# Aortic Stenosis & US

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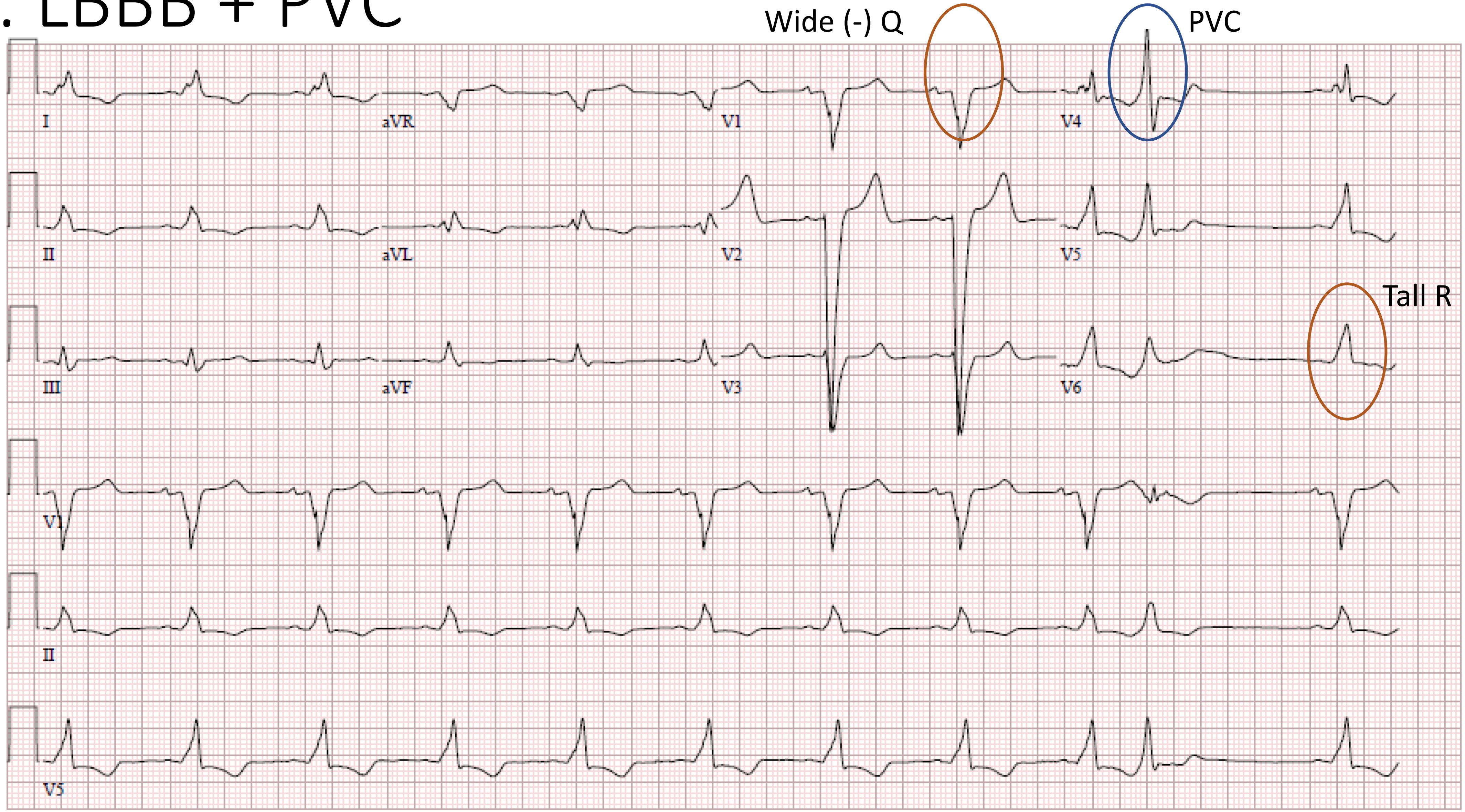
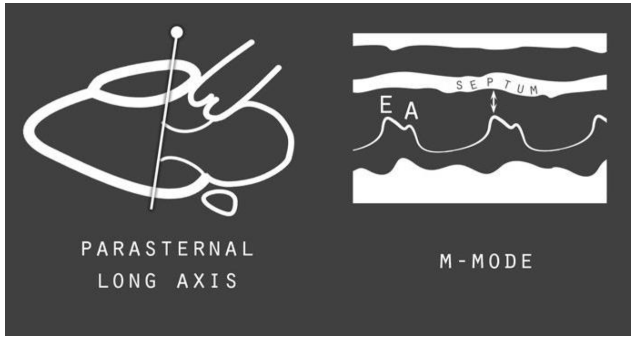
# Clinical Presentation

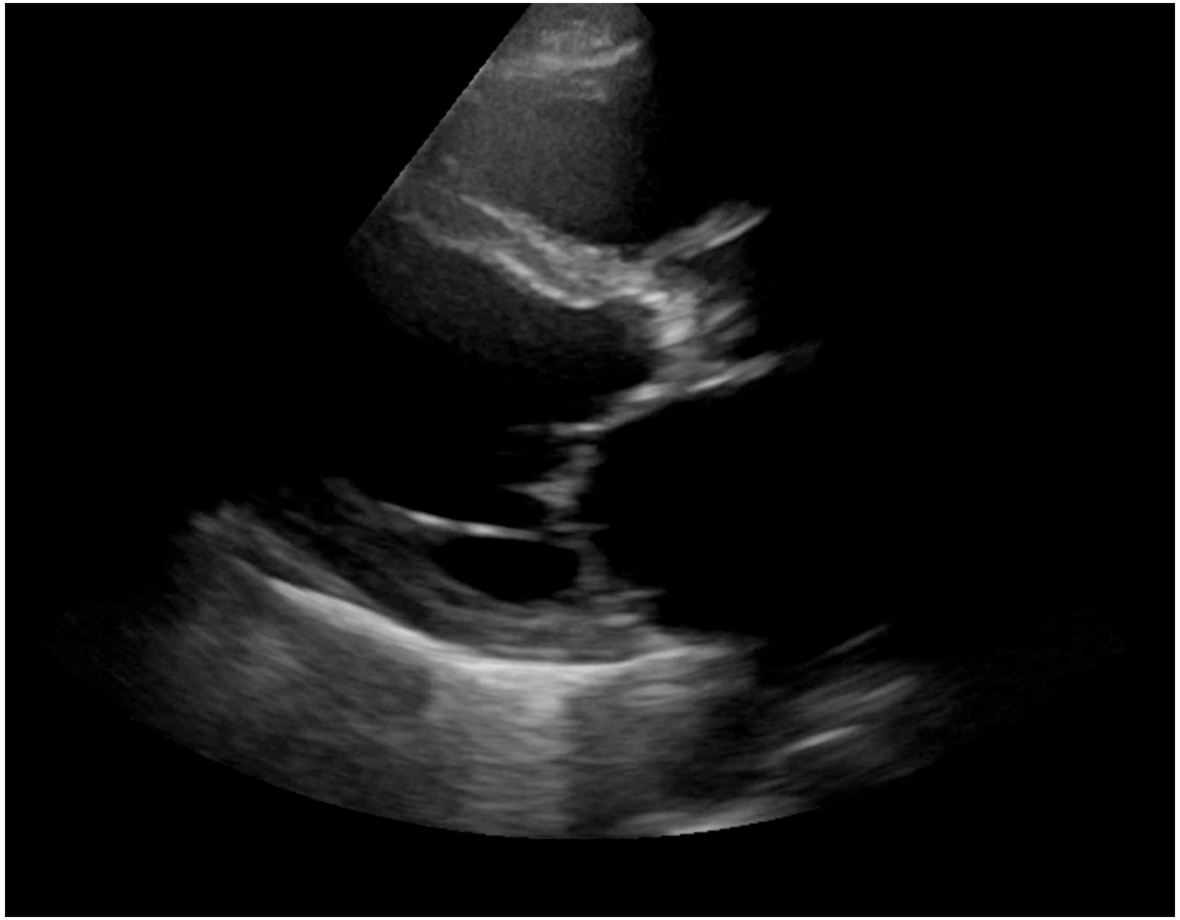
- 80M with CAD with CABG in 2010
- CC: Syncope, dyspnea on exertion, exertional chest pain
- Vitals: Afebrile, HR = 90, BP = 110/76, saturating well on RA
- Exam: anasarca, +JVD, no murmur
- Troponin peak 0.8, BNP>5000, Cr 1.6, LFT Ok
- Rhinovirus & influenza +

# EKG: LBBB + PVC



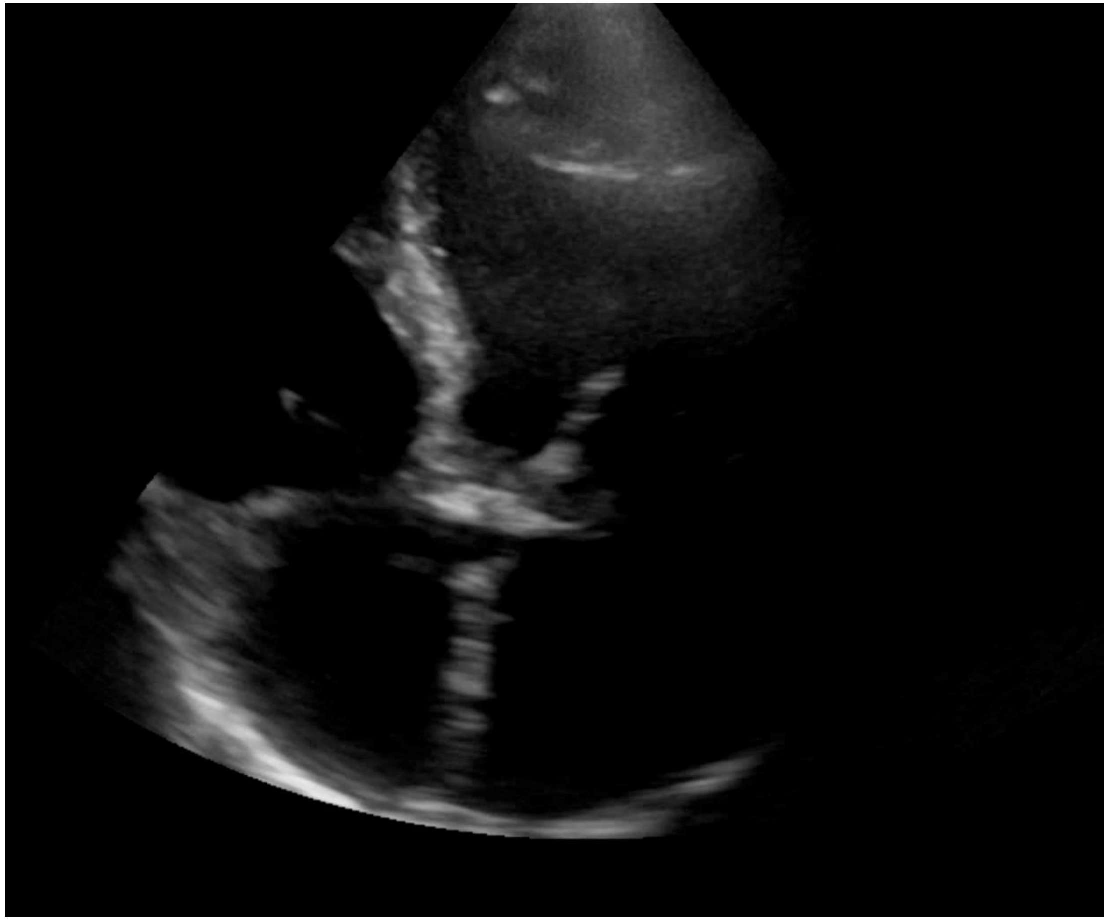
# E-Point of Septal Separation



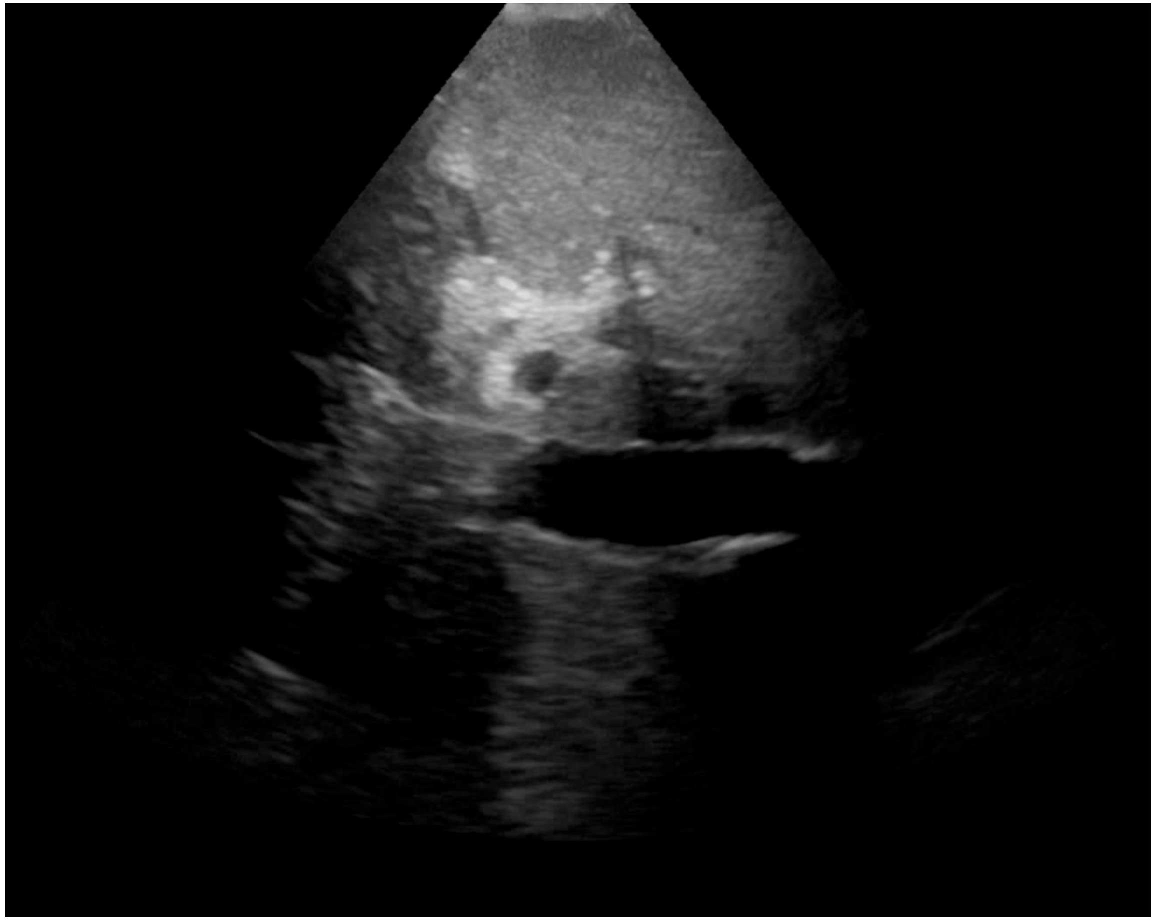



# Endocardial Excursion & Myocardial Thickening

# Chamber Size



# IVC >2 cm & <50% Respiratory Variation

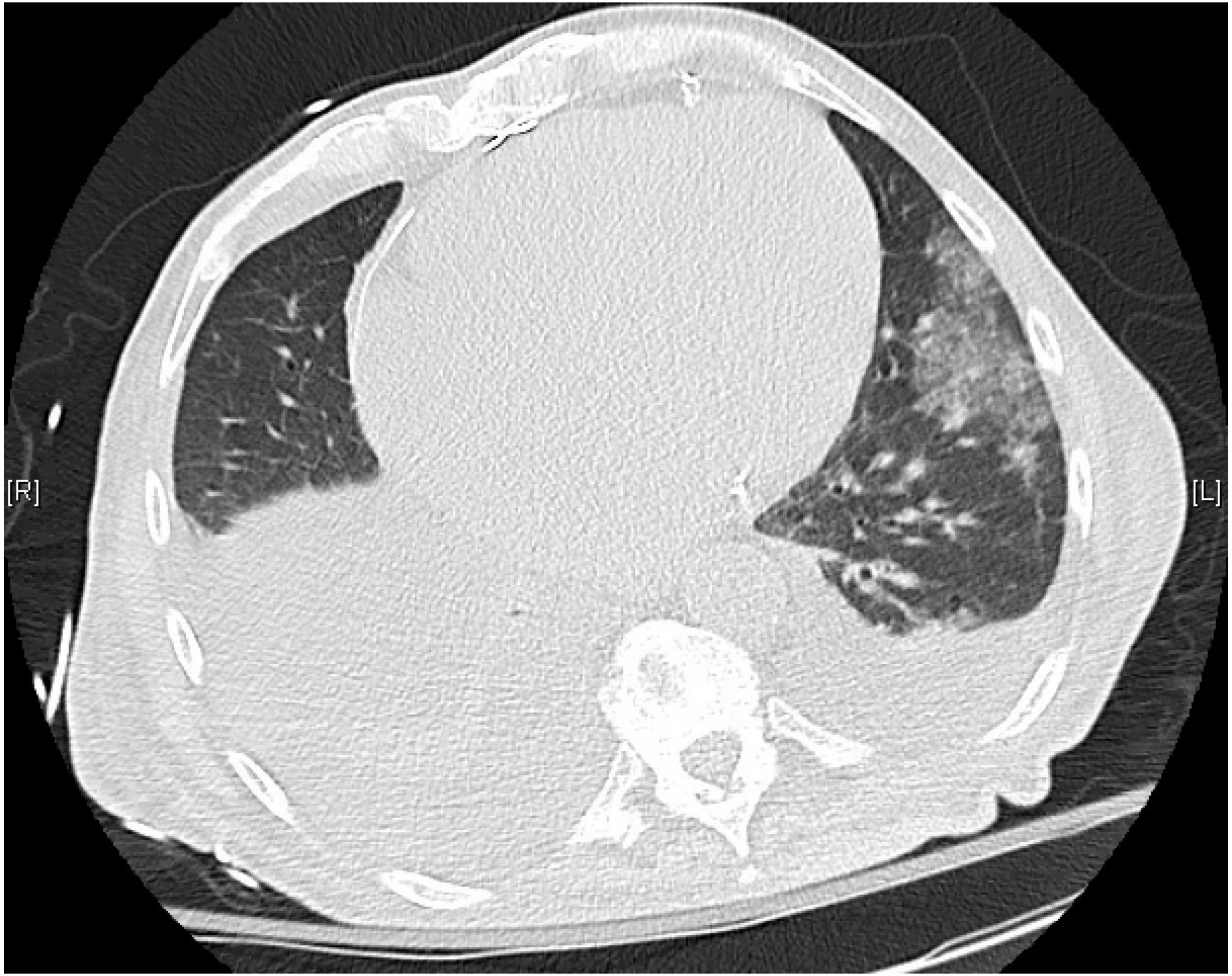


# Bedside US

- Reduced ejection fraction:
  - EPSS > 1cm
  - Myocardial thickening < 40% during systole
- Dilated R atria & ventricle
  - RV > 2/3 LV
- Dilated IVC without inspiratory variation
  - IVC > 2 cm with < 50% inspiratory decrease in diameter

# CT chest

- Pleural effusions
- Pulmonary edema
- Cardiomegaly
- Large R atria & ventricle



# Clinical Course

- He was diuresed
- Refused labs/Foley
- Had worsening AKI, LFT, lactate
- Foley drained purulent cloudy urine

- Septic (post viral PNA vs UTI) vs. Cardiogenic vs. Hypovolemic shock (over-diuresis)?
- Cold extremities. Bedside echo with severely reduced EF & large IVC

# Official Echo:

EF 8 %

Aortic Valve Area: 0.8 $cm^2$
LVOT diameter: 4 $cm^2$
LVOT Vmax 0.92 m/s & LVOT VTI 15.6 cm
Aortic Vmax 3.9 m/s & Aortic VTI 75.0 cm

Peak velocity 3.9 m/s
Mean Aortic Gradient: 39 mmHg
Peak Aortic Gradient: 62 mmHg

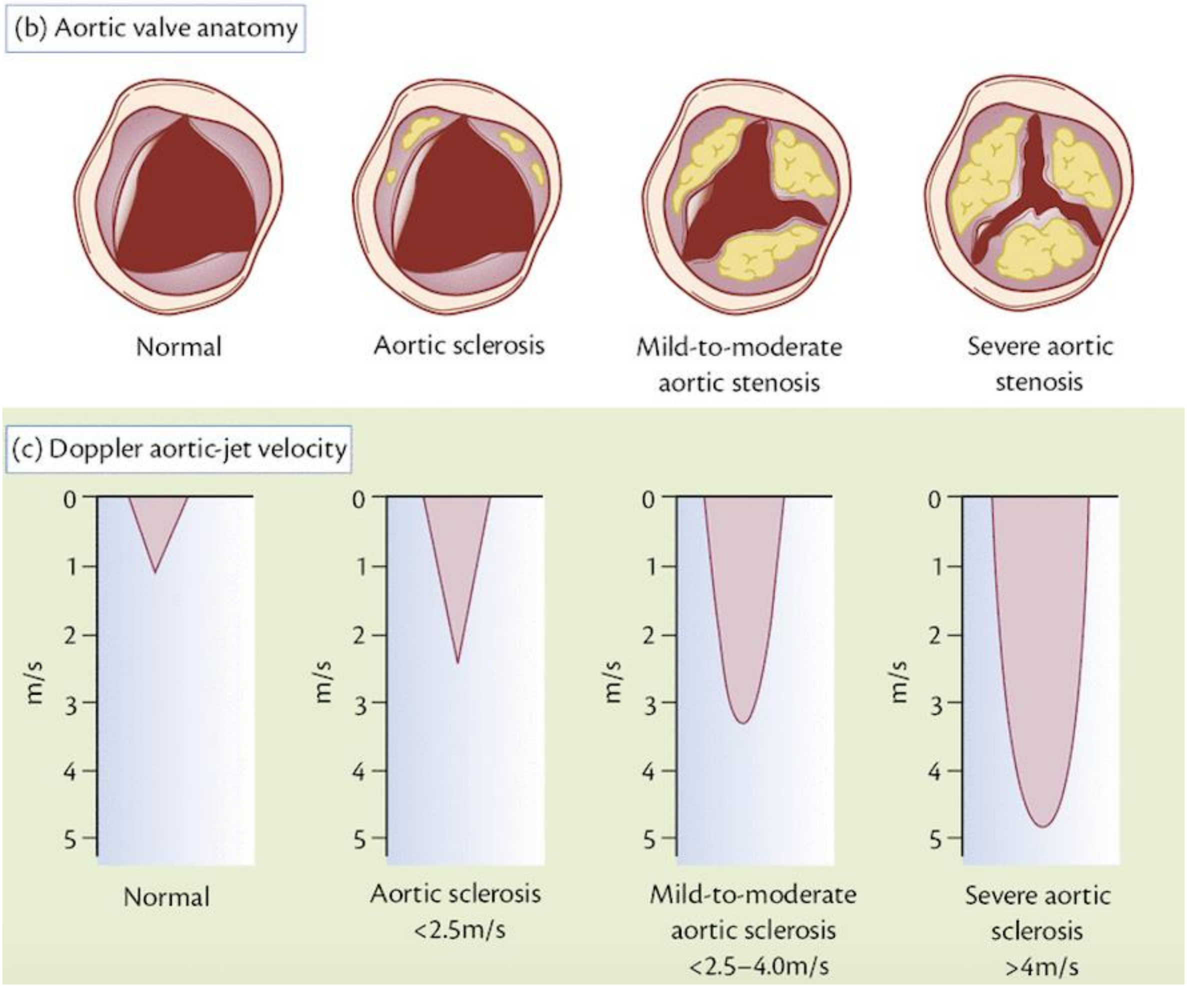
Est PA Syst Pressure: 55 mmHg
IVC is normal in size (1.5-2.5 cm) but without respiratory variability

# Aortic Valve Assessment by Ultrasound

1. Valve area
2. Mean gradient
3. Peak velocity across the aortic valve
4. Ejection Fraction
   - Low-flow, low-gradient (LF-LG) severe AS with reduced LVEF
   - Low-flow, low-gradient (LF-LG) severe AS with normal LVEF

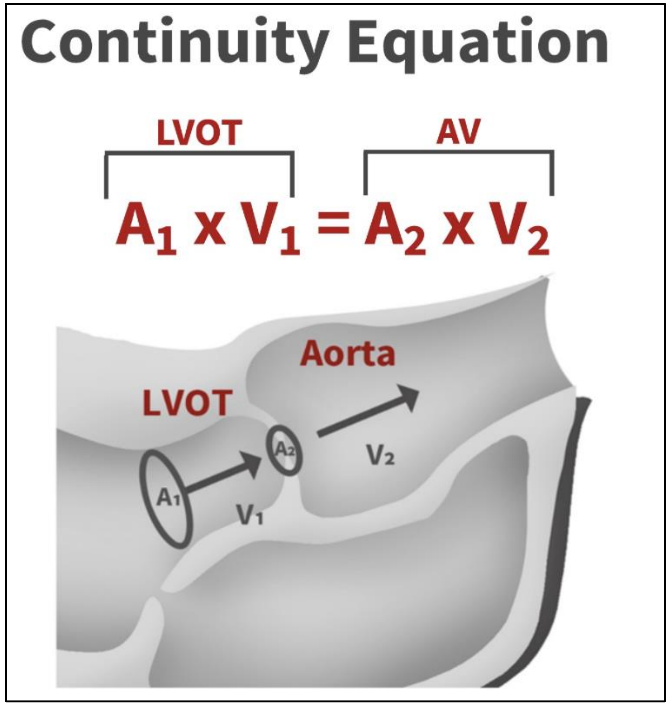
# Severe Aortic Stenosis

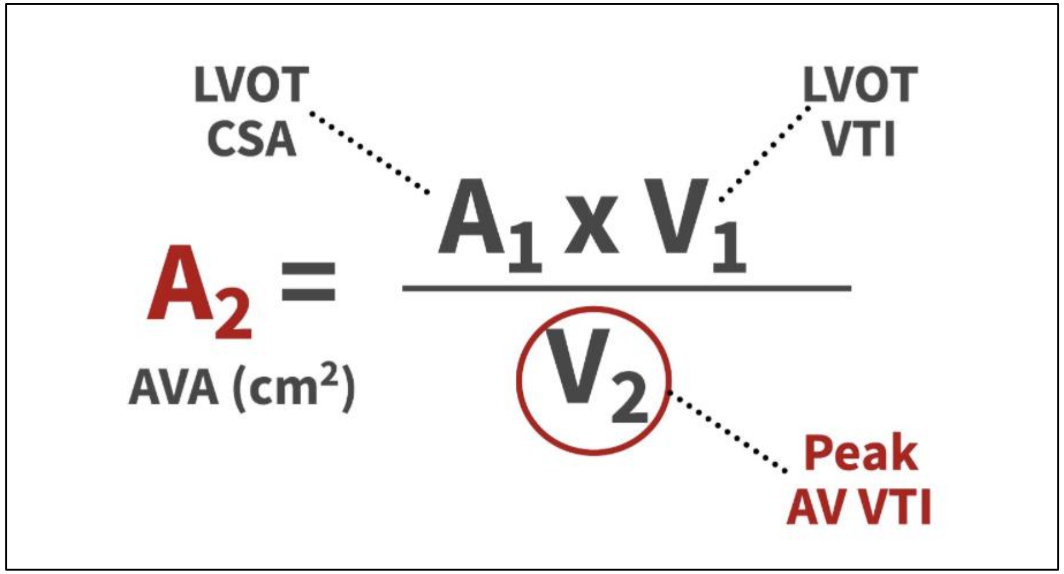
- Valve area < $1cm^2$
- Peak velocity > 4 m/s
- Mean gradient > 40mmHg



# Steps in Measurements

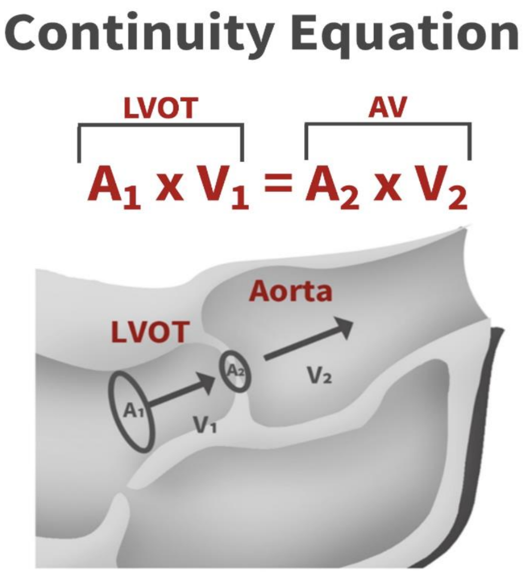
Valve area

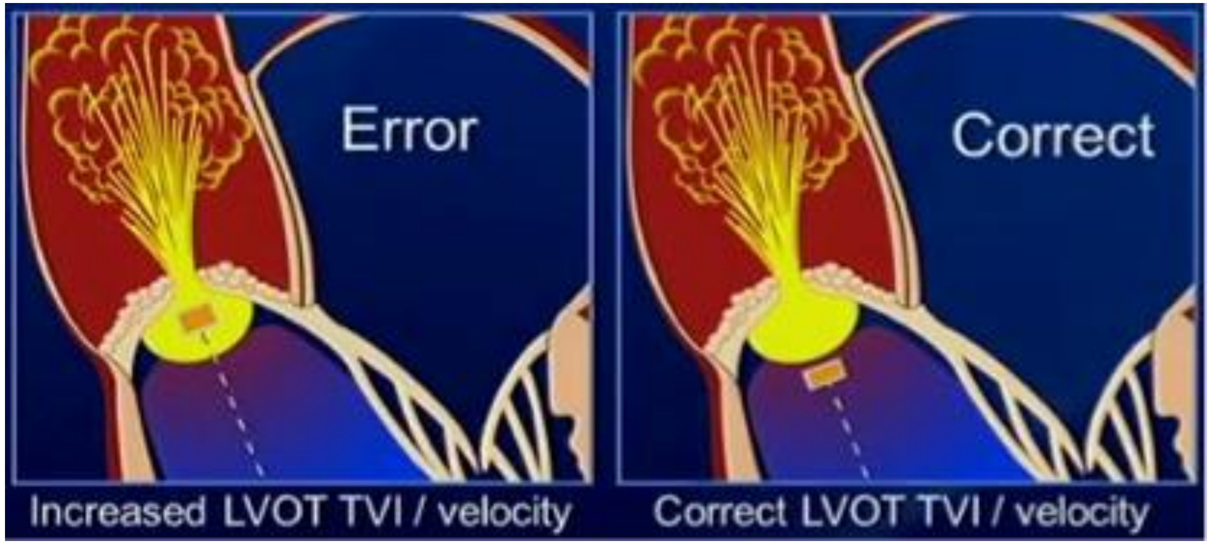


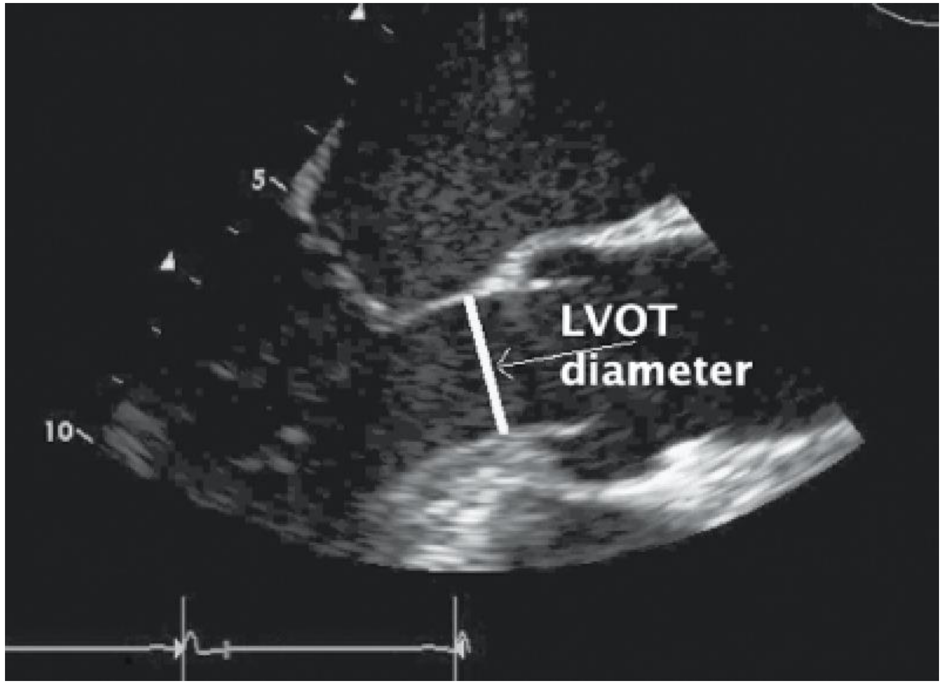



# A1 (LVOT Diameter)

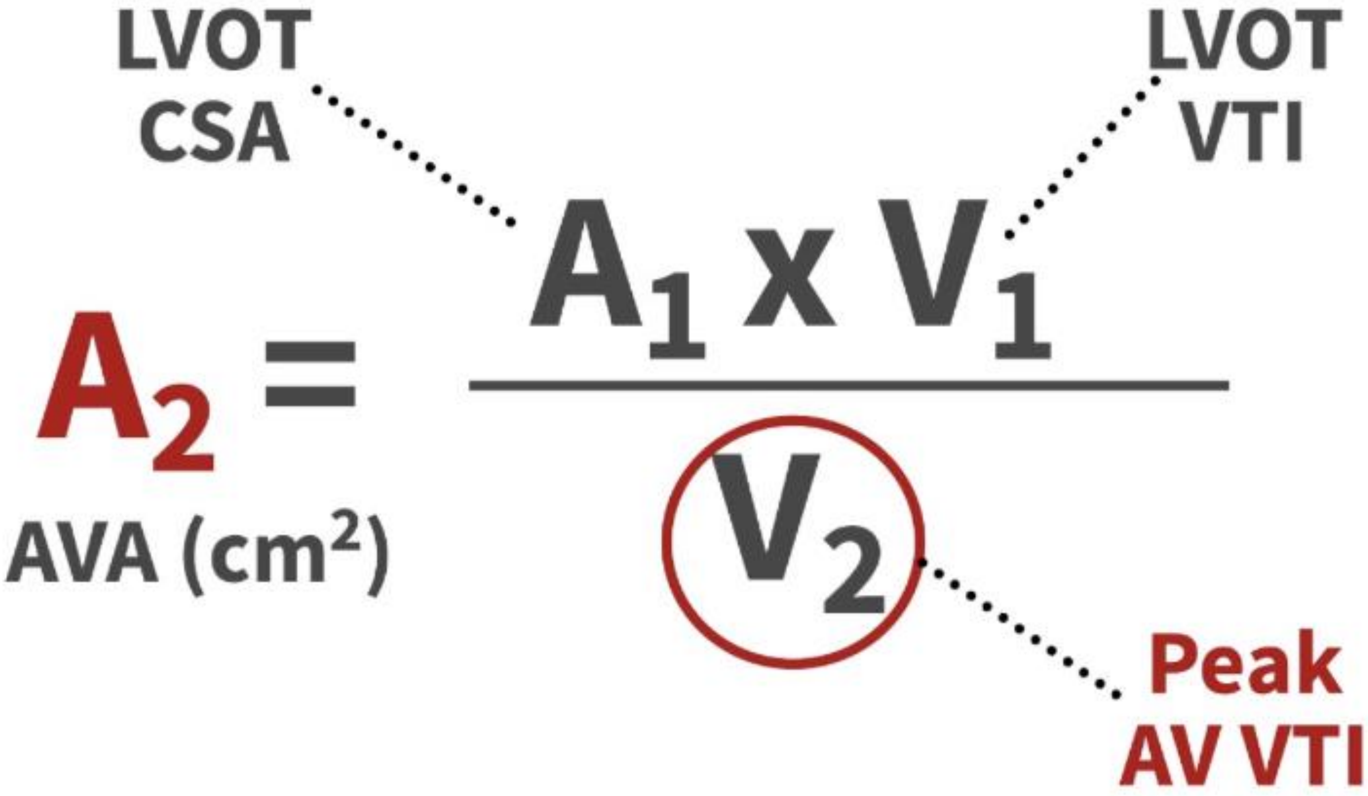
- Parasternal long axis view
- Zoom on the aortic valve
- Scroll to systole where valve is wide open



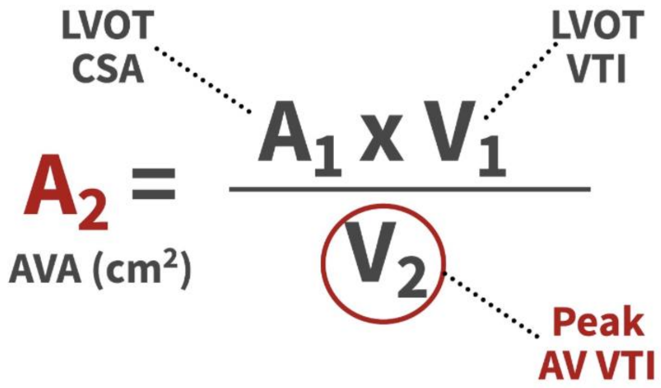



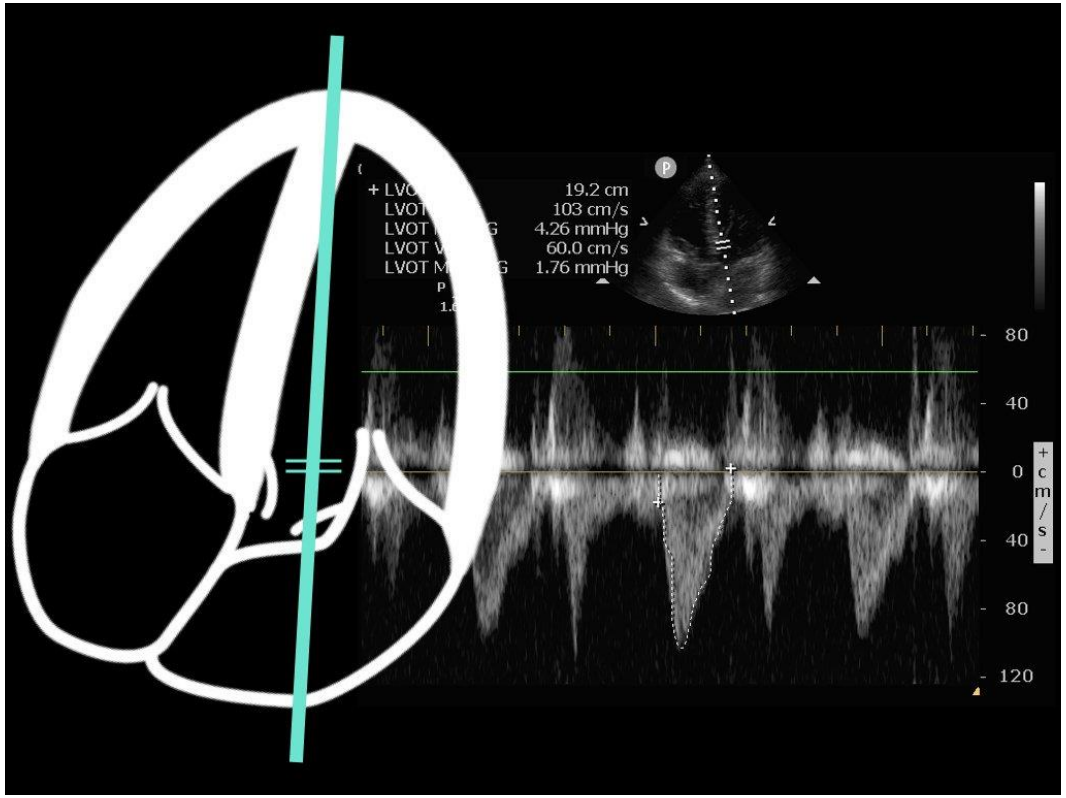
# V1 & V2 Calculation



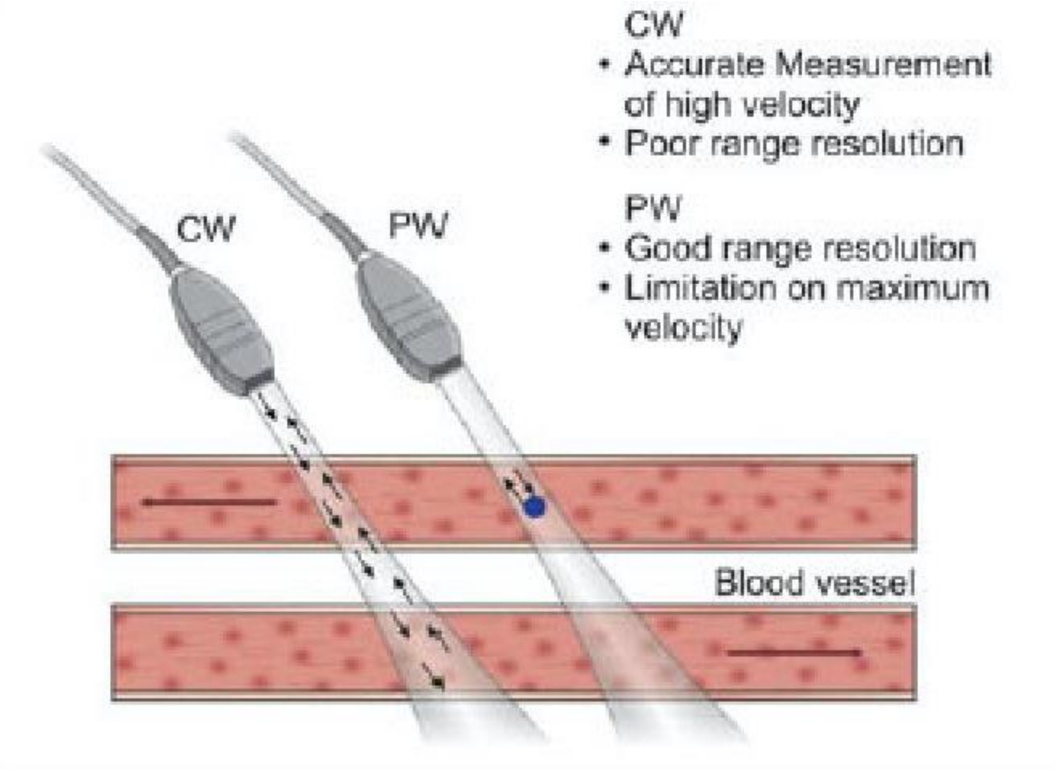
# V1 (LVOT Velocity)

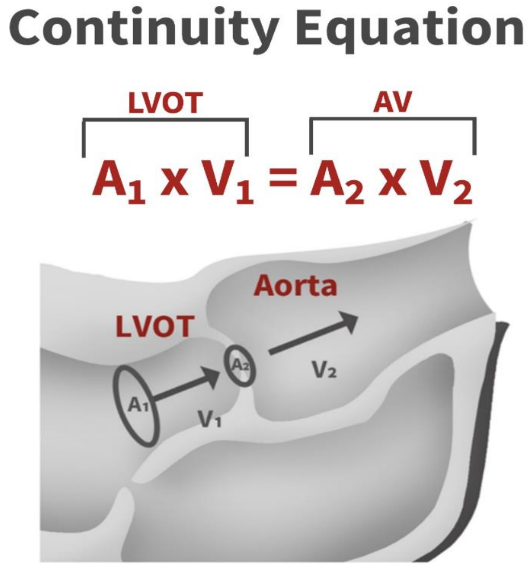
- Apical 5 chamber view
- Pulsed Wave mode
- Place probe at LVOT
- Get Vmax & VTI by tracing the jet

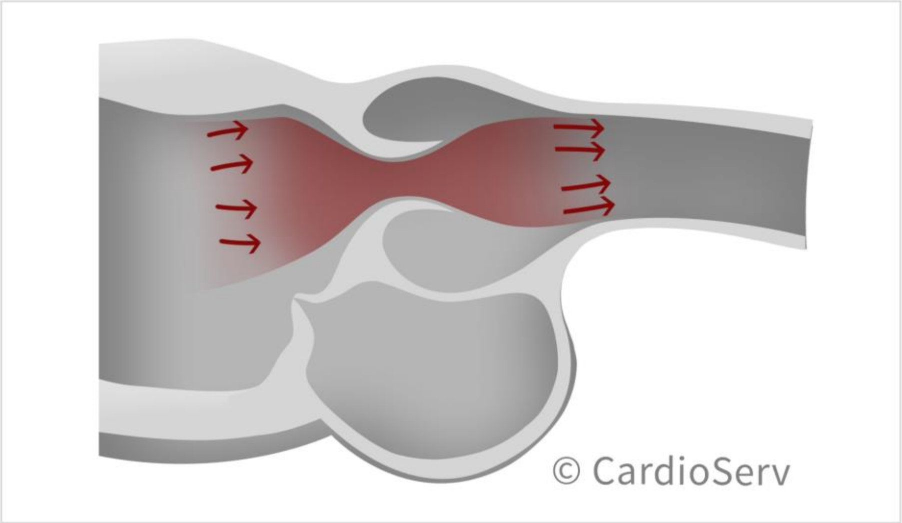


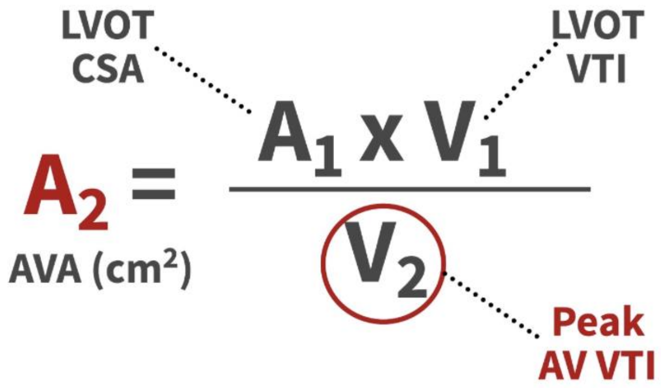
# Continuous vs. Pulsed Wave



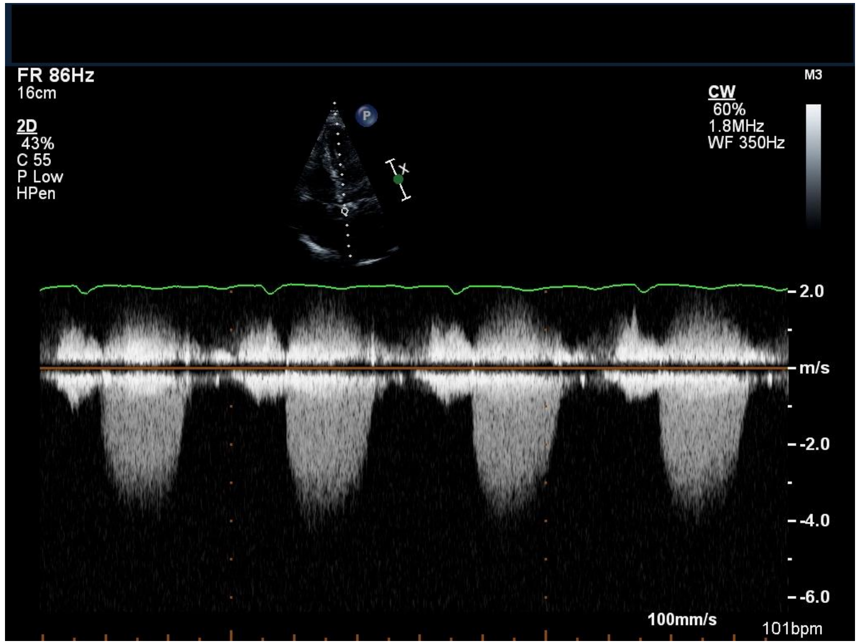



# V2 (AV Velocity)

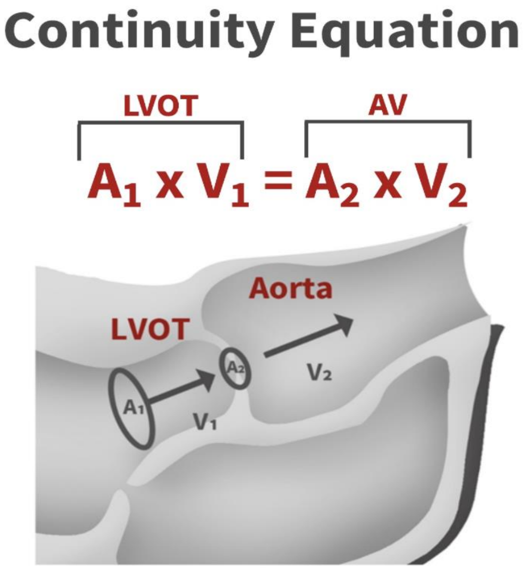


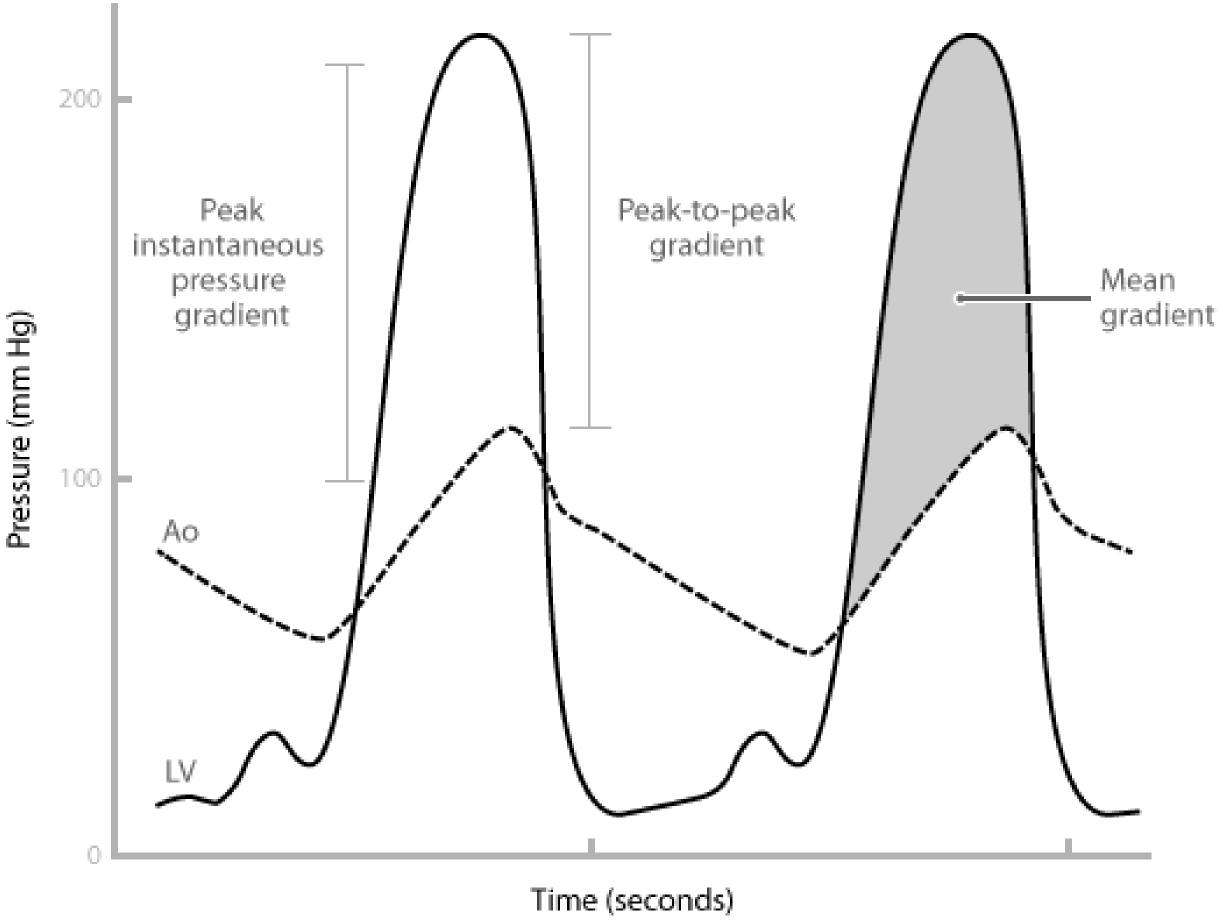

- Apical 5 chamber view
- Continuous Wave mode
- Measure Vmax  to obtain Peak Velocity
- Measure VTI by tracing the jet

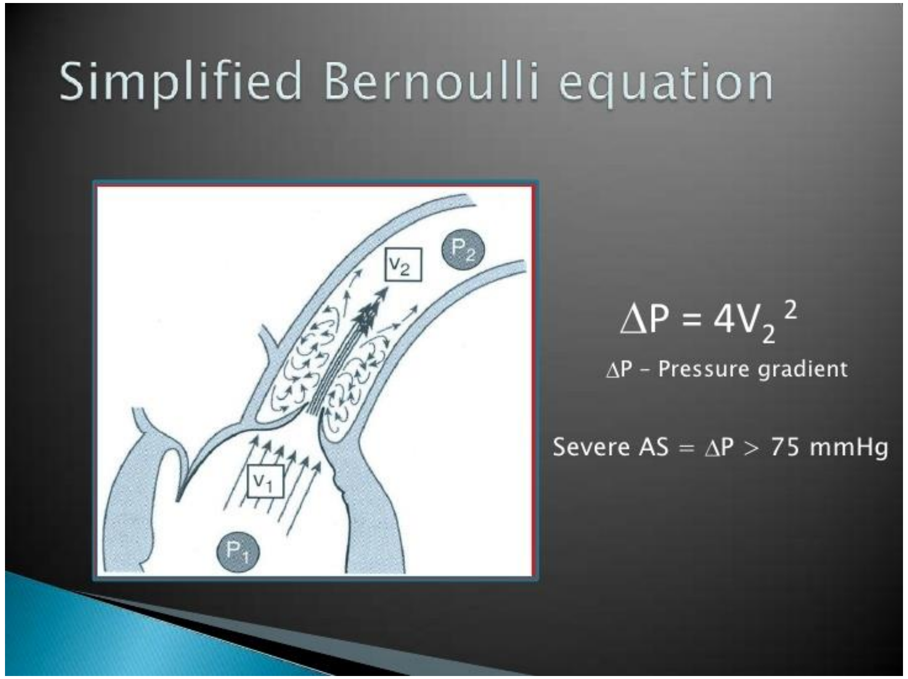


# AV Mean Gradient

- From AV-VTI, the mean gradient is calculated



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# Underestimation of AS severity

- Low-flow, low-gradient (LF-LG) severe AS with reduced EF (<40%)
- Low-flow, low-gradient (LF-LG) severe AS with preserved EF from restrictive physiology (concentric remodeling, small LV size & reductions in LV compliance and filling)

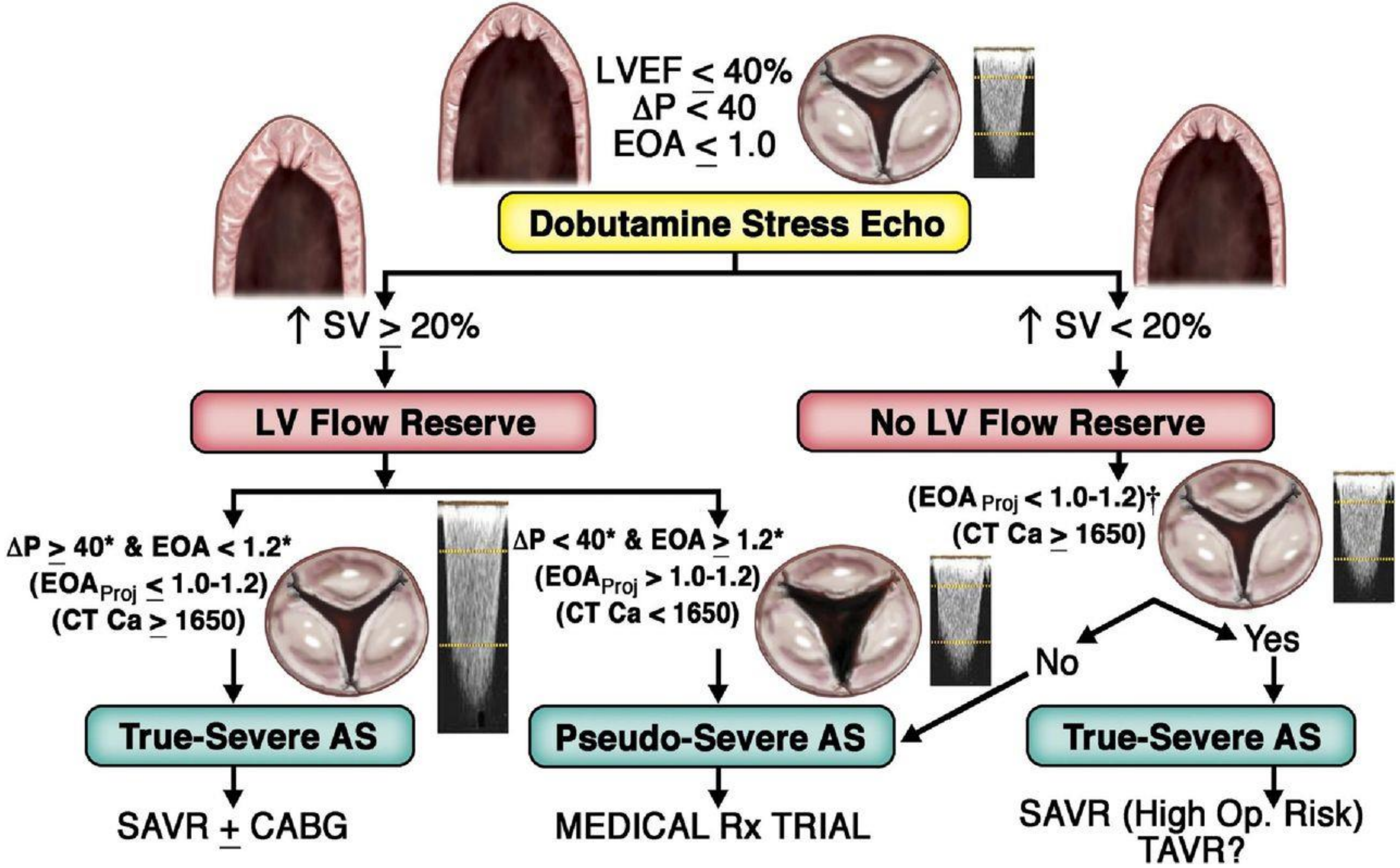
# How to diagnosis & treat low-flow low-gradient (LF-LG) severe AS with reduced LVEF?

- True severe AS vs. pseudo-severe AS
- Distinction is essential as true severe AS requires aortic valve replacement
- Dobutamine stress echo distinguishes true vs. pseudo-severe AS

# Dobutamine Stress Echo

- Pseudo-severe AS:
  - ↑ EF → ↑ flow with little ↑ in gradient with ↑ AVA
  - It is defined as AVA (>1 $cm_2$) at a flow rate of 250 ml/s
- True severe AS:
  - ↑ EF → ↑ flow with ↑ in gradient without ↑ AVA

- 15% of patients with no LV flow reserve have insufficient flow (<250 ml/s) to allow accurate AVA measurements.
- Valve calcification quantification ($CT_{CA}$>1,650 AU) distinguishes true severe from pseudo-severe AS.


LVEF ≤ 40%
ΔP < 40
EOA ≤ 1.0
Dobutamine Stress Echo
↑ SV ≥ 20%
↑ SV < 20%
LV Flow Reserve
No LV Flow Reserve
(EOA Proj < 1.0-1.2)†
(CT Ca ≥ 1650)
ΔP ≥ 40* & EOA < 1.2*
(EOAProj ≤ 1.0-1.2)
(CT Ca ≥ 1650)
ΔP < 40* & EOA ≥ 1.2*
(EOAProj > 1.0-1.2)
(CT Ca < 1650)
No
Yes
True-Severe AS
Pseudo-Severe AS
True-Severe AS
SAVR ± CABG
MEDICAL Rx TRIAL
SAVR (High Op. Risk)
TAVR?

# Citations


- Low-Flow, Low-Gradient Aortic Stenosis With Normal and Depressed Left Ventricular Ejection Fraction Philippe Pibarot, Jean G. Dumesnil Journal of the American College of Cardiology Nov 2012, 60 (19) 1845-1853; DOI: 10.1016/j.jacc.2012.06.051