

Case Studies: Normal LVEF; severe AS; low gradient; Why strain helps

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Disclosures



- Research support from Medtronic, Abbott, Boston Scientific, Edwards
- No relevant disclosures for this presentation

Strain Imaging helps...

Why strain helps!



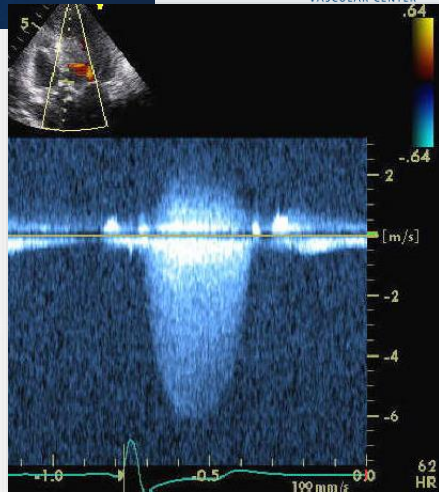
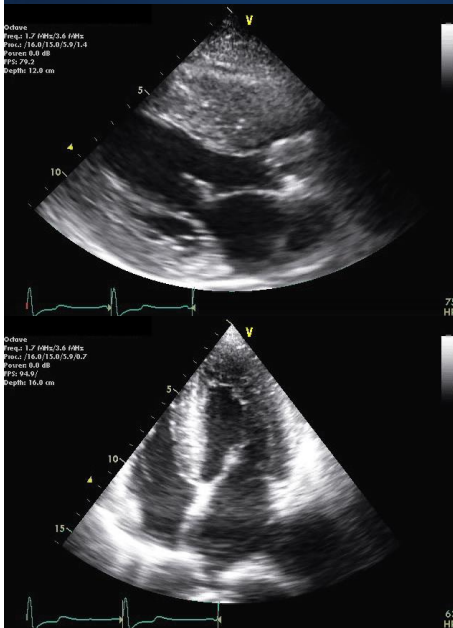
Why strain helps ?



62 yr Female with Dyspnea

- Large pleural effusion – thoracentesis, improved.
- Large (13cm) abdominal mass – non-hodgkins lymphoma.
- Murmur identified
- Started chemotherapy; 1/6 rounds completed

February 2010

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LVEF 65%
Peak AV Velocity 605m/s
Mean AV gradient 100mmHg
AVA 0.4cm²

The Clinical Dilemma

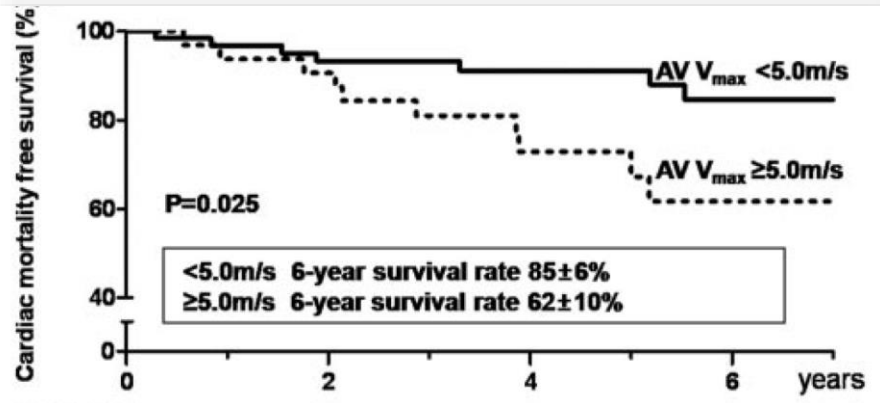
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Patient feels well. Reports no dyspnea.

Treatment options:

1. Do nothing. Patient is asymptomatic.
2. Interrupt the chemotherapy for urgent AVR surgery?
3. Finish the chemotherapy (8-12 weeks), then AVR?
4. Balloon aortic valvuloplasty now!

Outcomes for Critical AS

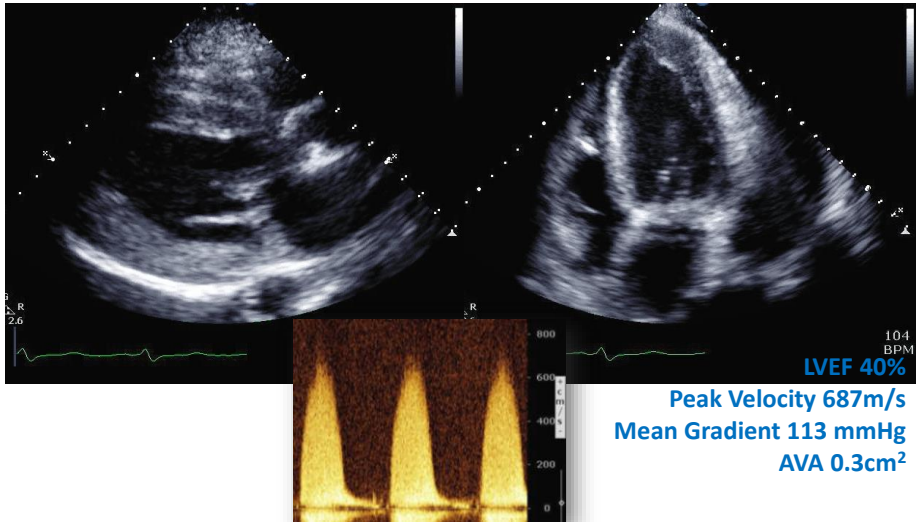


Kang et al. *Circulation* 2010;121;1502-1509

June... 4 Months Later

- Completed 4 of 6 courses of chemotherapy
- Developed refractory thrombocytopenia (plts <50)
- Complains of fatigue. Reports no dyspnea.
- Strongly advised to undergo AVR
- Patient refused

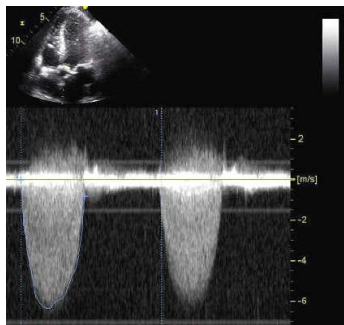
July – Intubated for SOB



Aortic Balloon Valvuloplasty



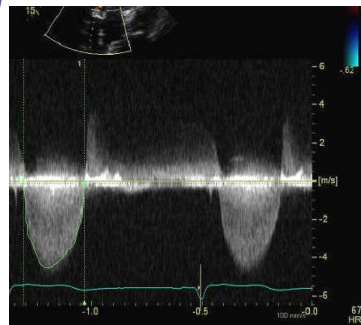
Pre-Balloon



Mean Gradient 103mmHg



Post-Balloon



Mean Gradient 52mmHg

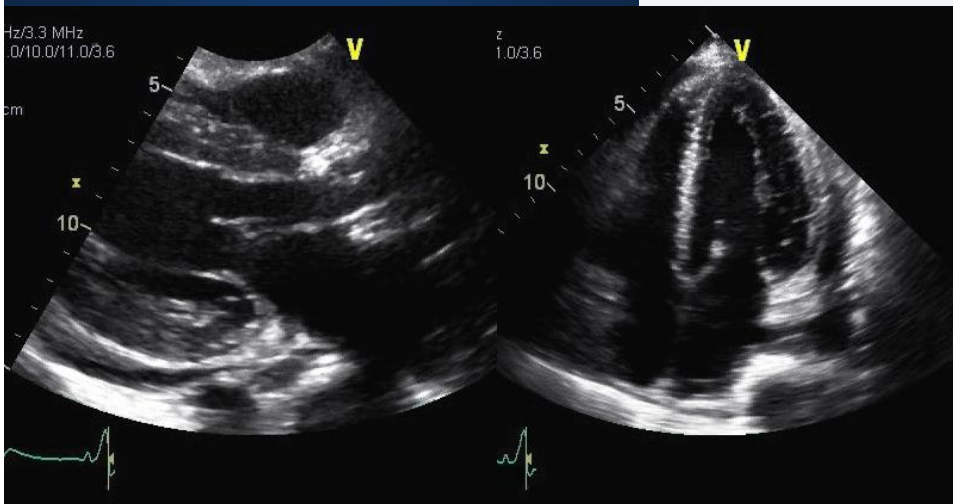
2 Weeks Later... The Dilemma Revisited

- Patient at home. Reports no dyspnea.
- Thrombocytopenia (plts ~50)

Treatment options:

1. Do nothing. Patient is asymptomatic.
2. Repeat aortic valvuloplasty, PRN!
3. AV replacement ASAP.
4. AV replacement in 4-6 weeks.

After Bioprosthetic AVR



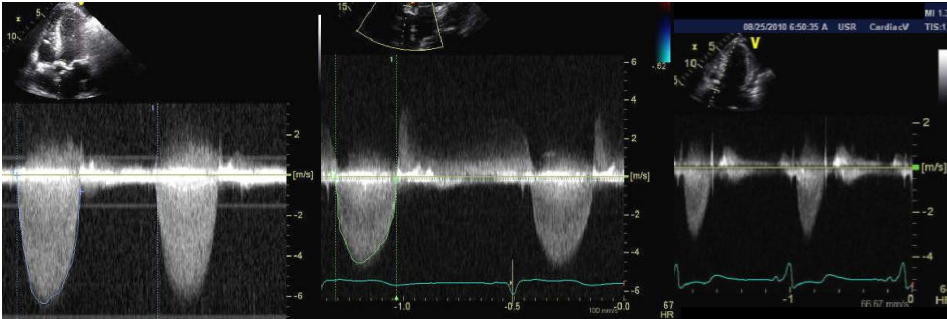
The Doppler Procession...



Pre-Balloon

Post-Balloon

Post-AVR



**Mean Gradient
103mmHg**

**Mean Gradient
52mmHg**

**Mean Gradient
21mmHg**

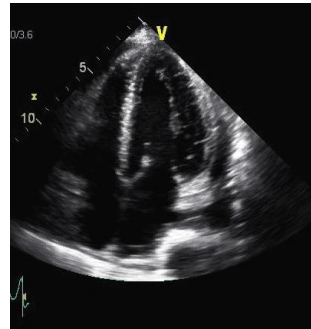
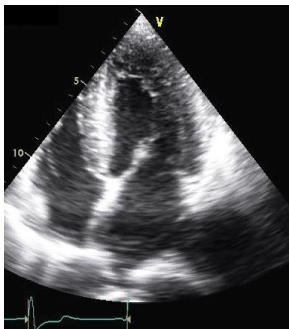
LV Response to Afterload



February

July (before BAV)

August (after AVR)

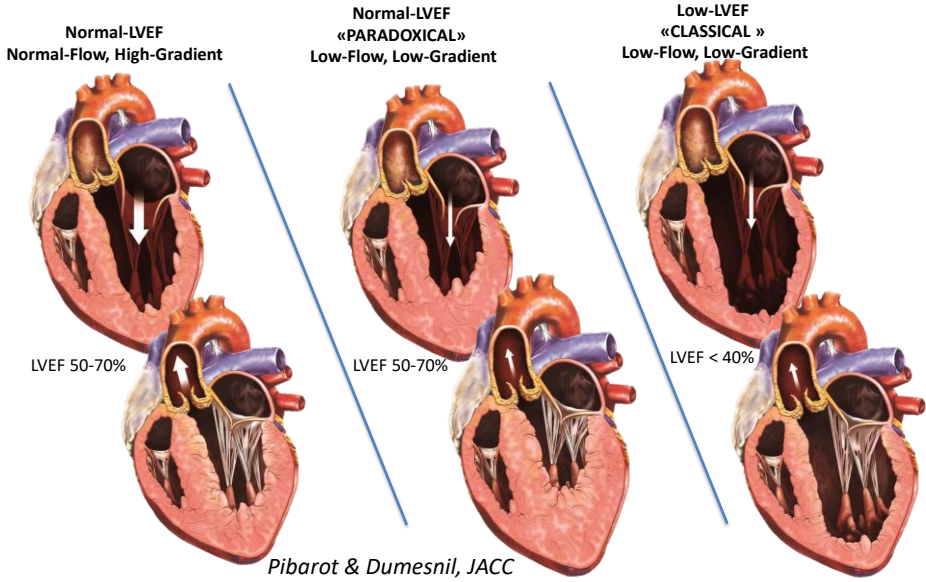


**LVEF 65%
Peak Velocity 6.0 m/s
Mean Gradient 100 mmHg
AVA 0.4 cm²**

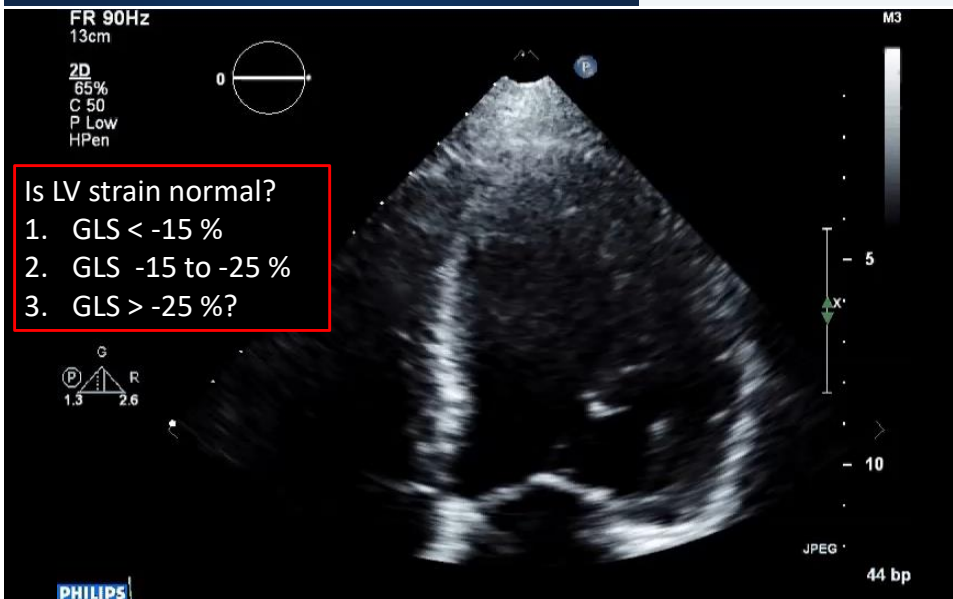
**LVEF 40%
Peak Velocity 6.7 m/s
Mean Gradient 113 mmHg
AVA 0.3 cm²**

**LVEF 60%
Peak Velocity 3.1 m/s
Mean Gradient 21 mmHg
Bio EOA 1.0 cm²**

Patterns of Aortic Stenosis

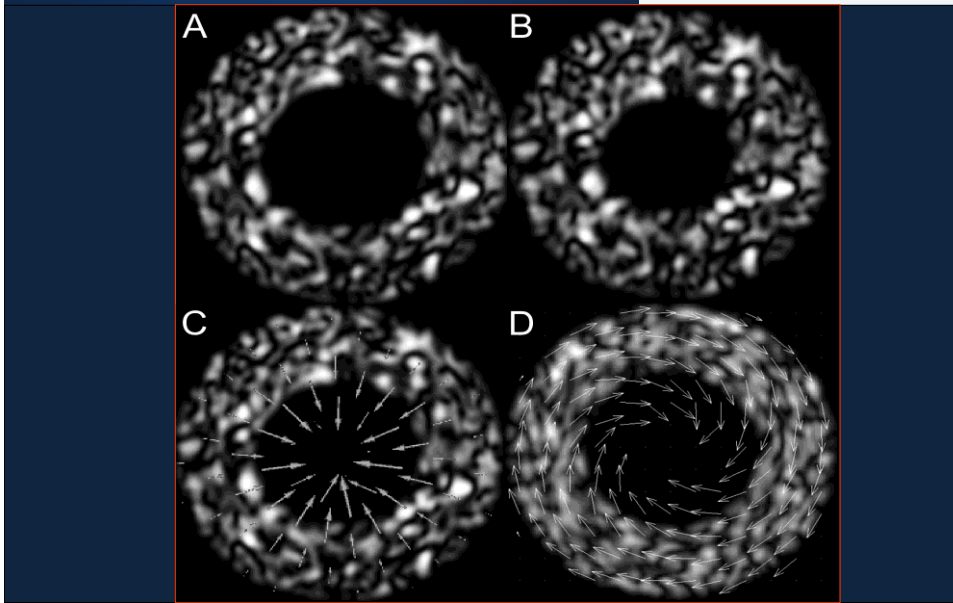


Is LV function normal?



Speckle Tracking

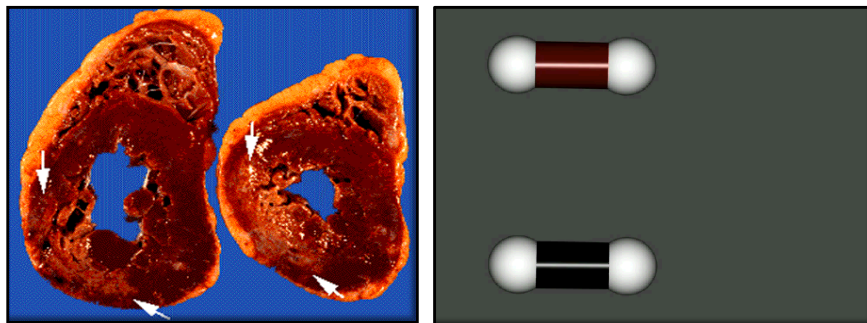
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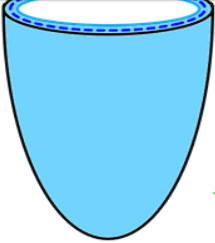
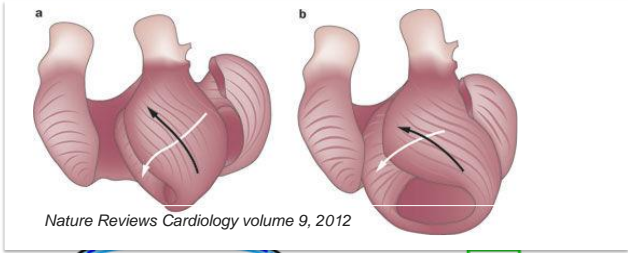
Myocardial Strain

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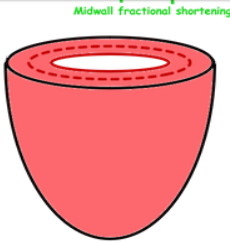
- **Strain** – deformation (or displacement), is produced by application of a stress (Force)
- The % change from the original dimension (% thickening)



Longitudinal displacement !



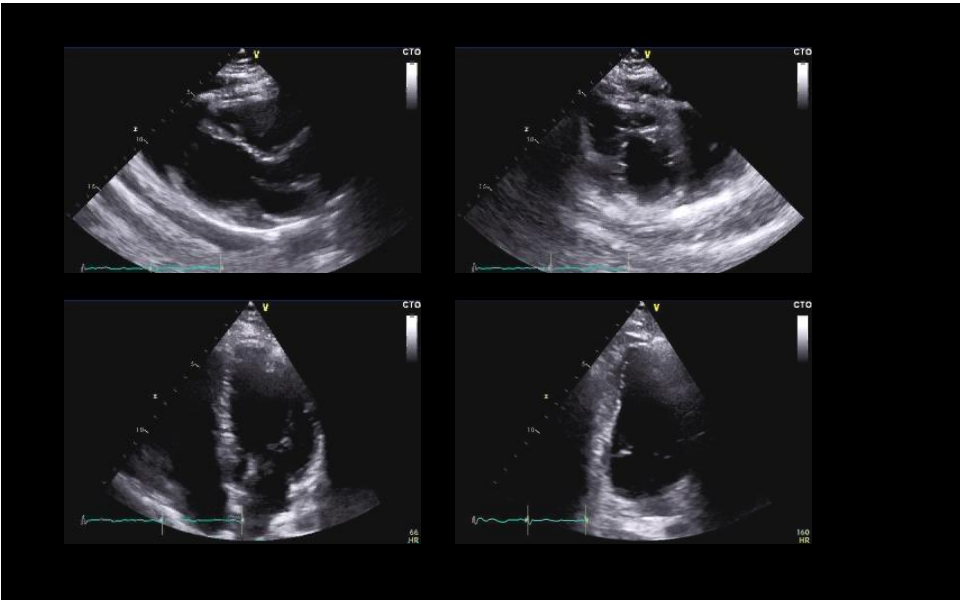
Diastole



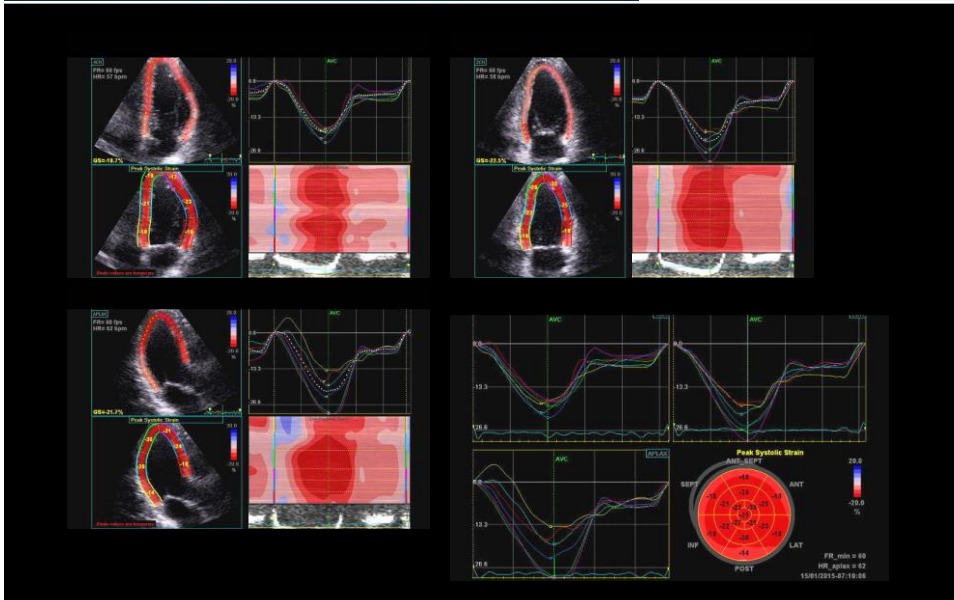
Systole

Dr. Asbjørn Støylen, St.Olavs Hospital, Norway

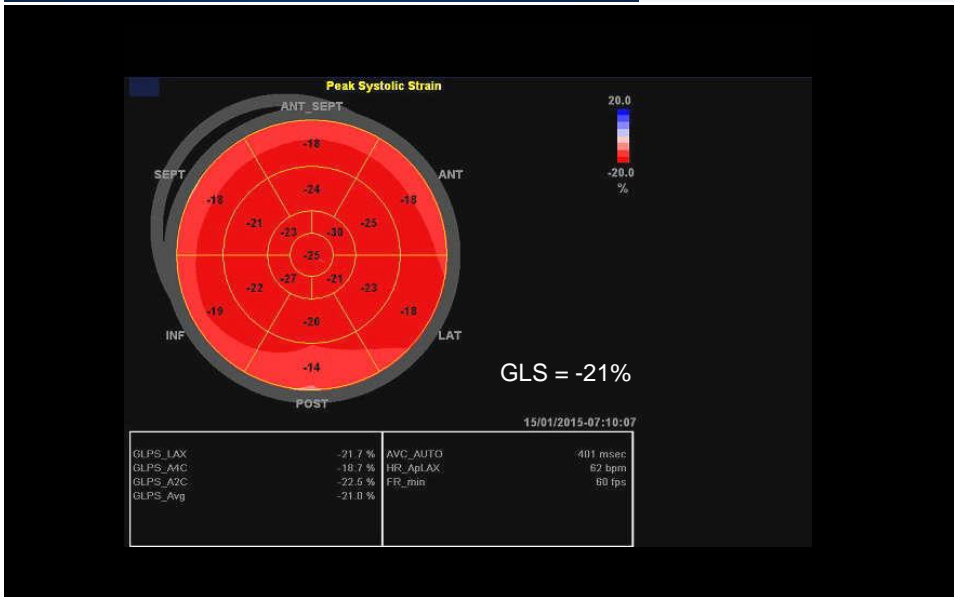
Normal LV Strain



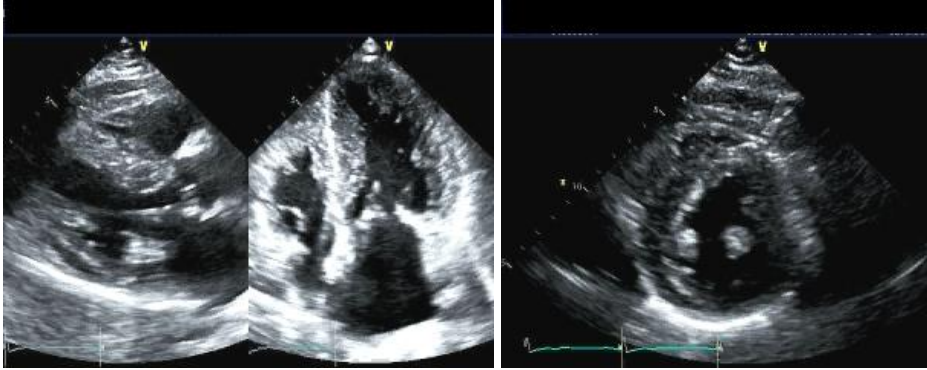
Normal LV Strain



Normal LV Strain

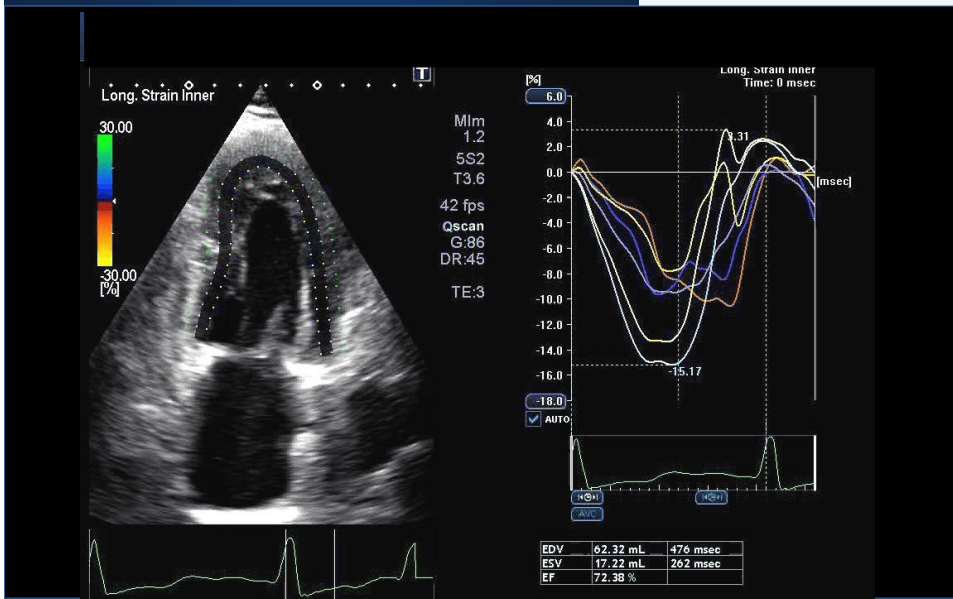


45M with severe hypertension

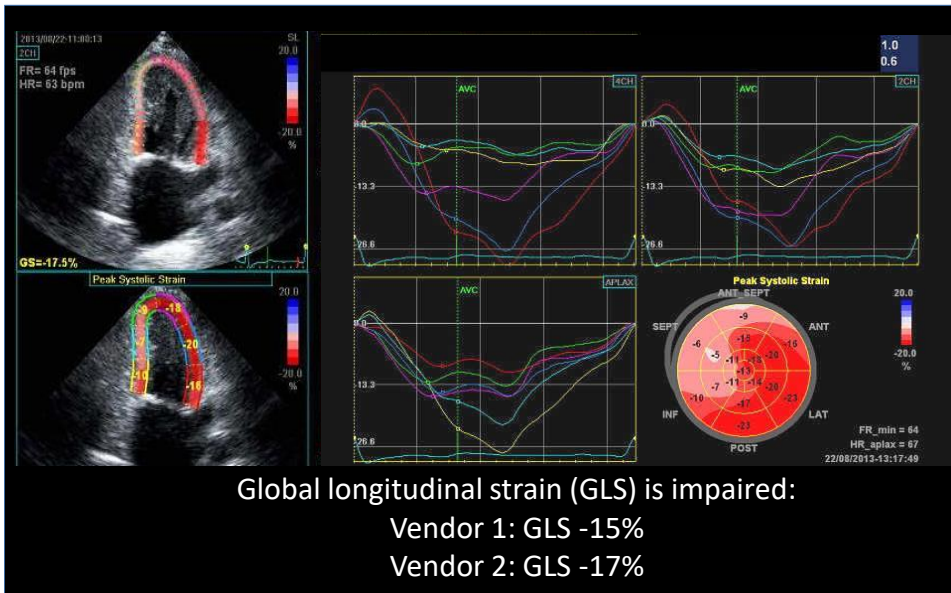


LVEF > 75%; Cavity Obliteration

45M with severe hypertension



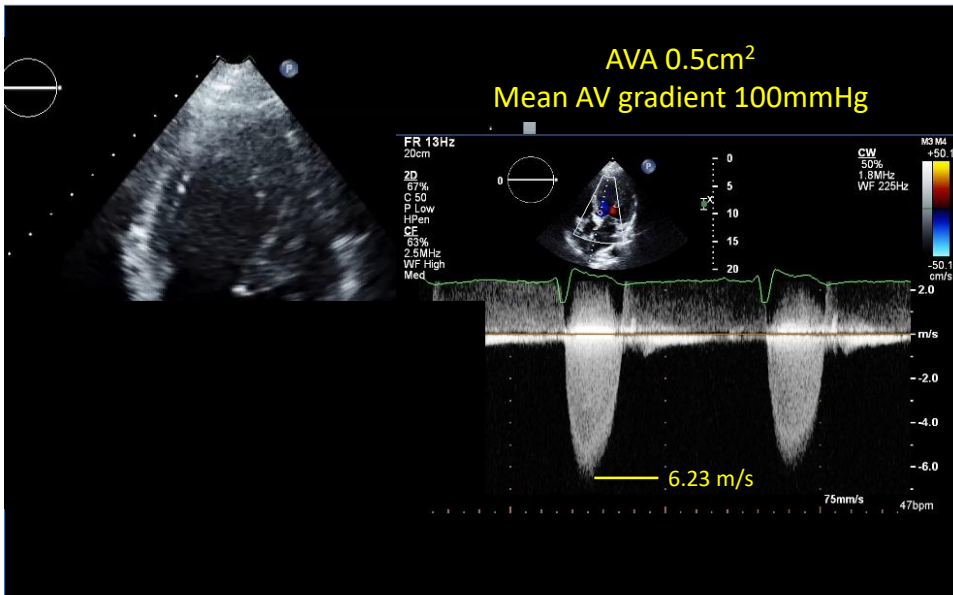
45M with severe hypertension



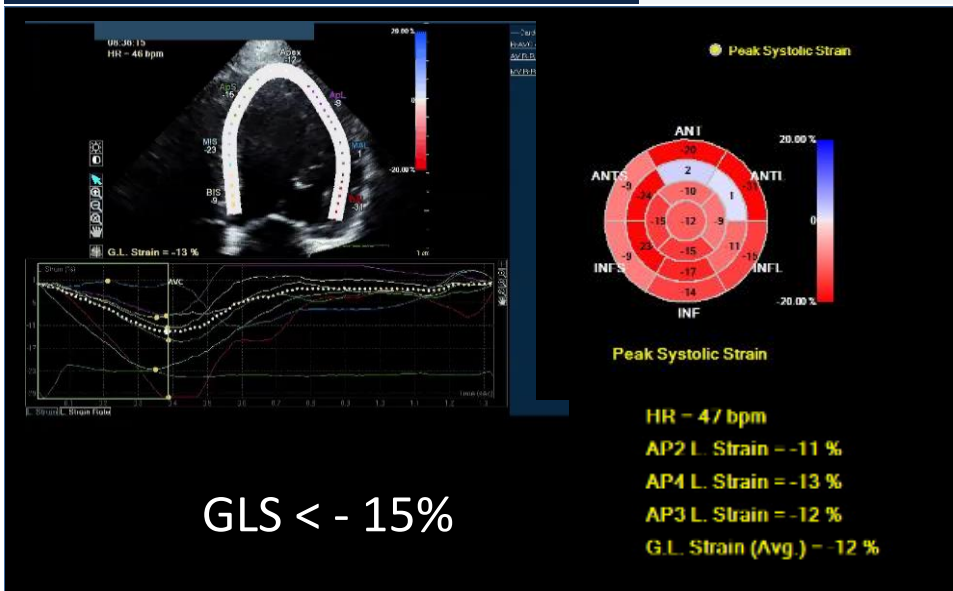
Clinical History

- 82 yr male
- Fully independent
- c/o mild fatigue
- Primary care MD referred to you for murmur

Is LV function normal?



LVEF is normal; GLS is reduced

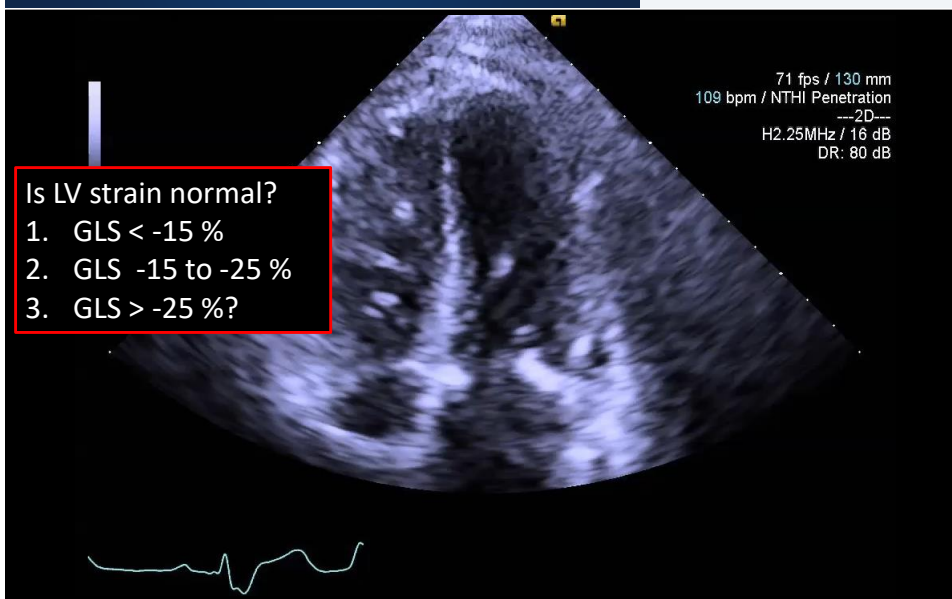


Clinical History

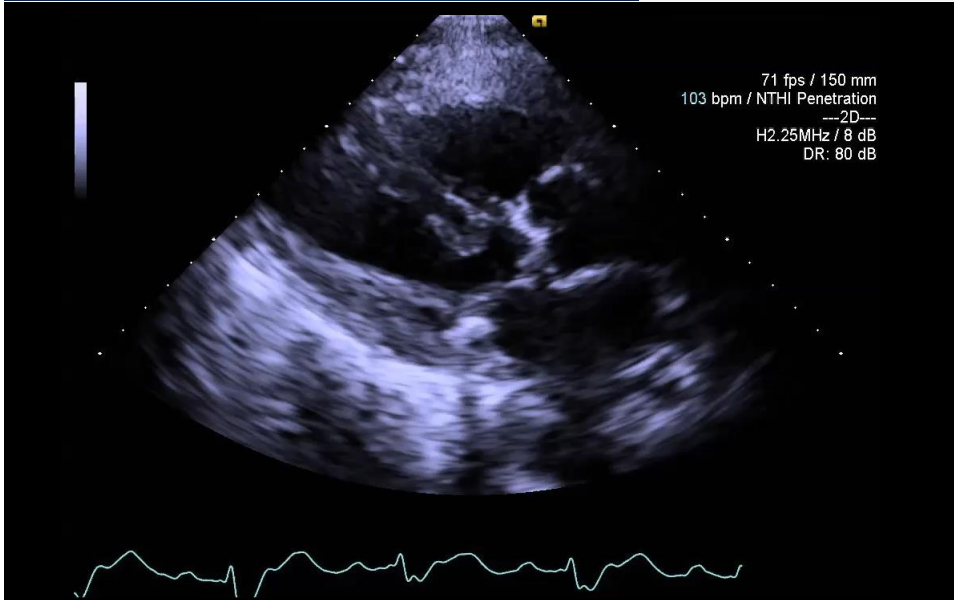
- 82 yr female
- Assisted living
- c/o profound fatigue, dyspnea on exertion

- Referred to your echo lab...

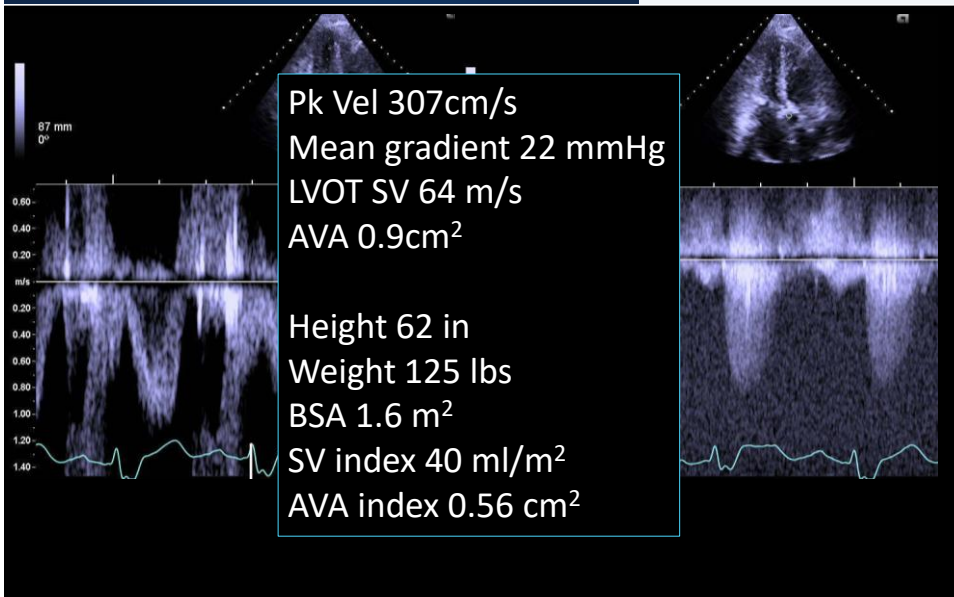
Is LV function normal?



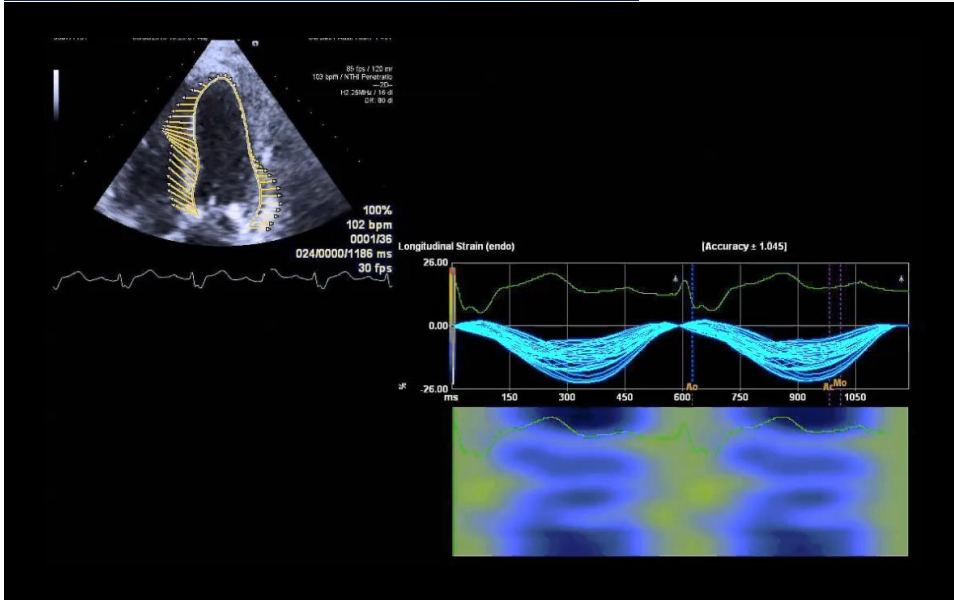
Is LV function normal?



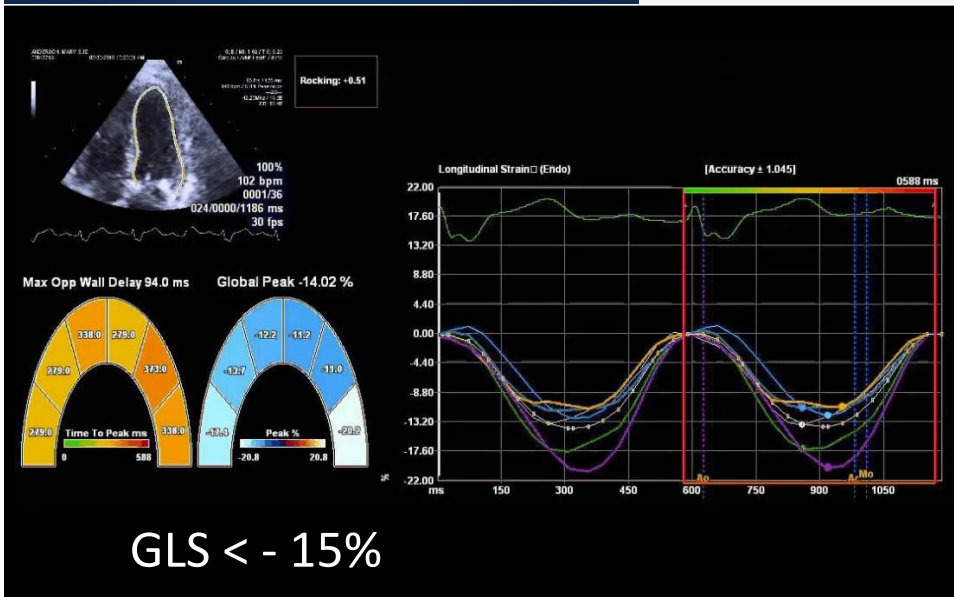
What is the AS severity?



LV strain imaging

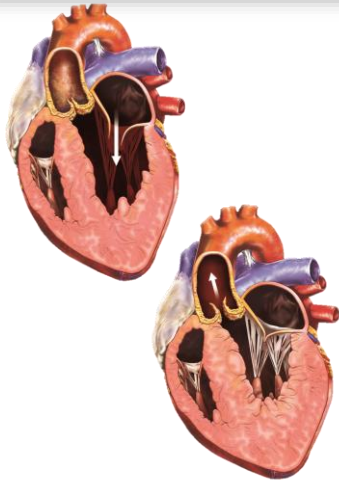


LV strain is reduced



Paradoxical Low-Flow, Low-Gradient Severe Aortic Stenosis Despite Preserved Ejection Fraction Is Associated With Higher Afterload and Reduced Survival

Zeineb Hachicha, MD; Jean G. Dumesnil, MD; Peter Bogaty, MD; Philippe Pibarot, DVM, PhD

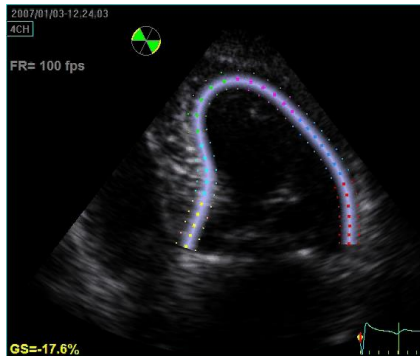


- Advanced age
- Women
- Hypertension
- Diabetes/metabolic syndrome

Hachicha Z et al., Circulation, 2007
Dumesnil et al. Eur Heart J, 2009
Pibarot & Dumesnil JACC, 2012

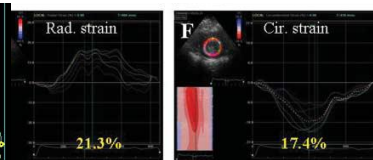
Paradoxical low-flow AS have abnormal systolic function

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Deterioration of Myocardial Function in Paradoxical Low-Flow Severe Aortic Stenosis: Two-Dimensional Strain Analysis

Seung-Pyo Lee, MD, Yong-Jin Kim, MD, PhD, Ji-Hyun Kim, MD, Kyungil Park, MD, Kyung-Hee Kim, MD, Hyung-Kwan Kim, MD, PhD, Goo-Yeong Cho, MD, PhD, Dae-Won Sohn, MD, PhD, Byung-Hee Oh, MD, PhD, and Young-Bae Park, MD, PhD, *Seoul and Seongnam, Korea*



Lancellotti et al. Eur J Echo 2010

Lee et al. J Am Soc Echocardiogr, 2011

Low-Flow, Low-Gradient Severe Aortic Stenosis Despite Normal Ejection Fraction Is Associated With Severe Left Ventricular Dysfunction as Assessed by Speckle-Tracking Echocardiography : A Multicenter Study

Jérôme Adda, Christopher Mielot, Roch Giorgi, Frédéric Cransac, Xavier Zirphile, Erwan Donal, Catherine Sportouch-Dukhan, Patricia Réant, Stéphane Laffitte, Stéphane Cade, Yvan Le Dolley, Franck Thuny, Nathalie Touboul, Cécile Lavoute, Jean-François Avierinos, Patrizio Lancellotti and Gilbert Habib

Circ Cardiovasc Imaging 2012;5:27-35: originally published online November 22, 2011;
DOI: 10.1161/CIRCIMAGING.111.967554

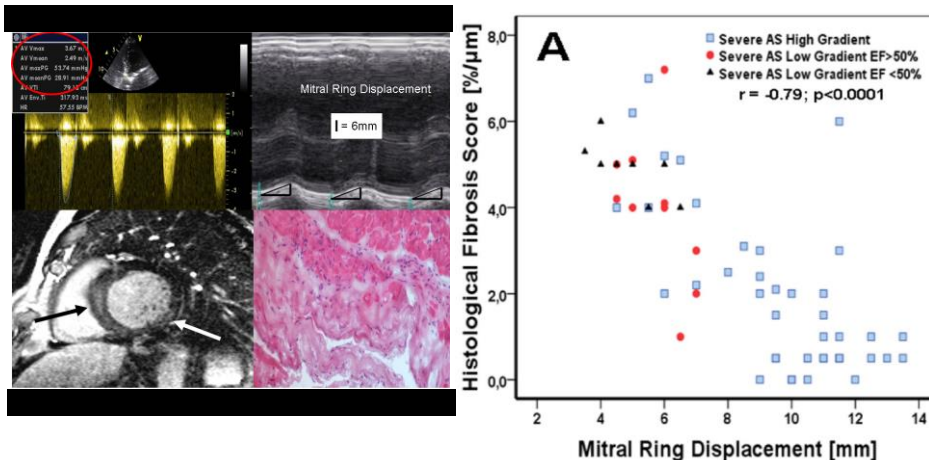
Circulation: Cardiovascular Imaging is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75214

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- LFLG AS is observed in 9% of patients with severe AS and normal ejection fraction
- Is associated markedly reduced longitudinal systolic function

PLFLG AS & Myocardial fibrosis

Paradoxical Low-Flow, Low-Gradient, Preserved LVEF



Hermann et al. *JACC* 2011;58:402-412

86 female; dyspnea



Ht: 61 in **BP:** 164/67
Wt: 135 lb **HR:** 78
BSA: 1.6 m²
Outpatient: Room Imagine
Indications for Study: Aortic Stenosis, Shortness of Breath
Procedures: 2D Echo, Colorflow Doppler, Strain
Previous Study: Date: 11/29/2016
Referring MD: LITTLE, STEPHEN, MD
Sono / Tech: Gates Steen, RCS
Fellow/NP: Avenatti, Eleonora MD
DOB, Age: 1/18/1931, 86 yr

2D Measurements

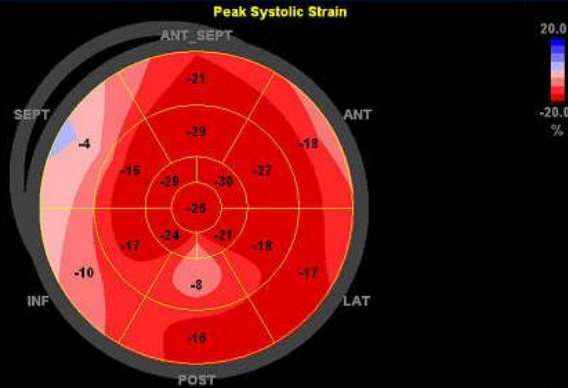
Ao An	1.9 cm	LV Mass	151.3 g
Ao Rtd	2.4 cm	LA Area	23.6 cm ²
Index	1.5 cm/m ²	RA Vol	15.7 ml
IVSd	1 cm	Index	9.8 ml/m ²
LVIDd	4.1 cm	RA Area	9.1 cm ²
Index	2.5 cm/m ²	LVOT	1.7 cm
LVIDs	2.2 cm	LA LngAx	5.3 cm
LV%fs	46.3 %	LA Vol	81.6 ml
LVPWd	1 cm	Index	51 ml/m ²
LA Ds	3.9 cm	RA LngAx	4.2 cm
RWT	0.6		

Doppler Measurements

AV For Flow/AVA			
AV pkVel	366.9 cm/s	AV AC/ET	0.4
AV mnVel	255.5 cm/s	AV TVI	93.8 cm
AV pkPG	53.9 mmHg	AVpkAcRt	7722 cm/s ²
AV Mean G	31.2 mmHg	AV DeRt	1000.1 cm/s ²
AV AC	133 msec	AV Area	0.6 cm ²
AV ET	367 msec		
LVOT For Flow			
LVOT Area	2.3 cm ²	LVOT SV	55.7 ml
LVOTpkVel	102.5 cm/s	HR	62.1 bpm
LVOTpkPG	4.2 mmHg	LVOT CO	3.5 l/min
LVOTmnPG	2.1 mmHg	LVOT CI	2.2 l/m/m ²
LVOT TVI	24.5 cm		

Paradoxical Low flow, low gradient, severe AS with preserved LVEF

LFLGSAS w NLVEF

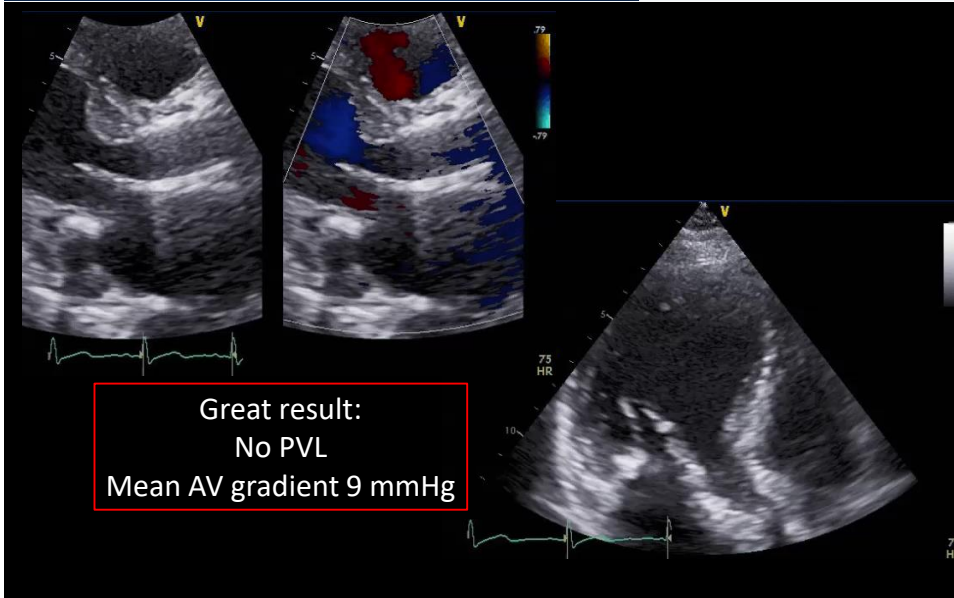


GLS = -19%

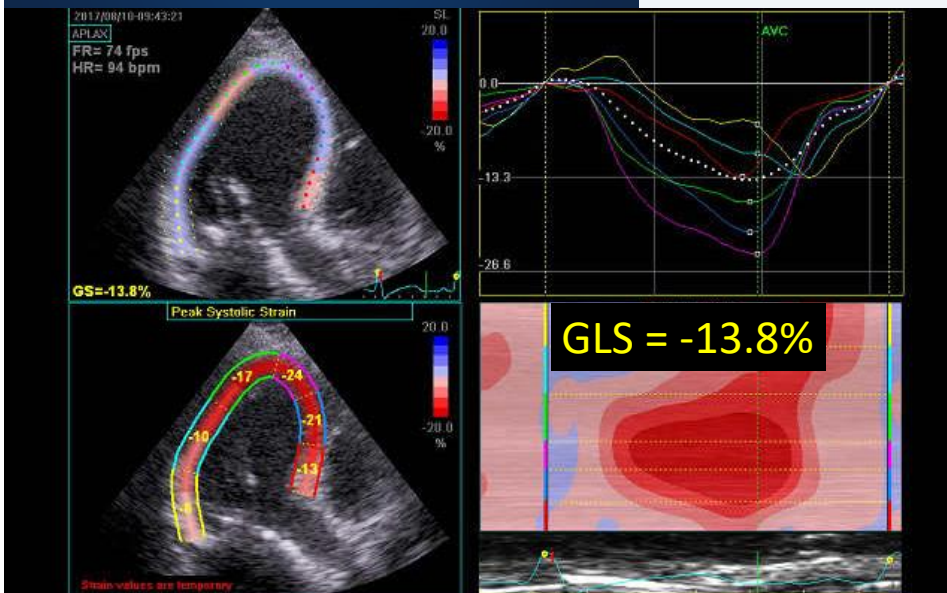
30/05/2017-09:14:50

GLPS_LAX	-18.4 %	AVC_AUTO	404 msec
GLPS_MC	-17.5 %	HR_AptLAX	88 bpm
GLPS_A2C	-21.1 %	FR_min	89 fps
GLPS_Avg	-18.0 %		

LFLGSAS w NLVEF w TAVR



Strain did what...?



Echo Features of Paradoxical Low-Flow, Low-Gradient AS

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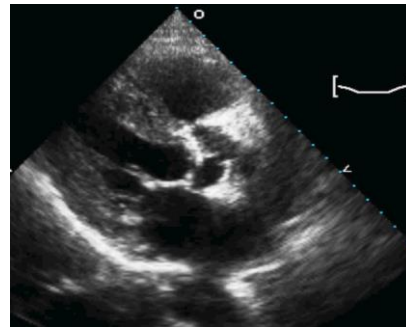
The Aortic Valve:

- $AVA < 1.0 \text{ cm}^2$ $AVA_i < 0.6 \text{ cm}^2/\text{m}^2$ $DVI < 0.25$
- Severely thickened/calcified valve
- Mean gradient $< 40 \text{ mmHg}$
- Valvulo-arterial impedance $> 4.5 \text{ mmHg}\cdot\text{ml}^{-1}\cdot\text{m}^2$



The Left Ventricle

- $EDD < 47 \text{ mm}$ $EDV < 55 \text{ mL/m}^2$
- RWT ratio > 0.50
- Myocardial fibrosis
- Impaired LV filling
- $LVEF > 50\%$
- $SV_i < 35 \text{ mL/m}^2$
- **GLS $< 15\%$**



Pibarot & Dumesnil, JACC 58;413-415, 2011

Strain Imaging...

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Why strain helps!

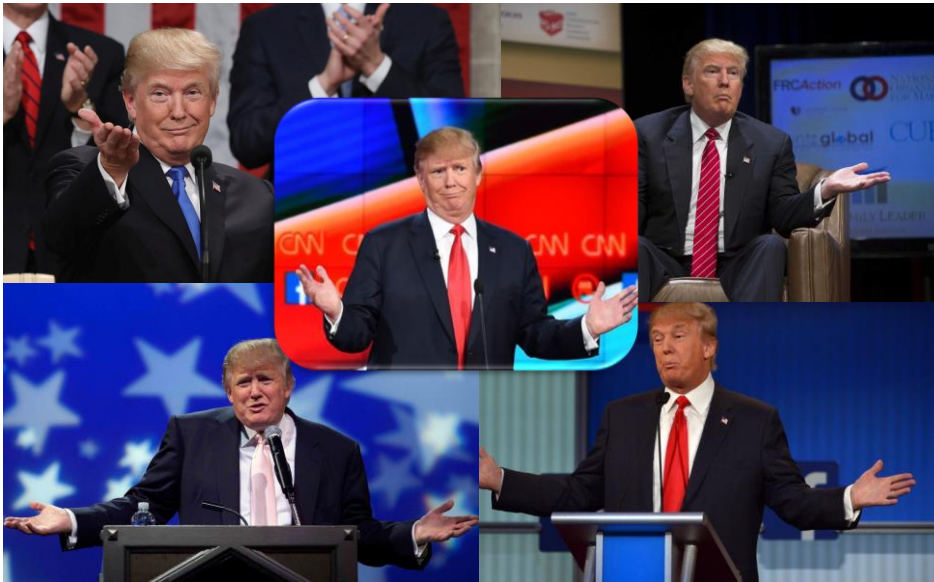


Why strain helps ?



For tough decisions
...look for guidance

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