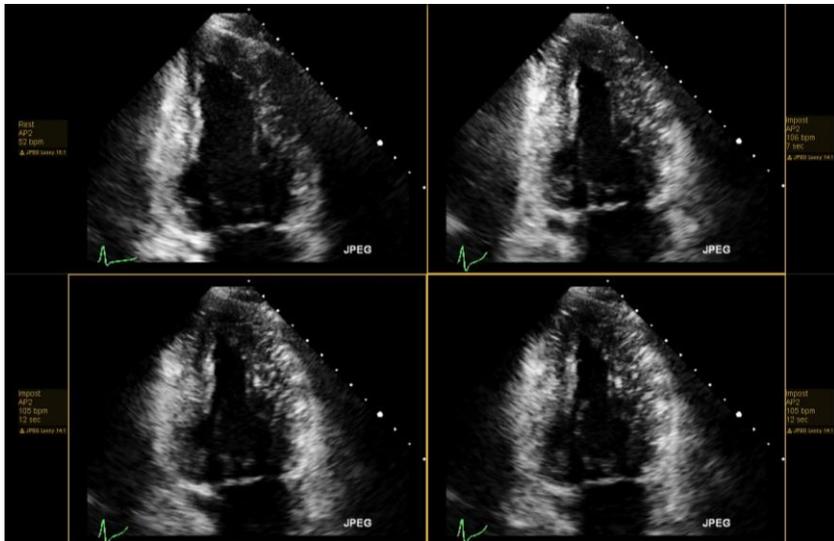


Regurgitant volume = 71 mL | Regurgitant Fraction 51%

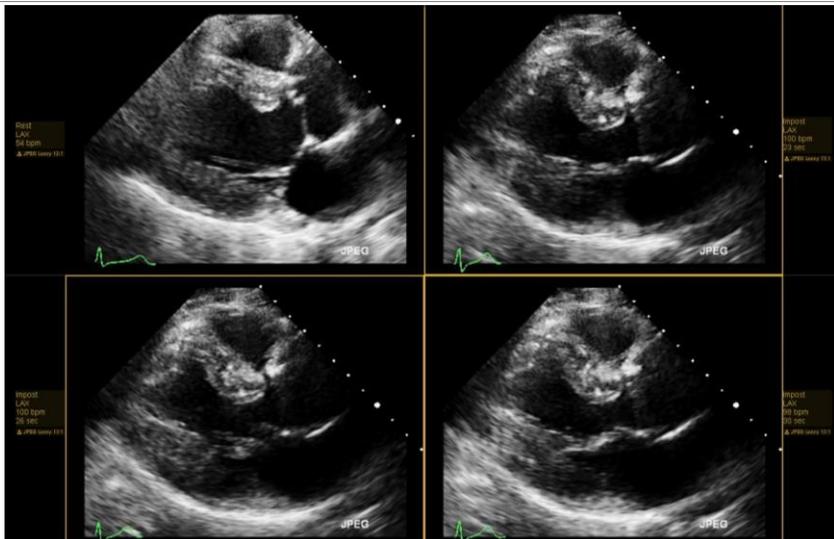
Exercise Stress Echo: A4C



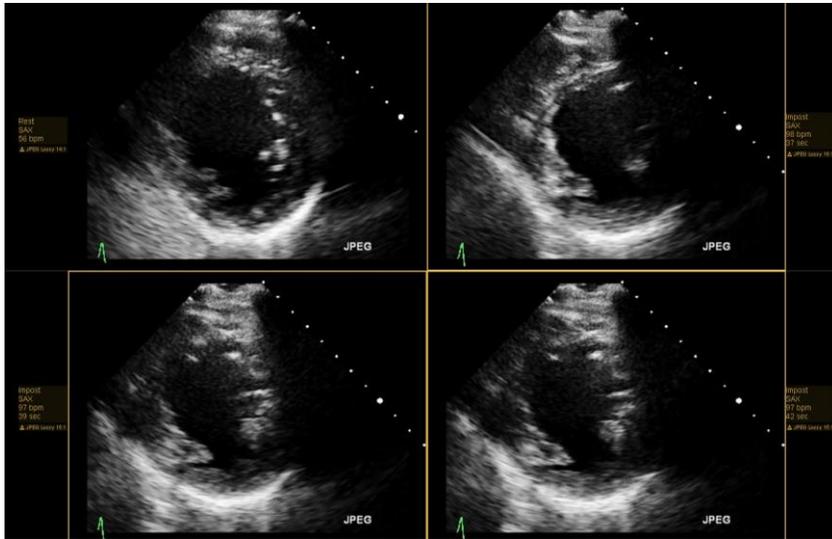
Exercise Stress Echo: A2C



Exercise Stress Echo: PLAX



Exercise Stress Echo: SAX



Question

With respect to **ischemia**, is this a positive or a negative stress echo?

Ischemia Conclusion

- Resting LVEF was 65 %.
 - Stress echo images were obtained within 60 to 90 seconds post-stress.
 - At time of stress imaging, the maximum heart rate was 125 bpm.
 - At peak stress LVEF was 75 %.
 - The left ventricular cavity size became smaller with stress.
 - There were no stress-induced wall motion abnormalities.
 - **Stress echo is negative for ischemia.**
- 

Question

Should have I provided you with stress echo data
specific to aortic regurgitation?



Stress Testing in Aortic Regurgitation

2014 ACC/AHA Valvular Guidelines

4.3.1.5. DIAGNOSTIC TESTING—EXERCISE TESTING

Exercise stress testing can be used to assess symptomatic status and functional capacity in patients with AR. Such testing is helpful in confirming patients' reports that they have no symptoms with daily life activities and in assessing objective exercise capacity and symptom status in those with equivocal symptoms.

- No formal recommendation for stress testing in aortic regurgitation.
- There is merely a descriptive paragraph in the guidelines.

Exercise Data

- Exercised for 12 minutes and 0 seconds on Bruce protocol which represents 114 % of expected exercise duration of approximately 10.5 min adjusted for age and gender.
- Reached stage 4 and achieved 12.4 mets.
- **Patient's functional capacity was above average for age.**
- **Developed no symptoms during the test.**

Conclusion

- Despite severe aortic regurgitation, patient has excellent exercise capacity and no exercise-induced symptoms.
 - Continue watchful waiting; no need for aortic valve replacement referral at this time.
- 

Case #2: Stress Testing in Aortic Stenosis



Case Presentation

74-year-old man

- Coronary artery disease; s/p CABG
- Apparent low-gradient, low LVEF severe aortic stenosis at rest

Referred for **dobutamine** stress echo

Dobutamine Stress Testing in Aortic Stenosis

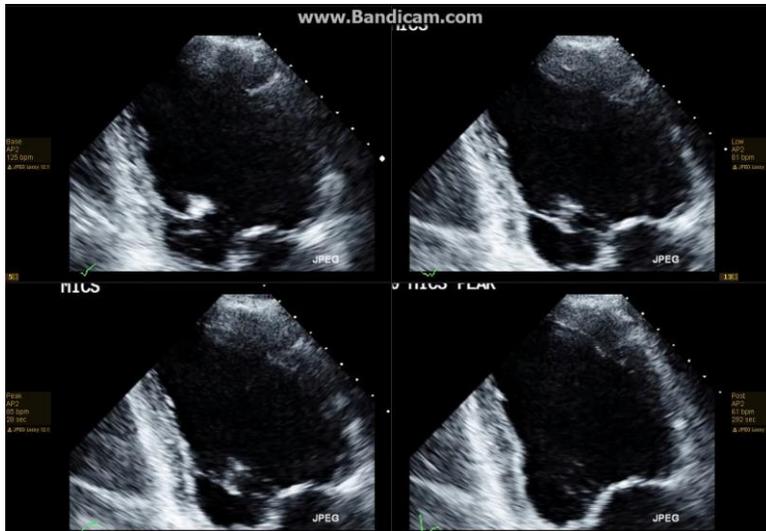
2014 ACC/AHA Valvular Guidelines

CLASS IIa

1. **Low-dose dobutamine stress testing using echocardiographic or invasive hemodynamic measurements is reasonable in patients with stage D2 AS with all of the following (95–97) (Level of Evidence: B):**
 - a. **Calcified aortic valve with reduced systolic opening;**
 - b. **LVEF less than 50%;**
 - c. **Calculated valve area 1.0 cm² or less; and**
 - d. **Aortic velocity less than 4.0 m per second or mean pressure gradient less than 40 mm Hg.**

- Dobutamine stress echo recommended only for D2 patients (low-gradient, low LVEF severe aortic stenosis)

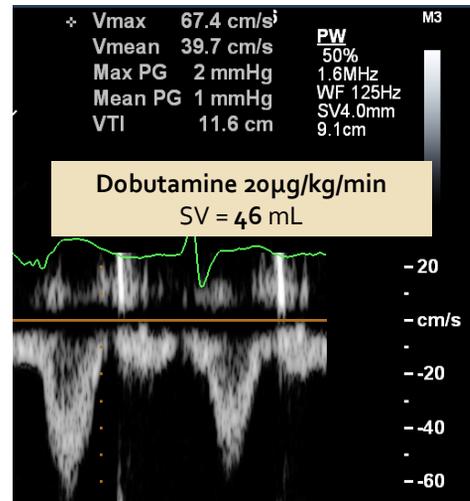
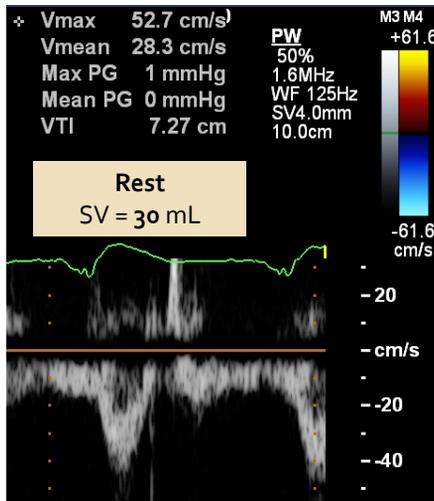
Exercise Stress Echo: A2C



LVOT Size

LVOT diameter 2.2 cm (area 3.8 cm²)

LVOT VTI



Question

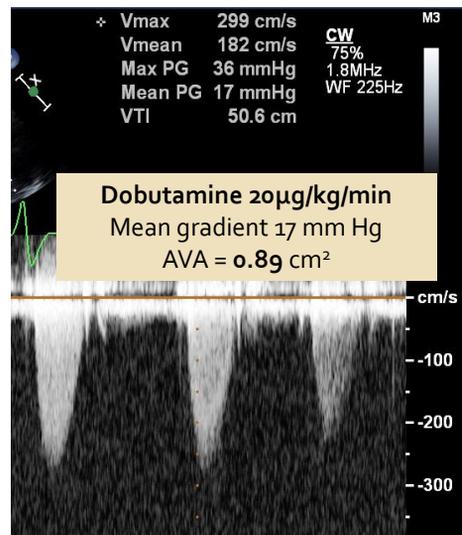
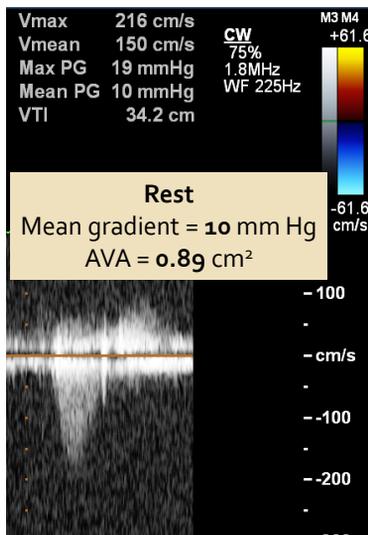
With respect to stroke volume change, was this a diagnostic test?

Answer

Yes

Diagnostic test implies an increase in SV of at least **20%**.

Aortic Valve Spectral Doppler



Question

Is this a true AS or pseudo AS?



Answer

This patient has **true severe** low-gradient aortic stenosis in the setting of low LVEF.

- With peak dobutamine dose of 20 ug/kg/min, there was >20% increase in LVOT stroke volume, an increase in the mean AV gradient from 10 mm Hg to 17 mm Hg and with no change in AVA.
 - These findings are consistent with true severe low-gradient aortic stenosis in the setting of severe LV systolic dysfunction and contractile reserve.
- 

Complete Calculations

BSA 1.8 m²

		Unit	Baseline	Dobutamine		
				5	10	20
LVOT	Diam	cm	2.2	2.2	2.2	2.2
	Area	cm ²	3.80	3.80	3.80	3.80
	Vmax	m/sec	0.5	0.5	0.7	0.7
	VTI	cm	8	9	11	12
	SV	mL	30	34	42	46
	% Change SV		0%	13%	38%	50%
	SVI	mL/m ²	17	19	23	25
AV	AVA	cm ²	0.89	0.88	0.87	0.89
	AVA Change	cm ²	0.00	-0.02	-0.02	0.00
	AVA Index	cm ² /m ²	0.50	0.49	0.48	0.50
	Vmax	m/sec	2.2	2.3	2.6	2.9
	Peak Grad	mm Hg	19	21	27	34
	Mean Grad	mm Hg	10	10	16	17
	VTI	cm	34	39	48	51
	DVI		0.23	0.22	0.27	0.24

Bonus Slides

ACC/AHA recommendations for **exercise** stress testing in aortic stenosis.

Exercise Stress Testing in Aortic Stenosis

2014 ACC/AHA Valvular Guidelines

CLASS IIa

1. Exercise testing is reasonable to assess physiological changes with exercise and to confirm the absence of symptoms in asymptomatic patients with a calcified aortic valve and an aortic velocity 4.0 m per second or greater or mean pressure gradient 40 mm Hg or higher (stage C) (25,46,47,117). (Level of Evidence: B)

CLASS III: Harm

1. Exercise testing should not be performed in symptomatic patients with AS when the aortic velocity is 4.0 m per second or greater or mean pressure gradient is 40 mm Hg or higher (stage D) (122). (Level of Evidence: B)

- Recommendations are only for high-gradient severe AS
- Test for
 - Symptoms
 - Exercise duration
 - BP response
 - Ventricular arrhythmia
- Don't use exercise stress testing in symptomatic patients with high-gradient AS

Exercise Stress Testing in Aortic Stenosis

▶ When to stop exercise (Positive exercise echo end-points in AS):

- **Symptoms:**
 - Syncopal or pre-syncopal episode, including severe dizziness
 - Angina
 - Limiting dyspnea or decreased exercise tolerance, defined as inability to reach 60% of age and sex adjusted metabolic equivalents of task (METs)
 - **Abnormal BP response:**
 - Lack of increase or a drop in systolic blood pressure
 - Exercise-induced hypotension is defined in some studies as failure to increase SBP by at least 20 mm Hg
 - **Ventricular arrhythmia**
 - Significant ventricular arrhythmias (≥4 consecutive ventricular premature beats)
- ▶ **AS gradients at peak stress:** Data on prognostic value of exercise-induced AS gradient are equivocal. Some suggest that a mean pressure gradient increase >20 mm Hg with exercise is prognostic of future cardiac events.

Source: saric.us/economy

Case #3: Stress Testing in Mitral Stenosis

Case Presentation

40-year-old woman

- Grew up in the former Soviet Union
- History of rheumatic heart disease
- Complains of exertional dyspnea
- Resting TTE shows
 - Modestly elevated mitral gradients and
 - No pulmonary hypertension.

Referred for **exercise** stress echo

Stress Testing in Mitral Stenosis

2014 ACC/AHA Valvular Guidelines

CLASS I

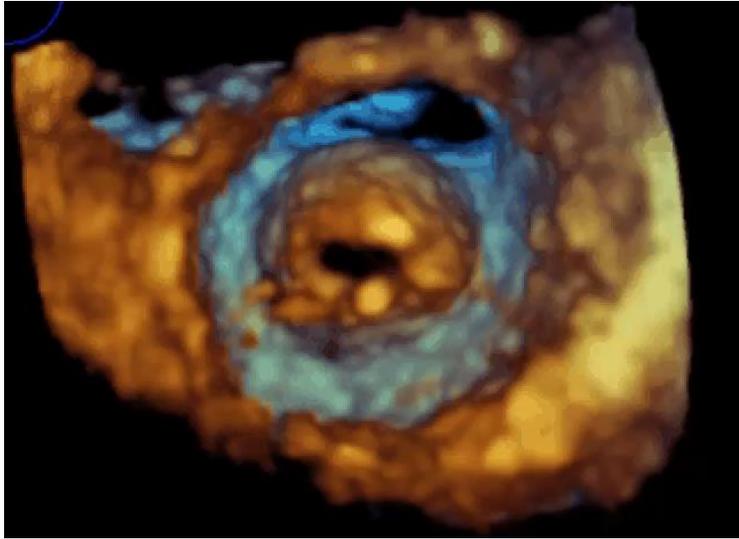
1. Exercise testing with Doppler or invasive hemodynamic assessment is recommended to evaluate the response of the mean mitral gradient and pulmonary artery pressure in patients with MS when there is a discrepancy between resting Doppler echocardiographic findings and clinical symptoms or signs. (Level of Evidence: C)

- Either exercise or dobutamine stress testing is acceptable.
- Assess for stress-related
 - Symptoms
 - Worsening mean mitral gradient
 - Worsening PA systolic pressure

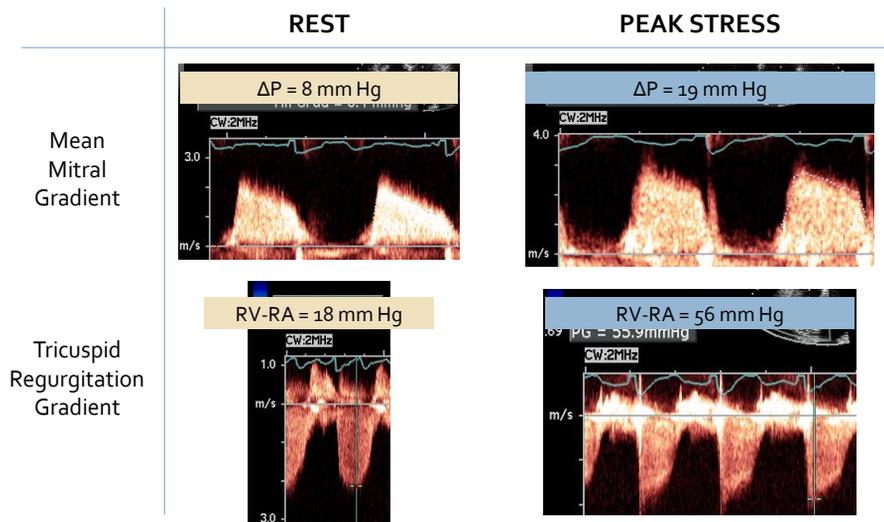
Resting Echo: Rheumatic Mitral Stenosis



Resting Echo: Rheumatic Mitral Stenosis



Exercise Stress Echo Data



Question

Is this a diagnostic stress echo with respect to mitral stenosis?



Answer

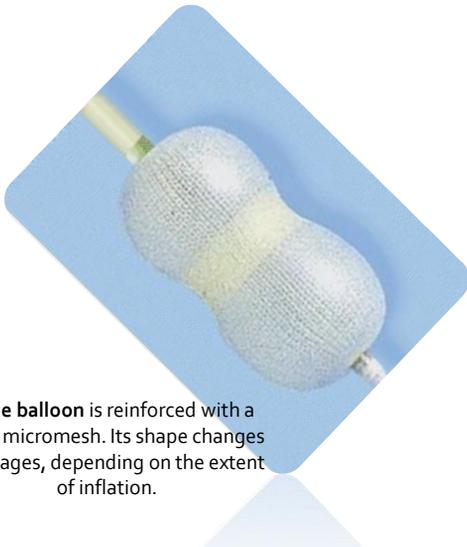
Yes, this stress echo is positive with respect to mitral stenosis?



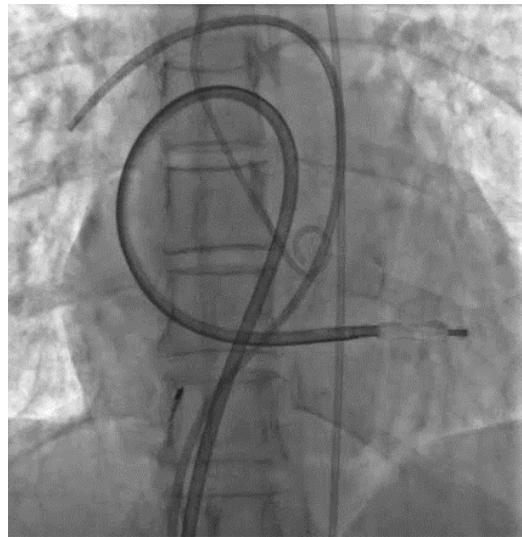
Question

Now that we know that the stress echo is positive with respect to mitral stenosis, what should we do next?

Referred for Percutaneous Mitral Balloon Valvuloplasty



Inoue balloon is reinforced with a nylon micromesh. Its shape changes in 3 stages, depending on the extent of inflation.



Stress Testing in Mitral Stenosis

Indications for Mitral Valvuloplasty (2006 ACC/AHA Valvular Guidelines)

instances:

- Symptomatic patients with moderate or severe mitral stenosis.
- In asymptomatic patients with moderate or severe mitral stenosis, PMBV is indicated when there is pulmonary artery systolic pressure is > 50 mm Hg at rest **or > 60 mm Hg with exercise**, or when there is new onset atrial fibrillation.
- PMBV may also be considered in symptomatic patient with mild mitral stenosis (valve area > 1.5 cm²) **when pulmonary artery systolic pressure greater > 60 mm Hg, pulmonary artery wedge pressure > 25 mm Hg, or mean mitral valve gradient > 15 mm Hg during exercise.**

Dobutamine stress echo is an acceptable alternative to exercise stress testing in mitral stenosis.

**15/60 mm Hg
Rule**

Thank You!



New York University Langone Medical Center

Stress in Mitral Regurgitation

Exercise Stress Testing in Primary Mitral Regurgitation

2014 ACC/AHA Valvular Guidelines

CLASS IIa

1. Exercise hemodynamics with either Doppler echocardiography or cardiac catheterization is reasonable in symptomatic patients with chronic primary MR where there is a discrepancy between symptoms and the severity of MR at rest (stages B and C) (377,378). (Level of Evidence: B)

CLASS IIa

2. Exercise treadmill testing can be useful in patients with chronic primary MR to establish symptom status and exercise tolerance (stages B and C). (Level of Evidence: C)

- Assess for worsening symptoms, MR and PASP with exercise
- Assess for symptoms and exercise capacity

Exercise Stress Testing in Functional Mitral Regurgitation

2014 ACC/AHA Valvular Guidelines

CLASS I

2. Noninvasive imaging (stress nuclear/positron emission tomography, CMR, or stress echocardiography), cardiac CT angiography, or cardiac catheterization, including coronary arteriography, is useful to establish etiology of chronic secondary MR (stages B to D) and/or to assess myocardial viability, which in turn may influence management of functional MR. (Level of Evidence: C)

- Stress echo is done primarily to test for ischemia and need for revascularization.
- No specific recommendations regarding symptom, MR or PASP response to exercise.