Imaging prosthetic mitral valve

This is how I do it – Sanket Shah, MD MHS

Children's Mercy KANSAS CITY

UMKC School of Medicine

KU School of Medicine The University of Kansas

Disclosures

- None
- Congratulations to the Eagles fans
- TED type talk – honest attempt at simplification.
- No Use of Artificial Intelligence ☺.

Because “Prosthetic valve is a disease”

Google Gemini AI

Search Labs | AI Overview

Prosthetic heart valves are not diseases, but they can develop complications that are serious and sometimes fatal. These complications include thrombosis, endocarditis, and structural valve deterioration.

Complications of prosthetic heart valves

- **Thrombosis**: A blood clot that can form on the valve, leading to reduced blood flow or stroke. Symptoms include chest pain, heart failure, and swelling in the legs or abdomen.
- **Endocarditis**: A bacterial infection of the valve that can be fatal.
- **Structural valve deterioration**: A long-term complication of bioprosthetic valves that can lead to stenosis or regurgitation.

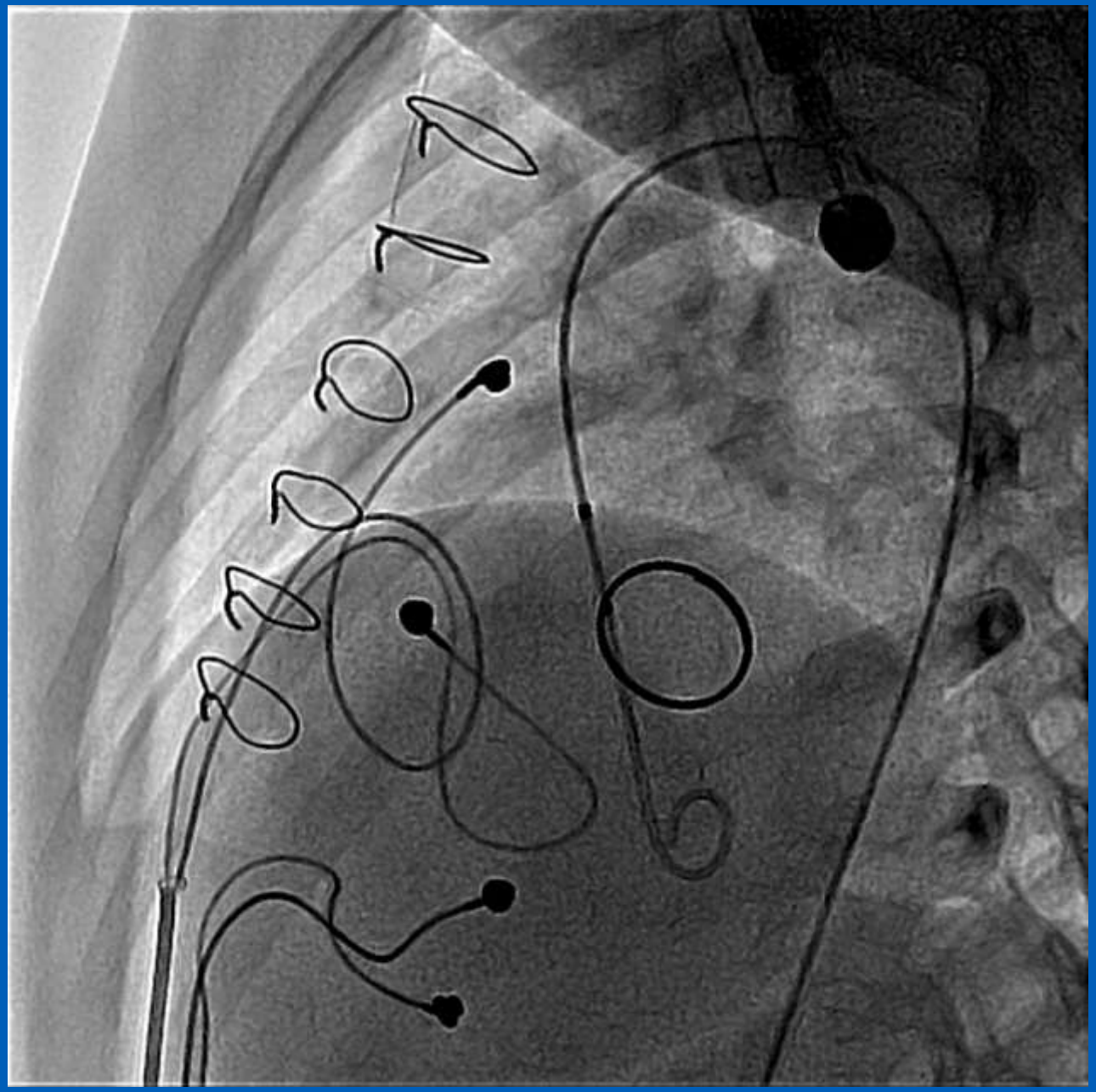
Tools

- Trans-thoracic Echo
- Trans-Esophageal Echo
- 3D Echo
- CT Angio
- Fluoro/Cath

Beyond scope today

- Stress Echo
- MRI
- Cardiac Positron Emission Tomography [fluorodeoxyglucose (FDG)]

LAO 60, Cranial 20



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Why Echo [TEE] & CT

Zoghbi et al JASE Guidelines Jan 2024

Table 3 Comparative strength of imaging modalities in evaluating prosthetic valve structure, function, and complications

	TTE	TEE	CT	CMR
Valve function/stenosis				
Valve structure, anatomic area (bioprosthetic)	++	++++	++++	+++
Valve structure, motion (mechanical)	+	++ (MV 4+)	++++	+
Gradient, EOA*	+++	++ (MV 3+)		++
Thrombus, pannus (mechanical)	+	+++	++++	+
Valve regurgitation				
Localization	++	++++	++	+
Valve dehiscence	++	++++	++++	++
Endocarditis†	++	+++	++	+
Quantitation	++	++++	++	++++

MV, Mitral valve.
On a scale of none to 4+.

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Know the valve type

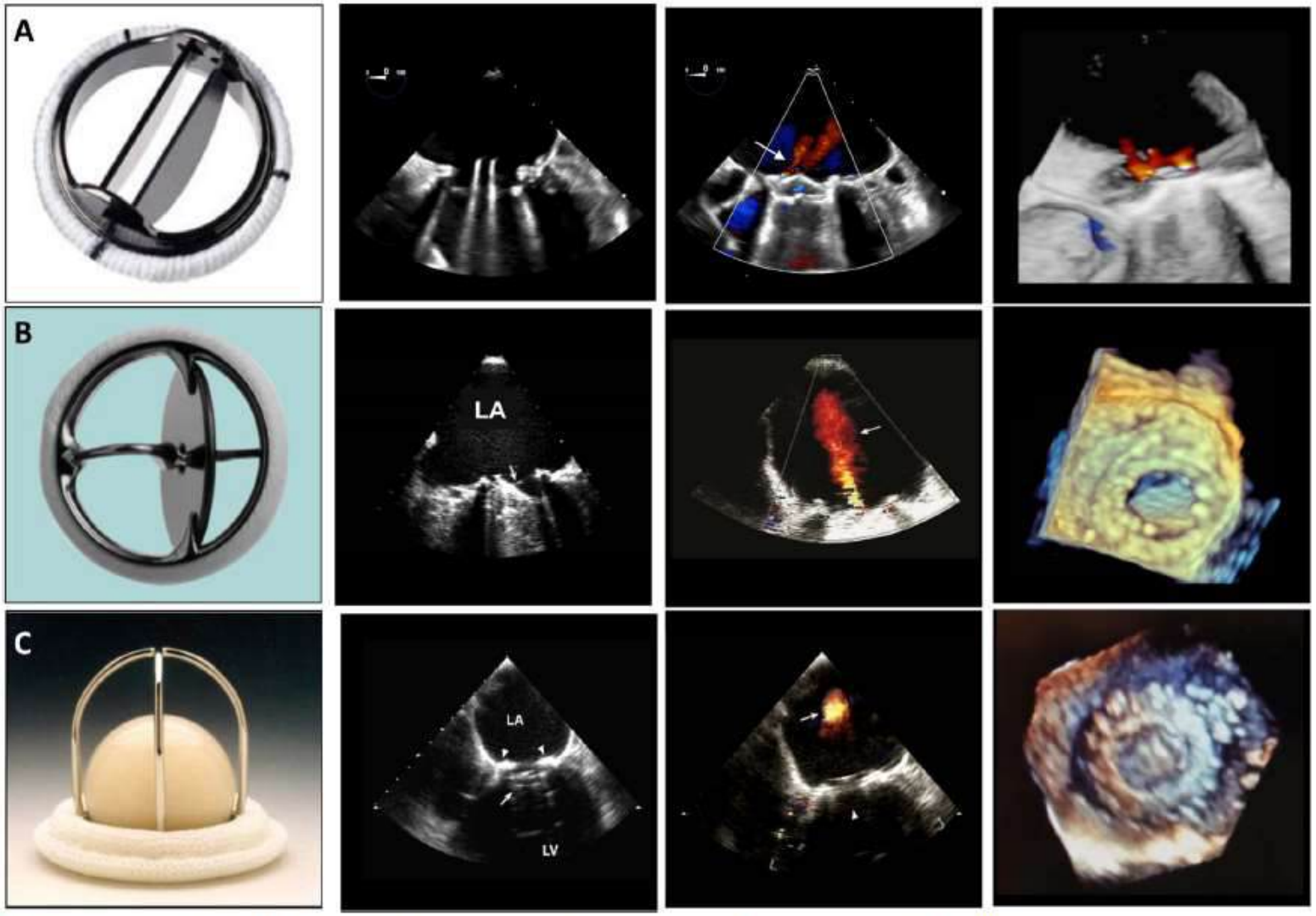

Figure 1 Mechanical valves: **(A)** bileaflet, **(B)** single-leaflet, and **(C)** caged-ball valves and their 2D and 3D transesophageal echocar-

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Abbott [St. Jude] and On-X Life Technologies

Pyrolytic carbon is wear resistant; low profile; >25mm Mitral

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TTE / TEE Mitral valve – ASE & I

Table 10 Echocardiographic parameters to evaluate prosthetic mitral valve function (stenosis or regurgitation)

Doppler echocardiography of the mitral valve	Peak early velocity
	Mean pressure gradient
	Heart rate at the time of Doppler
	PHT
	DVI (VTI_{PrMV}/VTI_{LVOT})
	EOA*
	Presence, location, and severity of regurgitation
Other pertinent echocardiographic parameters	LV size and function
	Left atrial size
	RV size and function
	Estimation of PA pressure

VTI_{PrMV}, VTI through the prosthetic mitral valve.
*Using the continuity equation.

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TTE of Prosthetic Mitral valve

- Zoom up
- Multiple views/angles [A4C, Parasternal]
- Sweep
- Color Compare
- Pulse and Continuous wave Dopplers
- Other details – LA, LV size and function, TR [RVP], RV function, Appendage
- X-Planes
- 3D TTE if good acoustic windows, best on TEE

A4C sweep

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Parasternal Long zoom color compare

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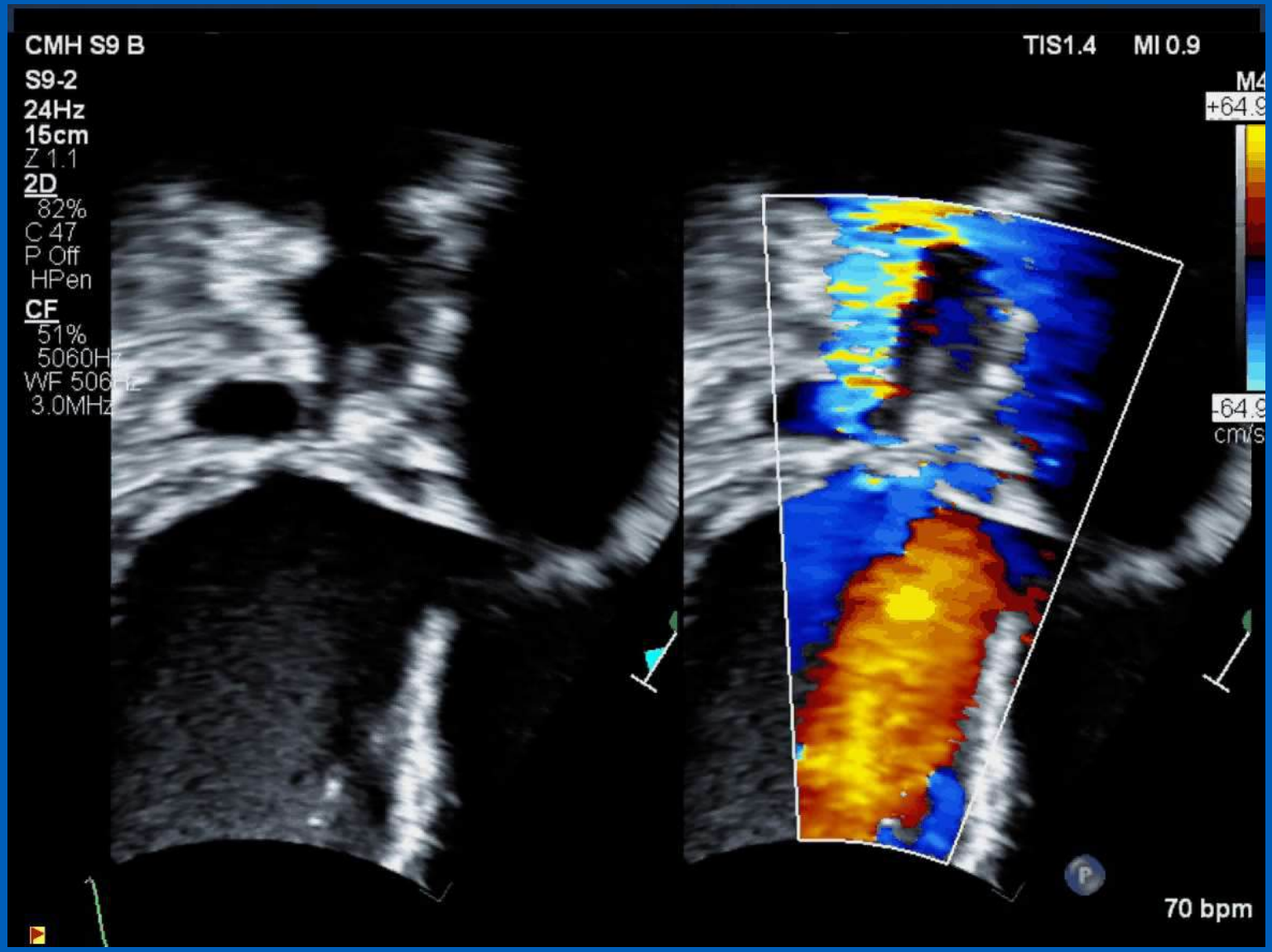
Zoom Color compare 3Chamber



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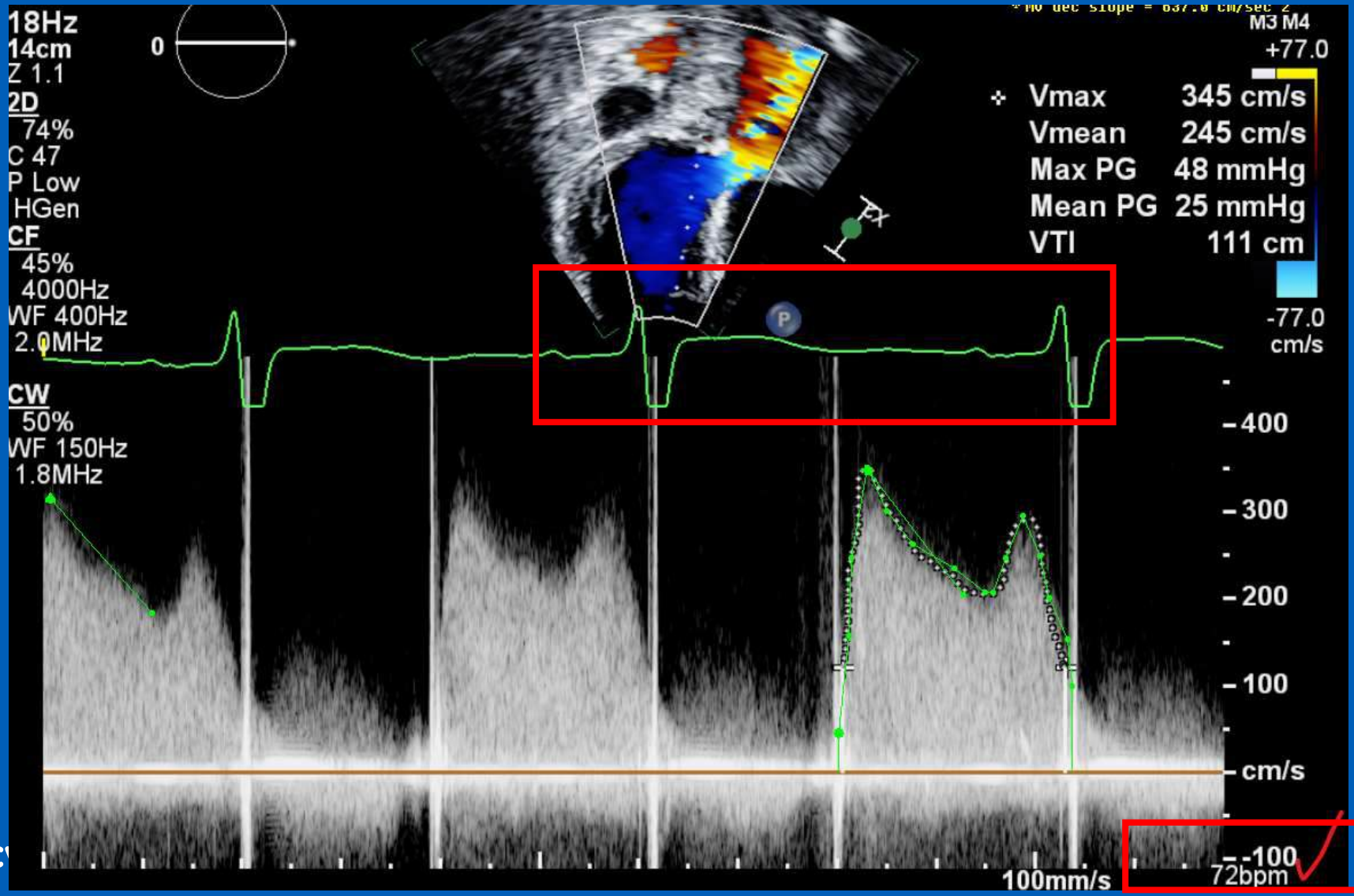
Doppler with ECG gain high- Rate & rhythm



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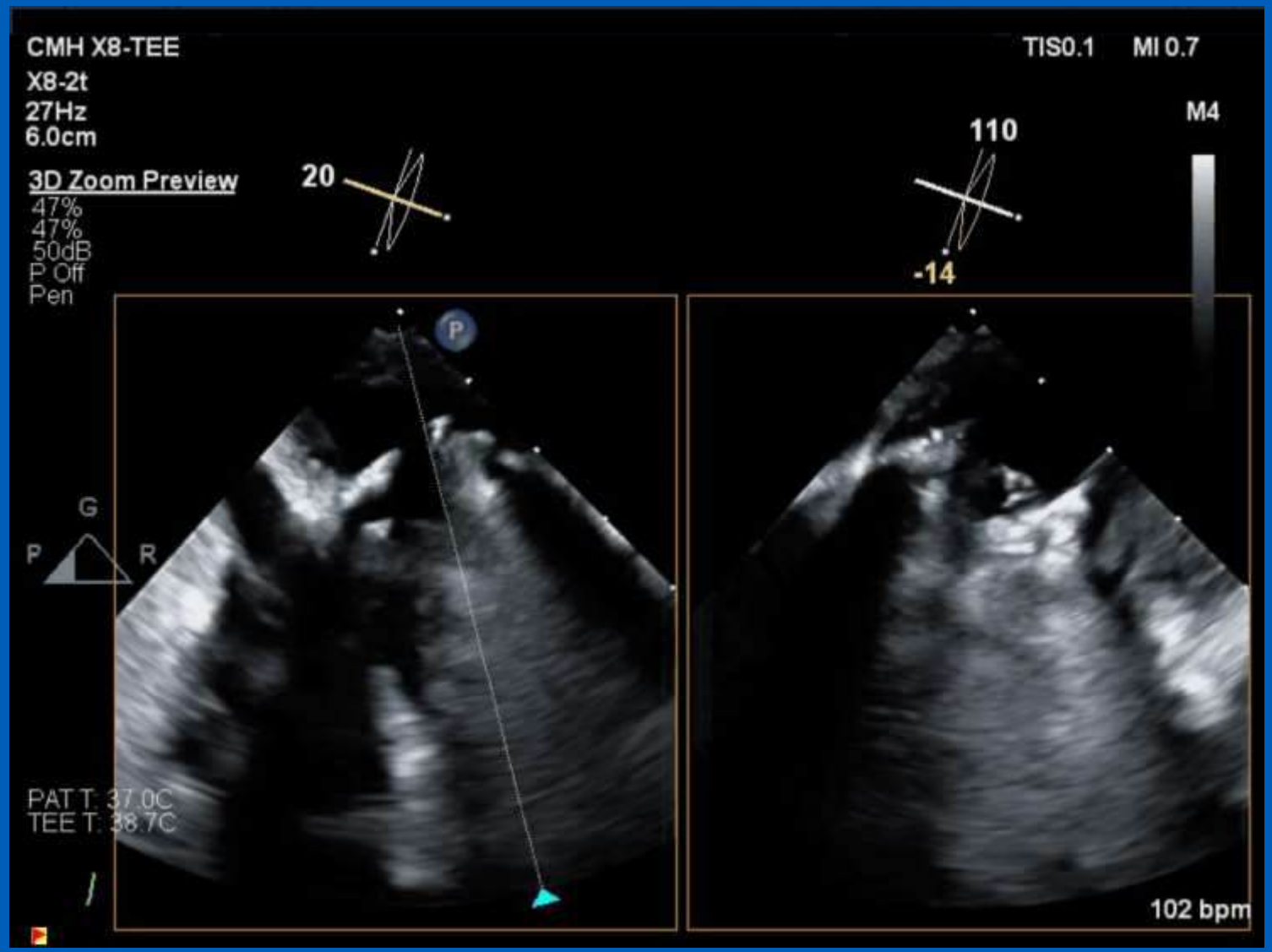
3D Zoom prep or 2 click crop



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3D Zoom 1 beat

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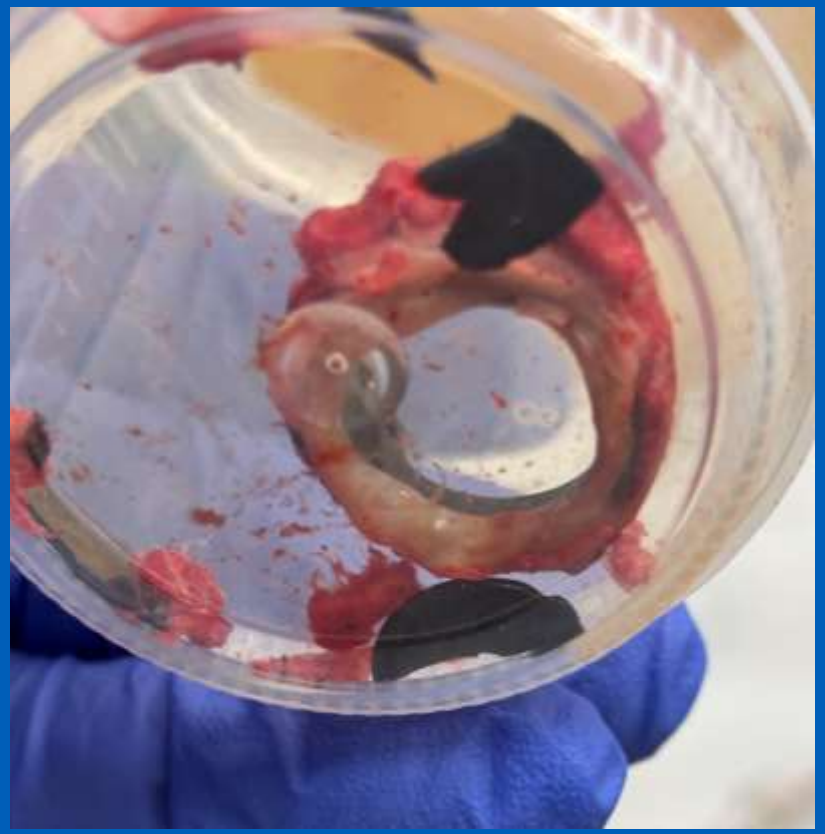
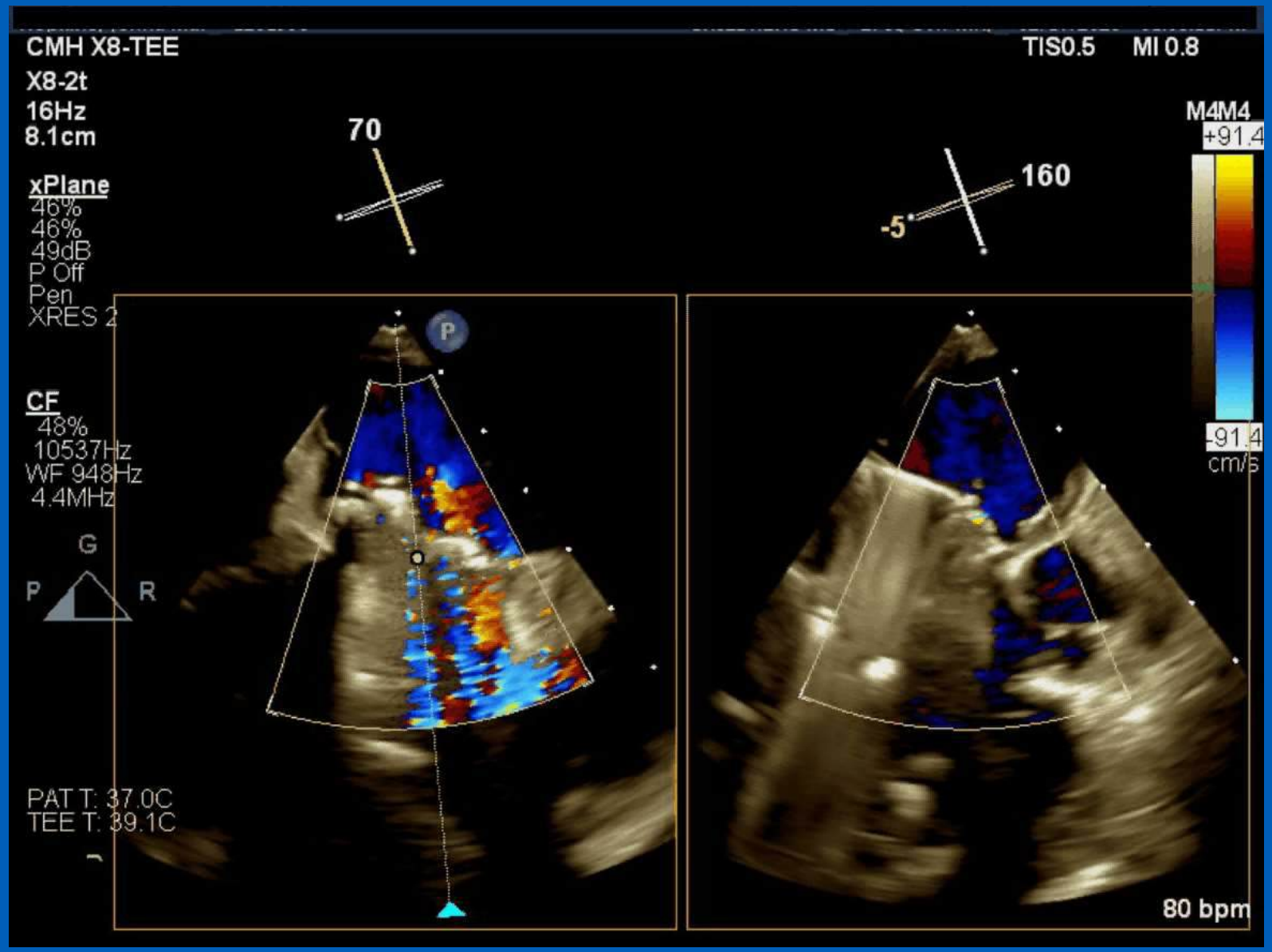
TEE – Tissue Pannus correlation



Color x-plane to assess para-valvar leak



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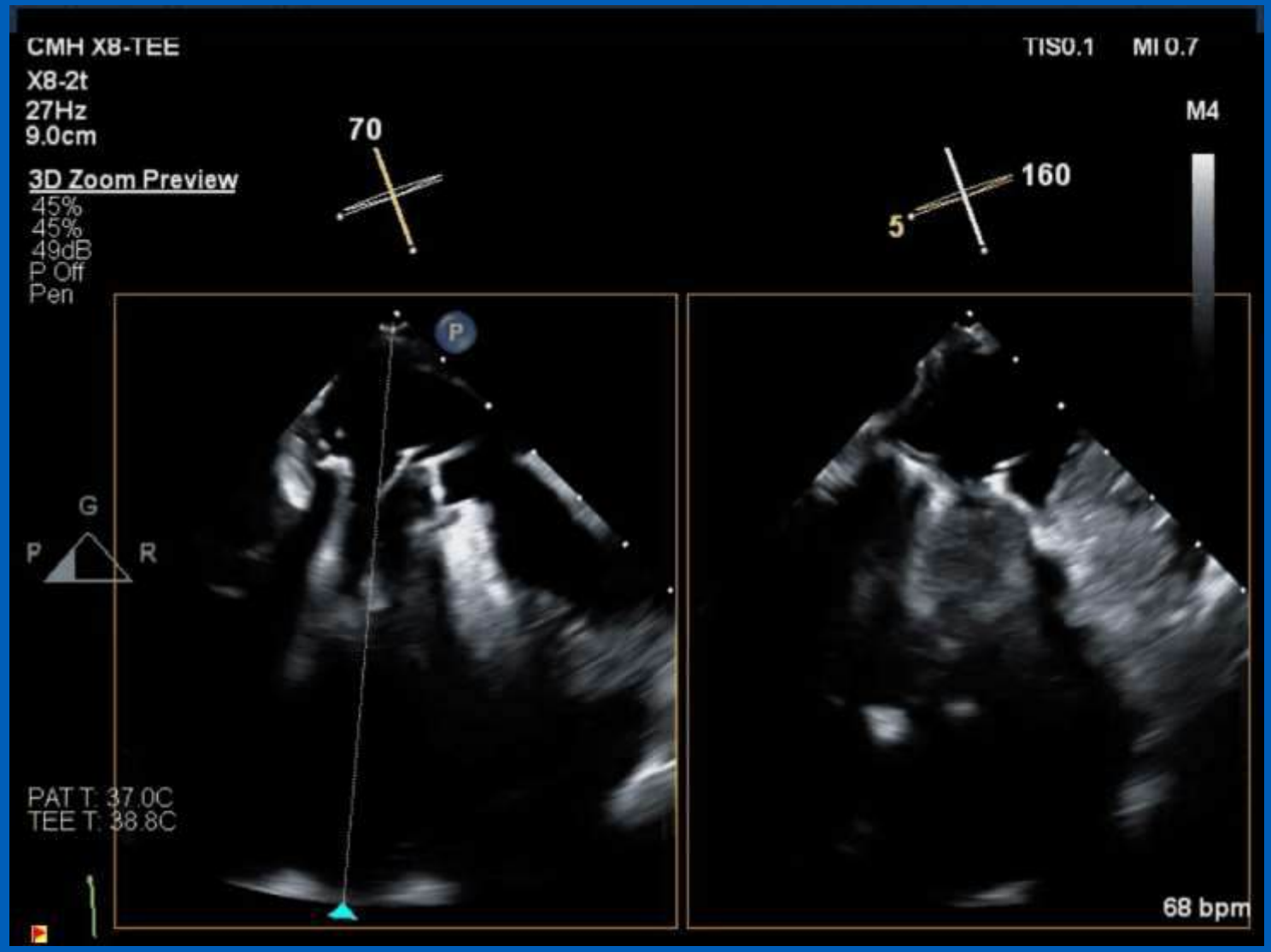
New valve 3D zoom prep



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3D valve at placement – rhythm in OR

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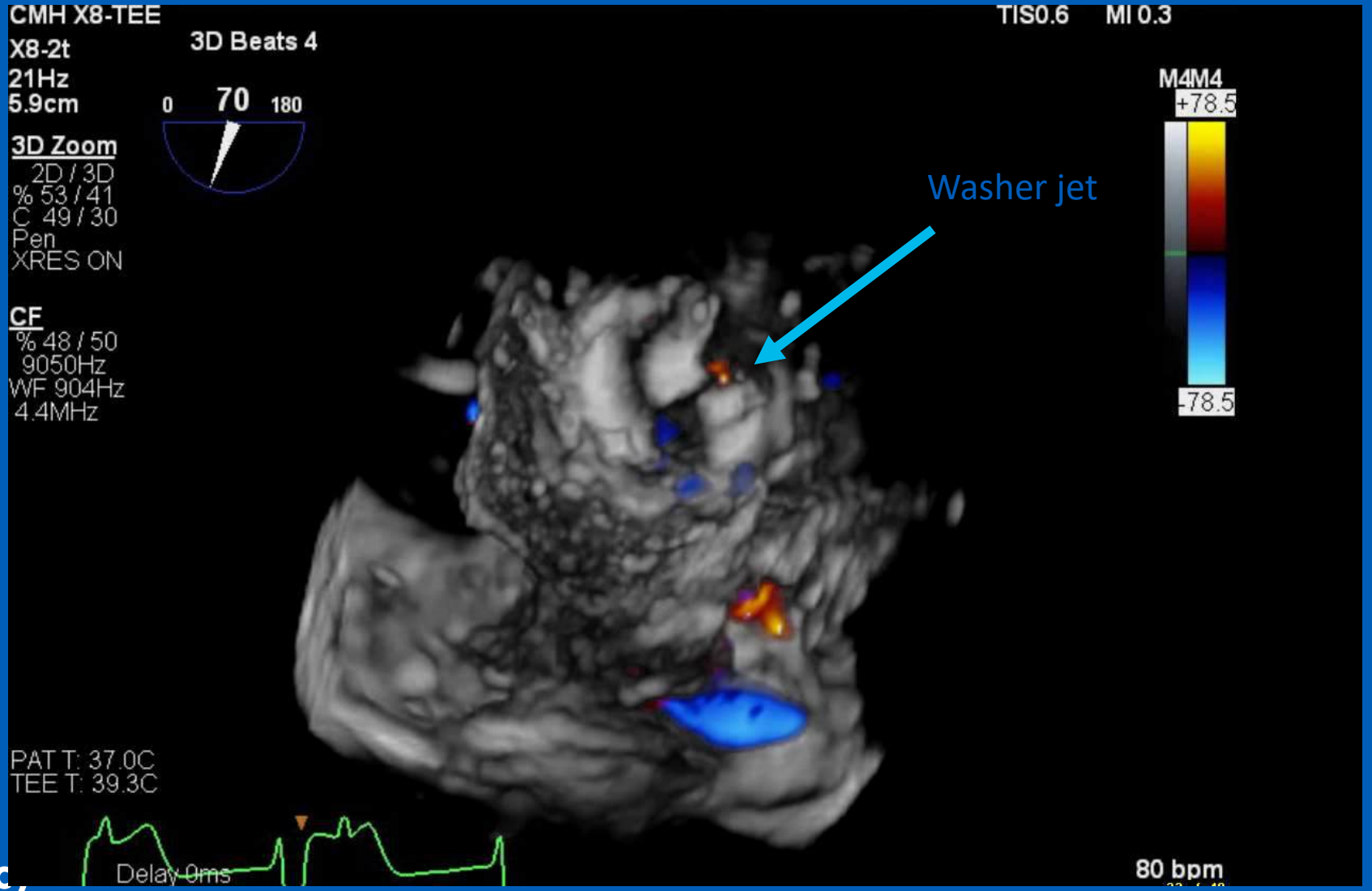
3D color-not perfect but screen PVR



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TEE &/or CTA

TEE

- Anesthesia
- Invasive
- Physiological information
- Good temporal resolution
- Wide-spread availability
- New Pediatric 3D TEE probes available

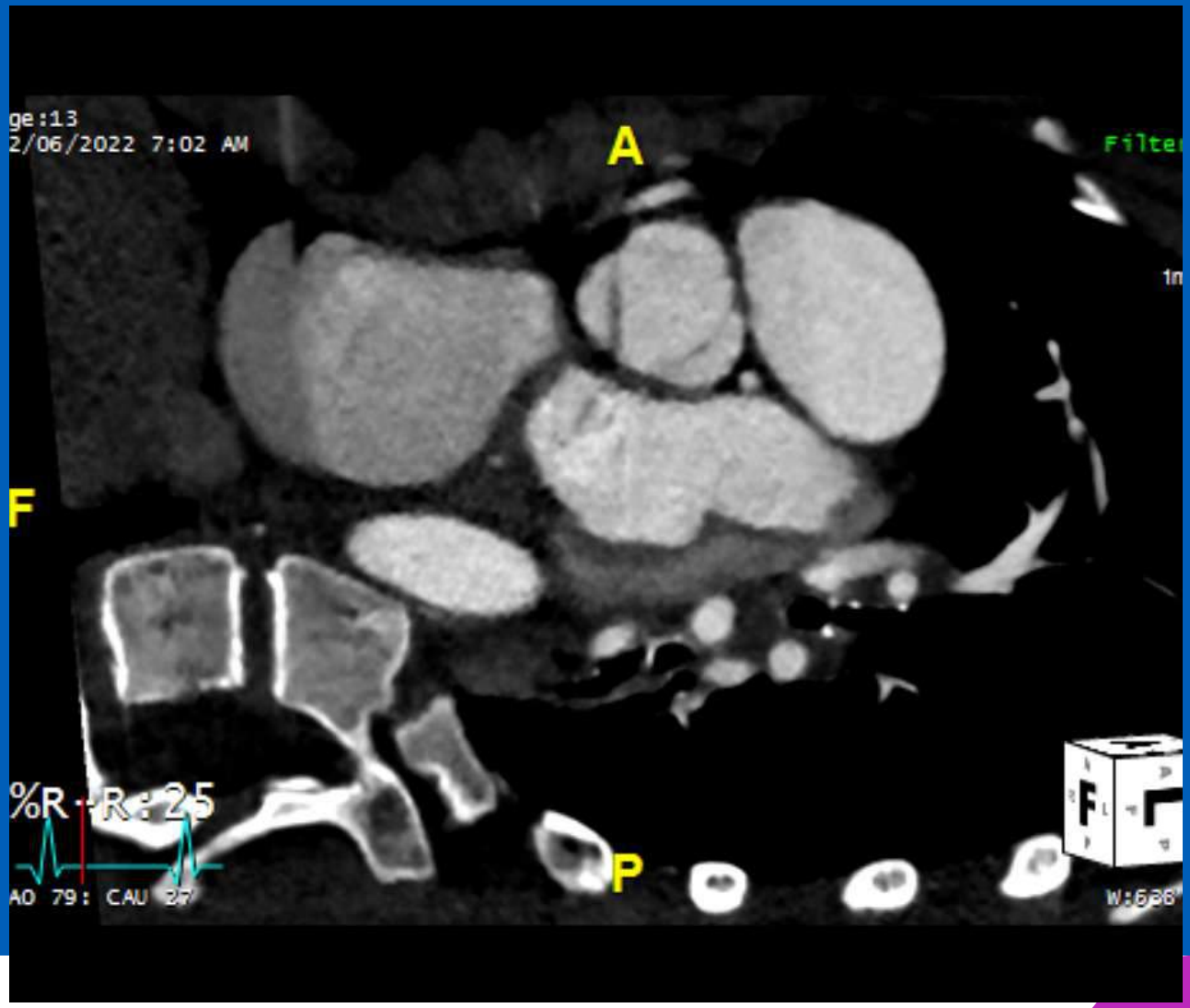
CTA

- Requires Anesthesia in younger
- Ionizing Radiation
- iv access and contrast
- Coronary and extracardiac details
- Good spatial resolution
- Volume/function-retrospective CTA
- Modeling / Planning is easier

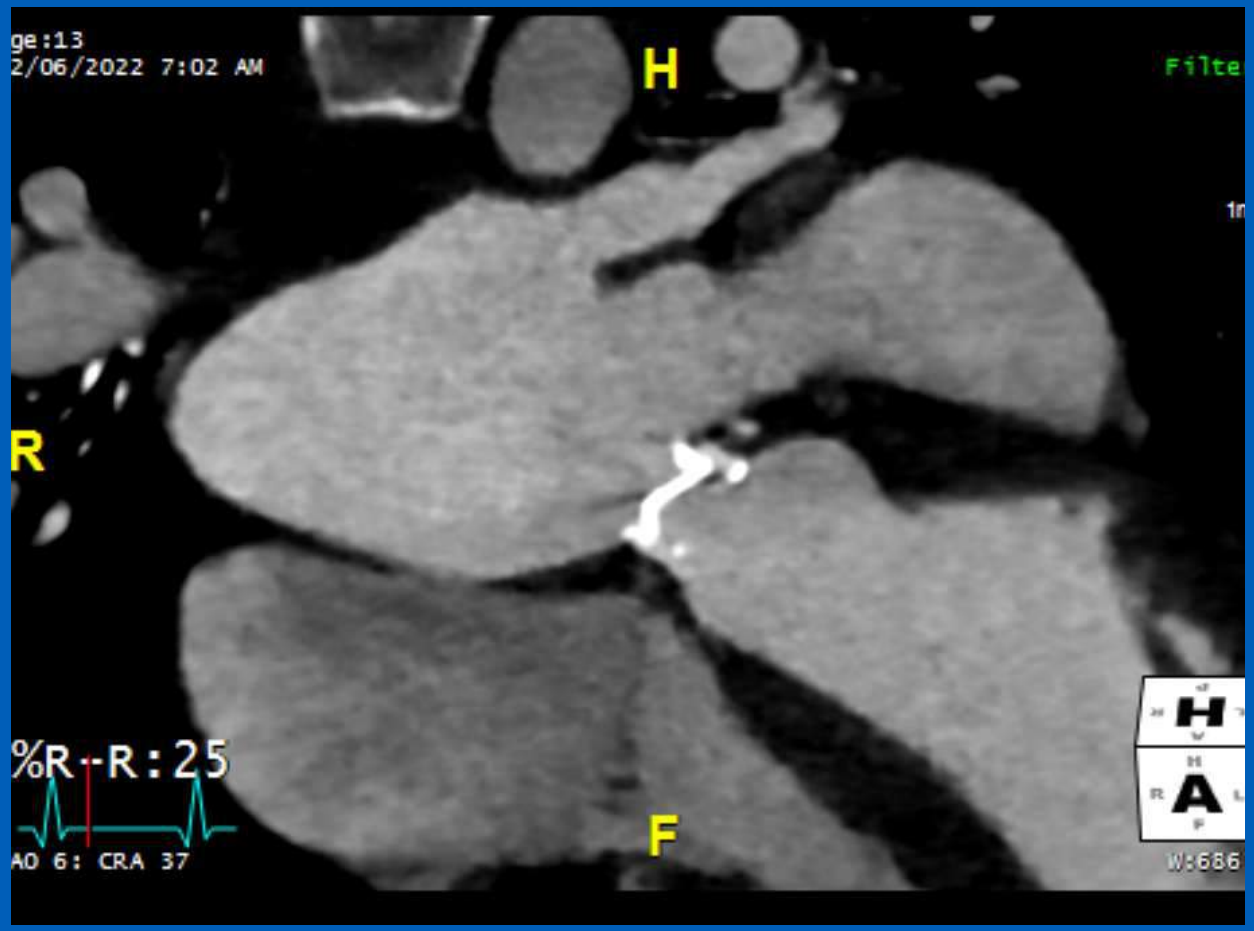
CT angio – how we do it

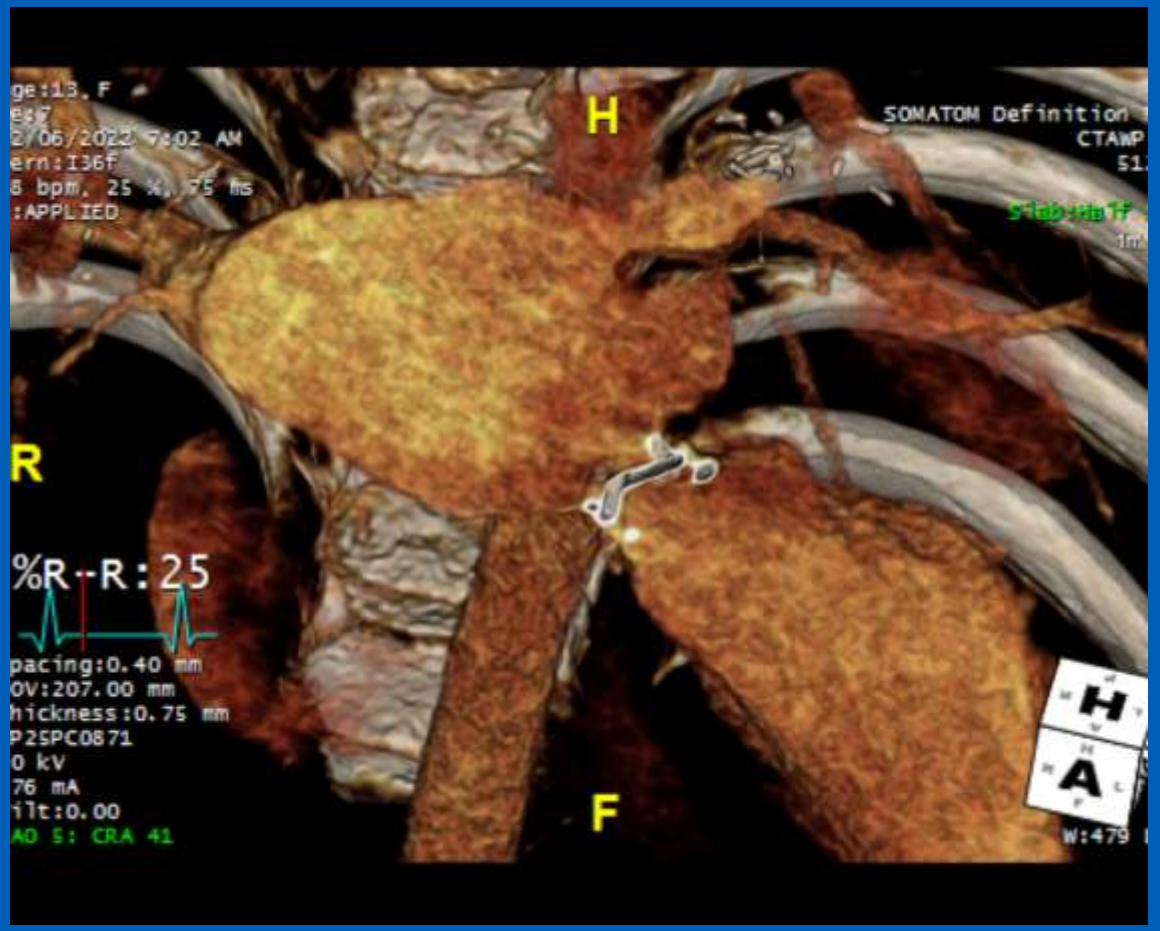
- Contrast timing bolus with contrast ROI: Aorta
- Contrast 300 mg/ml OMNIPAQUE
- Preferably 20 or 22 gauge IV via Right Forearm.
- Breath-hold
- Gating:
  - ✓ Prospective (adaptive sequential) -RR interval of 20-70
  - ✓ Retrospective with RR of 0-100.
- Dose reduction – CTDI vol: 5.3 - 13.1 mGy. [~ 100 chest x-rays]
- Post-processing MPR, 3D rendering/Aquarius viewer by Terarecon

CT 3D prospectively gated

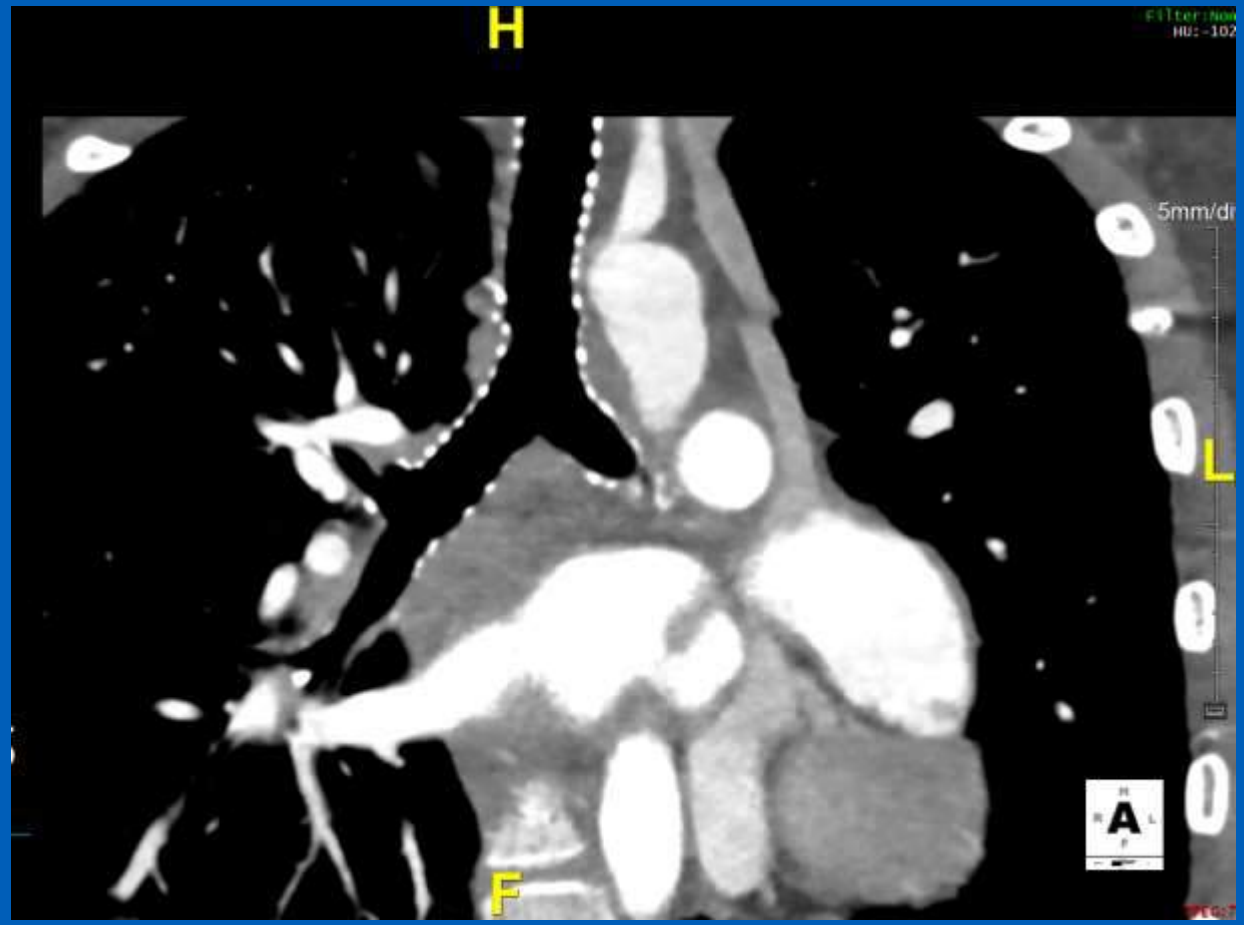


CT valve motion lateral view

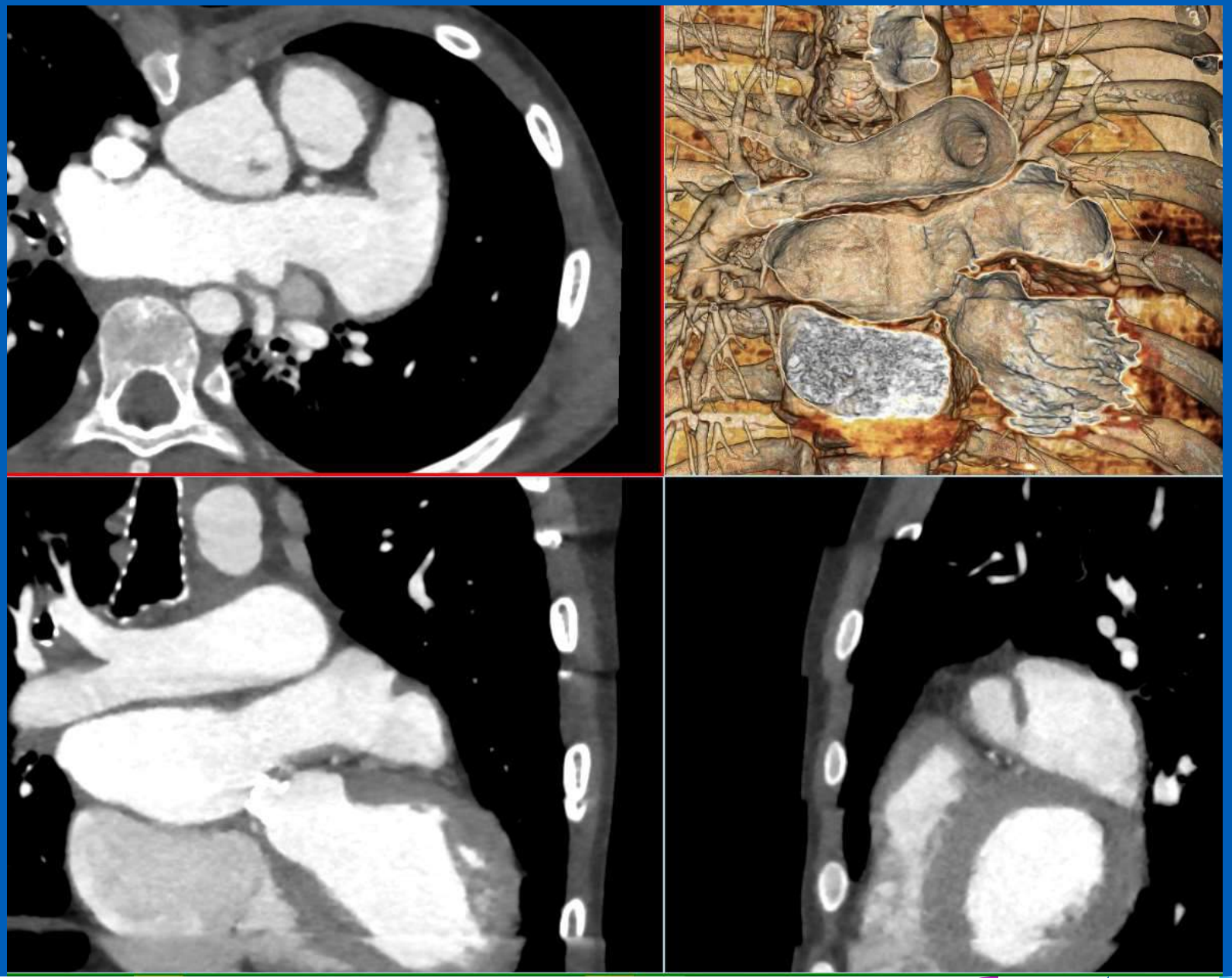




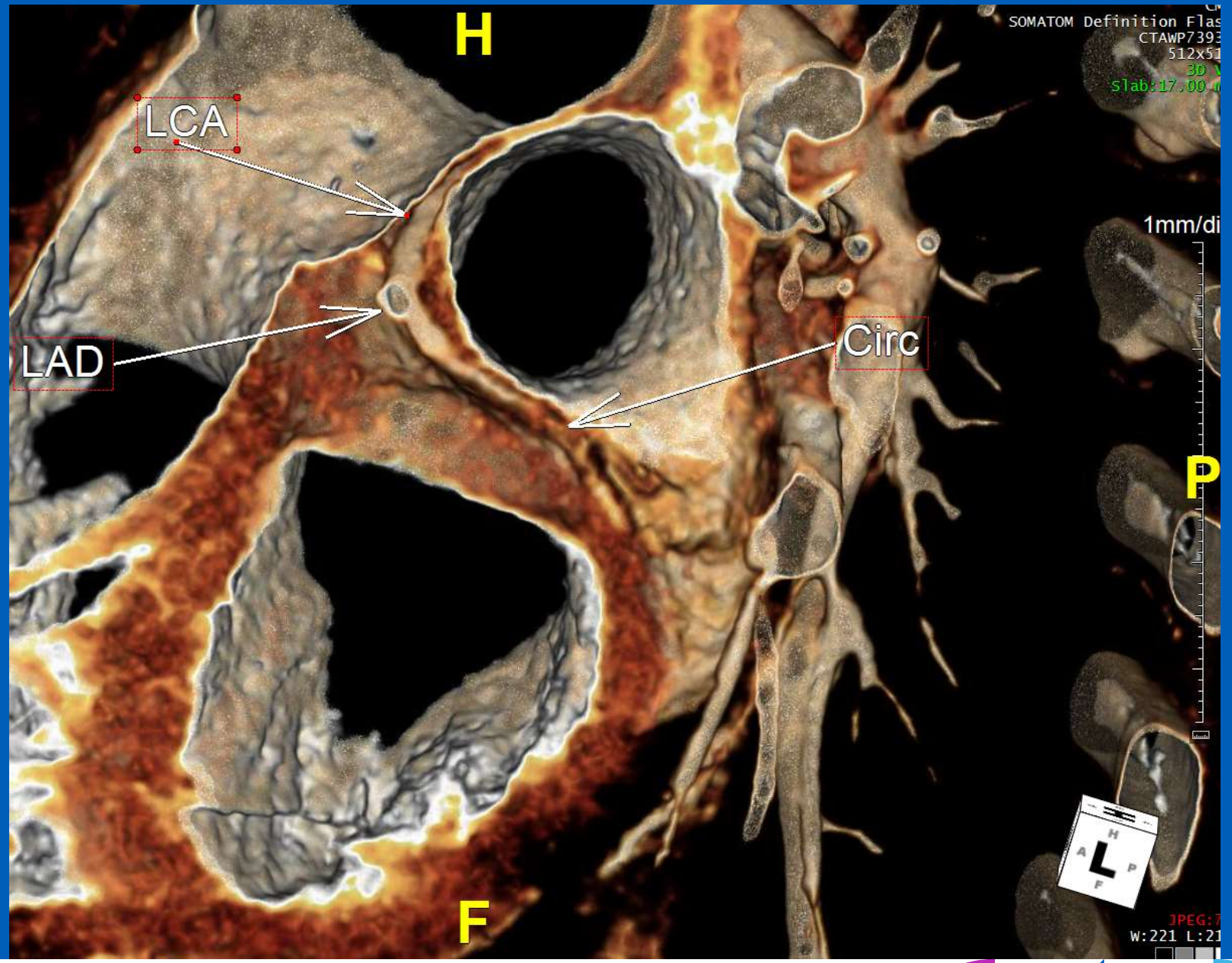
Incidentally “Coumadin” Calcification



Appendage
PA branches
Pectus



Cors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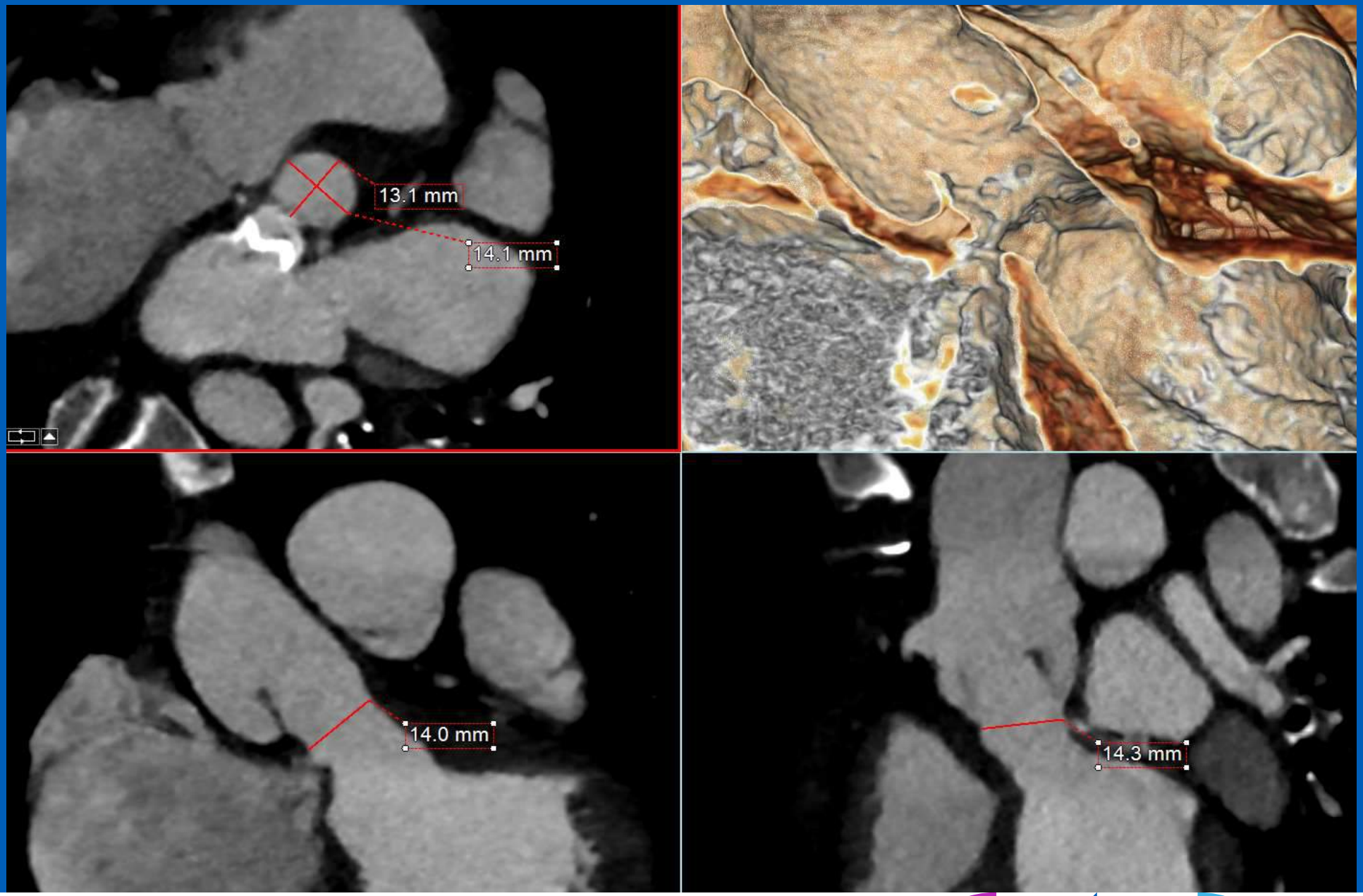
LVOT



Pannus
Hounsfield unit>200

Summary

- Prosthetic Mitral valve is a respectable disease/palliation.
- TTE for screening; low threshold for TEE/ 3D
  - Occluder/leaflet, Gradient @ HR, Thrombus, Pannus, I.E. need to be evaluated
  - X-plane, 3D Zoom/2-Click crop through the mitral valve
- Fluoro/Cath to eval disc motion
- ECG gated CT angio for valve motion/pannus/Thrombus
- TEE + CT is most powerful in symptomatic and peri-operative situations.

Thank you

- Additional Slides

Guidelines for the Evaluation of Prosthetic Valve Function With Cardiovascular Imaging: A Report From the American Society of Echocardiography Developed in Collaboration With the Society for Cardiovascular Magnetic Resonance and the Society of Cardiovascular Computed Tomography

William A. Zoghbi, MD (Chair), Pei-Ni Jone, MD (Co-Chair), Mohammed A. Chamsi-Pasha, MD, Tiffany Chen, MD, Keith A. Collins, MS, RDCS, Milind Y. Desai, MD, MBA, Paul Grayburn, MD, Daniel W. Groves, MD, Rebecca T. Hahn, MD, Stephen H. Little, MD, Eric Kruse, RDCS, Danita Sanborn, MD, Sangeeta B. Shah, MD, Lissa Sugeng, MD, Madhav Swaminathan, MD, MBBS, Jeremy Thaden, MD, Paaladinesh Thavendiranathan, MD, SM, Wendy Tsang, MD, SM, Jonathan R. Weir-McCall, MD, MBChB, PhD, and Edward Gill, MD, *Houston and Dallas, Texas; Chicago, Illinois; Philadelphia, Pennsylvania; Cleveland, Ohio; Aurora, Colorado; New York and Manhasset, New York; Boston, Massachusetts; Richmond, Virginia; Durham, North Carolina; Rochester, Minnesota; Toronto, Ontario, Canada; and Cambridge, United Kingdom*

In patients with significant cardiac valvular disease, intervention with either valve repair or valve replacement may be inevitable. Although valve repair is frequently performed, especially for mitral and tricuspid regurgitation, valve replacement remains common, particularly in adults. Diagnostic methods are often needed to assess the function of the prosthesis. Echocardiography is the first-line method for noninvasive evaluation of prosthetic valve function. The transthoracic approach is complemented with two-dimensional and three-dimensional transesophageal echocardiography for further refinement of valve morphology and function when needed. More recently, advances in computed tomography and cardiac magnetic resonance have enhanced their roles in evaluating valvular heart disease. This document offers a review of the echocardiographic techniques used and provides recommendations and general guidelines for evaluation of prosthetic

Measurements in Prosthetic MS

*For either mechanical or bioprosthetic valves; diagnostic accuracy is best if most of the parameters listed are normal or abnormal, respectively.

†Values of the parameters should prompt a closer evaluation of valve function and/or other considerations such as increased flow, increased heart rate, or PPM.

Table 11 Doppler findings suggestive of prosthetic mitral valve stenosis

	Normal*	Possible stenosis†	Suggests significant stenosis*†
Peak velocity, m/sec‡§	<1.9	1.9-2.5	≥2.5
Mean gradient, mm Hg‡§	≤5	6-10	>10
VTI_{PrMV}/VTI_{LVOT}‡§	<2.2	2.2-2.5	>2.5
EOA, cm^2	≥2.0	1-2	<1
PHT, msec	<130	130-200	>200

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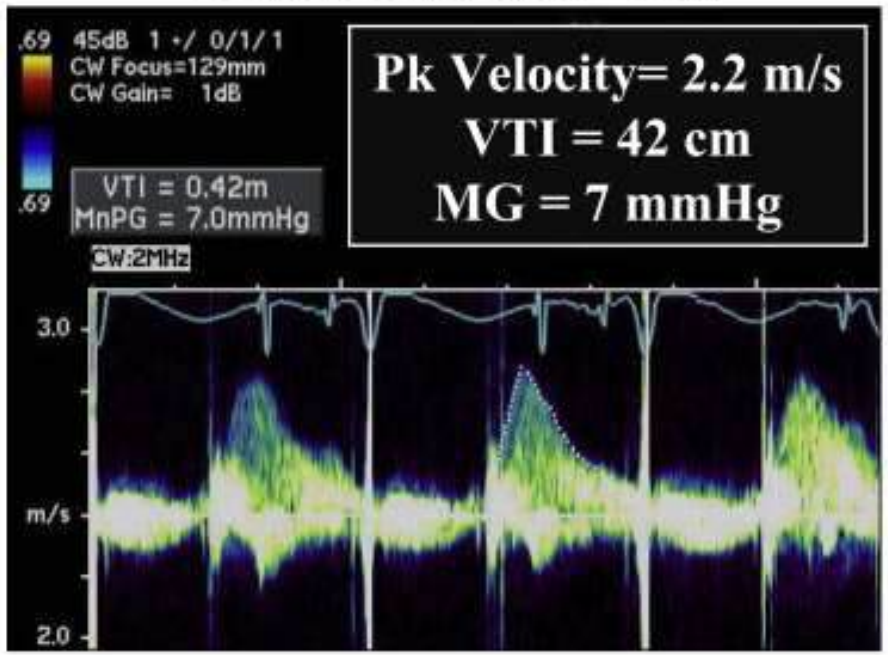
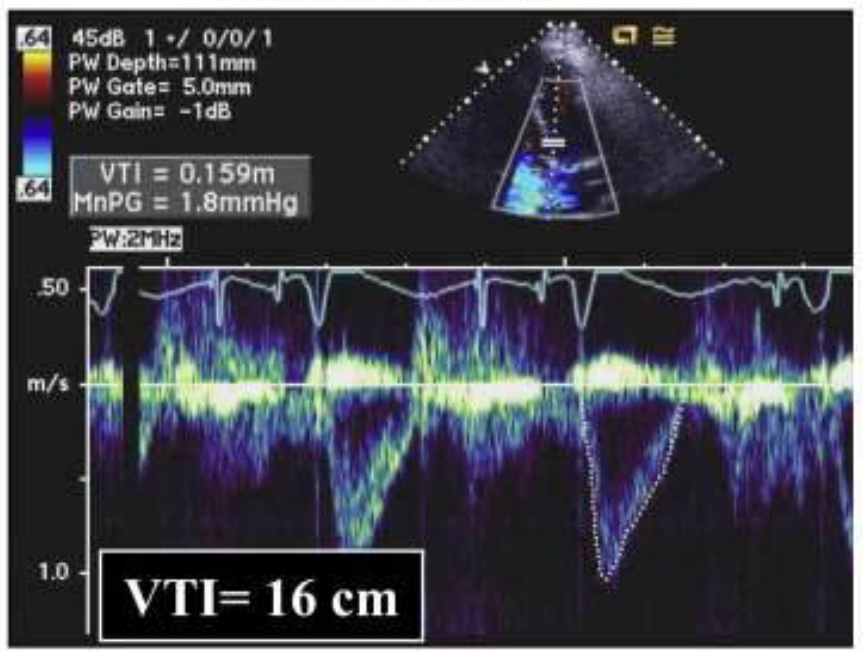
Pro MV VTI by CW / LVOT VTI by PW





$$\frac{VTI_{PrMV}}{VTI_{LVO}} = \frac{42}{16} = 2.6$$

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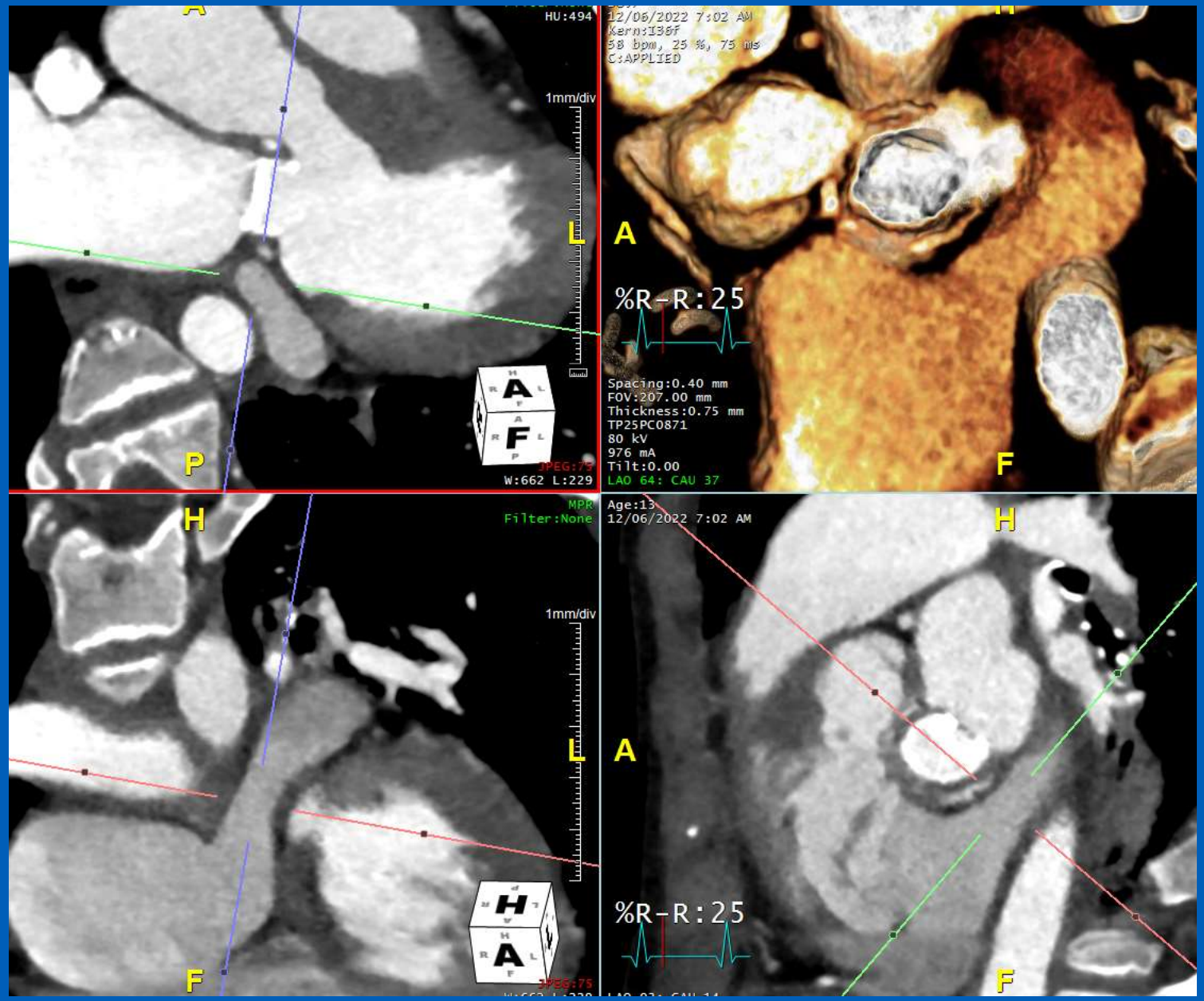
Echo

- CW Doppler over pulse wave.
- Multiple angles, parasternal/apical
- LA and LA Appendage size/function
- Thrombus/regurgitation/vegetations
- Pulmonary pressures
- X-Plane
- 3D echo

CS - LSVC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