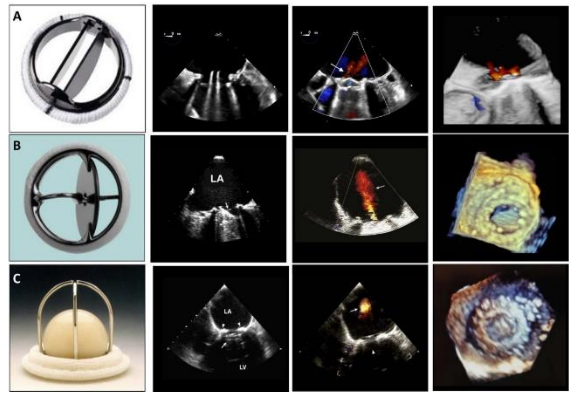
[#ASEchoJC](#) Twitter Chat
Tuesday, February 27, 2024 – 8 PM ET



- [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](#)

Moderators:

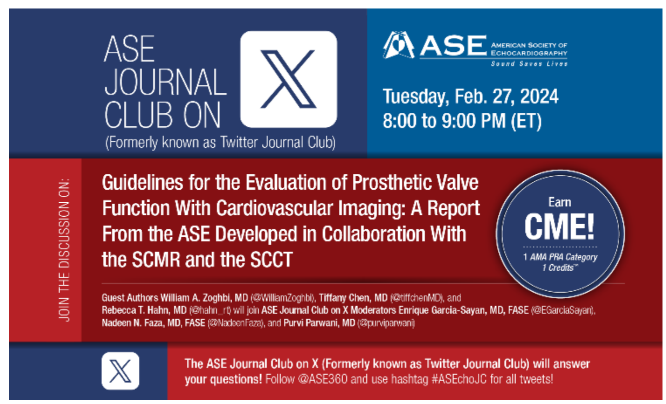
- Enrique Garcia-Sayan, MD, FASE (@EGarciaSayan)
- Nadeen N. Faza, MD, FASE (@NadeenFaza)
- Purvi Parwani, MD (@purviparwani)

Guest Authors:

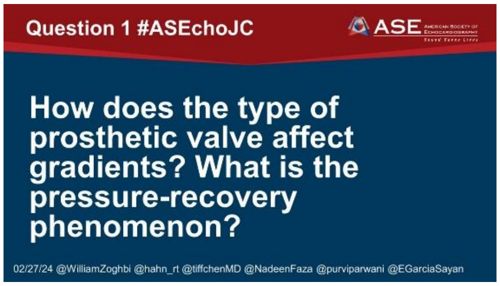
- William A. Zoghbi, MD (@WilliamZoghbi)
- Tiffany Chen, MD (@tiffchenMD)
- Rebecca T. Hahn, MD (@hahn_rt)

Introduction and Welcome:

@EGarciaSayan: Welcome to #ASEchoJC on the new @ASE360 guideline for PHV http://bit.ly/3vosxI5. Honored to be joined by authors @WilliamZoghbi @hahn_rt @tiffchenMD & co-moderators @NadeenFaza & @purviparwani. Follow #ASEchoJC to join the conversation, use the hashtag and get your ❓ answered.



Question 1:



A1 Notable Responses:

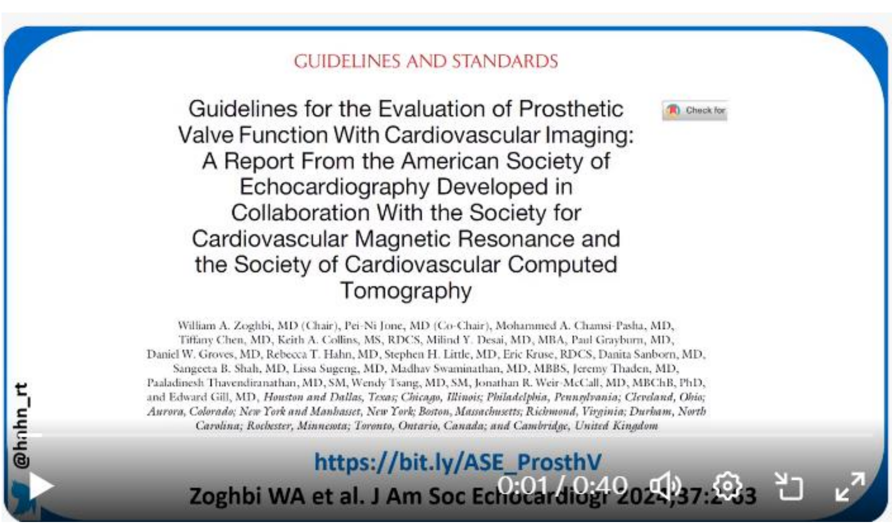
@purviparwani: -> The type, position, and size of a prosthetic valve influence its hemodynamic profile and rate of complications.

-> Normal transvalvular velocities and gradients are flow-dependent but can vary depending on the valve size and type.

@EGarciaSayan: How does the type of prosthetic valve affect gradients? @purviparwani shares insight from new @ASE360 #PHVguidelines. Mechanical vs biologic, SAVR vs TAVR and type of mechanical valve all affect gradients.

@WilliamZoghbi: Mechanical bileaflet valves have a higher pressure recovery (localized gradient between the 2 leaflets) than Bio valves—reason for significant overestimation of gradients by Doppler, specially in small valves and high flow.

@hahn_rt: New Prosthetic Valve Guideline https://bit.ly/ASE_ProsthV See also: https://bit.ly/BVD_Defn and https://bit.ly/ASE_RegurgSHDIntervene



https://twitter.com/i/status/1762644692380823921

@SIwa23288585: Grok search 🥺

PubMed search results highlight the importance of pressure recovery in evaluating the performance of prosthetic valves and the potential for pressure recovery to cause discrepancies in pressure drop calculations. The X posts show examples of pressure recovery in different types of prosthetic valves, such as mechanical and bioprosthetic valves, and emphasize the importance of considering pressure recovery when assessing valve function.

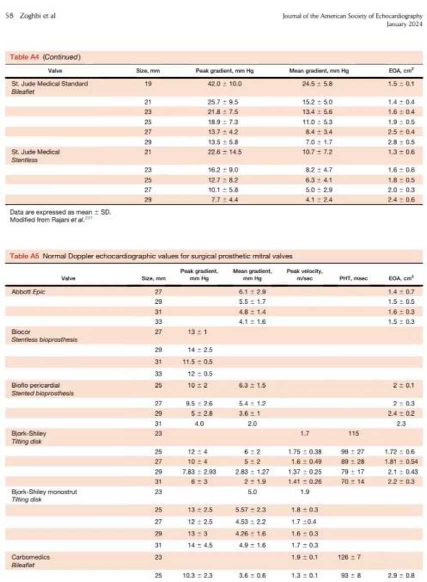
In conclusion, pressure recovery of prosthetic valves is a complex phenomenon that can impact the assessment of valve function and the calculation of pressure gradients. It is essential to consider pressure recovery when evaluating the performance of prosthetic valves to ensure accurate diagnosis and treatment.

Dr. Purvi Parwani @purviparwani · Mar 2, 2020

#Mitral Valve in Valve on #echofirst!

Left: stenotic bioprosthetic
Right: After Valve in Valve

@iamritu: Each type, position, size of prosthetic valve has hemodynamic profile since transvalvular velocities & gradients are flow dependent #Echofirst parameters of prosthetic valve types/ sizes in aortic, mitral, pulmonary, and tricuspid positions 👇



58 Zoghbi et al — Journal of the American Society of Echocardiography, January 2024

Table A4 (Continued)

Valve	Size, mm	Peak gradient, mm Hg	Mean gradient, mm Hg	EOA, cm²
St. Jude Medical Standard *Bileaflet*	19	42.0 ± 10.0	24.5 ± 5.8	1.5 ± 0.1
	21	25.7 ± 9.5	15.2 ± 5.0	1.4 ± 0.4
	23	21.8 ± 7.5	13.4 ± 5.6	1.6 ± 0.4
	25	18.9 ± 7.3	11.0 ± 5.3	1.9 ± 0.5
	27	13.7 ± 4.2	8.4 ± 3.4	2.5 ± 0.4
	29	13.5 ± 5.8	7.0 ± 1.7	2.8 ± 0.5
St. Jude Medical *Stentless*	21	22.6 ± 14.5	10.7 ± 7.2	1.3 ± 0.6
	23	16.2 ± 9.0	8.2 ± 4.7	1.6 ± 0.6
	25	12.7 ± 8.2	6.3 ± 4.1	1.8 ± 0.5
	27	10.1 ± 5.8	5.0 ± 2.9	2.0 ± 0.3
	29	7.7 ± 4.4	4.1 ± 2.4	2.4 ± 0.6

Data are expressed as mean ± SD.
Modified from Rajani *et al.*[231]

Table A5 Normal Doppler echocardiographic values for surgical prosthetic mitral valves

Valve	Size, mm	Peak gradient, mm Hg	Mean gradient, mm Hg	Peak velocity, m/sec	PHT, msec	EOA, cm²
Abbott *Epic*	27		6.1 ± 2.9			1.4 ± 0.7
	29		5.5 ± 1.7			1.5 ± 0.5
	31		4.8 ± 1.4			1.6 ± 0.3
	33		4.1 ± 1.6			1.5 ± 0.3
Biocor *Stentless bioprosthesis*	27	13 ± 1				
	29	14 ± 2.5				
	31	11.5 ± 0.5				
	33	12 ± 0.5				
Bioflo pericardial *Stented bioprosthesis*	25	10 ± 2	6.3 ± 1.5			2 ± 0.1
	27	9.5 ± 2.6	5.4 ± 1.2			2 ± 0.3
	29	5 ± 2.8	3.6 ± 1			2.4 ± 0.2
	31	4.0	2.0			2.3
Bjork-Shiley *Tilting disk*	23			1.7	115	
	25	12 ± 4	6 ± 2	1.75 ± 0.38	99 ± 27	1.72 ± 0.6
	27	10 ± 4	5 ± 2	1.6 ± 0.49	89 ± 28	1.81 ± 0.54
	29	7.83 ± 2.93	2.83 ± 1.27	1.37 ± 0.25	79 ± 17	2.1 ± 0.43
	31	6 ± 3	2 ± 1.9	1.41 ± 0.26	70 ± 14	2.2 ± 0.3
Bjork-Shiley monostrut *Tilting disk*	23		5.0	1.9		
	25	13 ± 2.5	5.57 ± 2.3	1.8 ± 0.3		
	27	12 ± 2.5	4.53 ± 2.2	1.7 ±0.4		
	29	13 ± 3	4.26 ± 1.6	1.6 ± 0.3		
	31	14 ± 4.5	4.9 ± 1.6	1.7 ± 0.3		
Carbomedics *Bileaflet*	23			1.9 ± 0.1	126 ± 7	
	25	10.3 ± 2.3	3.6 ± 0.6	1.3 ± 0.1	93 ± 8	2.9 ± 0.8

(Continued)

GIF

@tiffchenMD: Newly incorporated in the updated @ASE360 prosthetic valve guidelines are these tables of expected hemodynamic parameters for both surgical and some transcatheter valves (#TAVR)

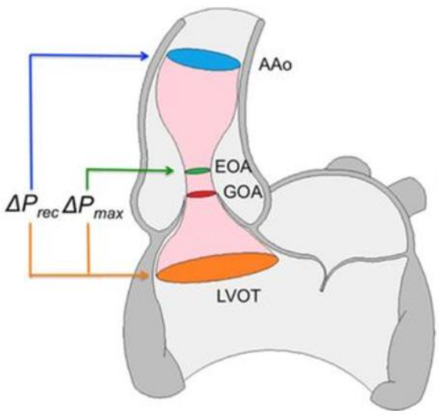
@EGarciaSayan: How does the type of prosthetic valve affect gradients? What is the pressure-recovery phenomenon? @iamritu summarizes key tables from the new @ASE360 #PHVguidelines

@purviparwani: Pressure recovery -> reconversion of maximal kinetic energy in the vena contracta distal to AS into potential energy in the ascending aorta.

-> Most of the kinetic energy is dissipated in heat as a result of turbulence—this results in less pressure recovery

-> With small aortas there is more pressure recovery

Link: https://ahajournals.org/doi/10.1161/CIRCULATIONAHA.113.002310



$$C_c = \frac{EOA}{GOA}$$

$$EOA = \frac{A_{LVOT} VTI_{LVOT}}{VTI_{VC}}$$

@EGarciaSayan: Question 1 #ASEchoJC: How does the type of prosthetic valve affect gradients? What is the pressure-recovery phenomenon? @purviparwani elegantly explains the pressure-recovery phenomenon, which can affect bileaflet mechanical valves regardless of the diameter of the asc aorta.

@EGarciaSayan: Question 1 #ASEchoJC: How does the type of prosthetic valve affect gradients? What is the pressure-recovery phenomenon? 👏Fantastic summary by the great @hahn_rt

@NadeenFaza: Normal #TAVR and ViV TAVR gradients included in the current guidelines

Table A2 Normal Doppler echocardiographic values for percutaneous CoreValve and Evolut R valves by valve size in native aortic stenosis

Valve iteration	Normal values				
CoreValve	23 mm	26 mm	29 mm	31 mm	All sizes
EOA, cm^2	1.12 ± 0.36	1.74 ± 0.49	1.97 ± 0.53	2.15 ± 0.72	1.88 ± 0.56
Mean gradient, mm Hg	14.43 ± 5.72	8.27 ± 3.82	8.85 ± 4.17	9.55 ± 3.44	8.85 ± 4.14
DVI	0.44 ± 0.09	0.59 ± 0.15	0.54 ± 0.12	0.49 ± 0.12	0.55 ± 0.13
Evolut R (30 d)	23 mm	26 mm	29 mm	34 mm	All sizes
EOA, cm^2	1.09 ± 0.26	1.69 ± 0.40	1.97 ± 0.54	2.60 ± 0.75	2.01 ± 0.65
Mean gradient, mm Hg	14.97 ± 7.15	7.53 ± 2.65	7.85 ± 3.08	6.30 ± 3.23	7.52 ± 3.19
DVI	0.42 ± 0.04	0.61 ± 0.13	0.59 ± 0.14	0.58 ± 0.15	0.59 ± 0.14

Table A1 Normal Doppler echocardiographic values for percutaneous SAPIEN valves in native aortic stenosis by valve size

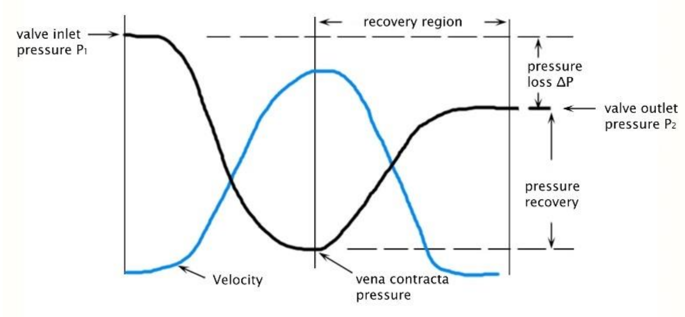
Valve iteration	Normal values				
SAPIEN	20 mm	23 mm	26 mm	29 mm	All sizes
EOA, cm^2	NA	1.56 ± 0.43	1.84 ± 0.52	NA	1.70 ± 0.49
Mean gradient, mm Hg	NA	9.92 ± 4.27	8.76 ± 3.89	NA	9.36 ± 4.13
DVI	NA	0.53 ± 0.13	0.53 ± 0.13	NA	0.53 ± 0.13
SAPIEN XT	20 mm	23 mm	26 mm	29 mm	All sizes
EOA, cm^2	NA	1.41 ± 0.30	1.74 ± 0.42	2.06 ± 0.52	1.67 ± 0.46
Mean gradient, mm Hg	NA	10.41 ± 3.74	9.24 ± 3.57	8.36 ± 3.14	9.52 ± 3.64
DVI	NA	0.52 ± 0.10	0.54 ± 0.11	0.53 ± 0.11	0.53 ± 0.11
SAPIEN 3	20 mm	23 mm	26 mm	29 mm	All sizes
EOA, cm^2	1.22 ± 0.22	1.45 ± 0.26	1.74 ± 0.35	1.89 ± 0.37	1.66 ± 0.38
Mean gradient, mm Hg	16.23 ± 5.01	12.79 ± 4.65	10.59 ± 3.88	9.28 ± 3.16	11.18 ± 4.35
DVI	0.42 ± 0.07	0.43 ± 0.08	0.43 ± 0.09	0.40 ± 0.09	0.43 ± 0.09

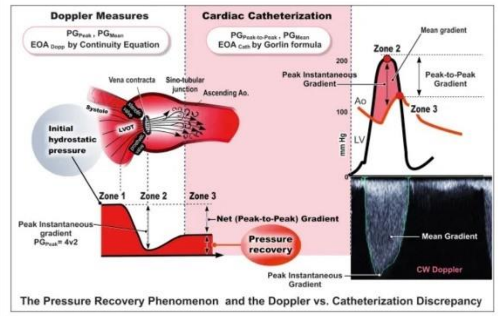
@tiffchenMD: @Important to consider #THV size when assessing gradients. #ViV implant can result in ⬆️ gradients that may not be pathologic

@iamritu: abrupt change in diameter at stenosis(P1) causes instability & turbulence losses (loss of kinetic energy as heat) & this cannot be "recovered"= pressure drop b/w P1 & P2 (Pressure loss)

As flow reattaches to vessel wall, some of momentum is converted to pressure energy & this phenomenon is called pressure recovery (difference b/w exit pressure P2 & pressure at

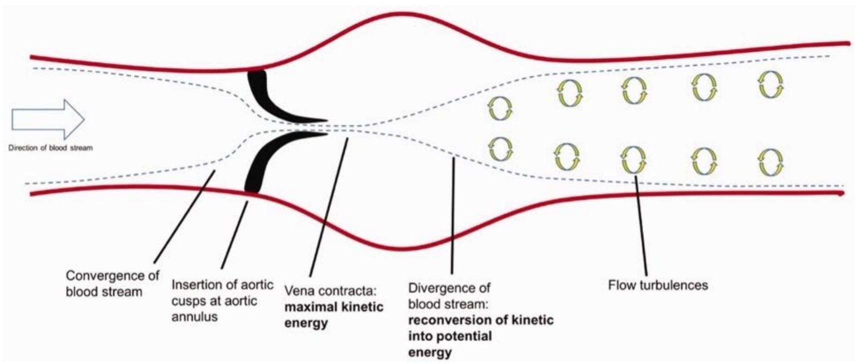
vena contracta

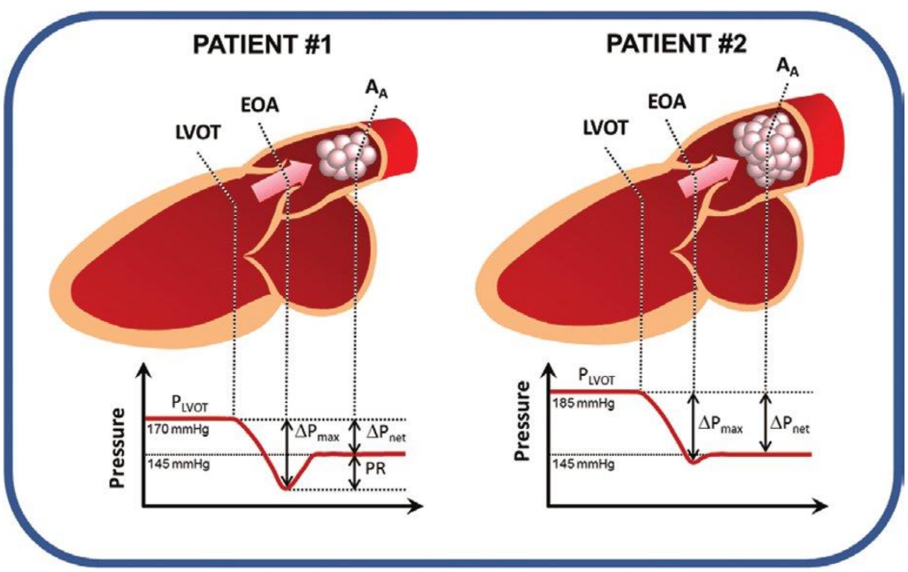




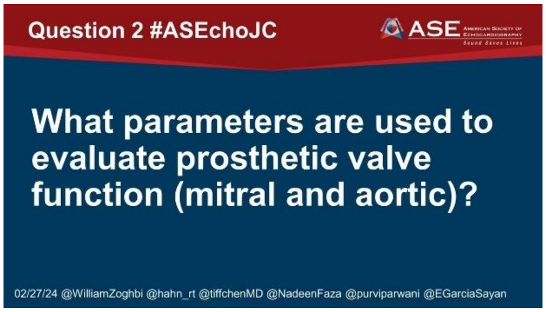
@purviparwani: velocities are lower and systolic BP is higher at the distal aorta than at the level of the vena contracta. Doppler gradients are estimated from maximal velocity at the level of the vena contracta and represent the maximal pressure drop.

See the example of two different patients- one with a smaller aorta and another one with relatively larger aorta



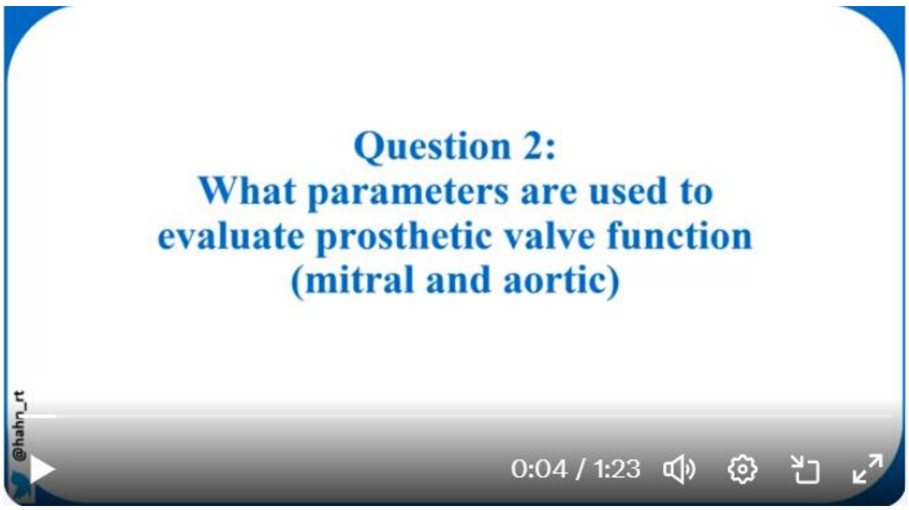


Question 2:



A2 Notable Responses:

@hahn_rt: Question 2 from New Prosthetic Valve Guideline https://bit.ly/ASE_ProsthV See also: https://bit.ly/BVD_Defn and https://bit.ly/ASE_RegurgSHDIntervene



https://twitter.com/i/status/1762645898021011695

@boegel_kelly: Multiparametric approach important in your evaluation of prosthetic valves

@iamritu: AT & AT/ET help tell true prosthetic obstruction 🆚 functional obstruction (high flow states with ⬆️ mean aortic prosthetic gradient)

functional obstruction: peak velocity > 3 m/s, but AT <80 ms

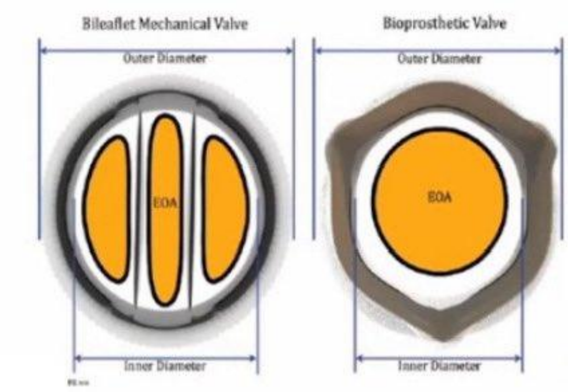
AT/ET, though it may be mildly ⬆️ will not typically be > 0.37

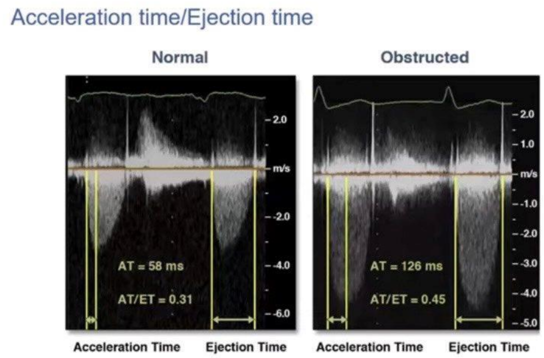
Stroke volume affects EOA calculation for all prostheses

Low SV→ EOA smaller than expected

High SV→ EOA larger than expected

EOA Better index of valve function than gradient Remember Valve size ≠ EOA

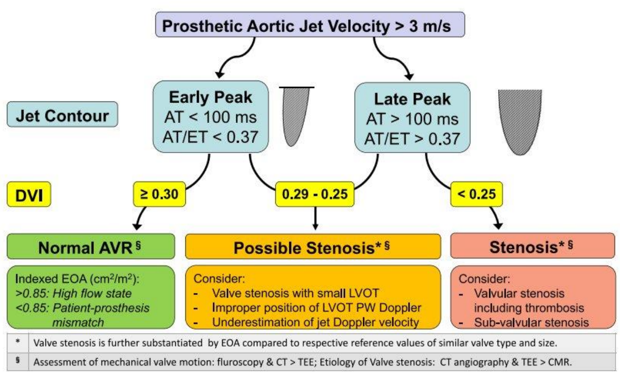




@EGarciaSayan: @iamritu highlights the importance of measuring AT and AT/ET for distinguishing true prosthetic obstruction from high flow or PPM

@NadeenFaza: The guidelines recommend a multiparametric approach in evaluating prosthetic aortic valve function, taking into consideration:

Peak prosthetic valve velocity
Jet contour
Acceleration time
DVI
AT/ET



@EGarciaSayan: Question 2 #ASEchoJC: What parameters are used to evaluate prosthetic valve function (mitral and aortic)?

@NadeenFaza highlights the updated algorithm for evaluation of prosthetic AoV velocity > 3 m/sec.

@tiffchenMD: **Multiparametric** is key 🔑... no single parameter should be relied on 💯, given the caveats for each. When in doubt after careful #echofirst assessment, consider a #multimodality approach & #cvImaging consult

@NadeenFaza: The guidelines also recommend a multiparametric approach when evaluating prosthetic mitral valve function, taking into account

-Peak velocity
-Mean gradient
-VTI PrMV/VTI LVOT
-EOA
-PHT

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

@EGarciaSayan: Question 2 #ASEchoJC: What parameters are used to evaluate prosthetic valve function (mitral and aortic)? @NadeenFaza summarizes parameters to evaluate prosthetic MV function.

@BiancaJudyC: What is your advice in case of MVR and MR. What parameters do you use to identify if the raised MV gradient is from true obstruction or from the MR ? I've been paying close attention to PHT , but are there any other parameters? I'm thinking about this even in the case of clips

@WilliamZoghbi: Evaluation of Pros V function:

Aortic—

✅ peak Velocity/gradient

✅ mean Gradient

✅ DVI—ratio of LVO velocity to jet velocity

✅ Effective orifice area-continuity

✅ acceleration time, AT/ET

@EGarciaSayan: Question 2 #ASEchoJC: What parameters are used to evaluate prosthetic valve function (mitral and aortic)?

@WilliamZoghbi summarizes 🔑 parameters to evaluate normal prosthetic AoV function. Notice ET/AT, new in these guidelines.

@WilliamZoghbi:

Evaluation of prosthetic, mitral valve includes

peak velocity, mean gradient, always referencing heart rate, pressure halftime, effective orifice area, using the continuity equation when needed.

ingredient is very dependent on heart rate in contrast to aortic prosthesis

@AntonioBarros_: #ASEchoJC

Table 1 Essential clinical and echocardiographic parameters in the comprehensive evaluation of prosthetic valve function

	Parameters
Clinical information	Date of valve replacement
	Type and size of the prosthetic valve
	Height/weight/body surface area
	Symptoms and related clinical findings
	Blood pressure and heart rate
Echocardiography	Opening and closing of leaflets or occluder
	Presence of leaflet thickening, calcifications, or abnormal echo density(ies) on the various components of the prosthesis or adjacent to prosthesis
	Valve sewing ring or stent integrity and stability
	Position of sewing ring or stent frame
Doppler echocardiography of the valve	Contour of the jet velocity signal
	Peak velocity and gradient
	Mean pressure gradient
	VTI of the jet
	DVI
	Acceleration time, acceleration time/ejection time for AV
	PHT in MV and TV
	EOA*
	Presence, location, and severity of regurgitation†
Other echocardiographic data	LV and RV size, function, and hypertrophy
	Left atrial and RA size and function
	Concomitant valvular disease
	Estimation of PA pressure
	Venous inflow pattern (i.e., pulmonary vein for MV and hepatic vein for TV)
Previous postoperative study(ies), when available	Comparison of above parameters is particularly helpful in suspected prosthetic valvular dysfunction

@EGarciaSayan: Question 2 #ASEchoJC: What parameters are used to evaluate prosthetic valve function (mitral and aortic)?

Question 3:

A3 Notable Responses:

@hahn_rt: Question 3: New Prosthetic Valve Guideline https://bit.ly/ASE_ProsthV

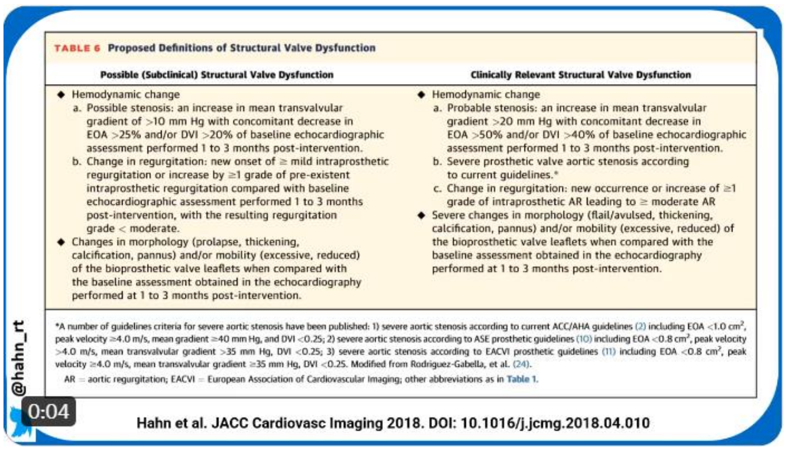


TABLE 6 Proposed Definitions of Structural Valve Dysfunction

Possible (Subclinical) Structural Valve Dysfunction	Clinically Relevant Structural Valve Dysfunction
◆ Hemodynamic change a. Possible stenosis: an increase in mean transvalvular gradient of >10 mm Hg with concomitant decrease in EOA >25% and/or DVI >20% of baseline echocardiographic assessment performed 1 to 3 months post-intervention. b. Change in regurgitation: new onset of ≥ mild intraprosthetic regurgitation or increase by ≥1 grade of pre-existent intraprosthetic regurgitation compared with baseline echocardiographic assessment performed 1 to 3 months post-intervention, with the resulting regurgitation grade < moderate. ◆ Changes in morphology (prolapse, thickening, calcification, pannus) and/or mobility (excessive, reduced) of the bioprosthetic valve leaflets when compared with the baseline assessment obtained in the echocardiography performed at 1 to 3 months post-intervention.	◆ Hemodynamic change a. Probable stenosis: an increase in mean transvalvular gradient >20 mm Hg with concomitant decrease in EOA >50% and/or DVI >40% of baseline echocardiographic assessment performed 1 to 3 months post-intervention. b. Severe prosthetic valve aortic stenosis according to current guidelines.* c. Change in regurgitation: new occurrence or increase of ≥1 grade of intraprosthetic AR leading to ≥ moderate AR ◆ Severe changes in morphology (flail/avulsed, thickening, calcification, pannus) and/or mobility (excessive, reduced) of the bioprosthetic valve leaflets when compared with the baseline assessment obtained in the echocardiography performed at 1 to 3 months post-intervention.

*A number of guidelines criteria for severe aortic stenosis have been published: 1) severe aortic stenosis according to current ACC/AHA guidelines (2) including EOA <1.0 cm^2, peak velocity ≥4.0 m/s, mean gradient ≥40 mm Hg, and DVI <0.25; 2) severe aortic stenosis according to ASE prosthetic guidelines (10) including EOA <0.8 cm^2, peak velocity >4.0 m/s, mean transvalvular gradient >35 mm Hg, DVI <0.25; 3) severe aortic stenosis according to EACVI prosthetic guidelines (11) including EOA <0.8 cm^2, peak velocity ≥4.0 m/s, mean transvalvular gradient ≥35 mm Hg, DVI <0.25. Modified from Rodriguez-Gabella, et al. (24).

AR = aortic regurgitation; EACVI = European Association of Cardiovascular Imaging; other abbreviations as in Table 1.

Hahn et al. JACC Cardiovasc Imaging 2018. DOI: 10.1016/j.jcmg.2018.04.010

https://twitter.com/i/status/1762647293012910115

@EGarciaSayan: Question 3 #ASEchoJC: How do we assess prosthetic aortic valve regurgitation? Fantastic summary by

@hahn_rt on updated recommendations, challenges and a new multiparametric algorithm for prosthetic AoV regurgitation.

@tiffchenMD: Prosthetic AR is not just about quantification/severity but also location matters (#echofirst realtor 🏠: "LOCATION, LOCATION, LOCATION") given the implications for therapeutic intervention.

@NadeenFaza: Love it! #EchoFirst realtor! Yes- location guides management!

@purviparwani: AR assessment similar to native valve however

-> #echofirst assessment of Aortic prosthetic valves in the aortic position can be limited by reverberation and shadowing of the posterior annulus/root.

-> TEE is recommended to improve visualization of the posterior annulus/root when poorly imaged with TTE or if there is concern for posterior annulus/root pathology.

-> Dedicated imaging of mechanical prosthetic aortic valve leaflets is recommended using #yesCCT or fluoroscopy when the range of motion cannot be seen with #Echofirst

-> Classification of intra- and paravalvular prosthetic aortic valve regurgitation severity is like that in native valves. If there is a discrepancy between echocardiographic qualitative and semiqualitative AR severity parameters that cannot be explained by image quality, technical, or physiologic factors and prevents consensus grading, then TEE, CMR, or CT is required.

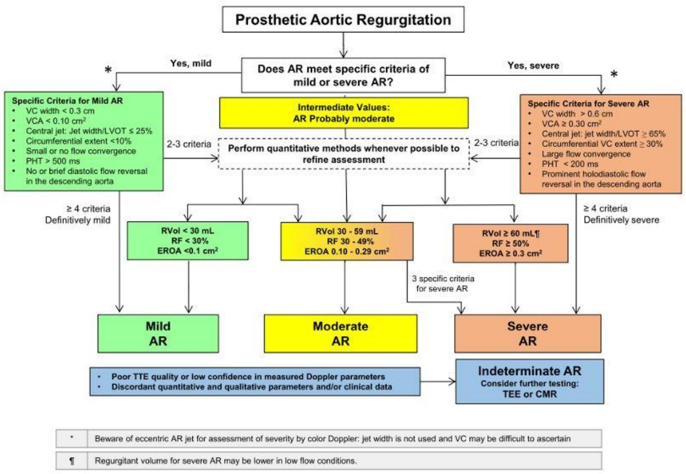
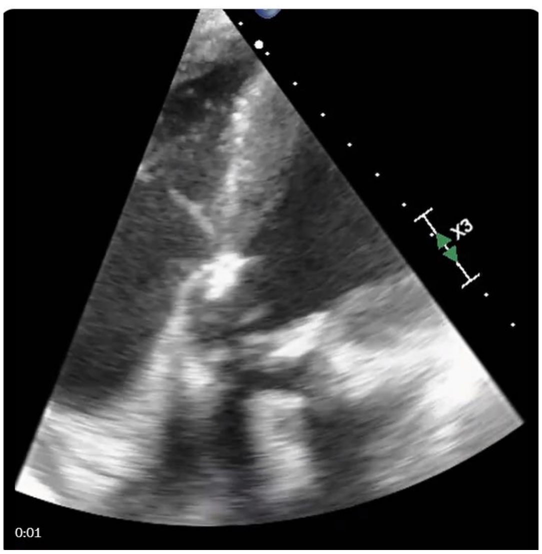


Table 8 Parameters for evaluation of the severity of prosthetic aortic valve regurgitation

Parameters	Mild	Moderate	Severe
Valve structure and motion			
Mechanical or bioprosthetic	Usually normal	Abnormal*	Abnormal*
Structural parameters			
LV size	Normal†	Normal or mildly dilated†	Dilated†
Doppler parameters (qualitative or semiquantitative)			
Jet width in central jets, % LVOT diameter, (CD)‡	Narrow (≤25%)	Intermediate (26%-64%)	Large (≥65%)
VC width, cm (CD)	<0.3	0.3-0.6	>0.6
VC area, cm^2 (2D/3D CD)§	<0.10	0.10-0.29	≥0.30
Circumferential extent of PVL, % (CD)¶‖	<10	10-29	≥30
Jet density (CW)	Incomplete or faint	Dense	Dense
Jet deceleration rate (PHT), msec (CW)#	Slow (>500)	Variable (200-500)	Steep (<200)
Diastolic flow reversal in the descending aorta (PW)	Absent or brief early diastolic	Intermediate	Prominent, holodiastolic
Doppler parameters (quantitative)			
Regurgitant volume, mL/beat	<30	30-59	≥60
Regurgitant fraction, %	<30	30-50	≥50

@boegel_kelly: Important to understand the limitations of TTE and when to use TEE or other imaging modalities such as CT or MRI in the evaluation of prosthetic aortic valve regurgitation. Excellent points made by @purviparwani

@NadeenFaza: One of my favorite views for prosthetic AI is the deep transgastric view! It helps different transvalvular vs paravalvular regurgitation. Below is an example of a prosthetic leaflet flail captured in the TG view.



@EGarciaSayan: @NadeenFaza highlights the use of TEE #EchoFirst deep trans gastric view for assessment of prosthetic AoV

@NadeenFaza:

✅ Sweep sweep sweep to unmask any potential PVLs!

✅ Transgastric imaging for prosthetic AV and 3D imaging for prosthetic MV

✅ CT imaging can also help in the diagnosis

Valvular vs Paravalvular Regurgitation

- Paravalvular regurgitation originates outside the valve ring
- It is important to differentiate between valvular vs paravalvular regurgitation as the management differs.
- Can be challenging to differentiate by TTE imaging- performing a comprehensive sweep of the valve is crucial.
- TEE, with trangastric imaging for prosthetic AV valves, further aids in the diagnosis.

@NadeenFaza

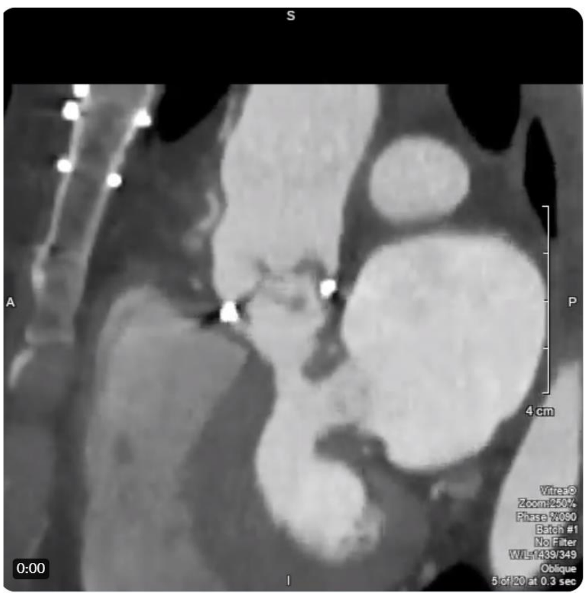
@rajdoc2005: 💯 Agree on Sweep Sweep Sweep!

Also Biplane (aka X-plane imaging) can help to tease out PVLs!

@rajdoc2005: Good idea for trainee fellows to practice getting the aortic valve aligned in transgastric view!

@tiffchenMD: Nice reminder not to forget the TG views, also to get around attenuation artifact (of anterior aspect). Also, can get #yesCCT to assess mechanism of AR and see flail etc.

@tiffchenMD: Example of prosthetic AR due to flail leaflet on #yesCCT. Can't quantify severity of AR like on #echofirst but can see structural abnormalities on CT.



@rajdoc2005: Now that's a cool image on CT! 😅 👏🏻 👏🏻

@tiffchenMD: i can't take credit for it - from this review article: https://t.co/oYiAeNYFaK

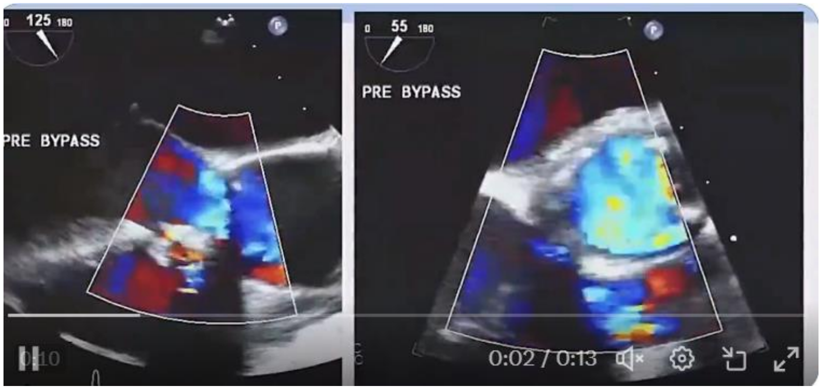
@EGarciaSayan: Question 3 #ASEchoJC: How do we assess prosthetic aortic valve regurgitation?

@tiffchenMD demonstrates an excellent use of #YesCCT to evaluate a bioprosthetic AoV with flail leaflet

@purviparwani: -> Define the aortic regurgitation by localizing the jet origin in the short-axis enface view.

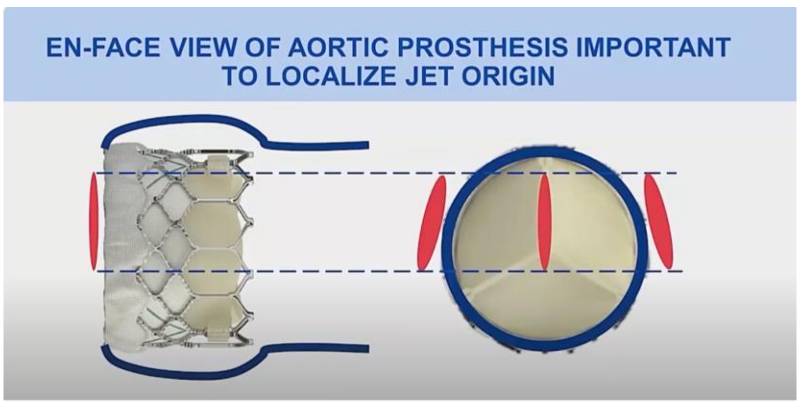
-> Important to identify the mechanism and severity of AR

-> Look at the other features (DBP, LV dilatation, MV movement with AR) link https://youtube.com/watch?v=YG3HhELeEXY

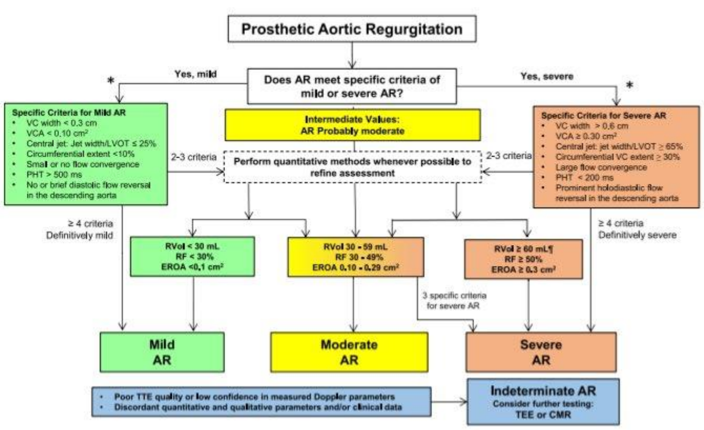


@purviparwani: > En-face View is important to determine the AR jet location and extent. Other views can be helpful but cannot differentiate between perivalvular vs valvular leak

Link: https://youtube.com/watch?v=YG3HhELeEXY



@AntonioBarros_: #ASEchoJC



@WilliamZoghbi: Assessing pros AV regurgitation severity:

✅ valve structure and ring

✅ color Doppler is essential to localize AR; May be tricky in eccentric jets

✅ size of central jet and flow convergence.

- [x] flow reversal in desc/abdominal Ao.
- [x] PHT
- [x] Regurgitant Vol and Fraction

Question 4:

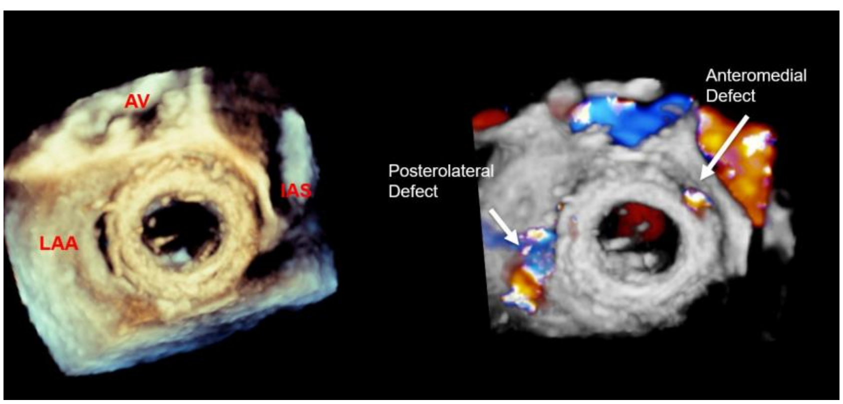
A4 Notable responses

@NadeenFaza: Clues for significant MR from spectral Doppler include increased mitral peak early velocity, mean gradient, DVI, and a relatively low systemic stroke volume in relation to total LV stroke volume. TEE is indicated in suspected cases of significant MR!

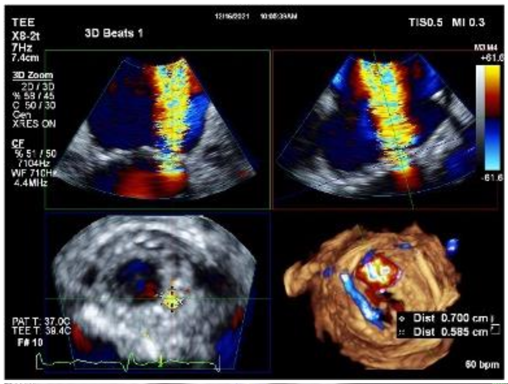
Table 12 Transthoracic echocardiographic findings suggestive of significant prosthetic MR in mechanical valves with normal PHT

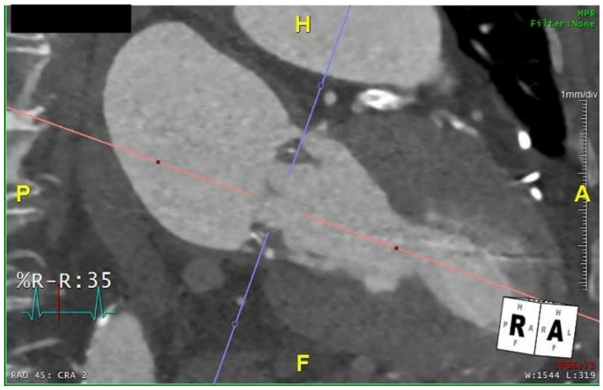
Finding	Sensitivity	Specificity	Comments
Peak mitral velocity ≥1.9 m/sec*	90%	89%	Also consider high flow, PPM
$VTI_{PrMV}/VTI_{LVOT} \geq 2.5$*	89%	91%	Measurement errors increase in atrial fibrillation because of difficulty in matching cardiac cycles; also consider PPM
Mean gradient ≥ 5 mm Hg*	90%	70%	At physiologic heart rates; Also consider high flow, PPM
Maximal TR jet velocity >3 m/sec*	80%	71%	Consider residual postoperative pulmonary hypertension or other causes
LV stroke volume derived by 2D or 3D echocardiography is >30% higher than systemic stroke volume by Doppler	Moderate sensitivity	Specific	Validation lacking; significant MR is suspected when LV function is normal or hyperdynamic and VTI_{LVOT} is small (<16 cm)
Systolic flow convergence seen in the left ventricle toward the prosthesis	Low sensitivity	Specific	Validation lacking; technically challenging to detect readily

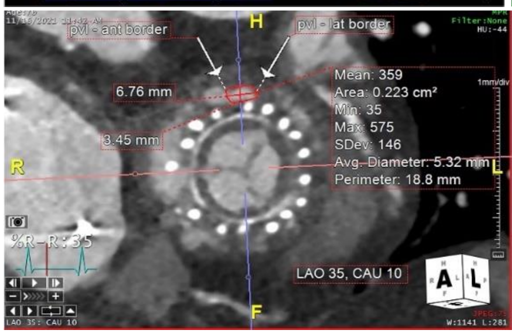
@NadeenFaza: Transcatheter PVL closure is reasonable in patient with 1)intractable hemolysis or NYHA Class III or IV symptoms and 2) who are at high or prohibitive surgical risk and 3) have anatomic features suitable for catheter-based therapies!



@tiffchenMD: #Mitral PVL can be localized and sized via 3D TEE and/or #yesCCT - both important for procedural planning







@NadeenFaza: **CAUTION**

"Because of shadowing and flow masking in the left atrium, particularly in mechanical mitral valves, significant prosthetic MR may be missed with color Doppler on TTE"

Look for clues that are suggestive of significant MR, e.g. low LVOT SV if LVEF is normal!

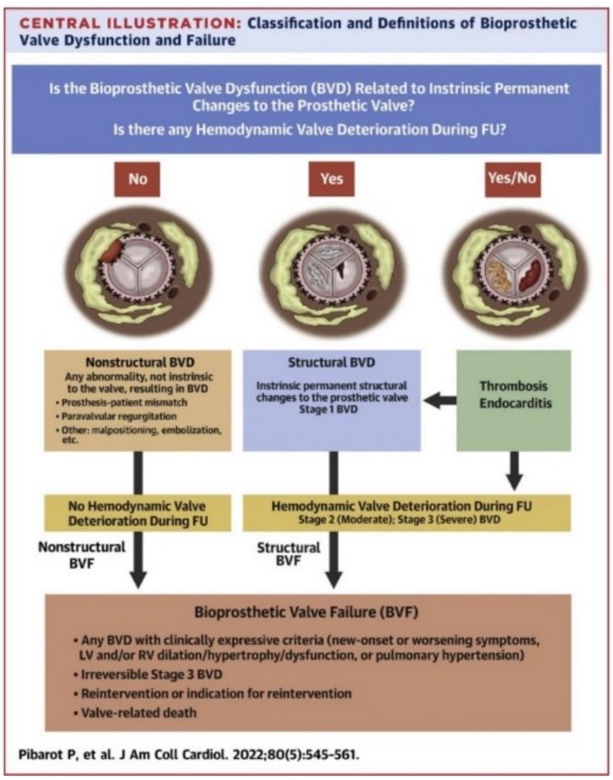
@rajdoc2005: It can be useful to try off-axis/non-standard views on both TTE & TEE to try avoid the shadowing. Need to be a little creative with the views. 😅

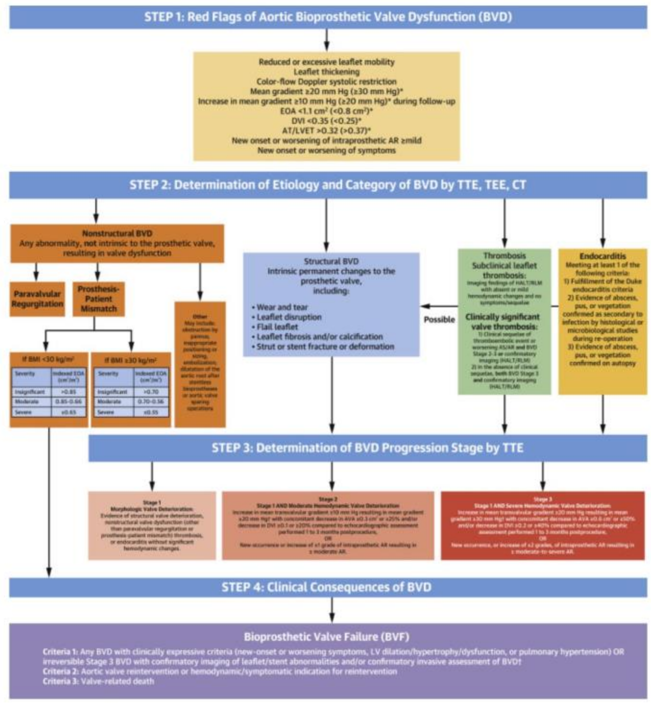
@hahn_rt: Question 4: New Prosthetic Valve Guideline https://bit.ly/ASE_ProsthV See also: https://bit.ly/BVD_Defn and https://bit.ly/ASE_RegurgSHDIntervene

https://twitter.com/i/status/1762648860017508859

@hahn_rt: Don't forget to review https://bit.ly/BVD_Defn

Central Illustration



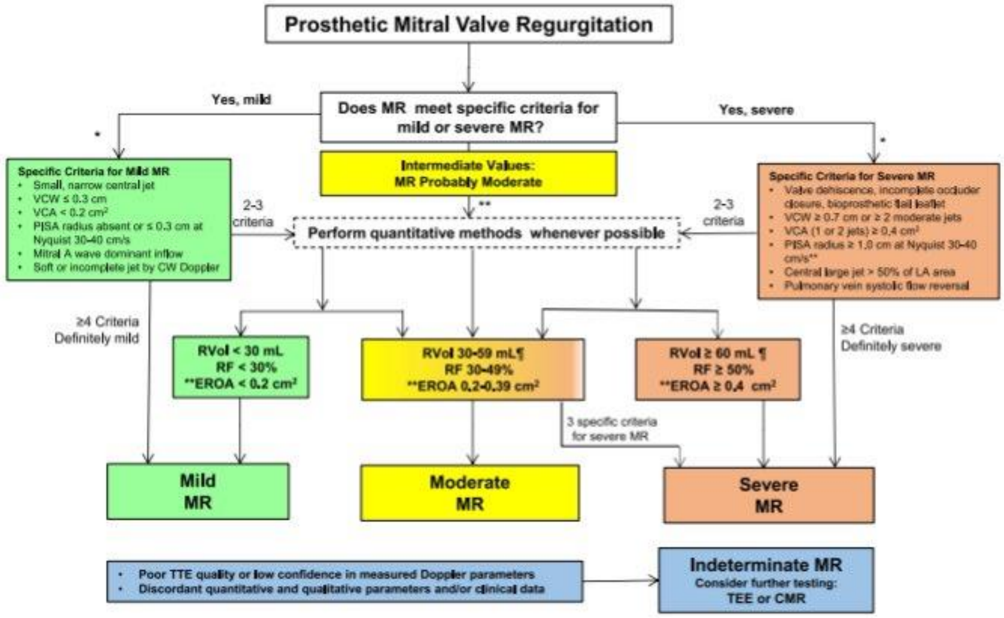


@EGarciaSayan: Question 4 #ASEchoJC: How do we assess prosthetic mitral valve regurgitation? Excellent summary of updated parameters, sensitivity & specificity by @hahn_rt

@AntonioBarros_: #ASEchoJC

Table 13 Echocardiographic criteria for severity of prosthetic mitral valve regurgitation using findings from TTE and TEE

	Mild	Moderate	Severe
Structural parameters			
LV size	Normal*	Normal or dilated	Usually dilated†
Prosthetic valve‡	Usually normal	Abnormal§	Abnormal§
Doppler parameters			
Color flow jet area‡¶	Small, central jet (usually <4 cm² or <20% of LA area)	Variable	Large central jet (usually >8 cm² or >50% of LA area) or variable size wall-impinging jet swirling in left atrium
Flow convergence‖	None or minimal	Intermediate	Large
Jet density (CW)‡	Incomplete or faint	Dense	Dense
Jet contour (CW)‡	Parabolic	Usually parabolic	Early peaking; triangular
Pulmonary venous flow‡	Systolic dominance#	Systolic blunting#	Systolic flow reversal**
Quantitative parameters††			
VC width (cm)‡	<0.3	0.3-0.69	≥0.7
RVol, mL/beat	<30	30-59‡‡	≥60‡‡
RF, %	<30	30-49	≥50
EROA, cm²	<0.20	0.20-0.39	≥0.40



@WilliamZoghbi: Assessing Pros MV Regurgitation:

✳️ flow masking occurs invariably in mechanical valves; Beware.

Clues:

✅ peak E > 1.9 m/s; Nl PHT

✅ mean gradient >5 mmHg—not sensitive

✅ DVI = VTI MV / VTI LVOT of > 2.5 (Match R-R in A Fib)

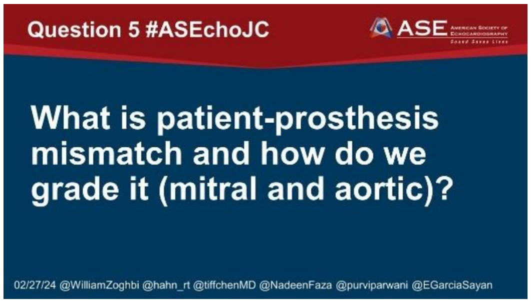
✅ Reg V and Reg F from LVVol & systemic flow

@EGarciaSayan: Question 4 #ASEchoJC: How do we assess prosthetic mitral valve regurgitation?

@WilliamZoghbi highlights key parameters for prosthetic MV regurgitation

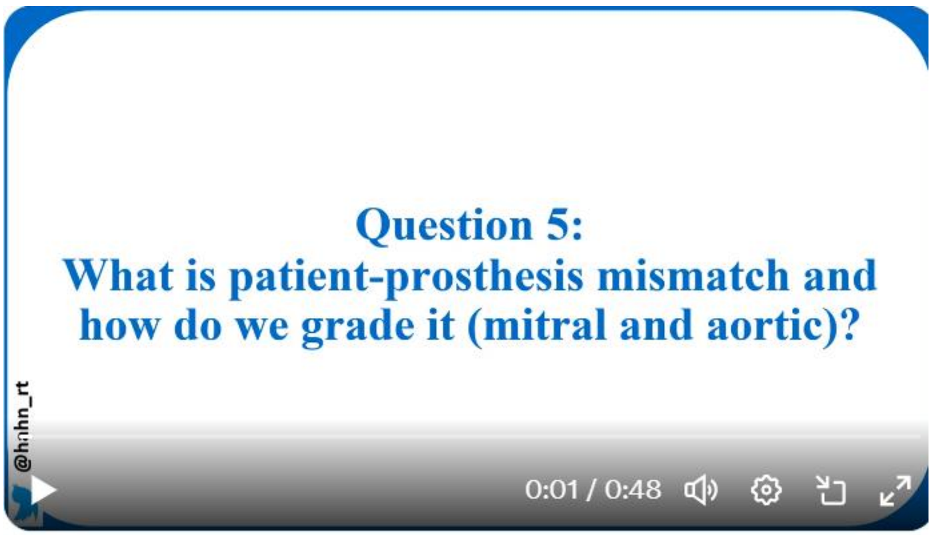
@tiffchenMD: More difficult than in native MR due to susceptibility artifact from prosthesis but could consider #whyCMR 🧲 when #echofirst (including TEE) equivocal for a volumetric assessment of MR.

Question 5:



A5 Notable responses

@hahn_rt: Question 5: New Prosthetic Valve Guideline https://bit.ly/ASE_ProsthV



https://twitter.com/i/status/1762650457711784309

@EGarciaSayan: Question 5 #ASEchoJC: What is patient-prosthesis mismatch and how do we grade it (mitral and aortic)?

@hahn_rt summarizes concept, new recommendations, including parameters for MV and BMI-dependent tresholds

@purviparwani: Patient prosthesis mismatch

-> Aortic PPM is considered not clinically significant when the indexed EOA is>0.85 cm2/m2,

moderate between 0.85 and 0.64 cm2/m2 or

severe when the indexed EOA is 0.65cm2/m2

-> The indexed EOA may overestimate the severity of PPM in obese patients (BMI> 30 kg/m2) therefore lower cut points of indexed EOA in obese patients (i.e.,<0.70 cm2/m2) for moderate PPM and<0.55 cm2/m2 for severe PPM

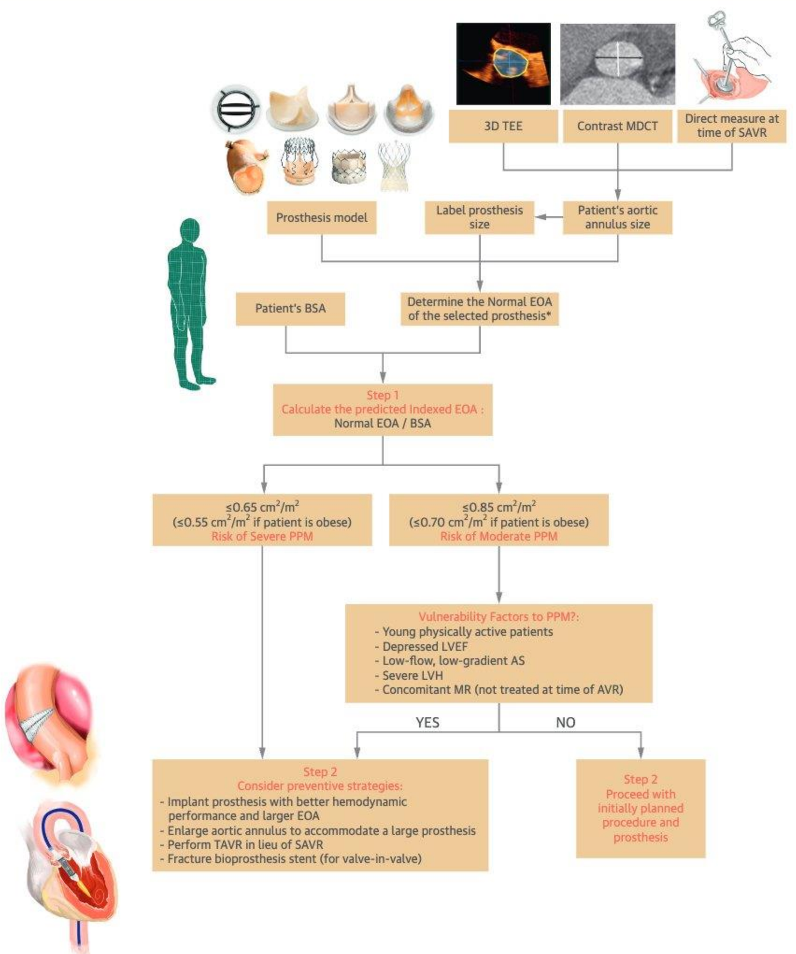
Link: https://jacc.org/doi/epdf/10.1016/j.jcmg.2018.10.020

TABLE 1 Imaging Criteria for the Differential Diagnosis of Normal Prosthetic Valve Function vs. PPM vs. Valve Stenosis

	Normal	Moderate PPM	Severe PPM	Mild/Moderate Stenosis	Severe Stenosis
Leaflet morphology and mobility by TTE/TEE or MDCT*	Normal	Normal	Normal	Often abnormal	Abnormal
Doppler echo parameters					
Peak velocity, m/s	<3	3-3.5	≥3.5	3-4	≥4
Mean gradient, mm Hg	<20	20-30	≥30	20-35	≥35
Doppler velocity index	≥0.35	≥0.30	≥0.30	0.25-0.35	<0.25
EOA, cm^2	>1.00	>1.00	>1.00	Variable	<0.80
Indexed EOA, cm^2/m^2	>0.85	0.66-0.85	≤0.65	0.66-0.85	≤0.65
If BMI ≥30 kg/m^2	>0.70	0.56-0.70	≤0.55	0.56-0.70	≤0.55
Difference (normal EOA - measured EOA), cm^2	<0.30 (<1 SD)	<0.30 (<1 SD)	<0.30 (<1 SD)	0.30-0.60 (1-2 SD)	>0.60 (>2 SD)
Contour of the transprosthetic jet†	Triangular, early peaking	Triangular, early peaking	Triangular, early peaking	Triangular to intermediate	Rounded, symmetrical
Acceleration time, ms†	<80	<80	<80	80-100	>100
Acceleration time/LV ejection time ratio†	<0.32	<0.32	<0.32	0.32-0.37	>0.37
Changes in Doppler echo parameters during follow-up					
Increase in mean gradient, mm Hg	<10	<10	<10	10-19	≥20
Decrease in EOA, cm^2	<0.30	<0.30	<0.30	0.30-0.60	>0.60
Percent decrease in EOA, %	<25	<25	<25	25-49	≥50
Percent decrease in DVI, %	<20	<20	<20	20-39	≥40
Hybrid (Doppler CT) parameters					
Indexed hybrid EOA, cm^2/m^2	>1.00	0.81-1.00	≤0.80	0.81-1.00	≤0.80
If BMI ≥30 kg/m^2	>0.85	0.71-0.85	≤0.70	0.71-0.85	≤0.70

See Lancellotti et al. (4) and Hahn et al. (32) to obtain the normal reference values of effective orifice area for the different models and sizes of surgical and transcatheter prostheses. *Valve leaflet that is immobile or with restricted mobility, thrombus, or pannus; abnormal biologic valves: leaflet thickening/calcification, thrombus, or pannus. The mobility and morphology of the leaflet is assessed by transthoracic echocardiography (TTE), transesophageal echocardiography (TEE), multidetector computed tomography (MDCT), or cinefluoroscopy (mechanical valves). †These parameters are affected by left ventricular (LV) function and chronotropy.

BMI = body mass index; CT = computed tomography; DVI = Doppler velocity index; EOA = effective orifice area.



@purviparwani: Patient prosthesis mismatch

#TAVR valves are less likely to have PPM compared to #SAVR

->> Worse prognosis with PPM in patients with

🔥 LV dysfunction or severe LV LVH,

🔥 concomitant MR, or

🔥 classical or paradoxical low-flow, low-gradient aortic AS

🔥 Age <65 to 70 years of age

Link: https://jacc.org/doi/epdf/10.1016/j.jcmg.2018.10.020

@EGarciaSayan: Question 5 #ASEchoJC: What is patient-prosthesis mismatch and how do we grade it (mitral and aortic)?

@purviparwani on TAVR vs SAVR. Recent data suggests discordant gradients in TAVR unrelated to PPM.

https://sciencedirect.com/science/article/abs/pii/S0894731723003814

@WilliamZoghbi: PPM is when the prosthetic valve is too small for body size and flow demands. More common in aortic than mitral prosthesis, becasue AV are usuaslly smaller... Guidelines provide the values for severe PPM.

@EGarciaSayan: Question 5 #ASEchoJC: What is patient-prosthesis mismatch and how do we grade it (mitral and aortic)?

@WilliamZoghbi summarizes this important concept and when to look for it

@WilliamZoghbi: Prosthesis-patient mismatch. Obesity matters here and has to be considered! Otherwise, with the obesity epidemic, everyone has PPM! Also, you have to have an elevated gradient at baseline to consider it.

Table 7 Doppler parameter criteria of aortic valve and mitral valve PPM

	Normal	Moderate	Severe
Aortic EOA*	• >0.85 cm^2/m^2 if BMI <30 kg/m^2 • >0.70 cm^2/m^2 if BMI ≥ 30 kg/m^2	• 0.85-0.66 cm^2/m^2 if BMI <30 kg/m^2 • 0.70-0.56 cm^2/m^2 if BMI ≥ 30 kg/m^2	• ≤ 0.65 cm^2/m^2 if BMI <30 kg/m^2 • ≤ 0.55 cm^2/m^2 if BMI ≥ 30 kg/m^2
Mitral EOA*	• >1.2 cm^2/m^2 if BMI <30 kg/m^2 • >1.0 cm^2/m^2 if BMI ≥ 30 kg/m^2	• 1.2-0.91 cm^2/m^2 if BMI <30 kg/m^2 • 1.0-0.76 cm^2/m^2 if BMI ≥ 30 kg/m^2	• ≤ 0.90 cm^2/m^2 if BMI <30 kg/m^2 • ≤ 0.75 cm^2/m^2 if BMI ≥ 30 kg/m^2

BMI, Body mass index

@purviparwani: In patients with TAVR use of #yesCCT and EOA on CT reclassify the prevalence and severity of PPM measurements (not associated with outcomes)

Link:https://sciencedirect.com/science/article/pii/S1936879817309950

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CT-Defined Prosthesis–Patient Mismatch Downgrades Frequency and Severity, and Demonstrates No Association With Adverse Outcomes After Transcatheter Aortic Valve Replacement

John Mooney, MD,[a] Stephanie L. Sellers, MSc,[a] Phillip Blanke, MD,[a] Philippe Pibarot, DVM, PhD,[b] Rebecca T. Hahn, MD,[c] Danny Dvir, MD,[d] Pamela S. Douglas, MD,[e] Neil J. Weissman, MD,[f] Susheel K. Kodali, MD,[c] Vinod H. Thourani, MD,[g] Hasan Jilaihawi, MD,[h] Omar Khalique, MD,[c] Craig R. Smith, MD,[c] Shaw Hua Kueh, MD,[a] Mickael Ohana, MD,[a] Romi Grover, MD,[a] Christopher Naoum, MD,[a] Aaron Crowley, MS,[i] Wael A. Jaber, MD,[j] Maria C. Alu, MS,[c] Rupa Parvataneni, MS,[i] Michael Mack, MD,[k] John G. Webb, MD,[a] Martin B. Leon, MD,[c] Jonathon A. Leipsic, MD[a]

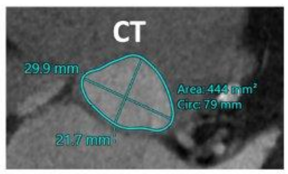
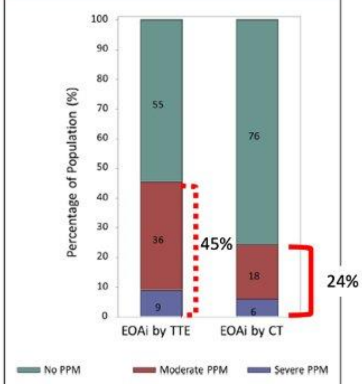
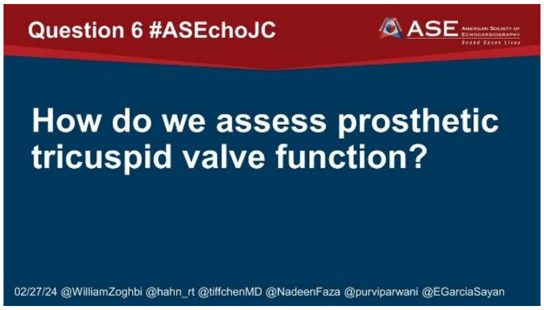


FIGURE 2 TTE-Derived Aortic Valve Area and CT-Derived Effective Orifice Area, Indexed to Body Surface Area



Comparison of grade of severity of patient prosthesis mismatch post-transcatheter aortic valve replacement; CT = computed tomography; EOAi = effective orifice area indexed; PPM = prosthesis-patient mismatch; TTE = transthoracic echocardiogram.

Question 6:



A6 Notable responses

@NadeenFaza: 👇 Prosthetic TV stenosis and regurgitation evaluation.

"Because of shadowing and flow masking in the RA, particularly in mechanical TVs, screening for TR should include modified RV inflow & subcostal views as well as PW Doppler interrogation of hepatic vein flow."

Table 21 Echocardiographic grading of TR after TVR or TV repair

Parameters	Mild	Moderate	Severe
Qualitative			
Color jet area*	Small, narrow, central	Moderate central	Large central jet or eccentric wall-impinging jet(s) of variable size swirling in right atrium
Flow convergence zone†	Not visible or small	Intermediate in size	Large
TR CW Doppler velocity waveform (density and shape)	Faint/partial/parabolic	Dense, parabolic or triangular	Dense, often triangular
Tricuspid inflow	A-wave dominant	Variable	E-wave dominant‡
Semiquantitative			
VC width, cm*	<0.3	0.3-0.69	≥0.7 or ≥2 moderate jets
PISA radius, cm†	≤0.5	0.6-0.9	>0.9
Hepatic vein flow§	Systolic dominance	Systolic blunting	Systolic flow reversal
Quantitative			
EROA, cm^2§	<0.20	0.20-0.39	≥0.40
RVol, mL§	<30	30-44	≥45

Table 19 Doppler parameters suggestive of prosthetic TV stenosis

	Bioprosthetic	Mechanical
Peak E velocity, m/sec)	≥2.1	≥1.9
Mean gradient, mm Hg	≥9	≥6
PHT, msec	≥200	≥130
EOA, cm^2	<1.5	<2.0
DVI (VTI_{PrTV}/VTI_{LVOT})*	≥3.3	≥2.1

@EGarciaSayan: Question 6 #ASEchoJC: How do we assess prosthetic tricuspid valve function? @NadeenFaza summarizes tables for the evaluation of prosthetic TV stenosis & regurgitation

@AntonioBarros_: #ASEchoJC

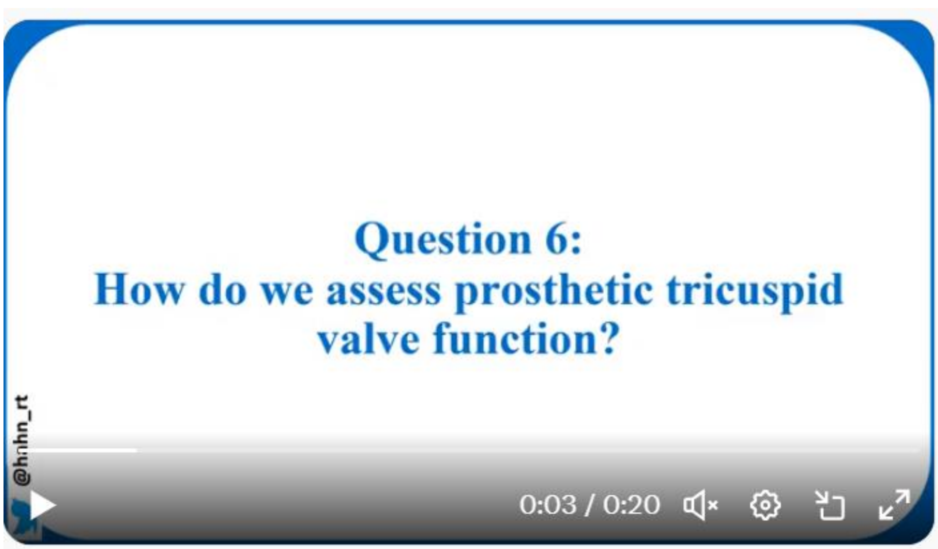
Key Points for Assessing Prosthetic TVs

1. A comprehensive evaluation of TVR requires multiple imaging planes in which 2D and 3D and Doppler echocardiography are used to assess valvular structure and function, as well as right heart chamber size and function. Because of shadowing and flow masking in the right atrium, particularly in mechanical TVs, screening for TR should include modified RV inflow and subcostal views as well as PW Doppler interrogation of hepatic vein flow, where feasible.
2. From the Doppler recordings of prosthetic TVs, peak velocity, mean gradient, PHT, and heart rate should be measured and reported whenever feasible. There is less experience with EOA and DVI of TVR.
3. Several factors can affect mean TV gradient in the absence of prosthetic valve dysfunction, including heart rate, flow, prosthesis size and type; considering these confounders, we suggest use of prosthesis type-specific cutoffs for determination of prosthetic TV stenosis.
4. A multiparametric echocardiographic approach for assessing prosthetic TV regurgitation is required, as validation of quantitative methods is lacking.
5. CMR may be useful for quantifying regurgitant volume and fraction; however, validation of its use in prosthetic valve function is lacking.
6. CT is helpful in identifying mechanisms of valve dysfunction, localization of significant PVLs and is essential in planning percutaneous interventions on the TV.

@hahn_rt:

Question 6 from #ASEchoJC New Prosthetic Valve Guideline https://bit.ly/ASE_ProsthV

See also: https://bit.ly/BVD_Defn and https://bit.ly/ASE_RegurgSHDIntervene



https://twitter.com/i/status/1762652610274750739

@iamritu: 👀 for:

Intra valve Signif Regurgitation

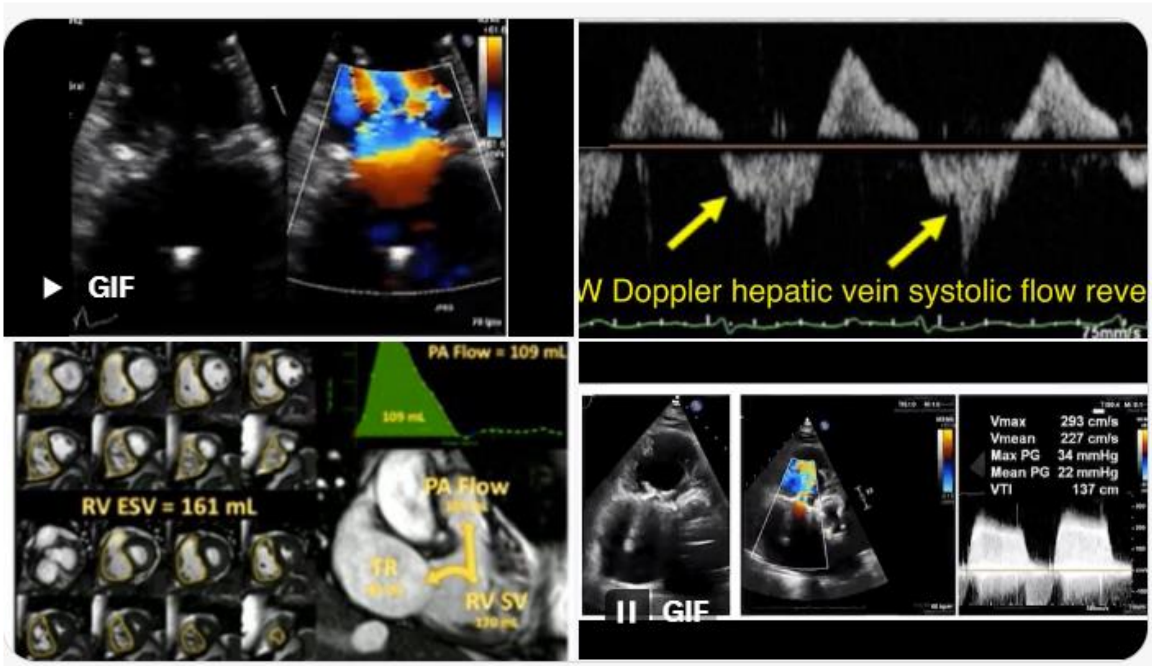
Thickened leaflets

Restricted motion

Diastolic Flow turbulence

Look for hepatic vein systolic reversal

#whyCMR for RV volume & function in TR can be helpful since so much variation in TR with load/respiration

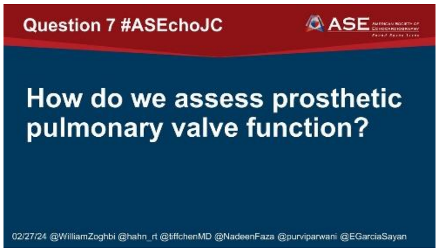


@EGarciaSayan: Question 6 #ASEchoJC: How do we assess prosthetic tricuspid valve function? @iamritu demonstrates key parameters for significant prosthetic TV regurgitation & stenosis

@tiffchenMD: #whyCMR generally helpful for quantifying native TR by volumetrics (as well as any associated RV function). However, in prosthetic tricuspid valves, as w/ mitral, in reality is very difficult to do accurately due to susceptibility artifact affecting RV volumes

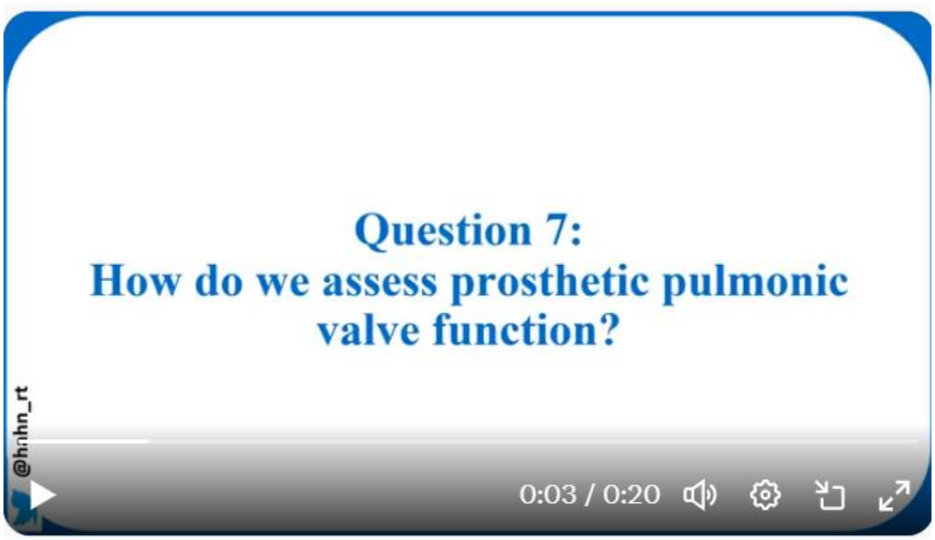
@EGarciaSayan: Question 6 #ASEchoJC: How do we assess prosthetic tricuspid valve function? @tiffchenMD on the advantages and challenges of #WhyCMR for the evaluation of prosthetic TV regurgitation.

Question 7:



A7 Notable responses

@hahn_rt: Question 7: Pulmonic prosthetic valve #ASEchoJC New Prosthetic Valve Guideline https://bit.ly/ASE_ProsthV



https://twitter.com/i/status/1762654670248353830

@EGarciaSayan: Question 7 #ASEchoJC: How do we assess prosthetic pulmonary valve function? @hahn_rt demonstrates key views and parameters in PV #EchoFirst imaging and parameters for normal PHV function.

@WilliamZoghbi: As for any PrV, look at structure and function. For stenosis, use Peak velocity and peak and mean gradients. Less experience with EOA. Always compare to a post surgical baseline.

	Normal	Possible obstruction
Qualitative	• Normal valve structure and motion • Laminar flow	• Abnormal valve structure and motion • Use PW Doppler to determine the location of stenosis • Increased turbulence by color Doppler with a narrow flow jet
Quantitative*	• Peak velocity <3.2 m/sec for bioprosthesis <2.5 m/sec for homograft • Mean gradient <20 mm Hg for bioprosthesis <15 mm Hg for homograft	• Peak velocity ≥3.2 m/sec for bioprosthesis ≥2.5 m/sec for homograft • Mean gradient ≥20 mm Hg for bioprosthesis ≥15 mm Hg for homograft

@EGarciaSayan: Question 7 #ASEchoJC: How do we assess prosthetic pulmonary valve function? @WilliamZoghbi reminds us of grading PV stenosis based on peak velocity and gradient (different based on valve type), importance of serial comparison.

@purviparwani: Pulmonary valve evaluation on #Echofirst

(1) characterization of the type and size of the prosthesis; (2) evaluate presence of degeneration or vegetation;

(3) quantitation of severity of regurgitation via Doppler

(4) Evaluate RV structures

#whyCMR can be incredibly helpful with Pulmonic valve evaluation

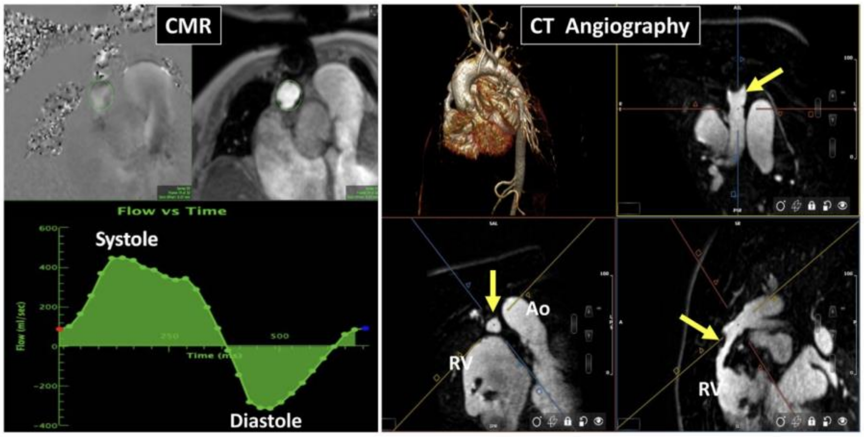


Table 16 Echocardiographic evaluation of severity of prosthetic pulmonary valve regurgitation

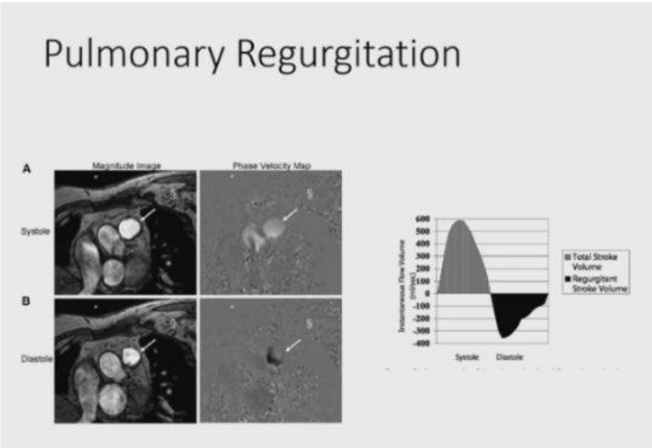
Parameters	Mild	Moderate	Severe
Valve structure	Usually normal	Abnormal or valve dehiscence	Abnormal or valve dehiscence
RV size	Normal*	Normal or dilated*	Dilated or progressive dilation†
Jet size by color Doppler (central jets)‡	Thin with a narrow origin; jet width ≤25% of pulmonary annulus	Intermediate; jet width 26%-50% of pulmonary annulus	Usually large, with a wide origin; jet width >50% of pulmonary annulus; may be brief in duration
Jet density by CW Doppler	Incomplete or faint	Dense	Dense
Jet deceleration rate by CW Doppler	Slow deceleration	Variable deceleration	Steep deceleration,§ early termination of diastolic flow
Pulmonary systolic flow compared with systemic flow by PW Doppler¶	Slightly increased	Intermediate	Greatly increased
Diastolic flow reversal in the distal main PA	None	Present	Present

@EGarciaSayan: Question 7 #ASEchoJC: How do we assess prosthetic pulmonary valve function? @purviparwani comments on #EchoFirst prosthetic PV evaluation, and use of multimodality imaging.

@iamritu: #whyCMR Gold standard for prosthetic pulmonary valve

Through-plane phase-contrast imaging allows assessment of

peak velocity through valve, conduit, &/or main PA or PAs separately. if have stent artifact, place phase contrast just proximal & distal to stent artifact



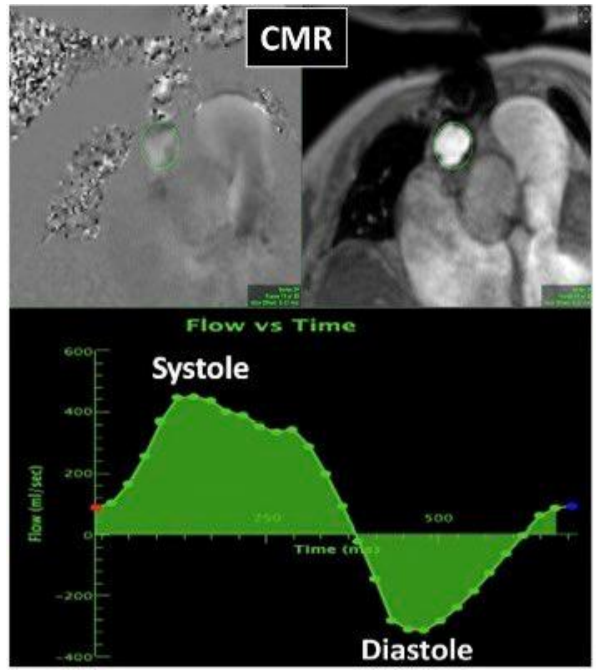
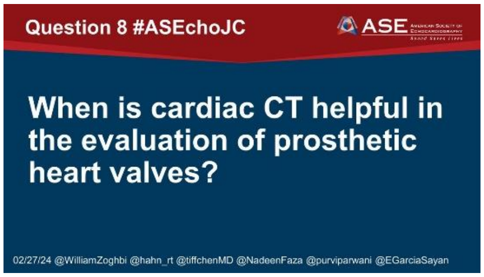


Table 15 Parameters for prosthetic pulmonary valve stenosis		
	Normal	Possible obstruction
Qualitative	• Normal valve structure and motion • Laminar flow	• Abnormal valve structure and motion • Use PW Doppler to determine the location of stenosis • Increased turbulence by color Doppler with a narrow flow jet
Quantitative*	• Peak velocity $<$3.2 m/sec for bioprosthesis $<$2.5 m/sec for homograft • Mean gradient $<$20 mm Hg for bioprosthesis $<$15 mm Hg for homograft	• Peak velocity $\geq$3.2 m/sec for bioprosthesis $\geq$2.5 m/sec for homograft • Mean gradient $\geq$20 mm Hg for bioprosthesis $\geq$15 mm Hg for homograft
Serial comparison with baseline	• Stable peak/mean gradient and peak velocity • No change in RV systolic pressures • No change in RV size and systolic function • No change in DVI	• Increased peak/mean gradient and peak velocity • Increased RV systolic pressure • Increased RV size and decreased systolic function • Decrease in DVI

*Measurements assume normal RV stroke volume. Accurate CW Doppler may be challenging because of the position of the homograft or bioprosthetic valve; important to use off-axis parasternal and suprasternal views. Normal values for various prosthetic PVs are shown in Appendix Table A7.

Question 8:



A8 Notable responses

@NadeenFaza: #YesCCT is helpful in the evaluation of:

✅ Mechanical leaflet motion

✅ Prosthetic valve structural failure

✅ Valve Dehiscence

✅ PVL

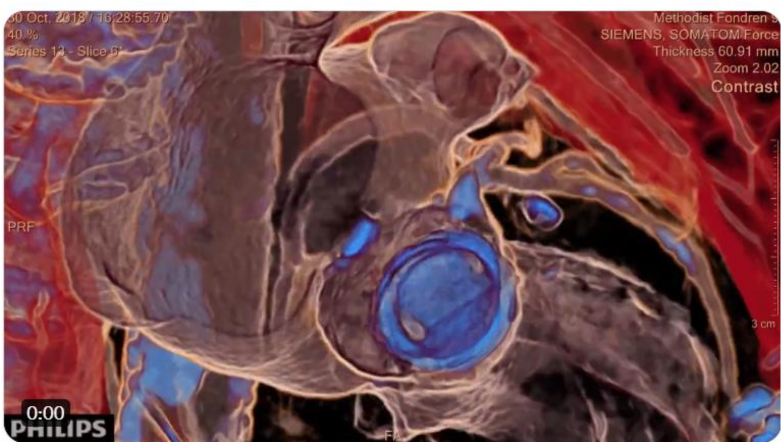
✅ Thrombosis

✅ HALT

✅ Endocarditis and its complications

✅ Pseudoaneurysm

Example of mechanical AV thrombosis with a stuck leaflet #3DCT



https://twitter.com/i/status/1762655425709691035

@EGarciaSayan: Question 8 #ASEchoJC: When is cardiac CT helpful in the evaluation of prosthetic heart valves? @NadeenFaza highlights the role of #YesCCT

@WilliamZoghbi:

CT is valuable in evaluating Pros V structure and related complications.

✅ advantage compared to Echo in assessing mech valves motion: PV, TV, AV; less advantage for MV

✅ CTA: thrombus vs pannus.

✅ para valvular complications & Extent

✅ advantage in multiple PrV

@tiffchenMD: #yesCCT is often underutilized for assessment of prosthetic valve function - powerful tool for:

- PVLs

- HALT

- masses/IE

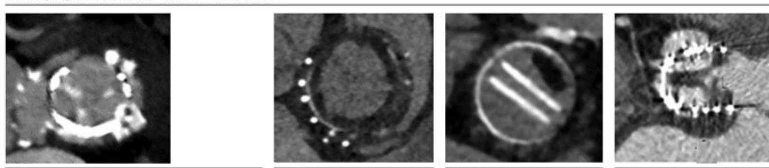
- mech leaflet motion

- and much more...

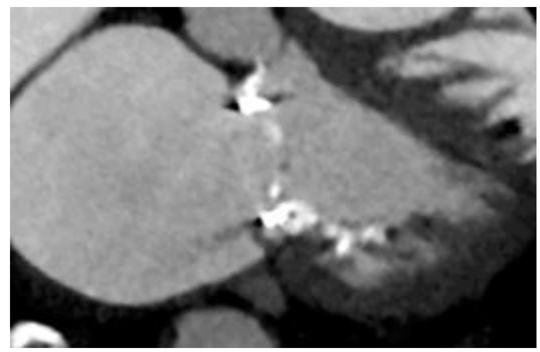
@tiffchenMD: Examples of #yesCCT assessment of prosthetic valve dysfunction - table of features to distinguish between them, calcification, pannus, and dehiscence. #ASEchoJC

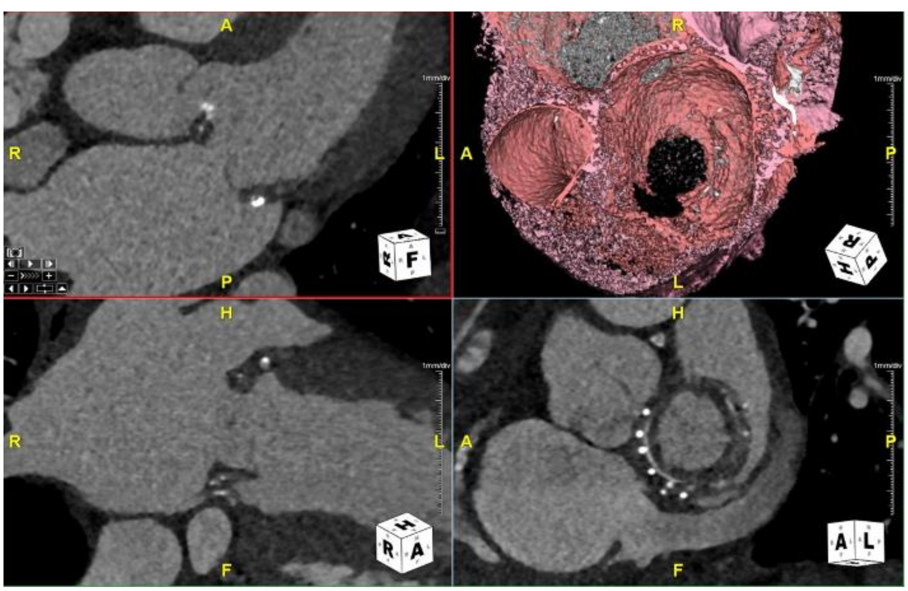
https://pubmed.ncbi.nlm.nih.gov/35183554/

Identifying Characteristics of PHV Masses on CT



		Calcification	Pannus	Thrombus	Vegetation
Clinical Information	Timing after surgery	Delayed (5+ years)	Delayed (1+ years)	Early or delayed	Anytime
	Acuity	Chronic	Subacute or chronic	Acute	Acute or subacute
	Valve type	Bioprosthetic	Both	Mechanical > Bioprosthetic	Both
CT Findings	Appearance	Bulky, fixed, irregular Hyperechoic with shadowing artifact	Smaller, fixed, crescentic Occasional calcification	Larger, mobile, irregular	Smaller, mobile, irregular
	Location	Annulus, commissures, or leaflets	Sewing ring/annulus Valve apparatus Ventricular side of AV	Leaflets, sewing ring, or occluder Aortic side of AV	Leaflets or sewing ring Ventricular side of AV
	Density	High (greater than 130 HU, but often greater than 400 HU)	High (>145 HU)	Low(<145 HU)	Low (<50)
	Enhancement	No	Yes	No	Enhancement surrounding vegetations

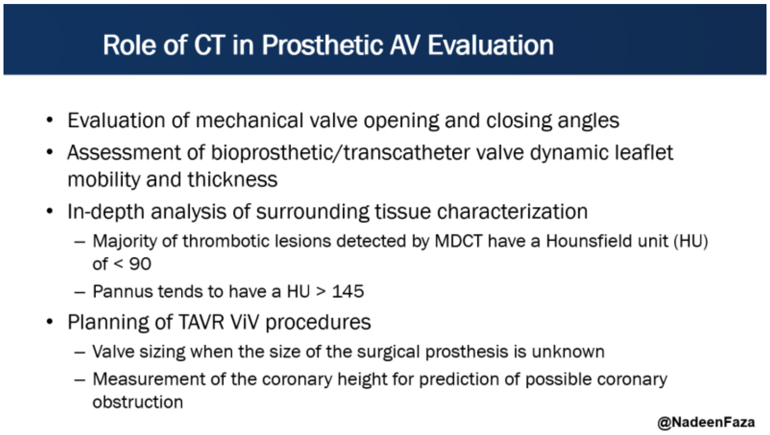




@NadeenFaza: Agree- a very powerful tool that is underutilized!

@EGarciaSayan: Question 8 #ASEchoJC: When is cardiac CT helpful in the evaluation of prosthetic heart valves? @tiffchenMD highlights important settings where #YesCCT can be complementary and superior to #EchoFirst.

@NadeenFaza: Role of #YesCCT in prosthetic AV evaluation!



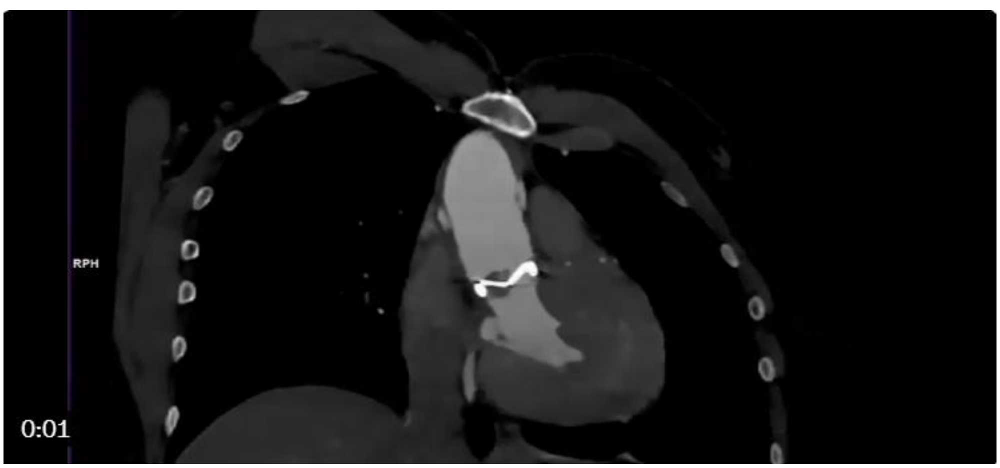
@purviparwani: Leaflet Thrombosis on #yesCCT

➡️ The incidence of prosthetic thrombosis ranges from 0.3% to 8% (Mechanical PHVs >>> bioprosthetic PHVs, and right-sided valves >>> left-sided valves)

➡️ Important to differentiate from Pannus

HU greater than or equal to 145 HU has a sensitivity of 87.5% and specificity of 95.5% in discriminating pannus from thrombus on #yesCCT

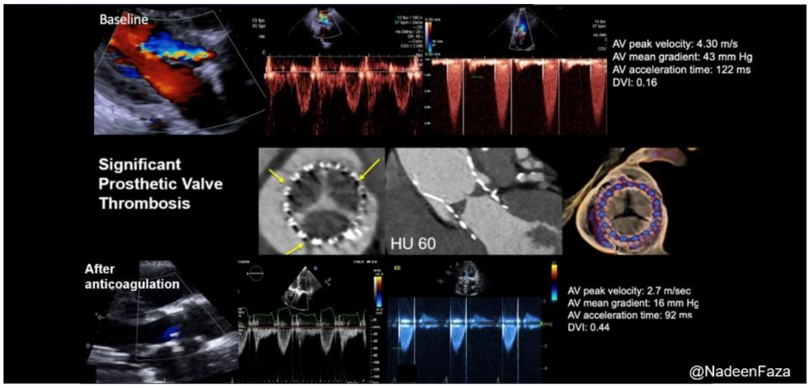
https://pubs.rsna.org/doi/full/10.11



https://twitter.com/i/status/1762656167006994584

@NadeenFaza: #TAVR valve thrombosis by #EchoFirst and #YesCCT!

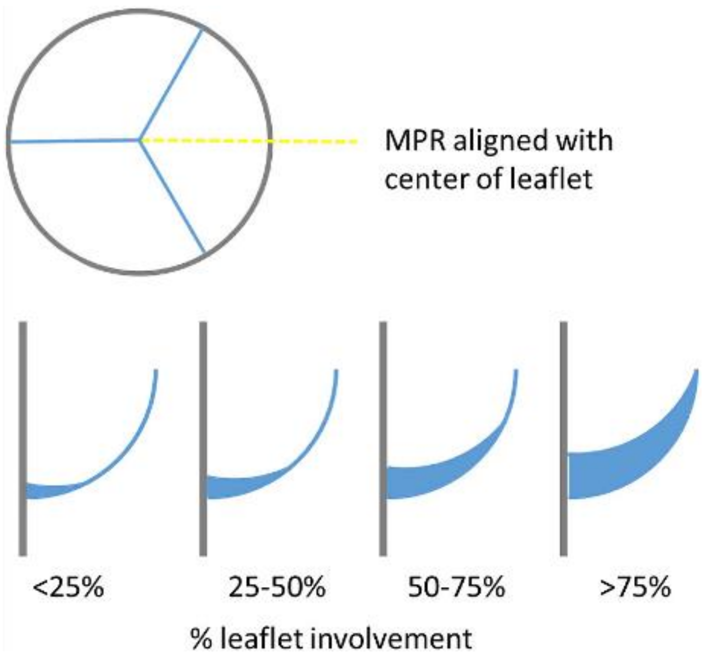
Initial #EchoFirst consistent with significant prosthetic valve obstruction. #YesCCT confirmed prosthetic valve thrombosis! Note improvement in Doppler parameters after anticoagulation.



@tiffchenMD: Remember that not all HALT is associated w/ RLM (reduced leaflet motion) or elevated gradients. Clinical significance is still somewhat unclear. #ASEchoJC

Semi-quantitative grading by SCCT guidelines:

https://cdn.ymaws.com/scct.org/resource/resmgr/docs/guidelines/scct_tavr_guideline.pdf



Tips on Optimization of #yesCCT Scan Technical Quality for Evaluation of Prosthetic Valve leaflets on #yesCCT

1.50-100 ml contrast

2. Full retrospective gating

3. Submillimeter scan slice thickness

4. No dose modulation

5. Heart rate below 70 beats/min, with beta-blockade where feasible

6.120-kV scanner voltage increased to 140 kV in the presence of

1)Denser stent frames (e.g., Lotus);

2)coexisting permanent pacemaker;

3)coexisting mechanical bioprosthetic valves;

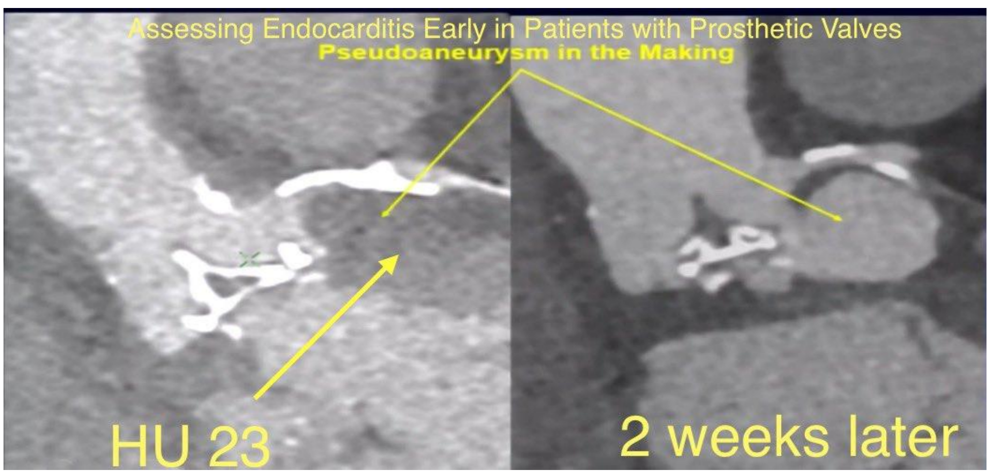
4)large body habitus

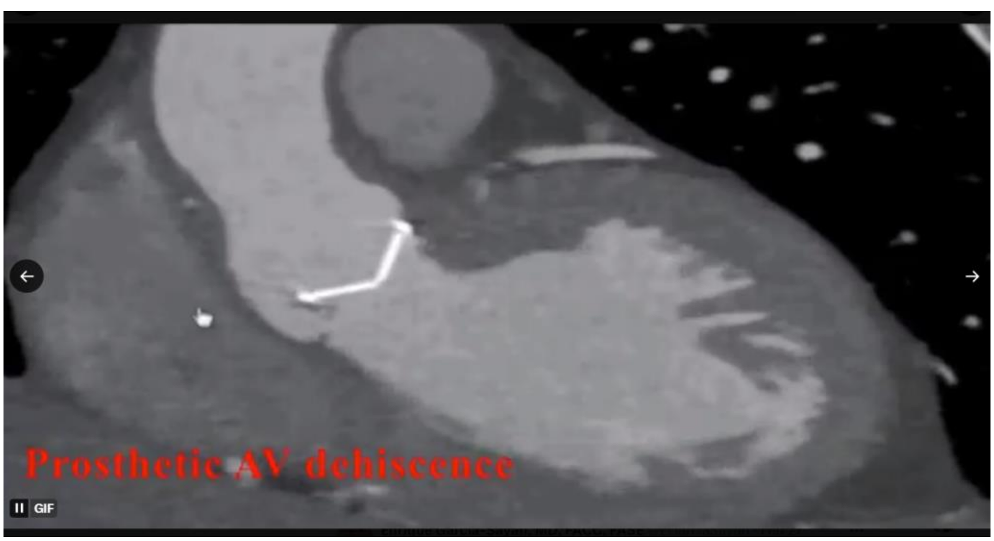
Table 1: Multidetector CT Imaging Protocol in Prosthetic Heart Valve Dysfunction

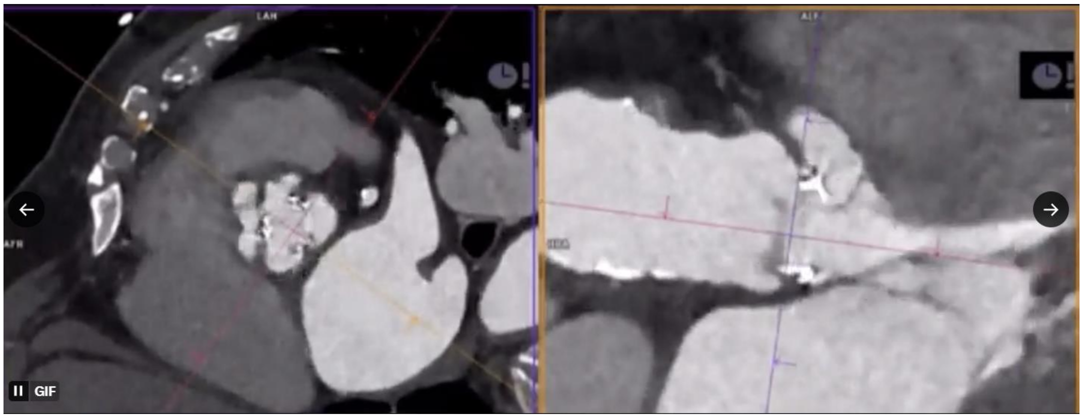
Parameter	Description
ECG gating	Retrospective gating preferred for functional evaluation Prospective gating may be enough if it is necessary to confirm location/extent of periprosthetic lesions without dynamic evaluation of the valve
Target heart rate	Low heart rate (60 beats/min) is preferable. However, patients with PHV dysfunction may have contraindications to β-blockers (rhythm disorders in postoperative phase or impaired LV function)
Dose of contrast medium	Nonionic iodinated contrast media via peripheral intravenous line; 1.0–1.5 mL/kg
Contrast medium injection and flow rate	Biphasic injection: 5–6 mL/sec contrast medium followed by saline chase (40–50 mL at same rate). Triphasic injection can be used for simultaneous evaluation of right-sided valves: first phase, one-half dose of contrast medium; second phase, remaining contrast material volume mixed with saline; third phase, saline chase
Triggering of acquisition	Bolus tracking method ROI placed in descending aorta with opacification threshold of 100 HU for initiating scan acquisition Timed bolus technique Small bolus of contrast material administered to measure contrast material arrival and travel time
Scan range	Depends on the indication; usually from 2 cm above carina to the diaphragm In cases of suspected endocarditis, entire aortic evaluation may be necessary to identify disease extent beyond the valves
Tube current and tube voltage	Automated tube current modulation Acquisition at high tube voltage (120–140 kV)
Image reconstruction	Minimum section thickness: 0.9 mm with increment of 0.45 mm Filtered back projection, model-based iterative reconstruction

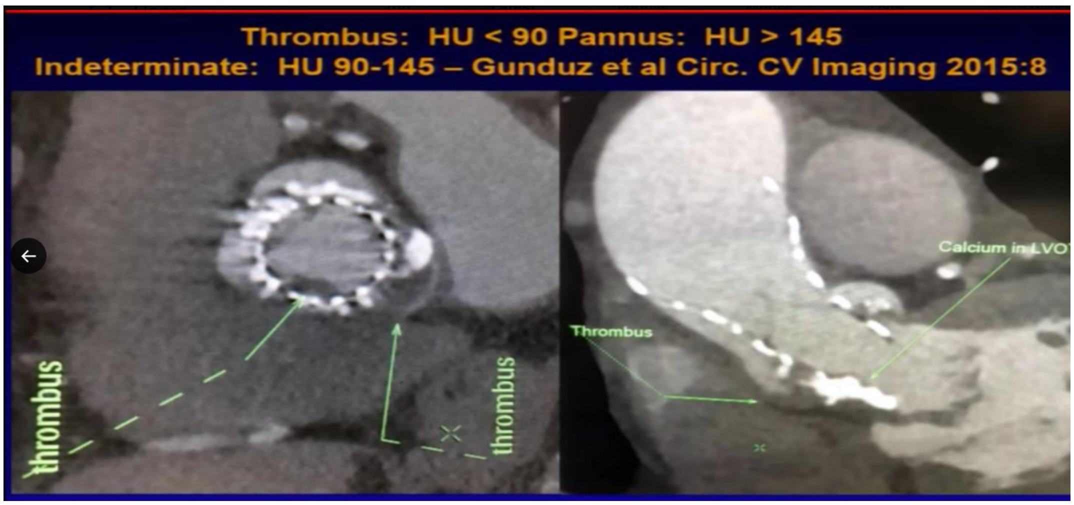
@EGarciaSayan: Question 8 #ASEchoJC: When is cardiac CT helpful in the evaluation of prosthetic heart valves? @purviparwani provides tips on optimization of #YesCCT technical quality for PHV evaluation

@iamritu: #yessct useful for early assessment of prosthetic valve endocarditis, pseudoaneurysm assessment, prosthetic valve dehiscence, Thrombus < 90 HU 🆚 Pannus >145 HU

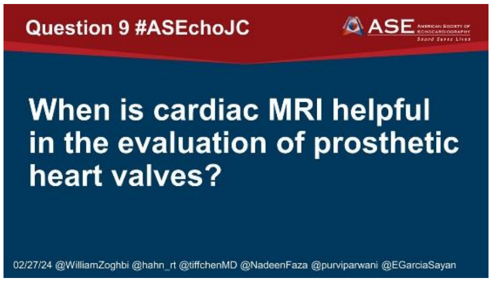





GIF


Thrombus: HU < 90 Pannus: HU > 145
Indeterminate: HU 90-145 – Gunduz et al Circ. CV Imaging 2015:8
thrombus
thrombus
Thrombus
Calcium in LVO

Question 9:



A9 Notable responses

@WilliamZoghbi: Cardiac MRI is helpful in Pros Valves

✅ major adv in Reg valves: quantitation of regurgitant Volume & fraction

✅ quantitation of cardiac volumes

✅ can quantitate Ao and Pv gradients

✅ limited visualization of valve structure, sp mechanical—susceptibility artifacts.

@EGarciaSayan: Question 9 #ASEchoJC: When is #WhyCMR helpful in the evaluation of prosthetic heart valves? 🔑 advantages highlighted by @WilliamZoghbi

@tiffchenMD: Excellent points - also ventricular assessment (volumes & myocardial characterization) to help w/ determining timing of potential intervention. Gradients (via through-plane PC) by #whyCMR often underestimated due limited temporal resolution & angulation effects.

@purviparwani: #whyCMR in prosthetic aortic valve assessment

🧲 Discrepancy in clinical history and echocardiographic findings or when

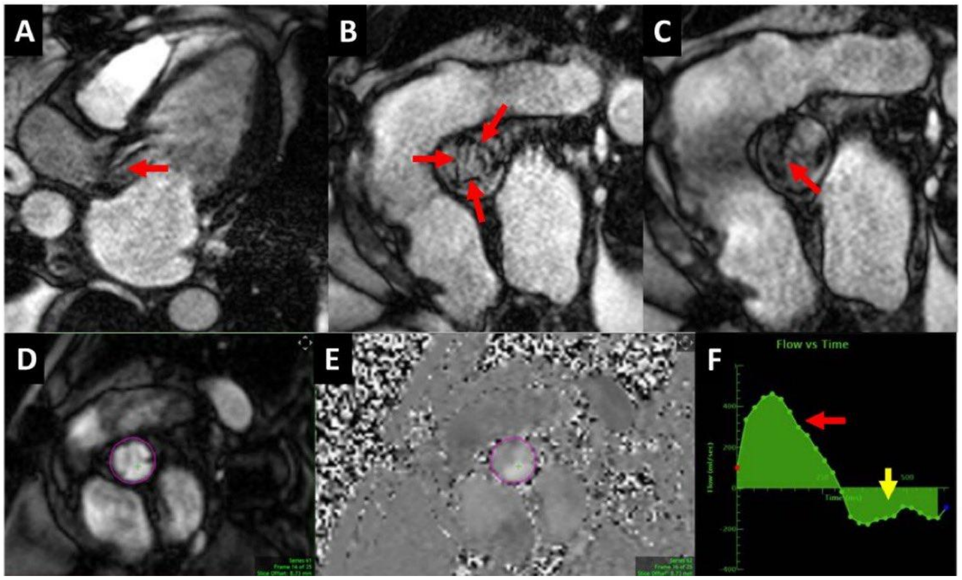
imaging quality from TTE or TEE is suboptimal

🧲 In cases in which valve area–gradient mismatch is seen on TTE; CMR is additive in assessing anatomic bioprosthetic valve area and ensuring the highest velocity captured across the valve

🧲 Assessment of aortic root in complicated endocarditis (paravalvular extension of disease, pseudoaneurysm, or root abscess)

🧲 Quantification of AR severity

🧲 Assessing adverse LV remodeling

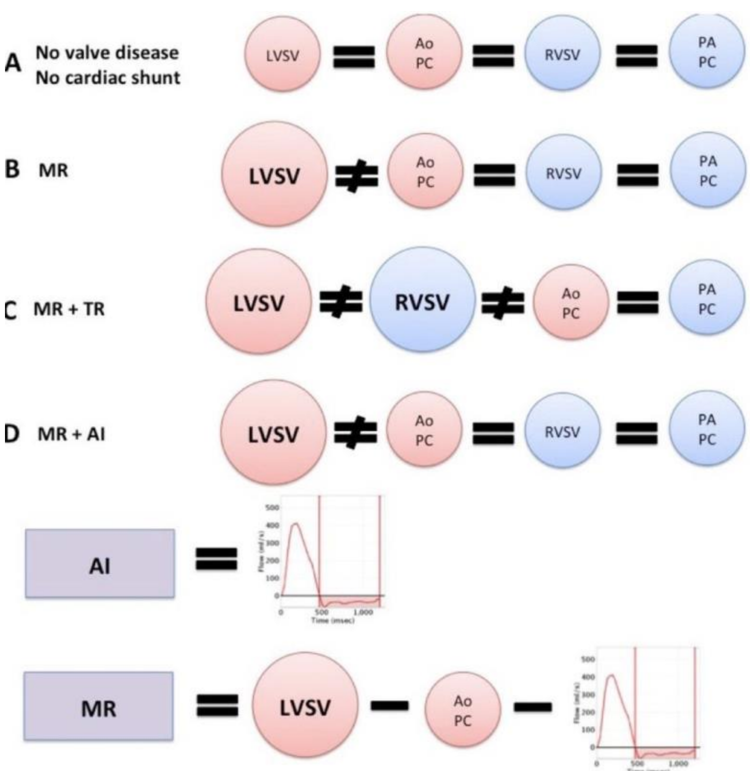


@EGarciaSayan: Question 9 #ASEchoJC: When is cardiac MRI helpful in the evaluation of prosthetic heart valves? @purviparwani highlights the superior accuracy for flow and RVol calculations & LV assessment.

@purviparwani: #whyCMR in Prosthetic Mitral valve evaluation

🧲 Remember you can use PA or aortic PC in the absence of cardiac shunts for MR RF and MR R volume calculation

🧲 🔥 risk for susceptibility artifact at the basal short-axis cine images from the PHV, reducing the accuracy of the LV total stroke volume quantification.

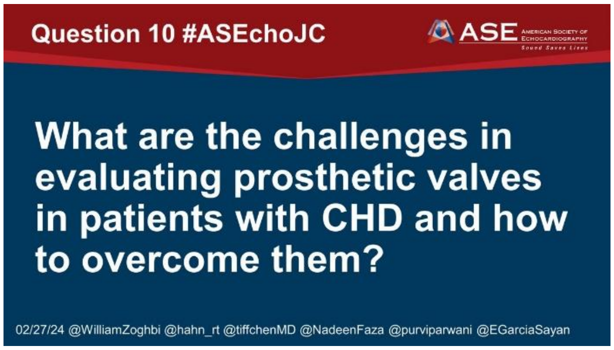


@EGarciaSayan: Question 9 #ASEchoJC: When is #WhyCMR helpful in the evaluation of prosthetic heart valves? @purviparwani provides tips for flow comparison and quantification depending on the valve assessed

@WilliamZoghbi: I draw your attention to this table in the guidelines: the comparative advantages and limitations of advanced imaging after a TTE. Very important as you navigate choices. Note the importance of valve location in echo!

	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	++	++++	++	++++

SQuestion 10:



A10 Notable responses

@DavidWienerMD: Last thought: The VARC-3 definitions, mentioned in the guideline, provide a useful way to understand prosthetic valve dysfunction:

- Type

▪Structural

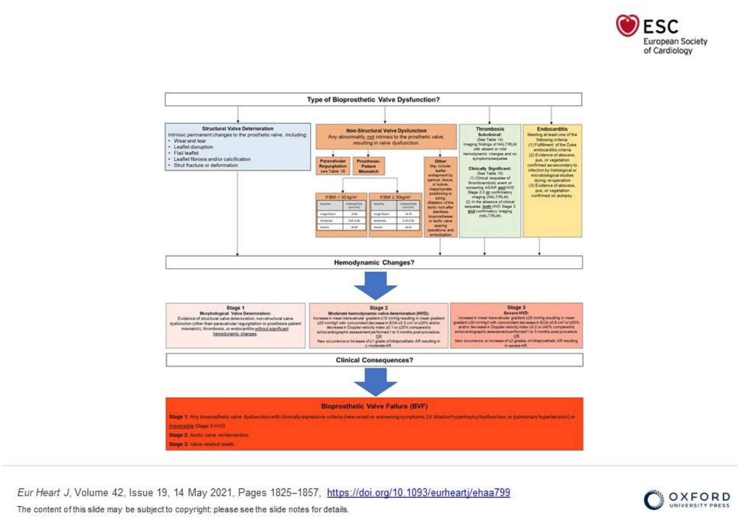
▪Non-structural

▪ Thrombosis

▪ Endocarditis

- Hemodynamic Changes

- Clinical Consequences



@EGarciaSayan: @DavidWienerMD highlights updated VARC-3 definitions for prosthetic valve dysfunction

@NadeenFaza:

-Evaluation in CHD requires modifications to standard TTE & TEE views.

-An understanding of different anatomies, conduits, & hemodynamics is required in PHV evaluation.

-3D echo can provide valuable information and en face views.

-CT & CMR are very helpful in CHD

Table 23 Challenges to prosthetic valve evaluation in patients with CHD
• Poor echocardiographic windows due to o Previous surgery o Chest deformities o Artifacts from prosthetic materials o Body size
• Underestimation of prosthetic valve/conduit gradients due to o The presence of associated shunts o Serial stenoses o Eccentric jets
• EOA calculation may be limited by o Serial stenoses, which affect use of the continuity equation o Noncircular LVOT or RVOT shape affecting calculation of pre-prosthesis flow o Inaccurate VTI in patients with subaortic or subpulmonary stenosis when the preobstruction flow velocity pattern is not laminar
• Long tubular narrowing in conduits will affect the pressure gradient calculated by the modified Bernoulli equation using peak flow velocity

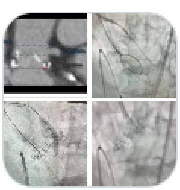
@boegel_kelly: May need to utilize different imaging modalities in evaluating prosthetic valves in patients with #CHD

@purviparwani: #whyCMR and #yesCCT to rescue for #ACHD or #CHD imaging. deep understanding of the #CHD syndromes and connections necessary

@SIwa23288585: My Grok search, `Rubik`s Cube` 😮

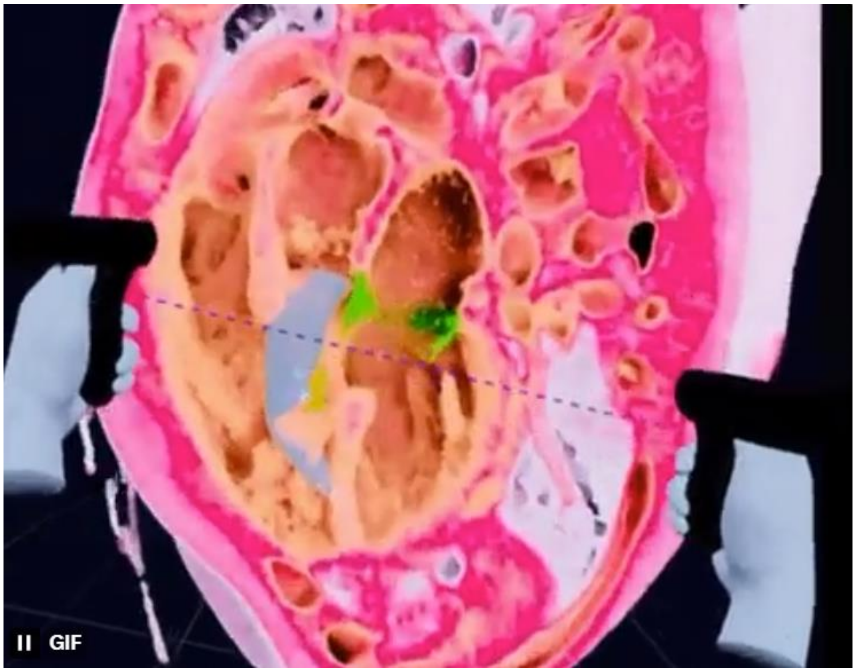
In conclusion, evaluating prosthetic valves in patients with CHD is like trying to solve a Rubik's Cube blindfolded. It requires a combination of advanced imaging techniques, multidisciplinary collaboration, and a good sense of humor to overcome the challenges and ensure the best possible outcomes for these patients.

Ahmed Almomani @drmomani · Apr 6, 2023



How do you deal with heavily calcified bioprosthetic valve leaflet during BASILICA? Trifecta VTC 2.5 mm @CathElectroSurg @AdamGreenbaumMD @jtsaxon @akcmahi @MohammedQintar @BillONeillMD @kalazizimd ...

@iamritu: to understand different CHD anatomy, conduits, & hemodynamics & evaluate PHV need all imaging modalities 3D #Echofirst #YescCT #WhyCMR which all lead to #VirtualReality to plan procedures like patch simulation for placing patch beyond straddle, routing Lv to PA



https://twitter.com/i/status/1762662551819522139

@EGarciaSayan: ⏰ And that's a wrap! Thank you all for participating in tonight's #ASEchoJC on X on the new PHV guideline w/ our guest authors @WilliamZoghbi @hahn_rtc@tiffchenMD & co-moderators @NadeenFaza & @purviparwani.

👉If you missed anything, catch up by following the #ASEchoJC hashtag.

@ase360: Thank you to EVERYONE who participated in tonight's #ASEchoJC! ❤️

Huge shout-outs to our moderators, @EGarciaSayan, @NadeenFaza and @purviparwani, and our guest authors, @WilliamZoghbi, @tiffchenMD, and @hahn_rt.

@boegel_kelly: Got tied up during #ASEchoJC Good thing I can just search the hashtag and catch up on all the #echofirst content

@EGarciaSayan: The whole discussion was on "X" (formerly Twitter) and you can catch up at a later time by following the hashtag #ASEchoJC. It's absolutely free to join (& CME credits are free for @ASE360 members)

👉More info: https://asecho.org/twitterjournalclub/