#ASEchoJC Twitter Chat
Tuesday, February 1, 2022 – 8 PM ET

- **Recommended Standards for the Performance of Transesophageal Echocardiographic Screening for Structural Heart Intervention** (JASE, January 2022)

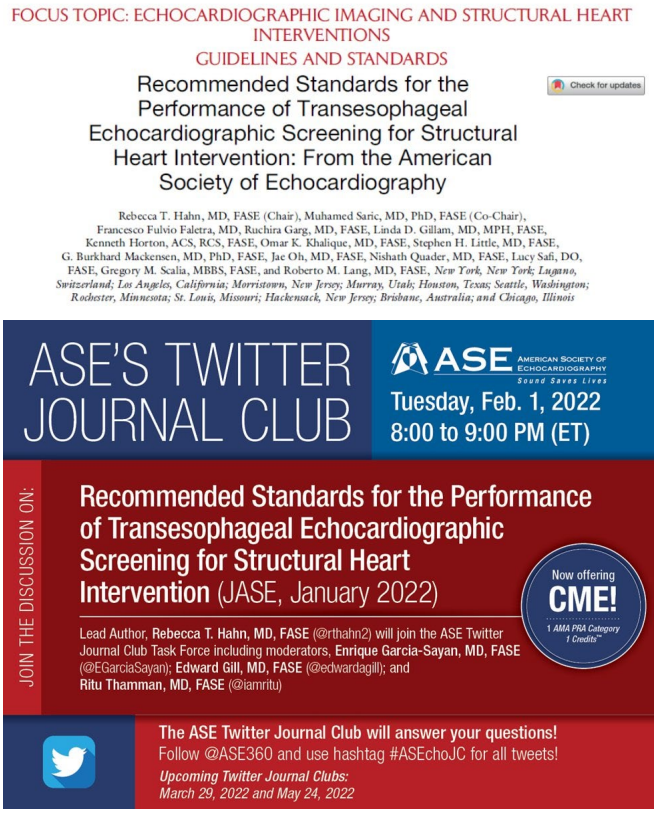
Lead Author/Moderator

- Rebecca T. Hahn, MD, FASE @hahn_rt

Moderators:

- Enrique Garcia-Sayan, MD, FASE @EGarciaSayan
- Edward Gill, MD, FASE @edwardagill
- Ritu Thamman, MD, FASE @iamritu

Introduction and Welcome: Welcome everyone to #ASEchoJC on the new guideline for TEE before SHI https://bit.ly/3ogGBN4. We're honored to be joined by lead author @hahn_rt & co-moderators @iamritu & @edwardagill. Follow #ASEchoJC to join the conversation, use the hashtag and get your questions answered!



Q1: Why were these standards needed and who is the target audience?

A1 Notable Responses:

@hahn_rt: SHD is a new, growing field & TEE is essential to facilitate shared decision-making by the Heart Team. New Guideline is for all professionals in/out of training, performing TEE on SHD patients

@EGarciaSayan:

- Rapid growth of SHI & Interv #EchoFirst (IE) as new subspecialty
- BUT pre-procedural screening for SHI often done by level 2 imagers without IE training
- These guidelines address acquisition of essential pre-interventional TEE images

@edwardagill: Deep gastric and deep esophageal views are not views that the usual level 2 echocardiographer is well versed in ….. but they should become very familiar with

@edwardagill: For previous perspective see Dr Hahn and other's 2013 TEE guidelines, and appreciate the two new views

Q2: How should measurements be performed in 3D datasets?

A2 Notable Responses:

@hahn_rt: Good 2D image makes a good 3D image! Decide what's important: Temporal vs Spatial Resolution. Then use appropriate 3D mode. Optimize information by using appropriate rendering, cropping tools.

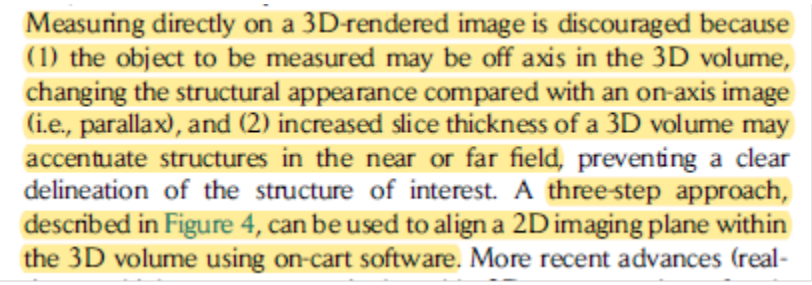
@iamritu: This is a key point #ASEchoJc @hahn_rt which do you need most? Temporal or Spatial resolution on both # of scan lines in 2D sector & # of 2D sectors in volume of interest

If ↓ scan lines & density: ↓ spatial resolution but ↑ frame rate/temporal resol

https://twitter.com/i/status/1488682198169444356

@EGarciaSayan:

- Rendered 3D images provide an excellent view of anatomy but not best for measurements (parallax)
- 2D can under or overestimate
- Use of 3D multi-planar reconstruction (MPR)


Measuring directly on a 3D-rendered image is discouraged because (1) the object to be measured may be off axis in the 3D volume, changing the structural appearance compared with an on-axis image (i.e., parallax), and (2) increased slice thickness of a 3D volume may accentuate structures in the near or far field, preventing a clear delineation of the structure of interest. A three-step approach, described in Figure 4, can be used to align a 2D imaging plane within the 3D volume using on-cart software. More recent advances (real-

@EGarciaSayan: 3 step approach to quantify cardiac structures

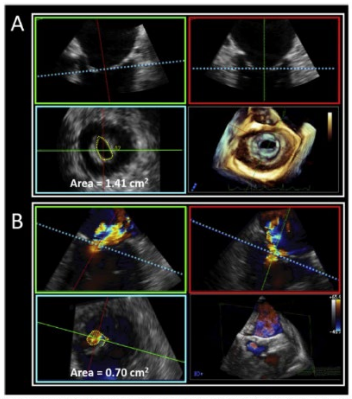


Figure 4 Three-step approach to quantify cardiac structures. Step 1: two orthogonal 2D planes (*green* and *red boxes*) are oriented perpendicular to the structure to be measured. In the examples shown, the *green and red planes* are perpendicular to the MV orifice (**A**) or the regurgitant MV color Doppler jet (**B**). Step 2: the third orthogonal 2D plane (*blue box*) is now the SAX view and is positioned at the level of the structure to be measured. In the examples shown, the *blue plane* is placed at the level of the mitral leaflet tips (**A**) or regurgitant vena contracta (**B**). Step 3: the structure in the SAX plane (*blue box*) is measured. In the examples shown, the MV area (**A**) or vena contracta area (**B**) is planimetered. Note that the 3D image in the lower right-hand corner can be used to confirm the orientation of the three orthogonal imaging planes.

@rajdoc2005: Agree re: MPR with 3D datasets. Thankfully most of this can be done right on the machine itself. And not needing a workstation! That helps with the workflow….

@edwardagill: There is a role for measuring on the 3D rendered image as long as confirmed by MPR cross sections as well. Parallax in 3D imaging is real! It cN be overcome by careful confirmation from at least two different 3D rendered views. MPR measurements also have the limitations—drop out

@EGarciaSayan: for further demonstration of why we need to use 3D MPR for accurate measurements (and avoidance of parallax), check this quick clip. Remember not to use continuity for MVA in MR patients.

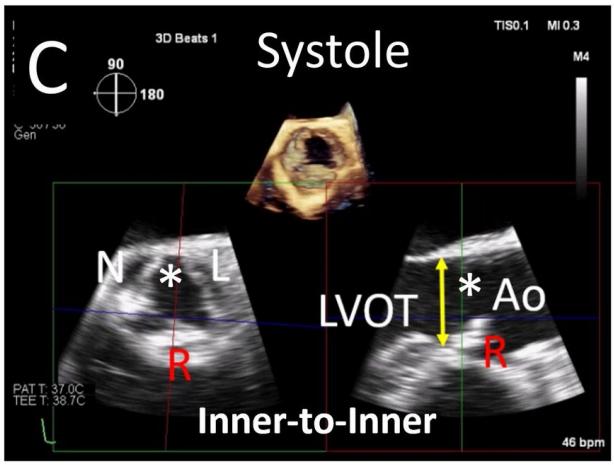
https://twitter.com/i/status/1488680867480358920

@AntonioBarros_: Three-step approach. Very Important: Measuring directly on a 3D-rendered image is discouraged

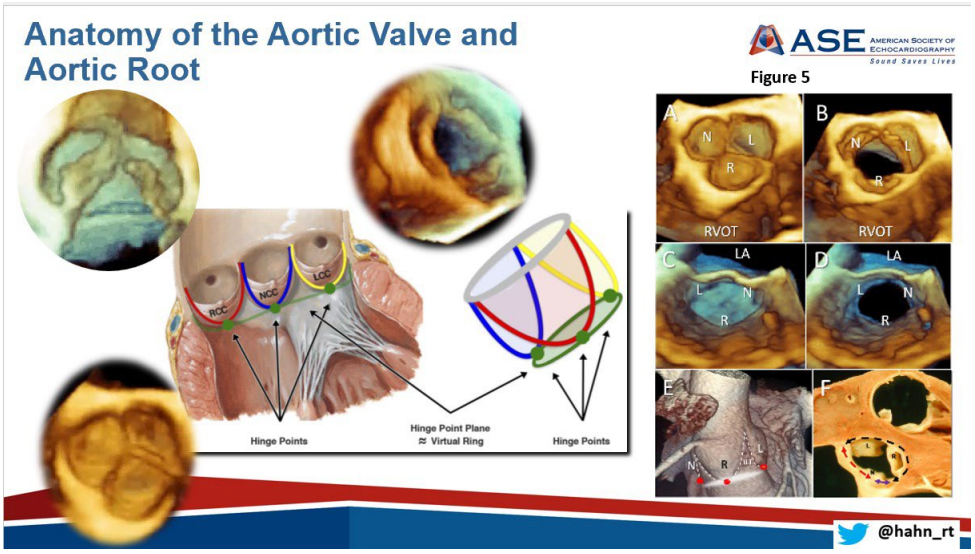
Q3: How do we optimally measure the aortic root and annulus?

A3 Notable Responses:

@hahn_rt: 1/2Measuring the Aortic Root: 2D LAX view optimizes “edge” detection—uses AXIAL resolution. Measure lead-to-lead edge for aortic root, but inner-to-inner for LVOT/annular dimension.

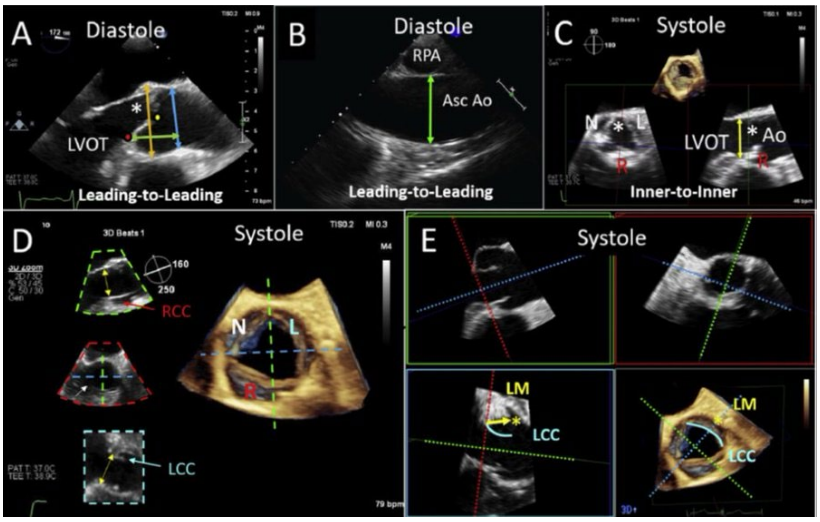


@han_rt: 2/2 Annulus is “virtual”: plane of Hinge points of Cusps-most of annulus is interleaflet trigone (ILT). Annulus diameter is from the RCC hinge (in far field) to the ILT opposite (perpendicular to LAX of aorta) in early systole.

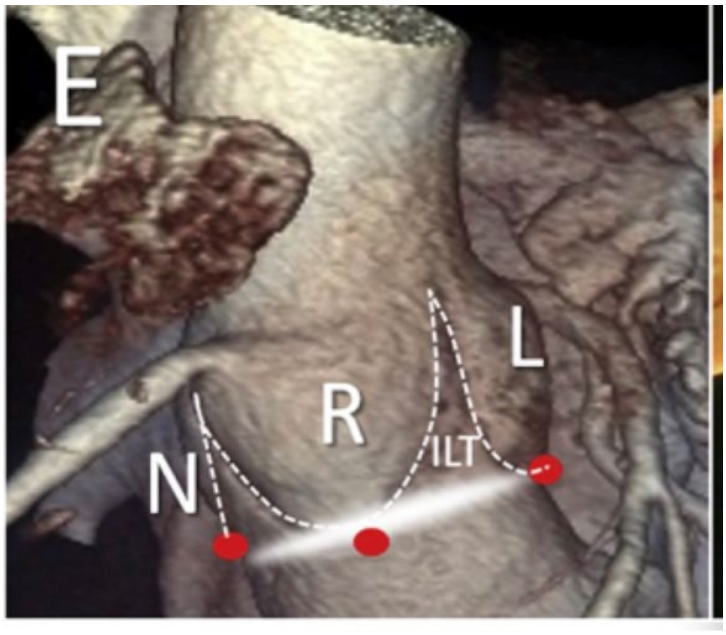


@EGarciaSayan:

- Aorta: end-diastole, using the leading edge–to–leading-edge technique
- LVOT (annulus): in mid-systole from R cusp hinge to base of LCC-NCC interleaflet trigone from inner edge-to-inner edge
- When sizing for TAVI, avoid 2D, use 3D MPR



@iamritu: The semilunar cusps attach in a semicircle which creates the inter leaflet triangles & virtual annulus attaches to the lowest hinge points of this inter leaflet triangle, leaflets not same size LCC is smallest, designed to fit on a curved aorta



@LilyLeiZhang1: Q: if we know LVOT/annulus are much bigger by 3D planimetry and CT derived areas. Why do we still use LVOT AP diameter to report AVA in aortic stenosis? I suppose this is the method in which historically Clinical and research outcomes are based AVA <1cm2.But in true likely higher

@hahn_rt: Because adverse OUTCOMES using the standard Echo methods is predicted by AVA </= 1.0 cm2, but outcomes for CT hybrid method for AVA </= 1.2 cm2. The strength of the association is not different thus no reason to do the Hybrid.

Q4: How can mitral valve imaging be optimized by probe position and manipulation?

A4 Notable Responses:

@hahn_rt: 1/2 Optimizing MV Imaging: Path of the Esophagus is along the lateral side of the left atrium. RIGHT Flexion brings the probe over the dome of the left atrium. Retro-flexion optimizes long-axis of LV.

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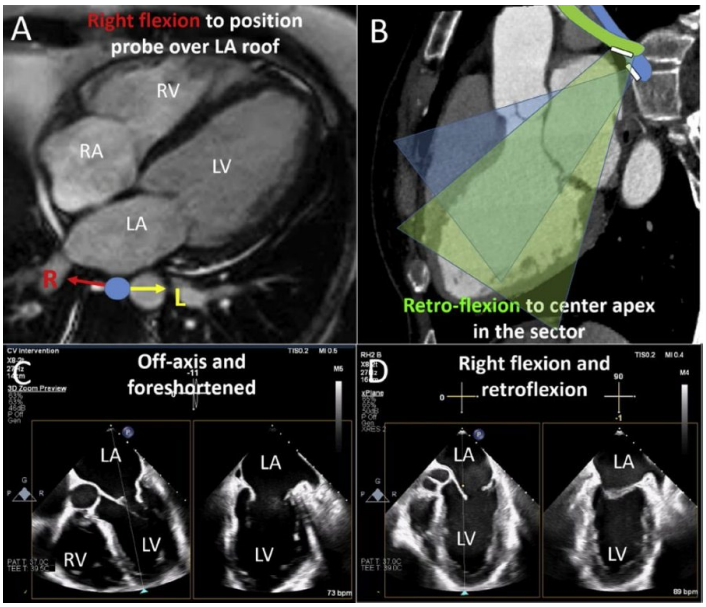
@hahn_rt: 2/2 Centering MV annulus in the imaging plane may improve assessment of MR severity and 3D image quality and allows acquisition of standard views with fewer probe manipulation.

@EGarciaSayan: #ASEchoJC probe manipulation for MV

- Esophagus closer to lat LA wall, use R flexion (small wheel) to position MV perpendicular to US beam
- Retroflex to align imaging plane with LV apex
- Withdraw for lat commissure, advance for med commissure



@iamritu: Using biplane imaging, the orthogonal imaging plane can be positioned across the commissural line, & thus sweep from lateral commissure of A1/P1 to midline (A2/P2 & finally medial commissure (A3-P3, without & with colour flow Doppler

Q5: What is the mitral commissural view and how can it be best utilized?

A5 Notable Responses:

@hahn_rt: Commissural View aligns 2D image along lateral to medial commissures, allows Sweep of entire commissural line using biplane Imaging, helps identify location of the pathology (without/with Color).

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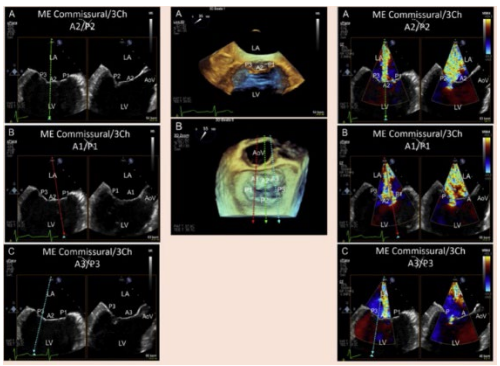
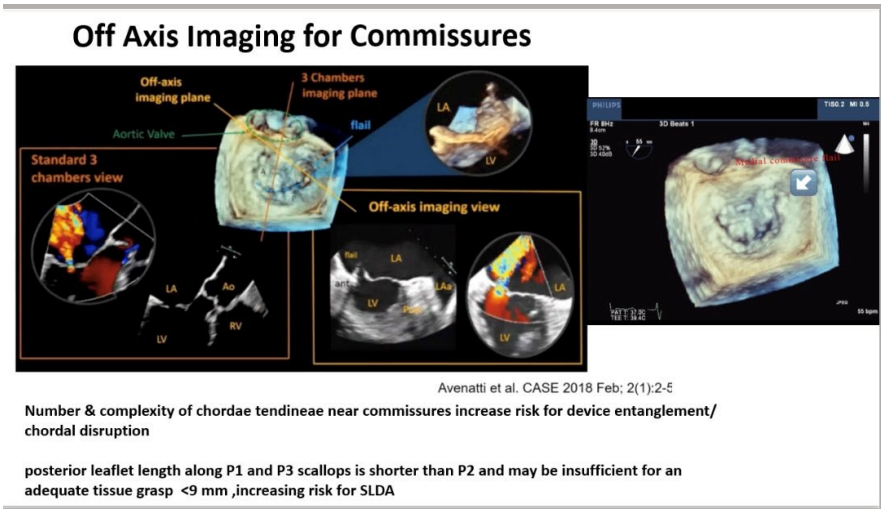
@EGarciaSayan: commissural view (~50-70)

- Can use live 3D for guidance
- Clock (anterior) & counter (post)
- Biplane (LAX) & interrogate each scallop, measure PML
- Sweeping with and without color
- Can use as starting view for 3D en-face imaging



@iamritu: Need off axis views for commissures because the number & complexity of chordae near commissures



@EGarciaSayan:

- For optimal ME commissural view of the MV valve, use live 3D (narrow volume) to verify that US beam perfectly aligns with commissures.
- Take a long clip sweeping from let (close to LAA) to med (towards septum) w/and without color

https://twitter.com/i/status/1488685340982456320

@LilyLeiZhang1: Experts: please enlighten us on how to get that perfect BICOM view with Xplane! Tips and tricks when LV is forshortened/LV apex is 7-8 o'clock instead of 6oclock. And when RV pushes LV to the side!

@EGarciaSayan: tricky at times indeed, a bit of retroflexion is needed, and live 3D is your friend.

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@LilyLeiZhang1: How many of you consistently obtain mitral annular PW(x3D MVA area) -LVOT PW , PISA method, and 3D planimetry EROA x MR CW to correlate MR severity?

@EGarciaSayan: Always! There is growing evidence that Doppler volumetric method may be more reliable than PISA or VCA in secondary MR. Proper measurements (esp LVOT & mitral annulus) are key.

@LilyLeiZhang1: I totally agree! LOVT VTI is important even though it maybe lower during TEE/sedation, still useful and mitral flow hopefully is similarly proportionally decreased during sedation

Q6: What are the key views for the assessment of the tricuspid valve?

A6 Notable Responses:

@hahn_rt: Imaging TV: added level=deep esophageal (DE); essential views=ME or DE Inflow-outflow ("commissural") view and TG SAX. DE level near diaphragm, avoiding left heart structures.

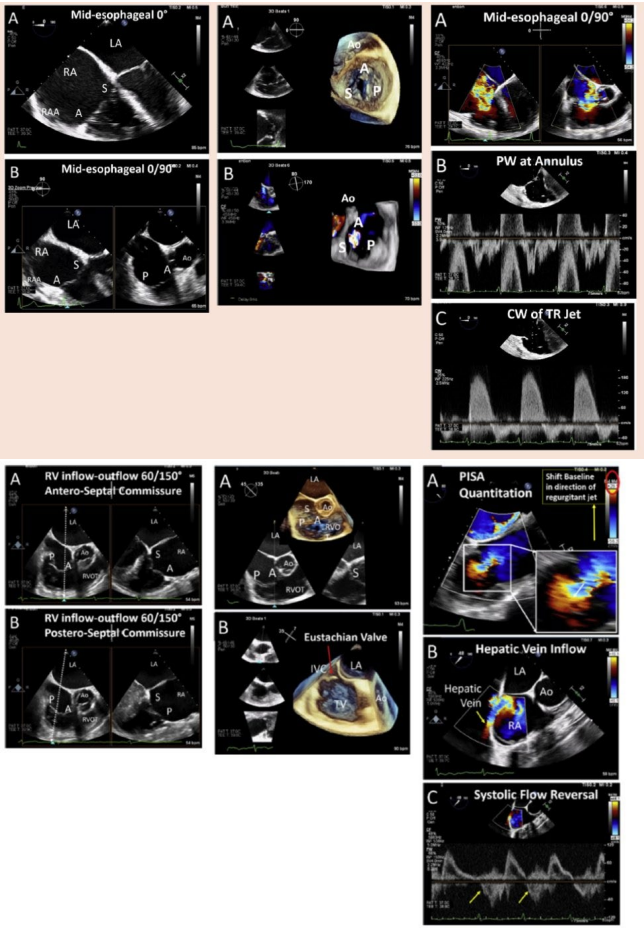
https://twitter.com/i/status/1488686623432736770

@AntonioBarros_: DE imaging plane

“The TV is positioned immediately superior to the diaphragm and is therefore very close to the TEE probe in the DE as well as TG views. Thus, a new imaging level is required. These views have become integral to preprocedural assessment of the TV.”

@EGarciaSayan: Key Views for TV

- ME 4 chamber
- RV inflow-outflow at 60 (biplane, sweep, 3D)
- Distal esophageal view
- TG inflow-outflow and biplane, SAX view
- Deep TG, assess TR Vel, RVOT SVol



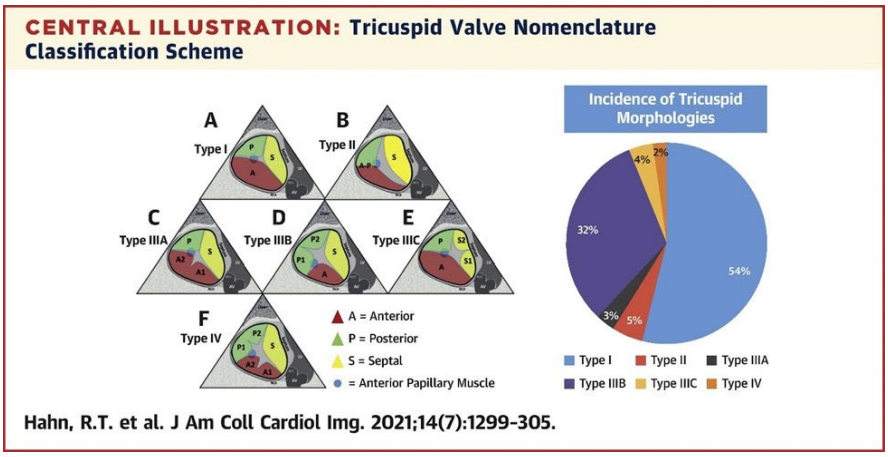
@EGarciaSayan: RV inflow-outflow can be used in many ways:

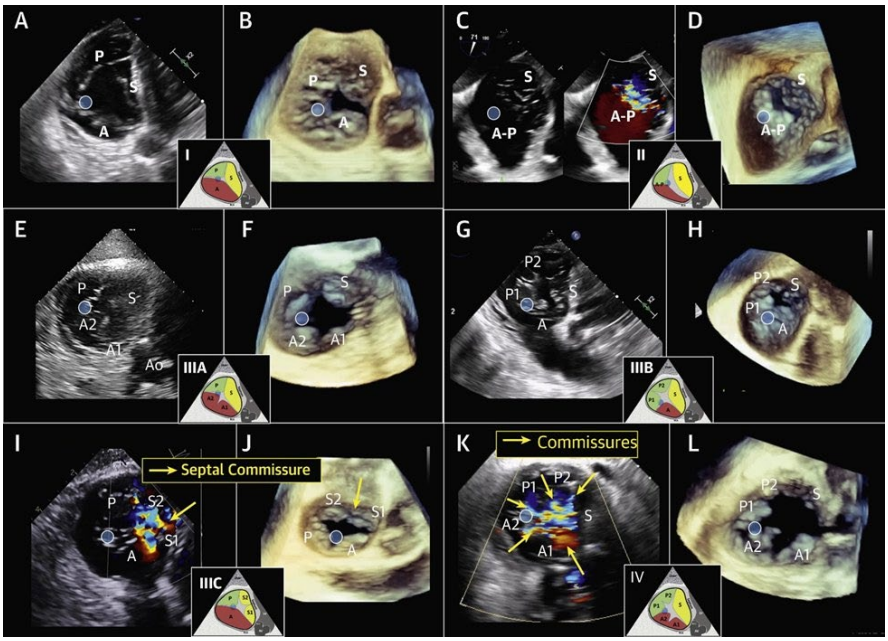
- Assess multiple scallops, biplane, sweep
- Close to aorta: Ant-Sept
- Away from aorta: Post-Sept
- 3D acquisition for MPR

https://twitter.com/i/status/1488688008421326849

@EGarciaSayan:

- TG 2D short axis of tricuspid valve can be key to identify leaflet morphology and number
- If having difficulty, can use biplane imaging from RV inflow-outflow view
- Remember that only ~50% are trileaflet: https://bit.ly/3GlXSef





Q7: What are the methods for quantifying the severity of TR by TEE?

A7 Notable Response:

@hahn_rt: Guidelines quantify using PISA and 3D vena contracta area. Note irregular shape of EROA and underestimation of PISA by 30-40% compared to 3D VCA--need for other methods like quantitative Doppler.

https://twitter.com/i/status/1488688740406947840

@EGarciaSayan: TR quantitation:

- PISA (baseline shift 25-35) - may underestimate
- 2D VC and 3D VCA (integrate over systole - higher cutoffs)
- Doppler Volumetric Method
- Consider using expanded grading: https://bit.ly/3ohiSN8

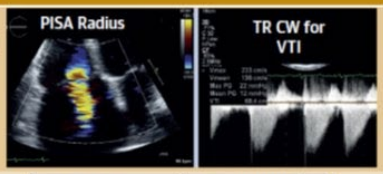
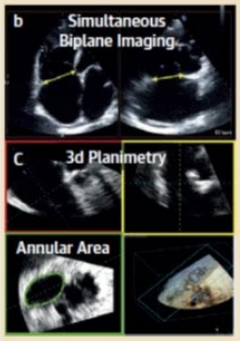
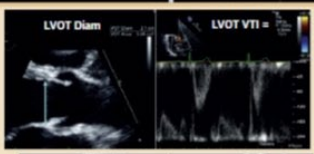
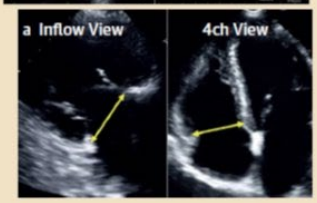
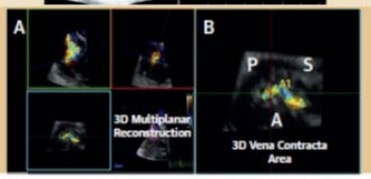
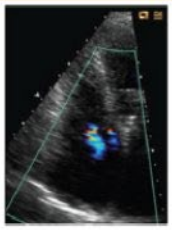
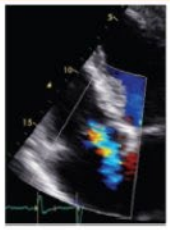
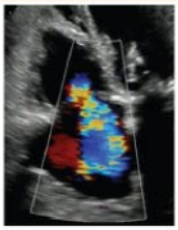
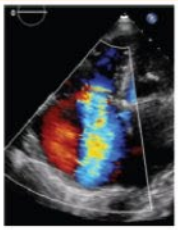
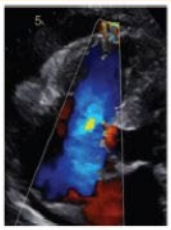
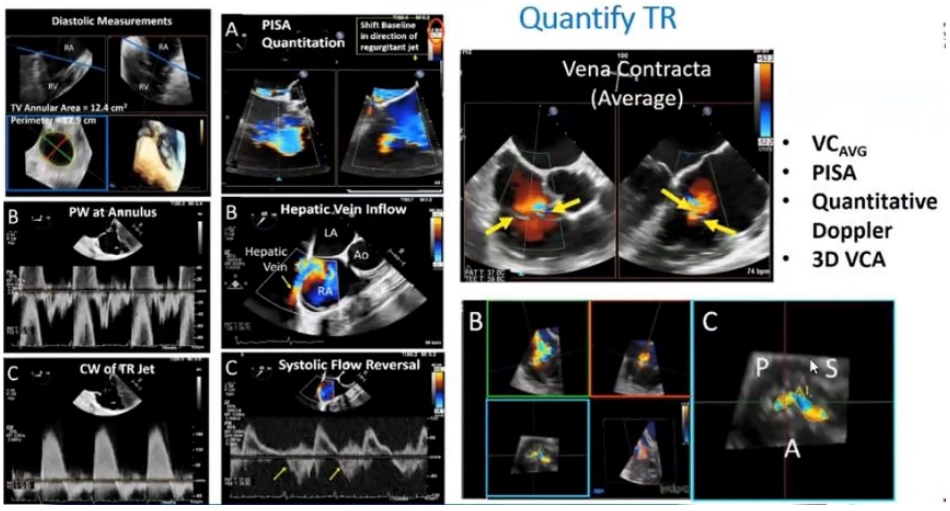
Quantitation Method	Measurements Required	Example	Calculation
PISA	1. PISA radius [r] 2. PISA aliasing velocity [v_a] (approximately 28 cm/s) 3. TR peak velocity [V_{max}] 4. TR velocity time integral [TR_{VTI}]		$Q = 2\pi r^2 v_a$ $ROA = Q/V_{max}$ $RegVol = ROA \times TR_{VTI}$
Quantitative Doppler 	1. LVOT Stroke Volume • LVOT diameter • LVOT PW 2. Diastolic $TV_{annulus}$ Area a. Option 1: Inflow and 4Ch TV annular diameters b. Option 2: simultaneous multiplane imaging aligned with the central orifice c. Option 3: Direct Planimetry of the 3D annular area (green circle) 3. TV velocity time integral [TV_{VTI}] • PW Doppler sample volume at the annulus	  	Forward Stroke Volume: -$LVOT_{annulus}$ Area x $LVOT_{VTI}$ Diastolic Stroke Volume = $TV_{annulus}$ Area x TV_{VTI} RegVol = Diastolic Stroke Volume – Forward Stroke Volume $ROA = RegVol \div TR_{VTI}$ Note: Forward stroke volume may be either the left ventricular or right ventricular stroke volume
3D Color Doppler	1. 3D color Doppler volume planimetry of the vena contracta area (VCA) 2. TR velocity time integral [TR_{VTI}]		$ROA = VCA$ $RegVol = VCA \times TR_{VTI}$

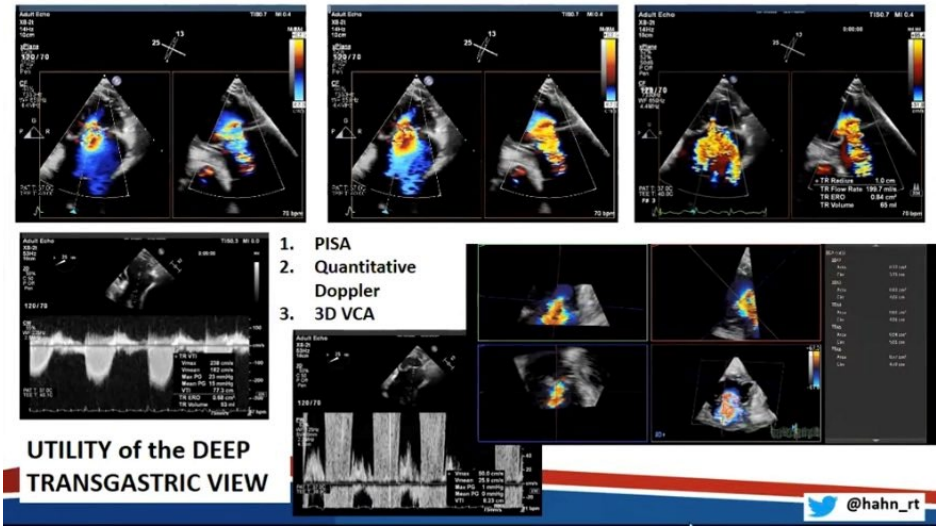
FIGURE 9 Proposed New Grading Scheme

Parameters	MILD	MODERATE	SEVERE	MASSIVE	TORRENTIAL
Vena Contracta width (biplane average)	<3 mm	3-6.9 mm	7 mm - 13 mm	14-20 mm	≥21 mm
EROA by PISA	<20 mm^2	20-39 mm^2	40-59 mm^2	60-79 mm^2	≥80 mm^2
3D Vena Contracta Area or Quantitative Doppler EROA	-	-	75-94 mm^2	95-114 mm^2	≥115 mm^2
Example:					

Given the late presentation of patients with functional TR, a new grading scheme has recently been proposed which extends the severity scale for TR to "massive" and "torrential." Because of the crescent shape of the TR orifice, the vena contracta width is the average of 2 orthogonal views. The PISA method calculation of EROA may be smaller than the EROA by either 3D planimetry of the vena contracta area or by quantitative Doppler calculations. Note that in the last example, there is low velocity laminar flow in the setting of rapid equilibration of flow. Reprinted with permission from Hahn et al. (34). Abbreviations as in Figure 1.

@iamritu: Quantitate with all the tools in the toolbox! Pisa EROA is prognostic despite its shortcomings #ASEchoJC don't just rely on color doppler (in euro only used as a Y/N TR assessment) VC widths averaged from orthogonal views have higher >= 9mm for severe than current guidelines





@EGarciaSayan: For TR assessment and quantification, don't forget that the hepatic veins CAN be assessed with TEE

https://twitter.com/i/status/1488689384006340612

Q8: What are the key views for assessment of the LAA prior to percutaneous LAAO?

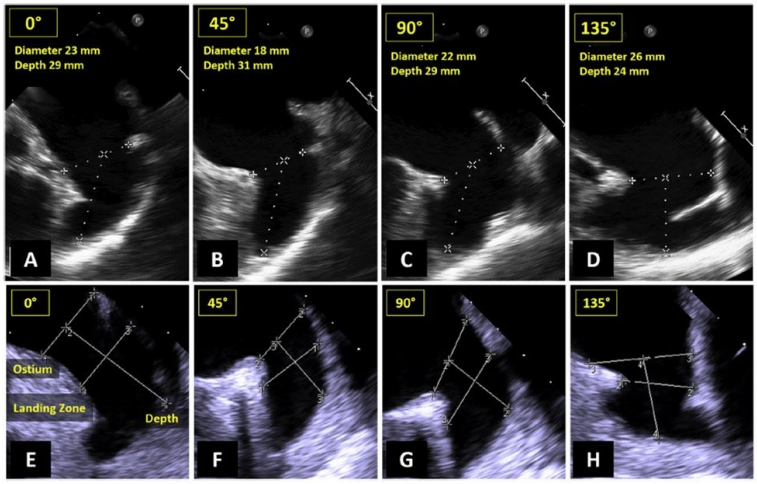
A8 Notable Responses:

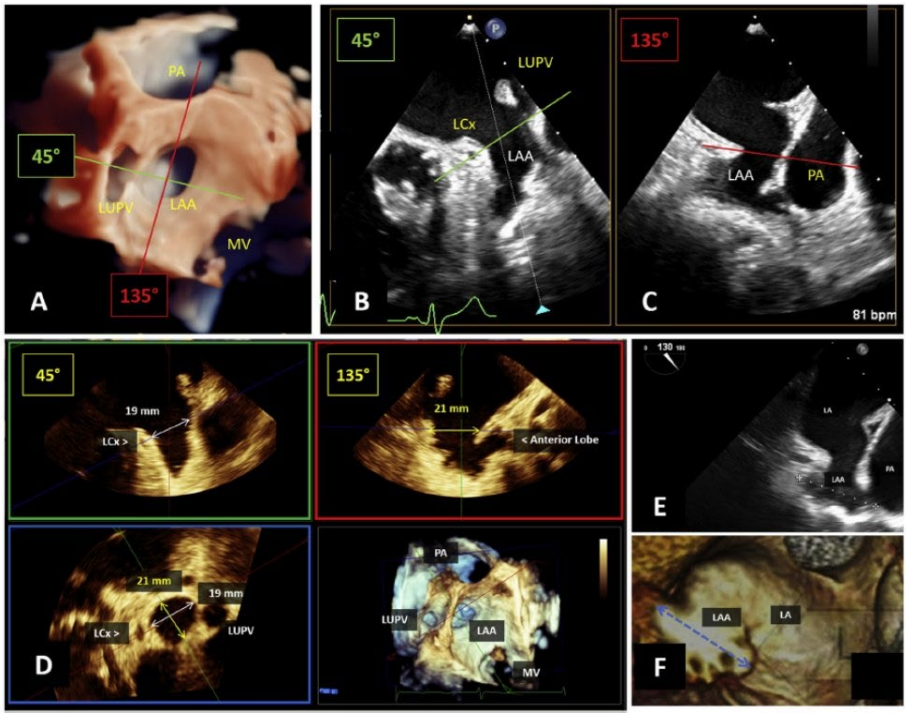
@hahn_rt: Center image w/ LAX of LAA in sector: Advance to the "lower" esophageal view and Ante Flex! Once there, use 3D biplane and/or mechanical rotation to image all angles of the LAA.

https://twitter.com/i/status/1488690872409477122

@EGarciaSayan: Key LAA Views:

- 2D at 0, 45, 90, 135
- 3D MPR - blue plane at landing zone
- Know where landing zone should be measured for each specific device
- Remember to exclude LAA thrombus & assess septum





@EGarciaSayan: Furthermore, here's a brief tweetorial on views and measurements of the LAA prior to LAAO procedures. Must understand LAA anatomical relationships. 3D MPR can be extremely helpful and may yield more accurate measurements.

https://twitter.com/i/status/1488690427809214467

@edwardagill: 3D MPR images are critically important for LAA os measurement correlation with CT. The newest LAA occluder technology has really decreased the procedure time

Q9: What are the rims that need to be assessed prior to ASD closure? What views do we use to measure them?

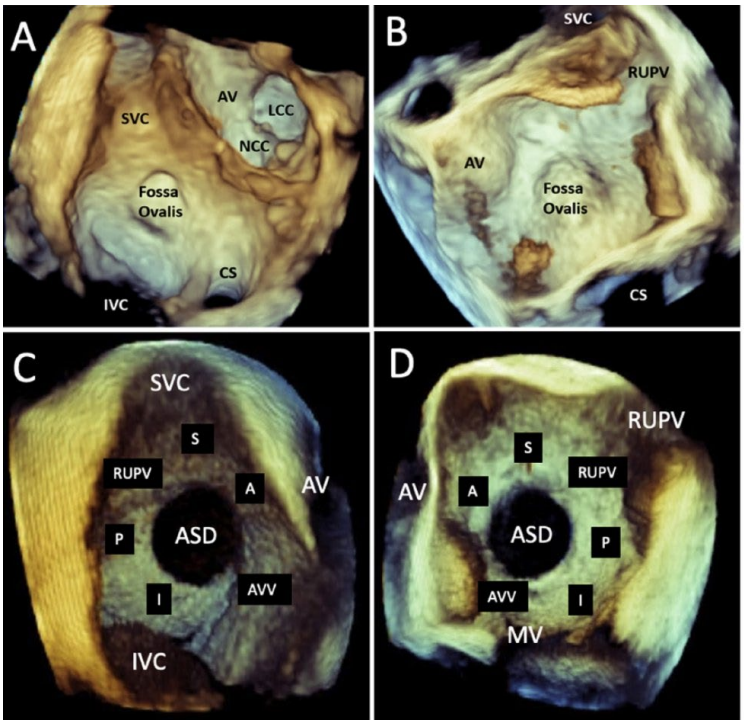
A9 Notable Responses:

@hahn_rt: All the rims surrounding the secundum ASD should be imaged: lacking the inferior rim or more than two other rims may require surgical closure.

https://twitter.com/i/status/1488692947218403332

@EGarciaSayan: ASD rims & views:

- SAX: aortic and posterior
- Bicaval: IVC and SVC
- 4 chamber: AV valve and posterior
- Use 3D imaging
- Remember to rule out assoc lesions / anomalous PVeins ASE guidelines: https://bit.ly/34eOnjM



@LilyLeiZhang1: There are a lot of rims Smiling face with open mouth and cold sweat. Aortic, RUPV, superior, inferior, posterior, CS

Q10: What parameters need to be assessed in a patent foramen ovale?

A10 Notable Responses:

@hahn_rt: What to measure for PFO: Location/Thickness septum secundum/Length of PFO tunnel/Size at RA and LA ends/Presence of an ASA/Presence septal fenestrations or defects.

https://twitter.com/i/status/1488693138197680130

@EGarciaSayan: PFO evaluation:

- PFO tunnel length
- PFO size at RA and LA
- Septum length
- Distance to venae cavae
- Absence of additional ASD or anomalous PVeins

Table 8 Essential components of atrial septal evaluation

ASD	PFO	Site of transseptal puncture
ASD type	PFO tunnel length	Secundum septal thickness
ASD size (maximal and minimal diameters) during end-systole and end-diastole	Maximal size at right atrial end	Presence of PFO or ASD
ASD location within the septum	Maximal size at left atrial end	Three-dimensional en face view of MV to identify commissural line and medial commissure
Measurement of all rims	Total length of atrial septum	
ASD shape	Distance from PFO to venae cavae	
Exclude pulmonary arterial hypertension	Right-to-left shunting by color Doppler or agitated saline contrast injection	
Exclude anomalous pulmonary venous connections	Exclude anomalous pulmonary venous connections	
Presence of multiple fenestrations or additional ASDs	Presence of additional ASDs	

For all three categories (ASD, PFO, and transseptal puncture), the following should also be evaluated: presence or absence of atrial septal aneurysm and associated findings (Eustachian valve or Chiari network).

@LilyLeiZhang1: Tunnel length >8-10mm, septal separation >2mm , aneurysmal >15mm max are considered higher risk for crypto stroke

@iamritu: PFO risk score for

cryptogenic stroke(🆘if score ≥2)

each worth 1 pt:

🆘large-size PFO ≥2 mm

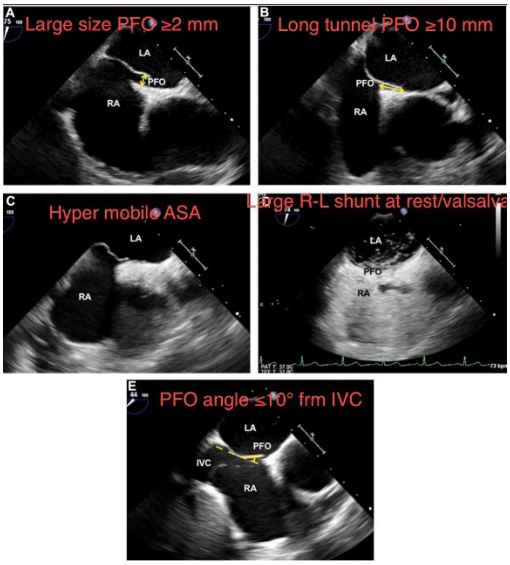
🆘long-tunnel PFO ≥10 mm ASA

🆘hypermobile ASA

🆘prominent eustachian valve/Chiari's network

🆘large R-L shunt at rest/Valsalva

🆘PFO ≤10° frm IVC #ASEchoJC https://bit.ly/3Hm1RJ3



@evandrofilhobr: Not all PFOs are made the same!