# Getting the most out of the cardiac “echo” report

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# Disclosures:

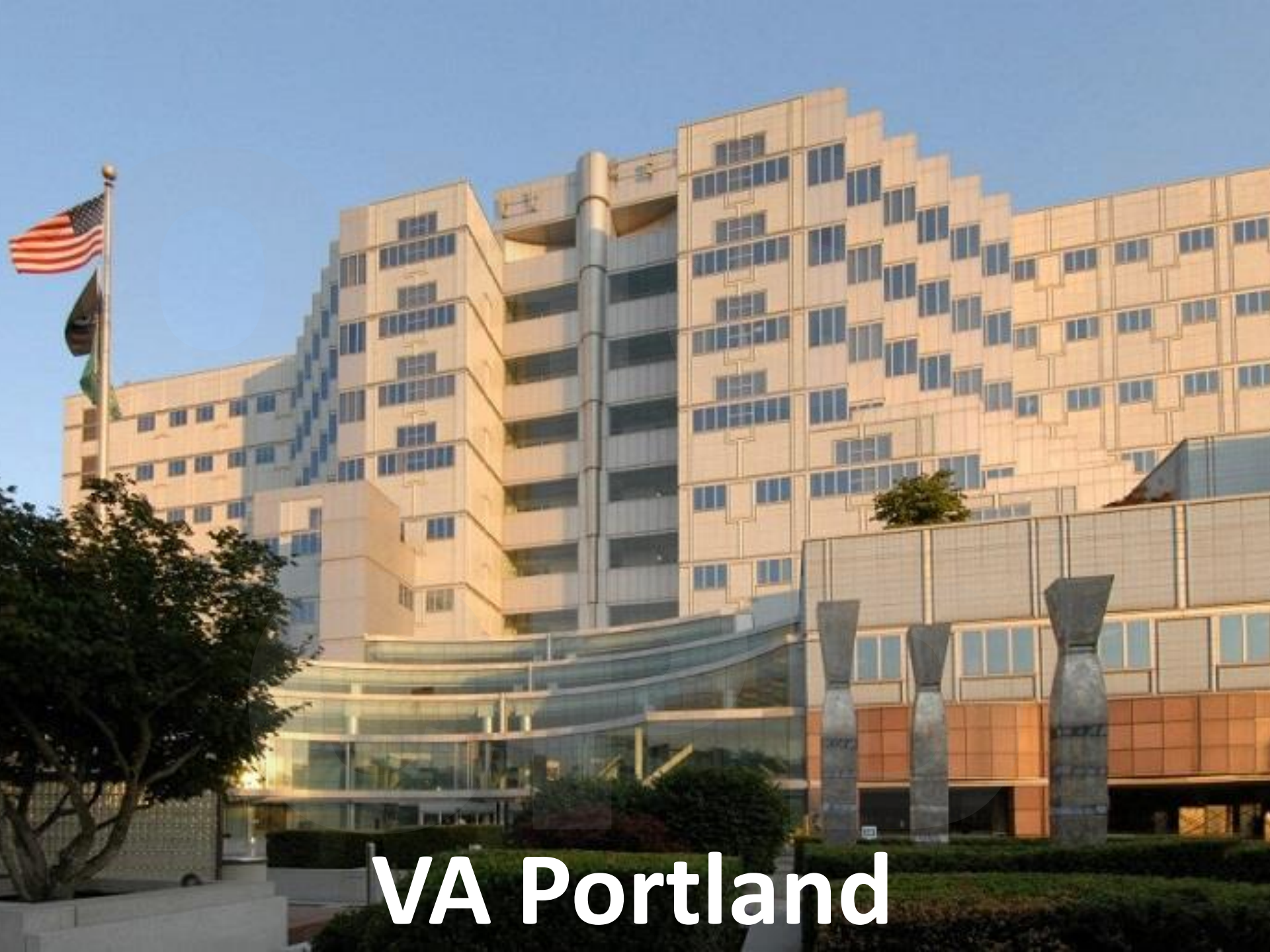
- I have no relevant financial interest in this topic.
- I prepared this lecture in my personal capacity. The opinions expressed in this lecture are my own and do not reflect the view of the Veteran's Health Administration or the United States government.

# Objective(s):

- To help referring providers extract clinically useful information from TTE reports, highlight current practices, and suggest some next steps in management of common cardiovascular conundrums.

# Common Queries & Concerns

- Murmur – please assess.
- Does this patient have pericarditis?
- Can you rule-out aortic aneurysm, please?
- Does this patient have heart failure?
- Reassess EF
- Is a cardiac cause of syncope present?


VA Portland

# MURMUR, PLEASE ASSESS

# The scenario:

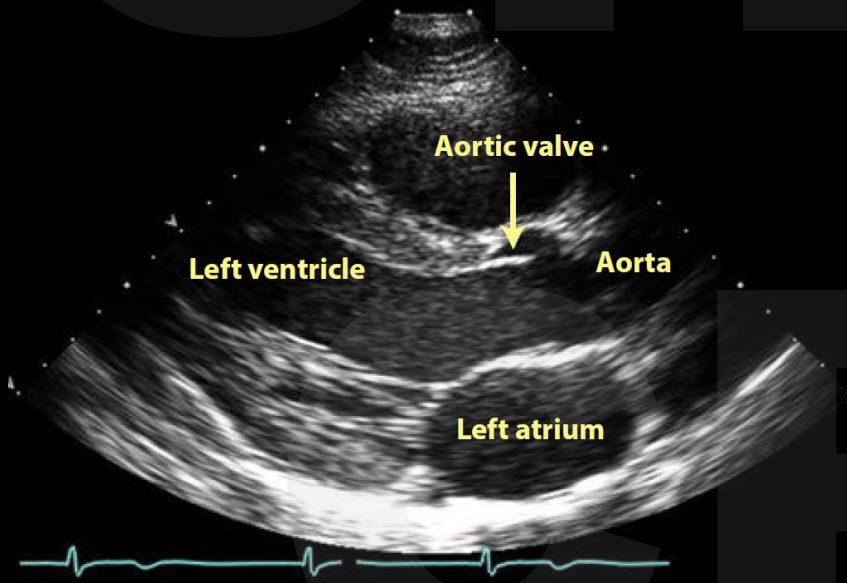
- A 78 year-old is transferring care from another medical system. A mid-peaking systolic murmur best heard at the RUSB is noted on exam. Chart review finds mild aortic stenosis documented on an echocardiogram 3 years ago. The TTE was otherwise normal and the patient denies chest pain, DOE, and syncope.

# When is the next TTE indicate?

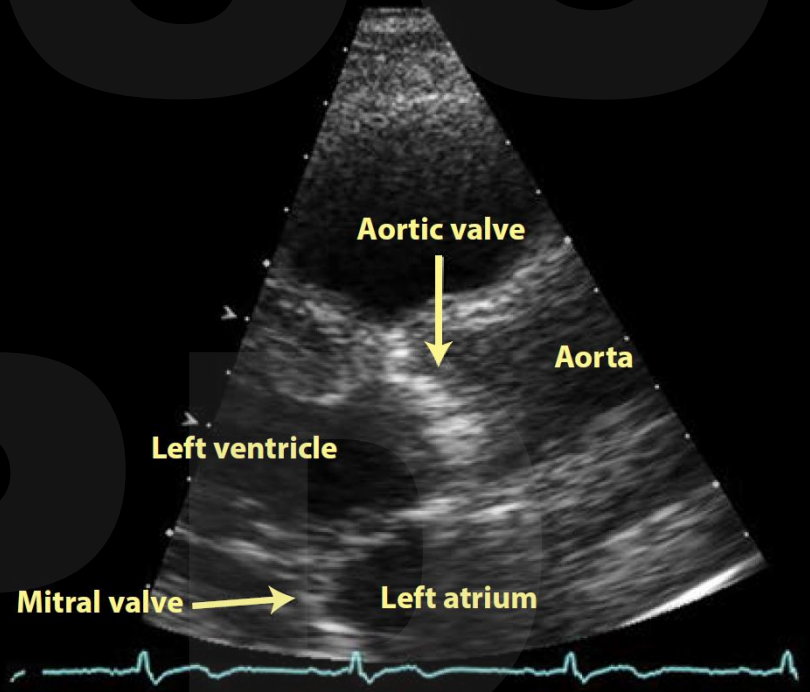
- Within the next 1-2 weeks
- Within the next 1-2 years
- Never

# 2-D PLAX

**Normal**

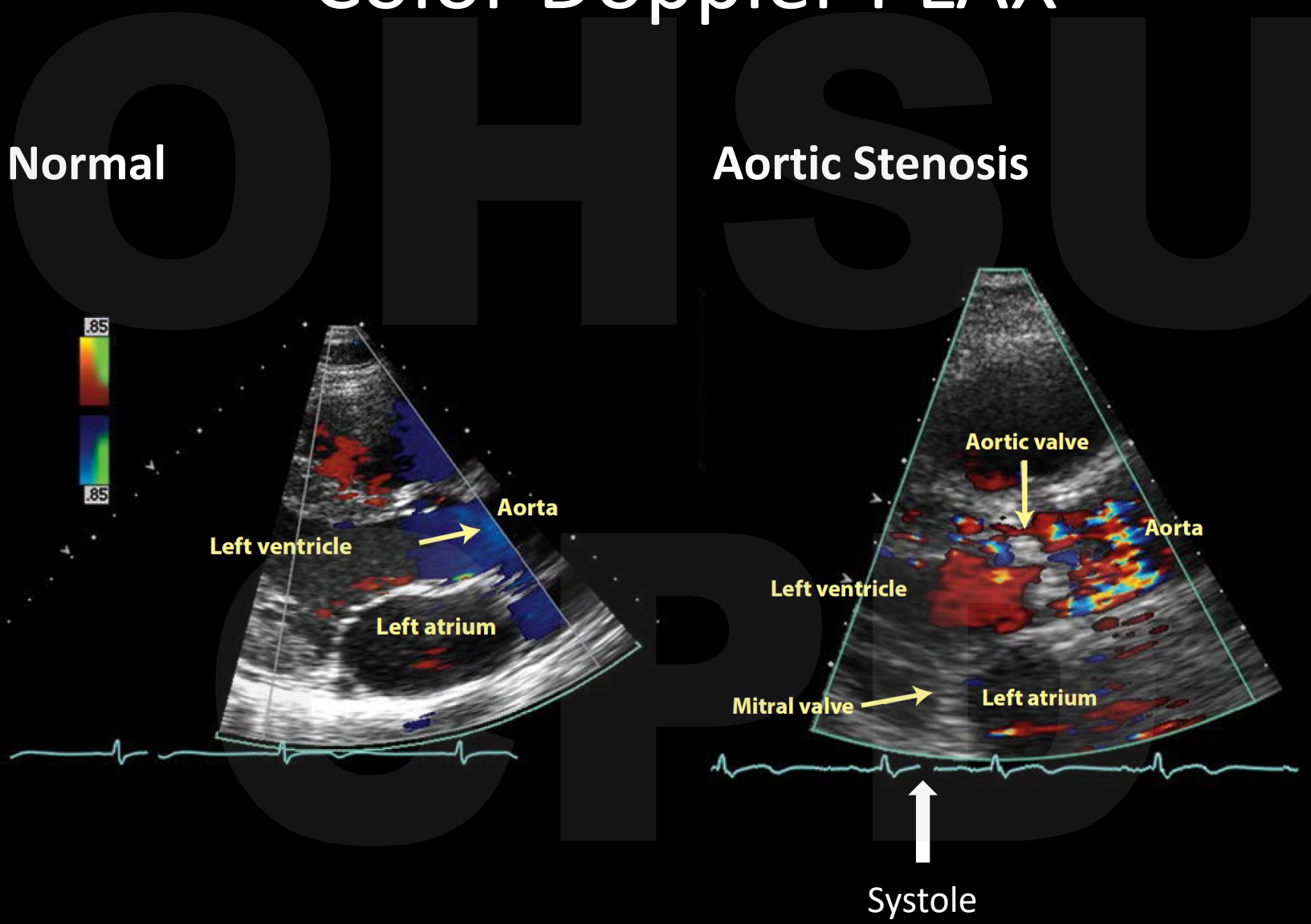



**Aortic Stenosis**



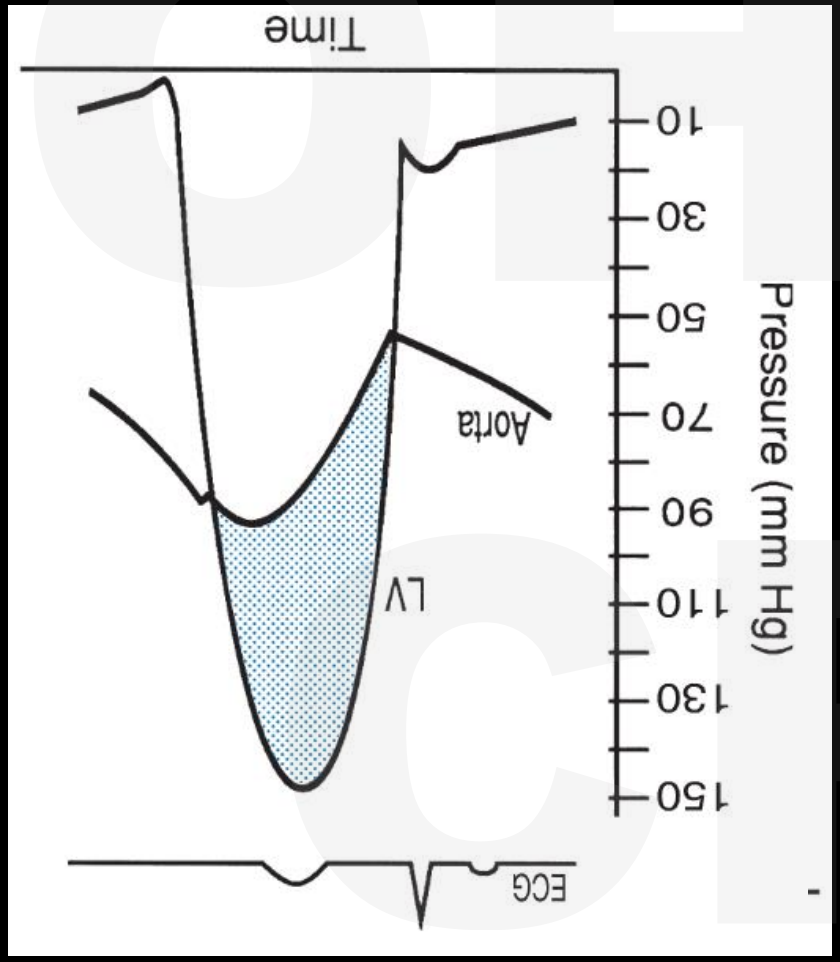

NEJM 371;8:744-756.

# Color Doppler PLAX

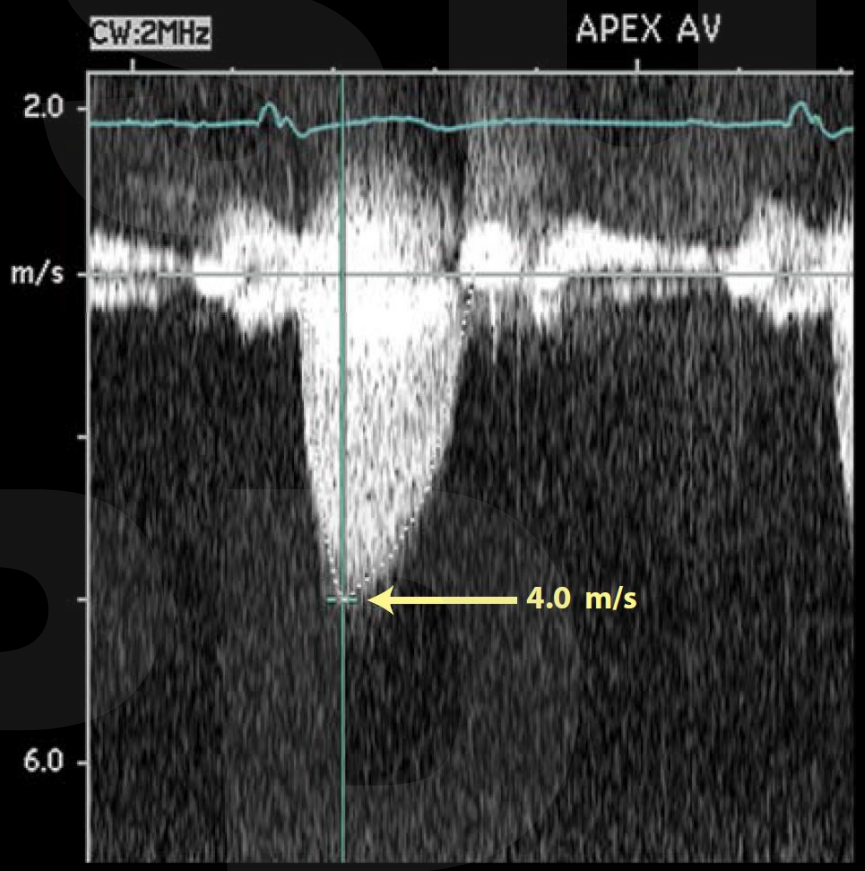



NEJM 371;8:744-756.

# AS: Invasive Measurement and Doppler Correlation

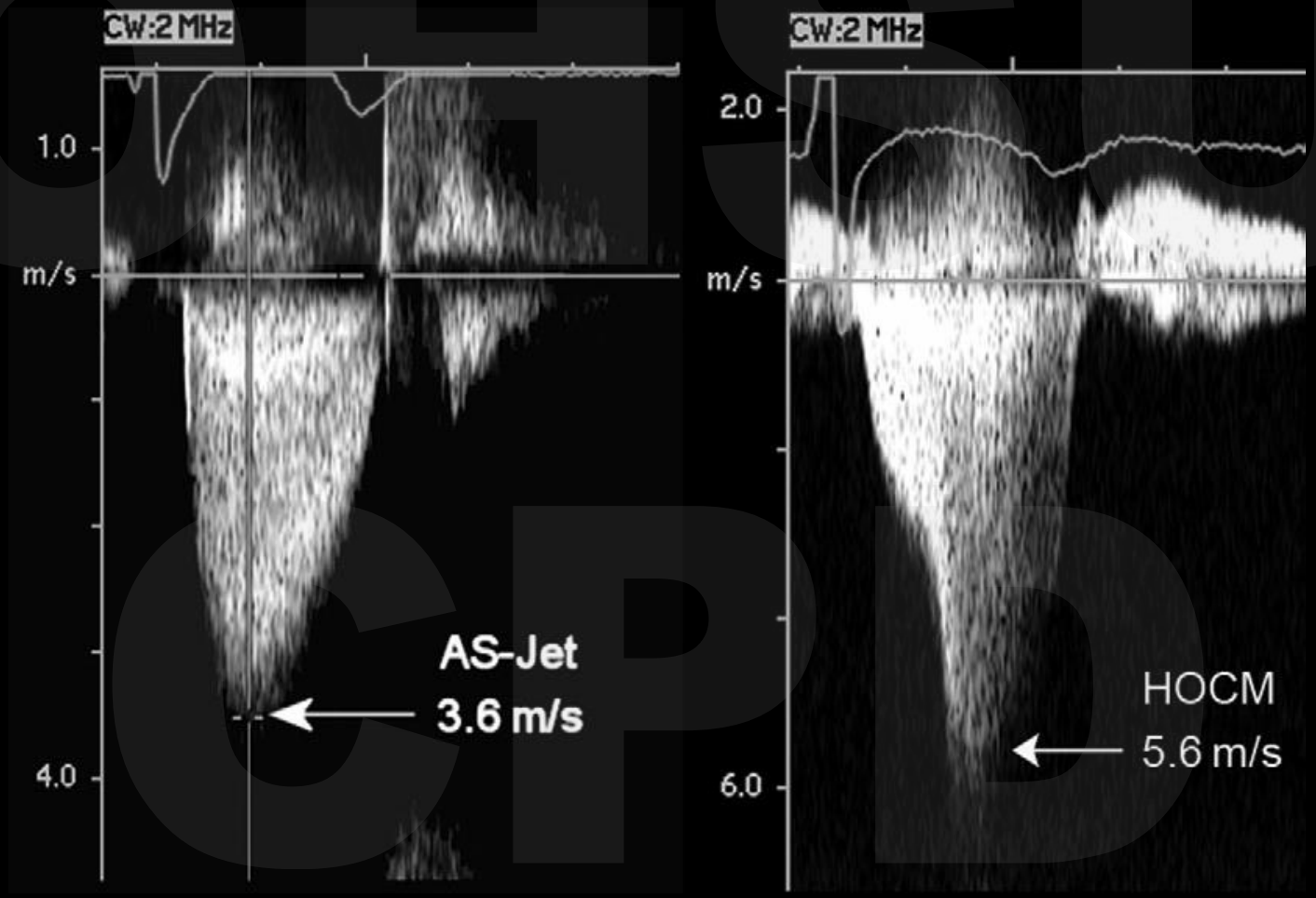



Lilly Pathophysiology of Heart Disease, 6th ed.



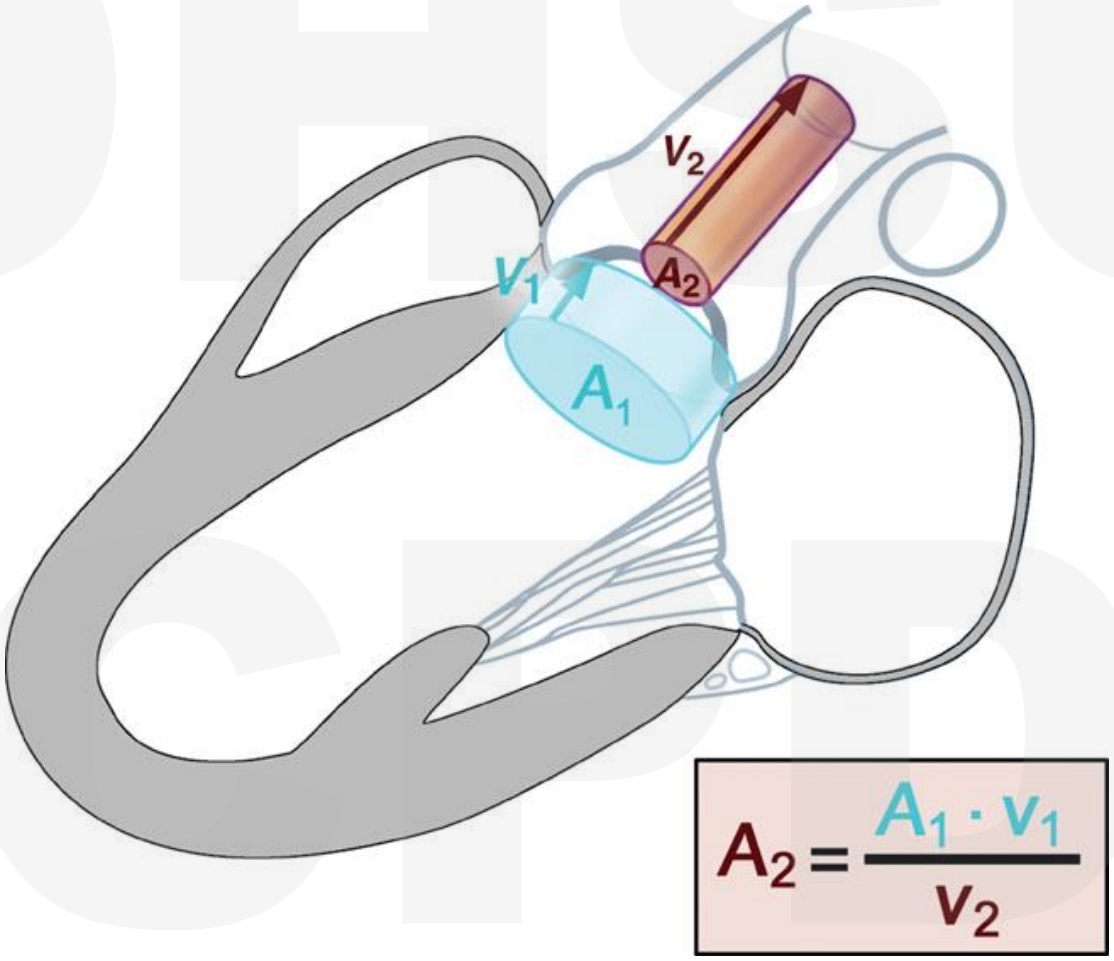

Eur J Echocardiogr 2009;10:1-25.

# AS v HOCM




Eur J Echocardiogr 2009;10:1-25.

# The Continuity Equation




Eur J Echocardiogr 2009;10:1-25.

# Aortic Stenosis

| | Mild | Moderate | Severe |
|---|---|---|---|
| Aortic Velocity | 2.0-2.9 m/sec | 3.0-3.9 m/sec | >4.0 m/sec |
| Mean Gradient | 10-19 mm Hg | 20-39 mm Hg | >40 mm Hg |
| Aortic Valve Area | 1.5-2.9 cm^2 | 1.0-1.4 cm^2 | <1.0 cm^2 |
| Aortic Valve Area Indexed | | | <0.6 cm^2/m^2 |
| Dimensionless Index | | | <0.25 |

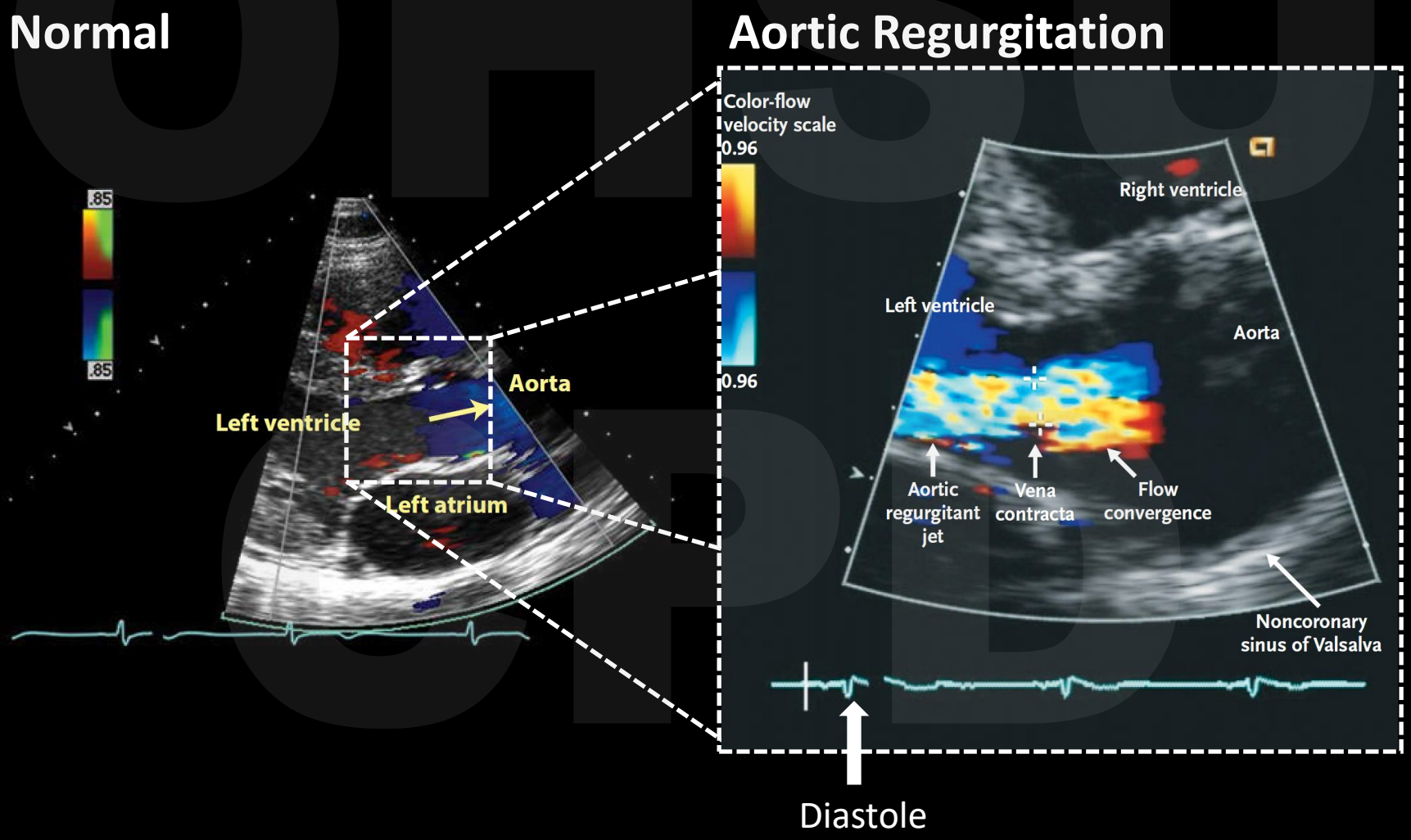
# The Scenario

- A 67 year-old presents to your clinic after an ED presentation for chest pain. ECG normal, troponin negative, stress test without ischemia/infarction. Echocardiogram report documents normal LV size & function, normal RV size & function, and moderate aortic valve insufficiency.

# When is the next TTE indicated?

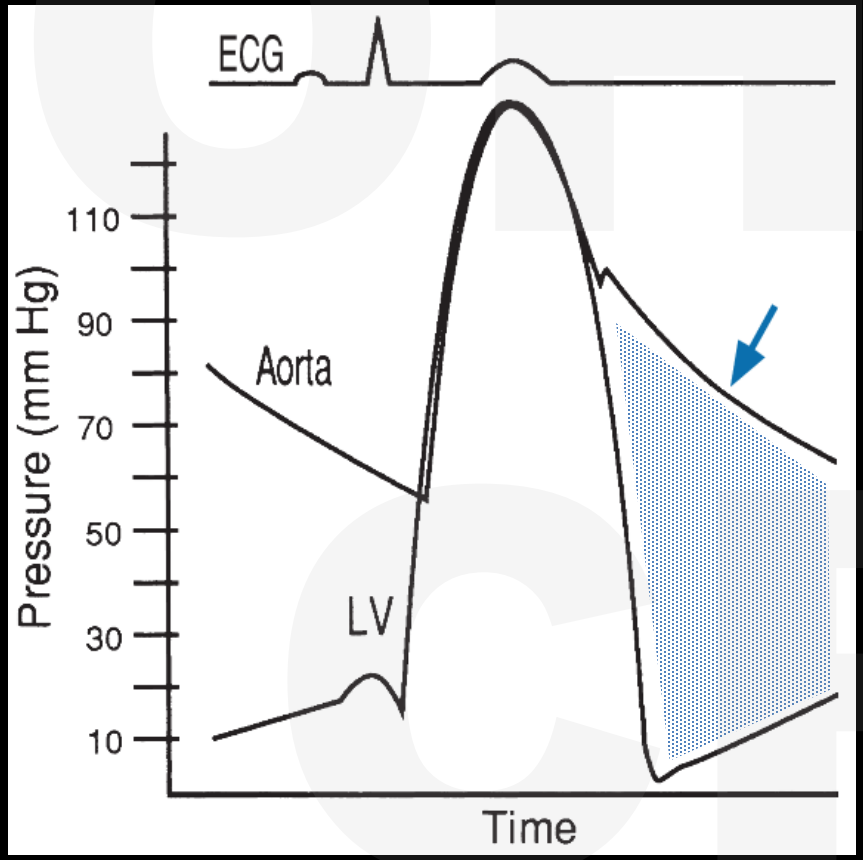
- 6-12 months
- 1-2 years
- 3-5 years

# Color Doppler PLAX

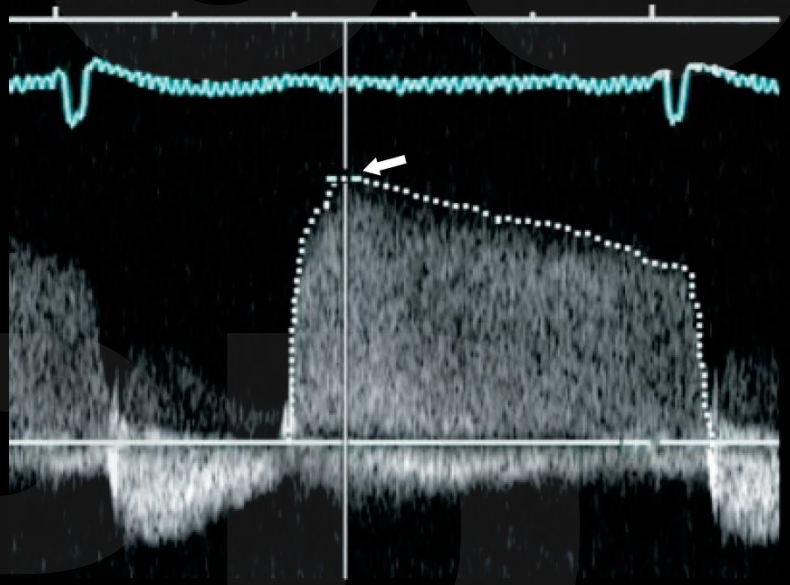



NEJM 351;15:1539-46.

# AI: Invasive Measurement and Doppler Correlation




Lilly Pathophysiology of Heart Disease, 6th ed.



NEJM 351;15:1539-46.

# Severe Aortic Insufficiency

| | |
|---|---|
| Doppler Jet Width | >65% LVOT |
| Vena Contracta | >0.6 cm |
| Flow in Proximal Abdominal Aorta | Holodiastolic reversal |
| Rvol | >=60 mL/beat |
| RF | >=50% |
| ERO | >=0.3 cm^2 |
| PHT | <250 msec |

Operate (Class I):

- Above + Symptoms
- Above + LVEF <50%

Operate (Class IIa):

- Above + LVESD >50mm

Operate (Class IIb):

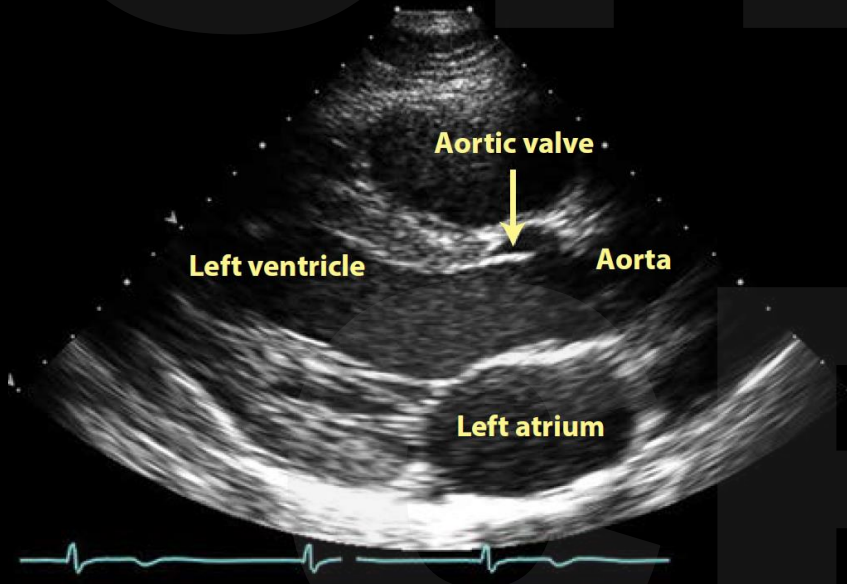
- Above + LVEDD >65 mm + low surgical risk

# The Scenario:

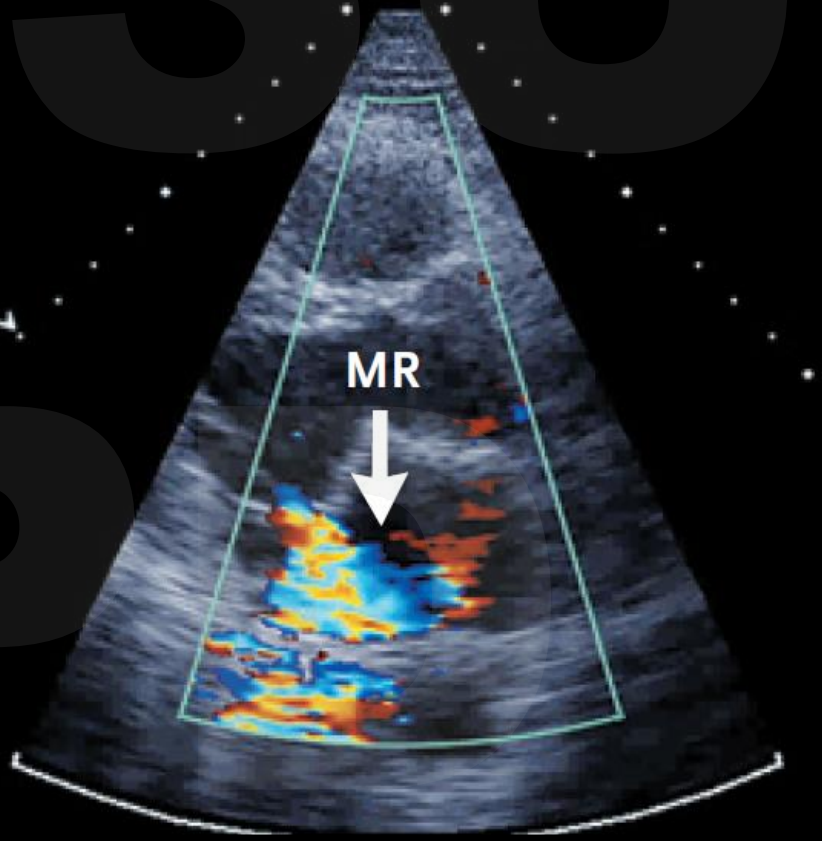
- A 35 year-old woman presents to clinic for an annual exam. She is well-appearing and the exam is unremarkable except for a mid-systolic click followed by a soft murmur (3/6). She reports no limitations in her activity.

# 2-D PLAX

**Normal**




**Mitral Valve Prolapse**




NEJM 2010 363:156-65.

# Recommended Monitoring by Valve Lesion

| | Aortic Stenosis | Aortic Regurgitation | Mitral Stenosis | Mitral Regurgitation |
|---|---|---|---|---|
| Mild | 3-5 yrs | 3-5 yrs | 3-5 yrs | 3-5 yrs |
| Moderate | 1-2 yrs | 1-2 yrs | 1-2 yrs | 1-2 yrs |
| Severe | 6-12 mos | 6-12 mos | 6-12 mos | 6-12 mos |

J Am Coll Cardiol 2014;63(22):e57-185.


Wallowa Mountains

# DOES THIS PATIENT HAVE PERICARDITIS?

# The Scenario:

- An echocardiogram was obtained by anesthesiology in a 56 y/o for a murmur on exam in preparation for a knee replacement. Exam is benign.  Vitals WNL. No valvular heart disease was noted on TTE, however, a small pericardial effusion was documented.

# What is the next step?

- Urgent referral for pericardiocentesis
- Proceed with operation & repeat echo in 3 months
- Proceed with operation & repeat echo in 6 months
- No further evaluation is necessary

# Natural history of small pericardial effusions

- 2/3 resolve
- 1/3 remain unchanged
- ~5% increase in size
- None developed cardiac tamponade

Am Heart J. 2011; 161(1):152-157.

# Monitoring for Asymptomatic Idiopathic Pericardial Effusion

| | Size | Follow-up |
|---|---|---|
| Small | <10 mm | none |
| Moderate | 10-20 mm | Echo every 6 months |
| Large | >20 mm | Echo every 3 months |

Eur Heart J. 2015; 36(42):2921-2964.


Crater Lake

# CAN YOU RULE-OUT AORTIC ANEURYSM, PLEASE?

# The Scenario:

- A 62 year old with recent uncomplicated anterior STEMI treated with primary PCI at an outside hospital presents to your clinic 3 months later. TTE prior to DC found hypokinesis of mid and apical anterior segments, but overall preserved function (EF 55-60%). Completed cardiac rehab, returned to work as a forest ranger, & is asymptomatic. Meds include: Aspirin + Clopidogrel, Atorvastatin, Lisinopril, & Carvedilol. You repeat the echocardiogram…

# Conclusions:

- Normal LV size, thickness, & function w/o WMAs.
- Normal RV size & function.
- No significant valve disease
- Aortic Root/Ascending Aorta Measurement
  - Sinus of Valsalva: 40 mm
  - Sinotubular junction:  33 mm
  - Ascending aorta: 49 mm
  - The aortic arch is not well visualized.

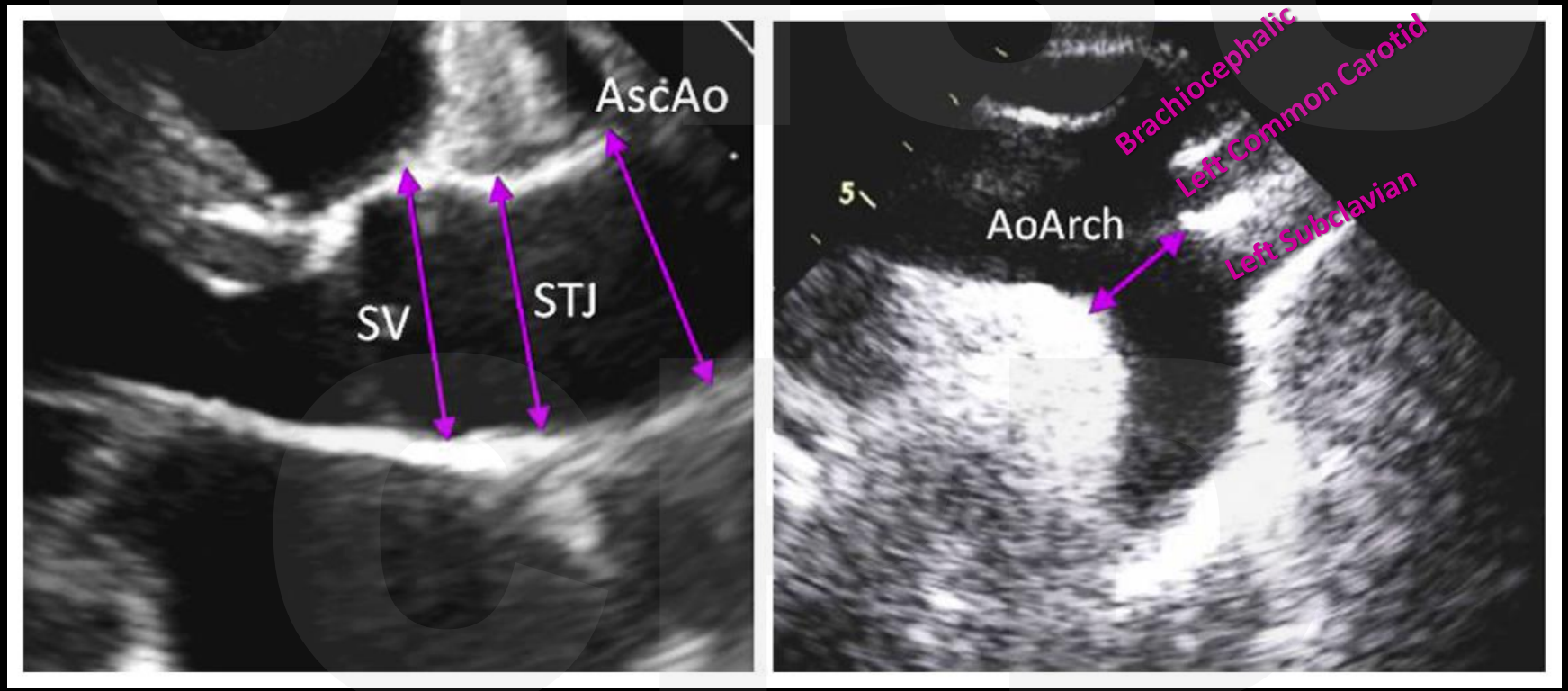
# What is the next step for this patient?

- Echocardiogram in 1 year
- Referral for ascending aorta repair
- Assess for high risk features & refer for repair if identified

# Measurements of the Aorta

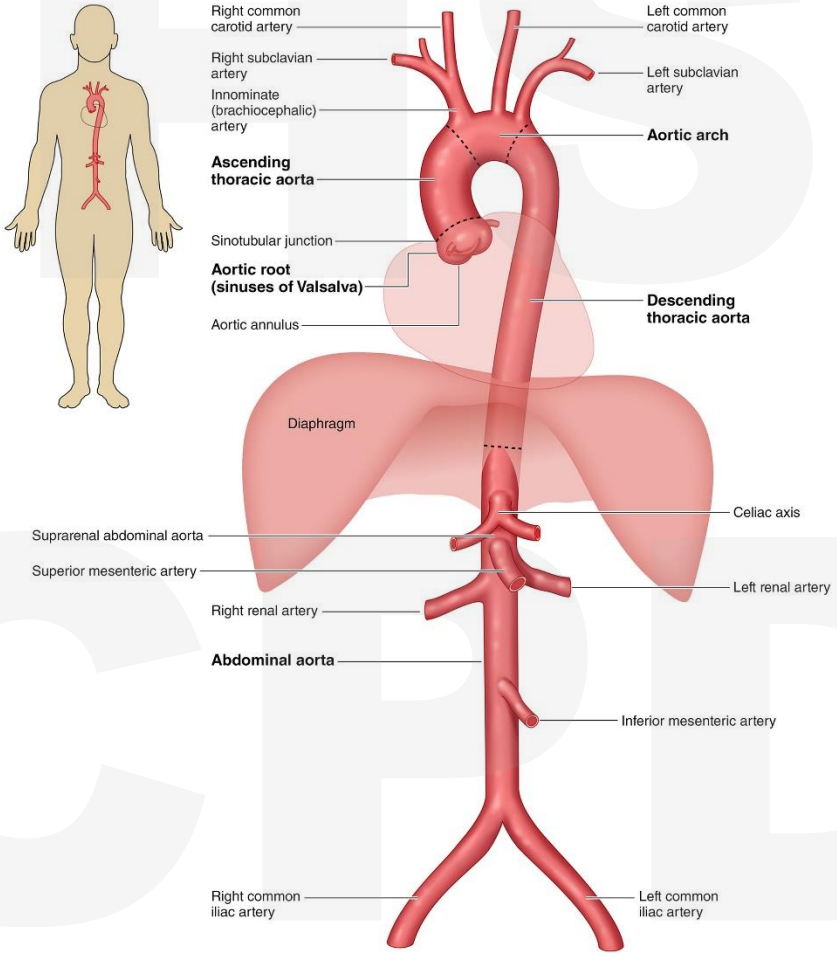
Parasternal Long Axis

Suprasternal Notch




J Am Soc Echocardiogr 2016;29:827-37.

# Anatomy of the Aorta



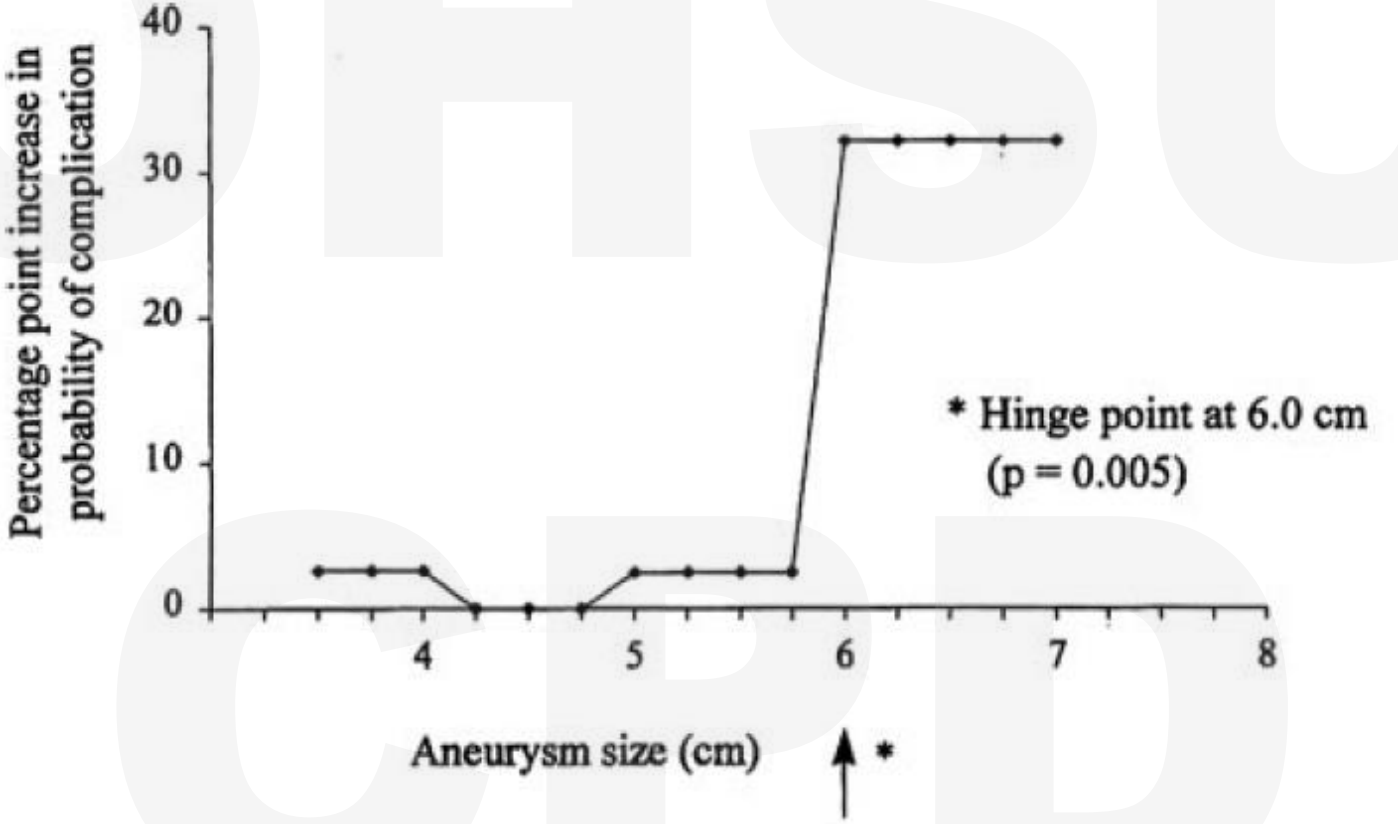

Circ 2022;146(24)

# Ranges for aortic measurements separately by age & sex

| | SV (mm) | STJ (mm) | AscAo (mm) | AoArch (mm) |
|---|---|---|---|---|
| Overall | 33.9 ± 4.2 | 25.1 ± 3.9 | 33.5 ± 4.5 | 25.1 ± 3.8 |
| Women | | | | |
| <50 y | 29.8 ± 3.1* | 22.1 ± 2.9* | 29.3 ± 3.8* | 22.7 ± 3.2* |
| 50–59 y | 33.0 ± 3.0* | 24.5 ± 3.4* | 32.9 ± 3.9* | 25.1 ± 3.2* |
| 60–69 y | 33.1 ± 2.6* | 24.2 ± 2.7* | 33.8 ± 3.0* | 24.4 ± 2.8* |
| 70–79 y | 34.0 ± 3.1* | 25.4 ± 3.2* | 35.9 ± 3.3 | 25.7 ± 3.5 |
| ≥80 y | 33.1 ± 3.4* | 24.8 ± 3.7* | 35.9 ± 4.3 | 24.8 ± 3.5 |
| Overall | 32.4 ± 3.3* | 24.0 ± 3.3* | 33.0 ± 4.3* | 24.4 ± 3.4* |
| Men | | | | |
| <50 y | 33.1 ± 4.9 | 24.9 ± 3.9 | 31.2 ± 4.3 | 24.3 ± 3.4 |
| 50–59 y | 36.6 ± 2.9 | 26.8 ± 3.8 | 34.4 ± 2.8 | 26.5 ± 3.8 |
| 60–69 y | 37.4 ± 3.4 | 27.6 ± 4.4 | 36.8 ± 4.0 | 28.0 ± 4.5 |
| 70–79 y | 36.9 ± 3.2 | 27.7 ± 3.5 | 36.5 ± 3.4 | 26.8 ± 3.9 |
| ≥80 y | 38.5 ± 2.7 | 27.8 ± 2.3 | 38.0 ± 2.5 | 25.1 ± 2.6 |
| Overall | 35.3 ± 4.5 | 26.3 ± 4.1 | 33.9 ± 4.6 | 25.9 ± 4.1 |

J Am Soc Echocardiogr 2016;29:827-37.

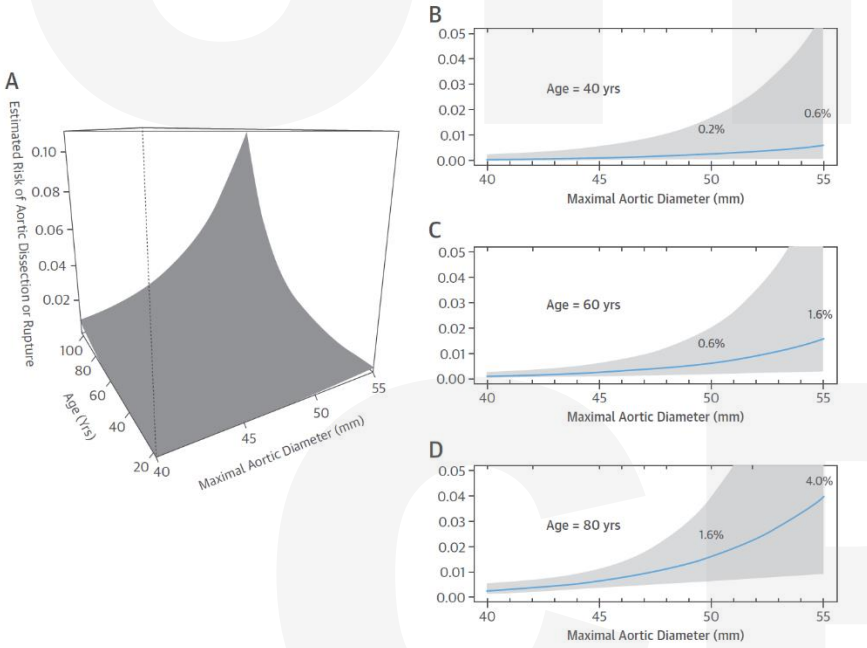
# Effect of aortic aneurysm diameter on risk of complication



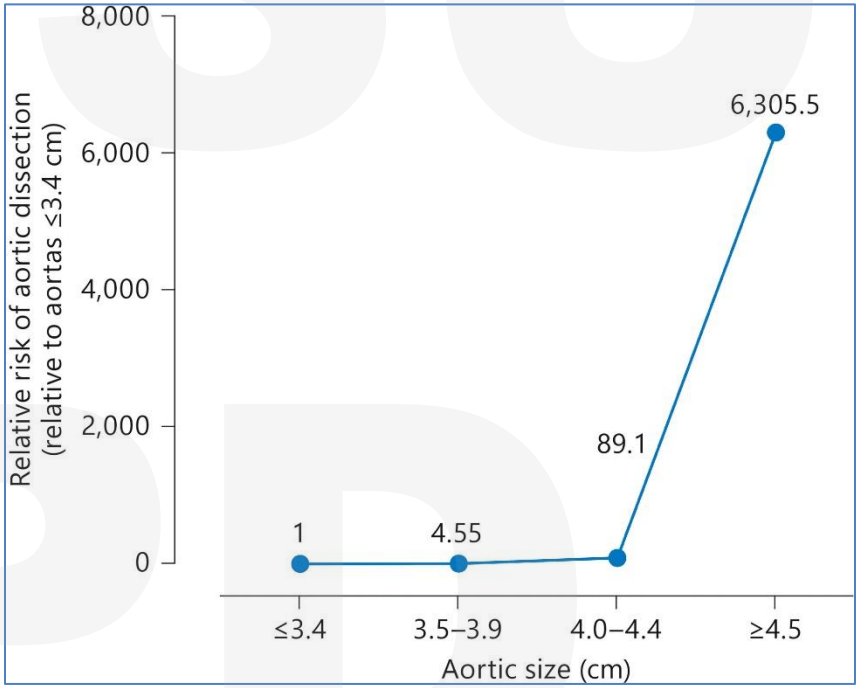

Estimated effect of ascending aortic aneurysm size on risk of complication.

Ann Thorac Surg 2002;74:S1877-88.
*Circ 2007;116(10):1120.

# Estimated Probability of Aortic Dissection or Rupture Within 5 Years




J Am Coll Cardiol 2016;68:1209-19.




Cardiology 2015;131:265-72.

# KISS:  Ascending Aorta

- Dilated 4.0-4.4 cm
- Aneurysmal >=4.5 cm
- Offer operation >5.0 cm

- Annual surveillance (gated CTA preferred)


Smith Rock

# DOES THIS PATIENT HAVE HEART FAILURE?

# The Scenario

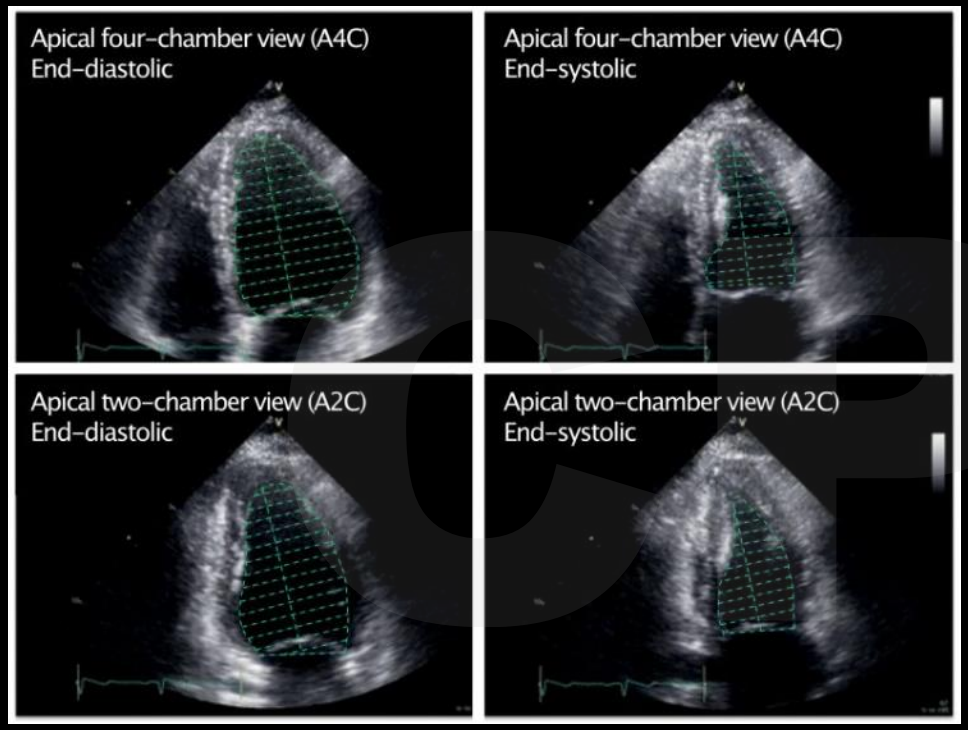
- A 70 y/o former smoker with chronic kidney disease (stage 3), PTSD, and BMI 35 among other maladies presents to clinic with a complaint of dyspnea on exertion for the last couple months.  In addition to an ECG (NSR) and lab work (NT-proBNP = 900), you order an echocardiogram.

# The echo report

- Normal LV size and thickness, LVEF 40-45%
- Normal RV size and function
- Mild mitral regurgitation

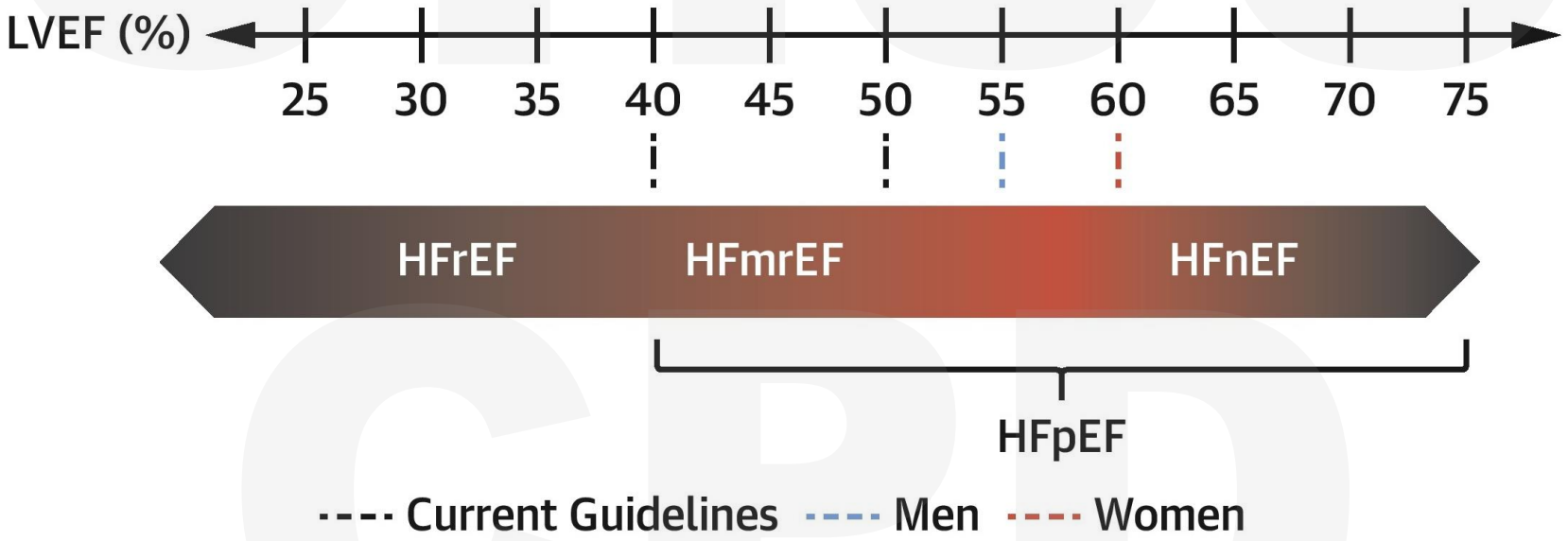
# Measurement of EF

| | Normal | Mildly Reduced | Moderately Reduced | Severely Reduced |
|---|---|---|---|---|
| Male | 52-72% | 41-51% | 30-40% | <30% |
| Female | 54-74% | 41-53% | 30-40% | <30% |




$$\text{Ejection fraction (\%)} = \frac{EDV - ESV}{EDV} \times 100$$

# Classification of heart failure by EF




JACC. 2021;77(25):3217-25.


Oregon Coast

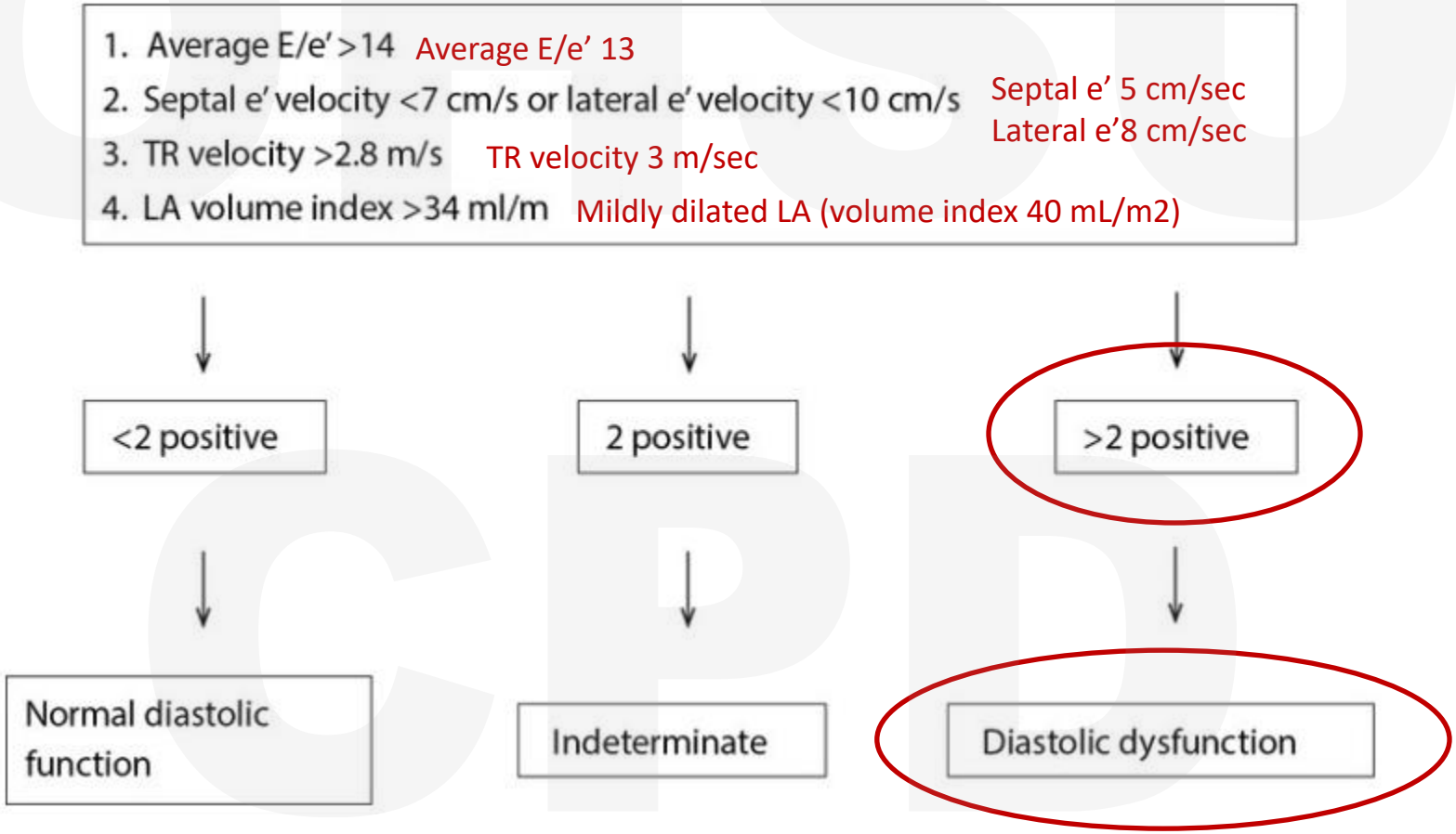
# The Scenario

- A 70 y/o former smoker with chronic kidney disease (stage 3), PTSD, and BMI 35 among other maladies presents to clinic with a complaint of dyspnea on exertion for the last couple months.  In addition to an ECG (NSR) and lab work (NT-proBNP = 900), you order an echocardiogram.

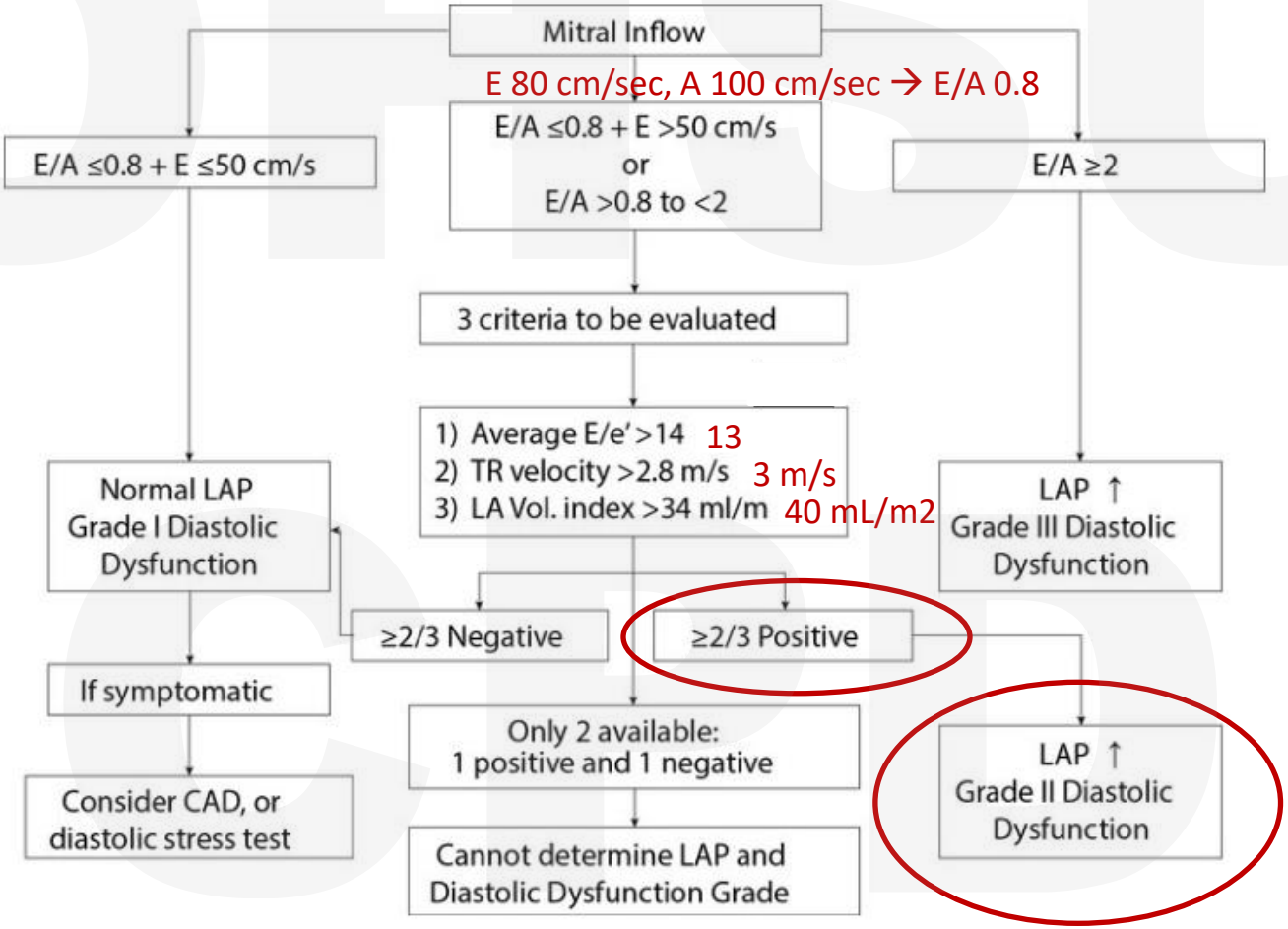
# The echo report

- Normal LV size, mild LV hypertrophy, LVEF 50-55%
- Normal RV size and function
- Mild mitral regurgitation
- See other findings above.
  - E 0.8 m/sec, A 1.0 m/sec
  - Septal e’ 5 cm/sec, Lateral e’8 cm/sec
  - Average E/e’ 13
  - Mildly dilated LA (volume index 40 mL/m2)
  - TR velocity 3 m/sec

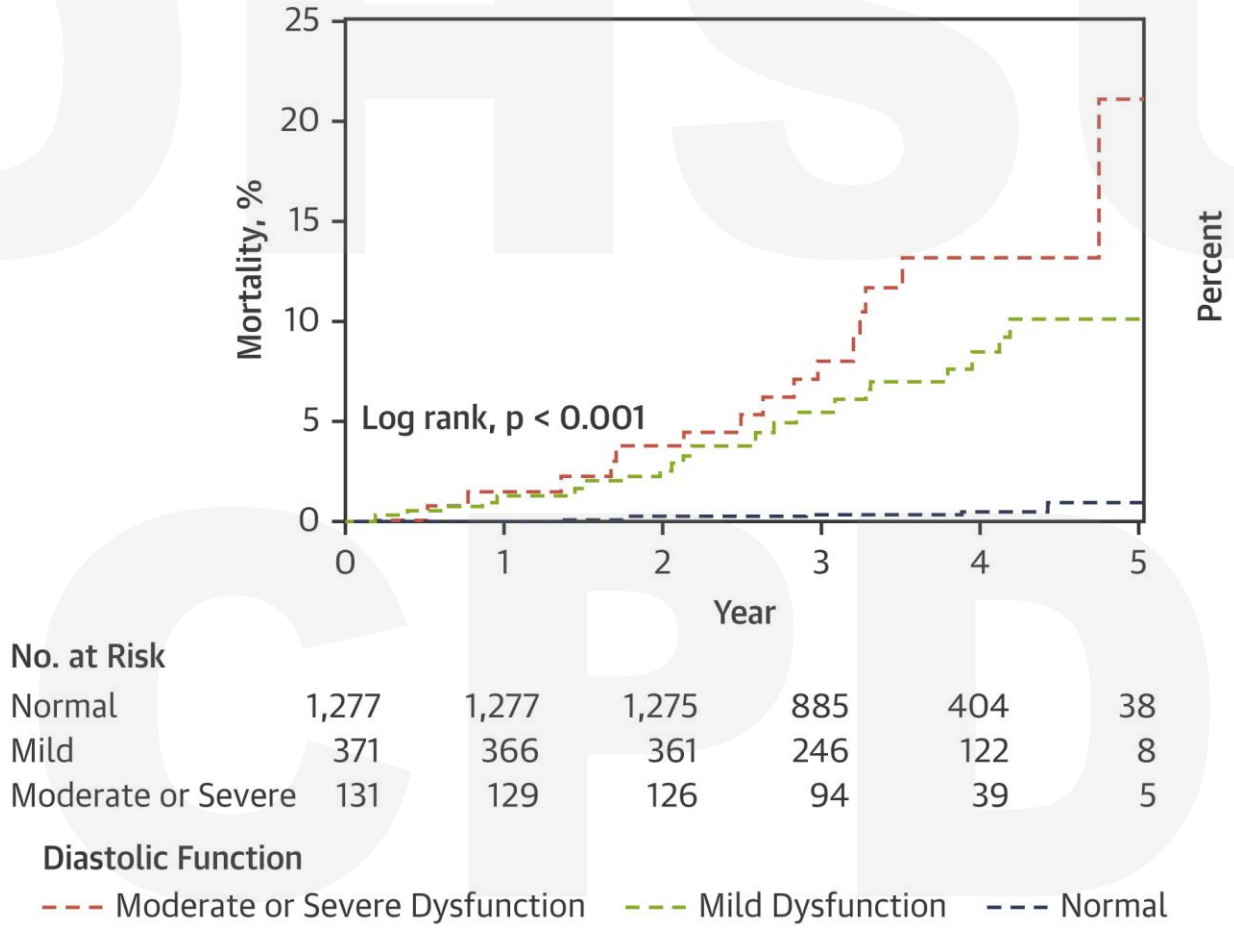
# Diastolic Dysfunction in Normal EF



# LV filling pressures and Grading Diastolic Dysfunction



# Prognosis associated with severity of Diastolic Dysfunction




J Am Coll Cardiol Img 2020;13:310-26.


Painted Hills

# The Scenario

- A 70 y/o former smoker with chronic kidney disease (stage 3), PTSD, and BMI 35 among other maladies presents to clinic with a complaint of dyspnea on exertion for the last couple months.  In addition to an ECG (NSR) and lab work (NT-proBNP = 900), you order an echocardiogram.

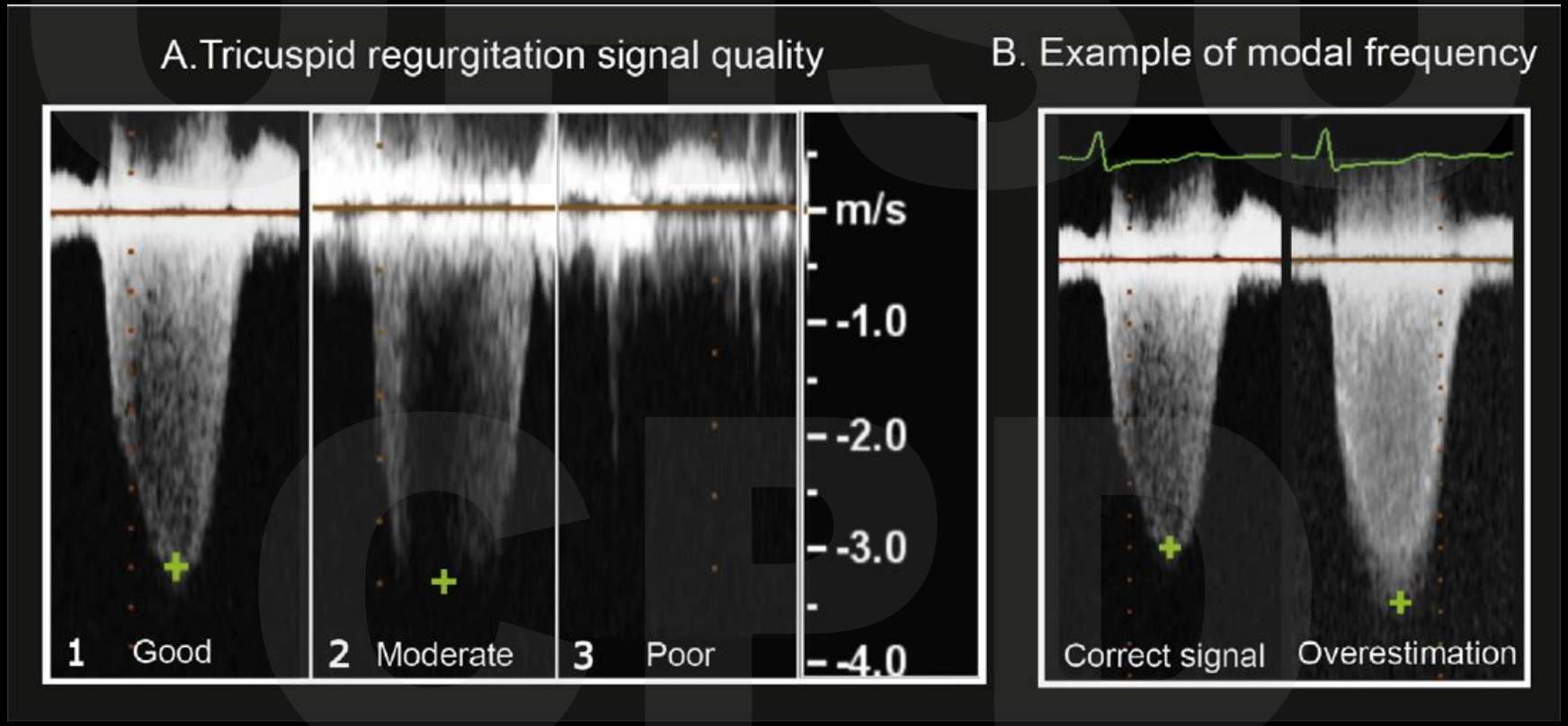
# The echo report

- Normal LV size, mild LV hypertrophy, LVEF 50-55%
- Normal RV size and function
- Mild mitral regurgitation
- RVSP 50-55 mmHg assuming RAP 15
- See other findings above
  - Trace/physiology tricuspid regurgitation
  - TR velocity 3 m/sec

# Would you initiate a loop diuretic in this patient?

- Yes
- No

# Classification of TR Signals Using CW and Example of Modal Frequency




J Am Soc Echocardiogr 2016;29:93-102.

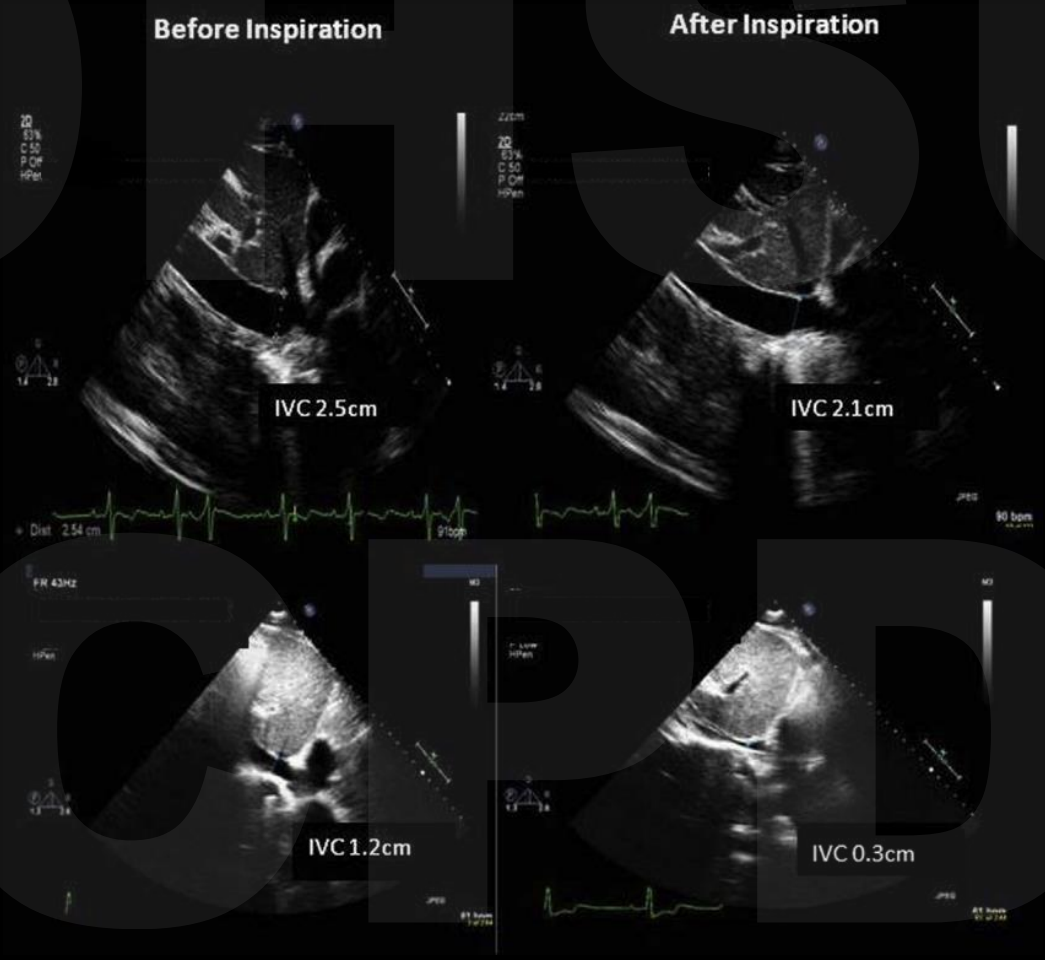
# How to calculate RVSP?

**RVSP = estimated RAP + 4(TR velocity)$^2$**

| TR Jet Velocity (m/sec) | Estimated RVSP* (mm Hg) |
|---|---|
| 2.0 | 21 |
| 3.0 | 41 |
| 4.0 | 69 |
| 5.0 | 105 |

*assuming RAP = 5 mm Hg.

# IVC Collapsibility Index



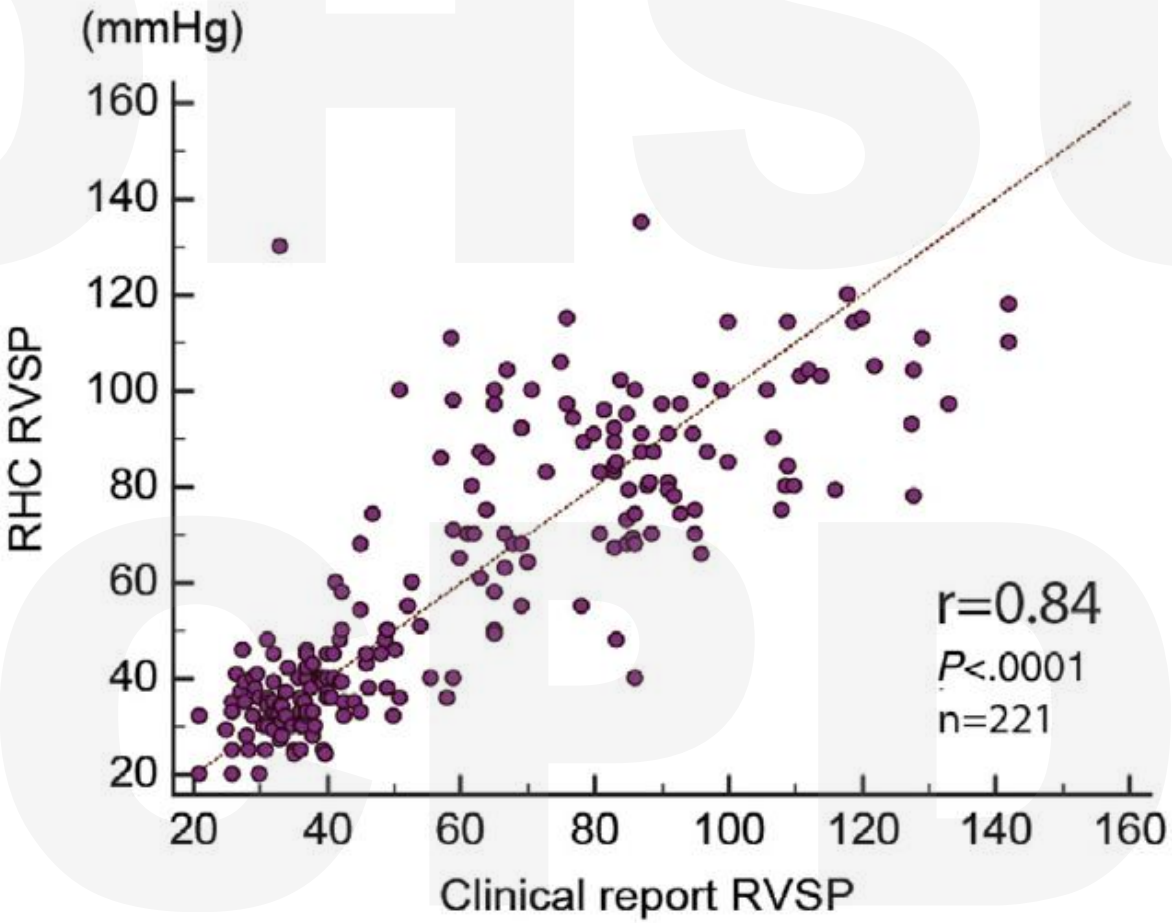

J Am Soc Echocardiogr 2015;28:40-56.

# How to calculate RAP

| IVC Collapsibility | IVC diameter | |
|---|---|---|
| | =<2.0 cm | >2.0 cm |
| >50% | 3 mm Hg | 8 mm Hg |
| <50% | 8 mm Hg | 15 mm Hg |

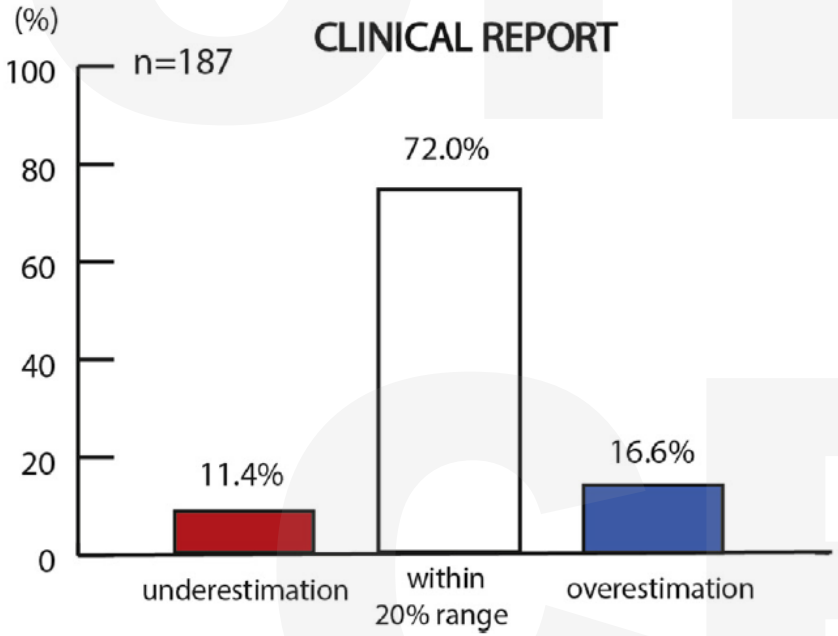
JASE 2015;28:40-56.

# Reported versus RHC




J Am Soc Echocardiogr 2016;29:93-102.

# What fools us?




| | Underestimation n=35 | | Overestimation n=51 | |
|---|---|---|---|---|
| Envelope not well defined | +++ | 33 | +++ | 23 |
| Estimate not at modal frequency | | 0 | ++ | 21 |
| Angle > 40° | | 2 | | 2 |
| Severe TR | | 1 | + | 15 |
| > 10mmHg difference in RAP | + | 3 | | 1 |
| > 2 days between RHC and echo | ++ | 8 | | 7 |

**RVSP = estimated RAP + 4(TR velocity)$^2$**

J Am Soc Echocardiogr 2016;29:93-102.


Mount Hood

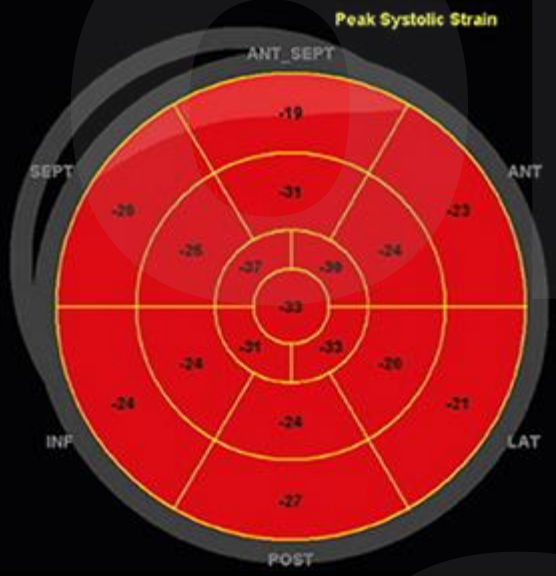
# The Scenario

- A 70 y/o former smoker with chronic kidney disease (stage 3), PTSD, and BMI 35 among other maladies presents to clinic with a complaint of dyspnea on exertion for the last couple months.  In addition to an ECG (NSR) and lab work (NT-proBNP = 900), you order an echocardiogram.

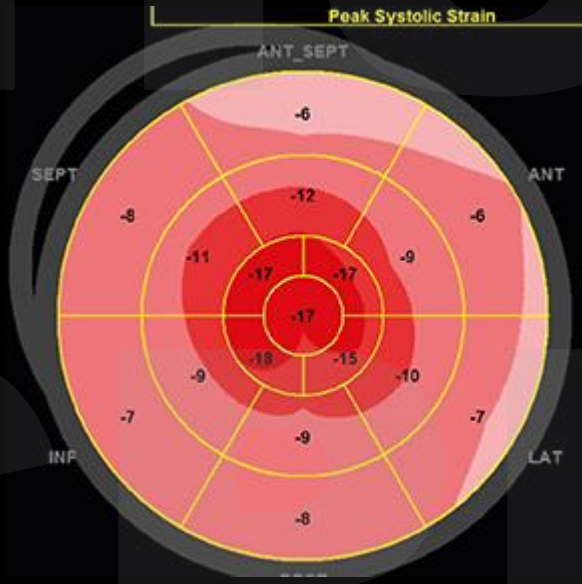
# The echo report

- Normal LV size, mild LV hypertrophy, LVEF 50-55%.
- GLS = -10.9%.  There is a basal reduction in strain with relative sparing of the cardiac apex aka “cherry-on-top”.
- Normal RV size and function
- Mild mitral regurgitation

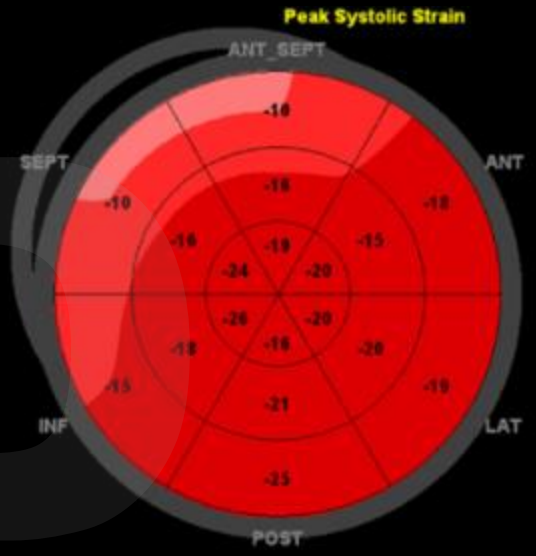
# Patterns in Global Longitudinal Strain




Normal




Amyloid




Hypertrophic Cardiomyopathy


Columbia River Gorge

# Topics covered today:

- Murmur – please assess
  - Aortic Stenosis
  - Aortic Insufficiency
  - Mitral regurgitation
- Does this patient have pericarditis?
  - Pericardial Effusions
- Can you rule-out aortic aneurysm, please?
  - Aortopathy/Aortic Aneurysm
- Does this patient have heart failure?
  - What the EF?
  - Dyspnea & Diastology
  - RVSP
  - Strain

OHSU

CPD

**THANK YOU!**

# The 7 Wonders of Oregon:

- The Wallowas
- Smith Rock
- Crater Lake National Park
- The Oregon Coast
- The Painted Hills
- Mt. Hood
- Columbia River Gorge