

## Aortic Valve, do we need 3D?



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## Benefits of 3DE in VHD

- ✓ Superior in understanding complex spatial geometry of the valves and subvalvular apparatus
- ✓ Detailed en-face visualization of valve structures
- ✓ Provides accurate quantitative data

**HOW CAN 3D HELP US WITH THE AORTIC VALVE?**

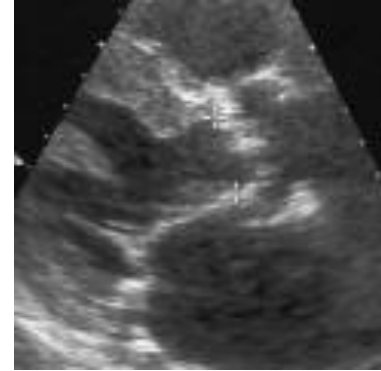


# AORTIC STENOSIS

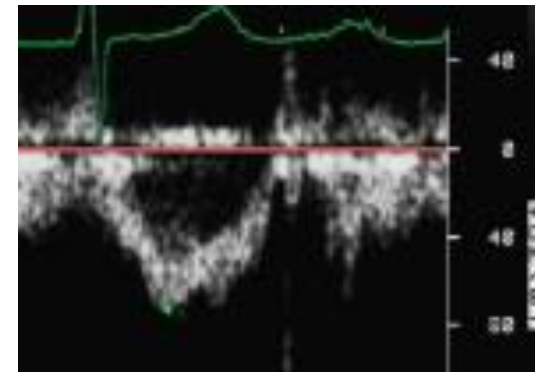
# Aortic Stenosis

## Sources of error with 2D

- ✓ **LVOT diameter**
- ✓ Poor acoustic window
- ✓ LVOT elliptical
- ✓ Oblique measurement



- ✓ **LVOT velocity**
- ✓ Too far from the valve
- ✓ Doppler beam not well aligned
- ✓ Subvalvular flow acceleration





# Aortic Stenosis

## Sources of error with 2D

- ✓ CW Doppler beam not well aligned
- ✓ Eccentric stenotic jets
- ✓ Inaccurate measurements for 2D AVA planimetry



# Aortic Stenosis

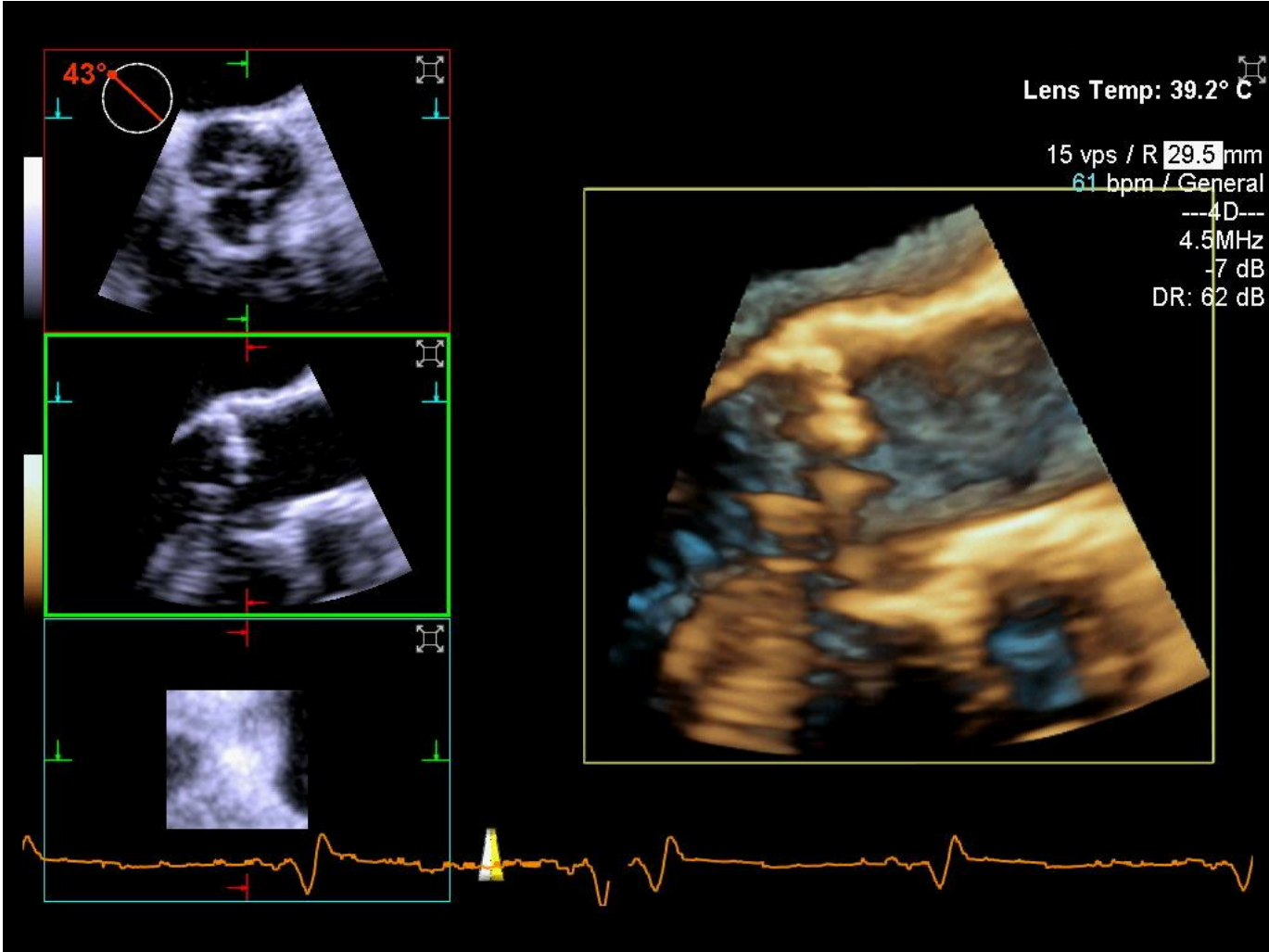
## CASE

- 75 yo man with history of calcific AS
- Controlled hypertension
- Dyspnea on exertion
- **TTE:**
  - BSA 1.8 cm<sup>2</sup>
  - LVEF 60%
  - Calcified aortic valve
  - Peak/mean gradient **52/30 mmHg**
  - **AVA 0.7 cm<sup>2</sup>**

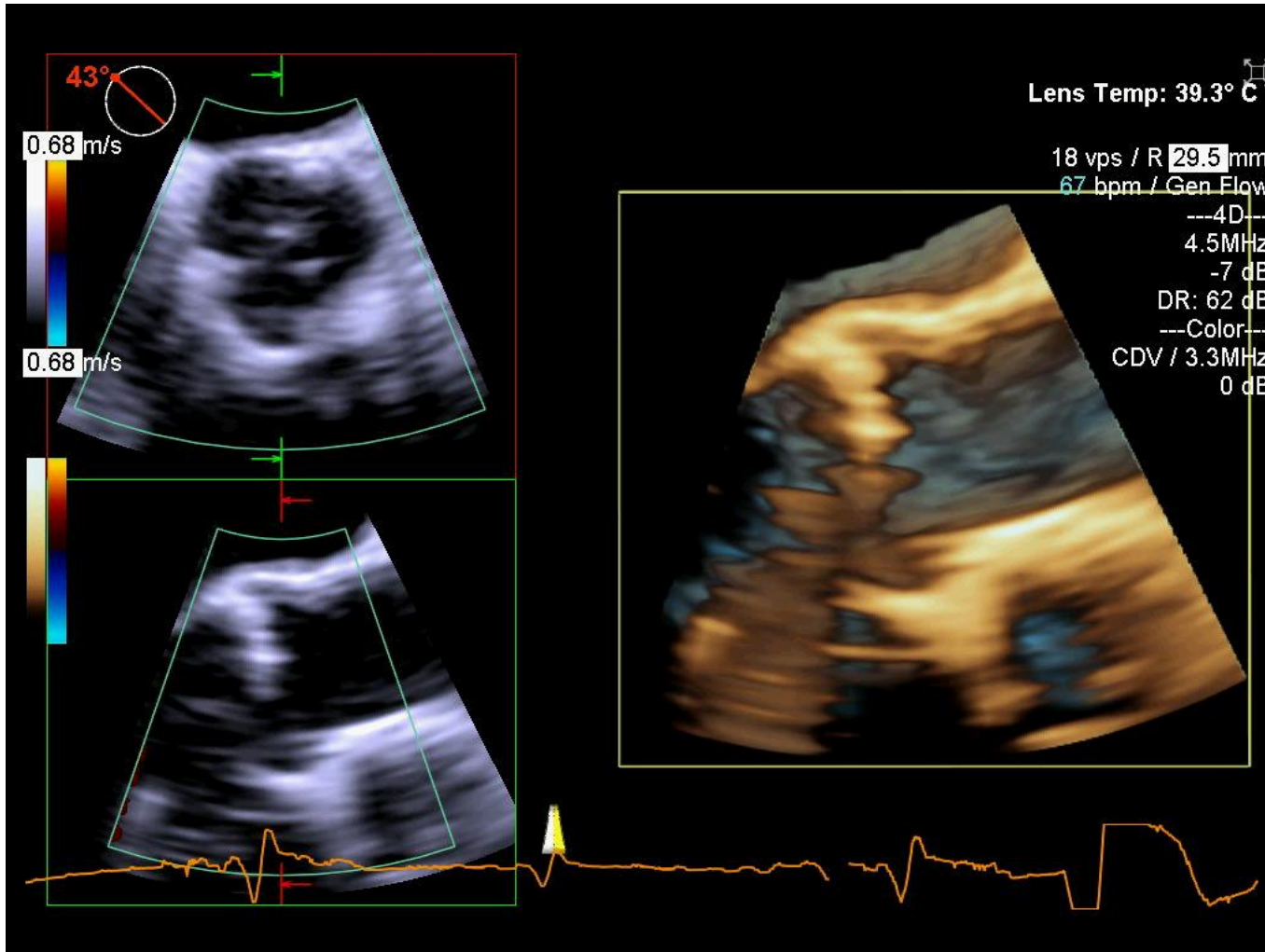




# Aortic Stenosis

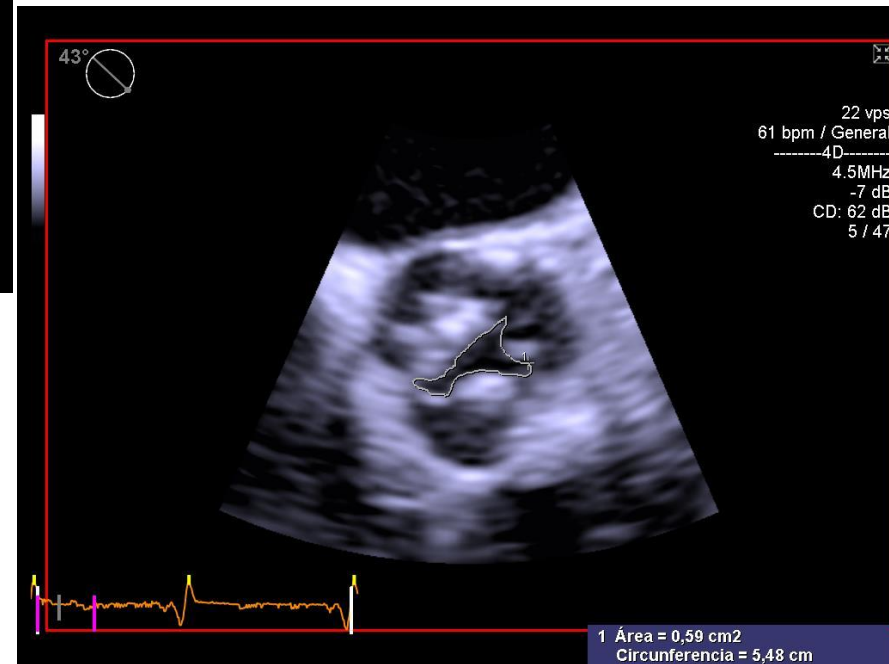
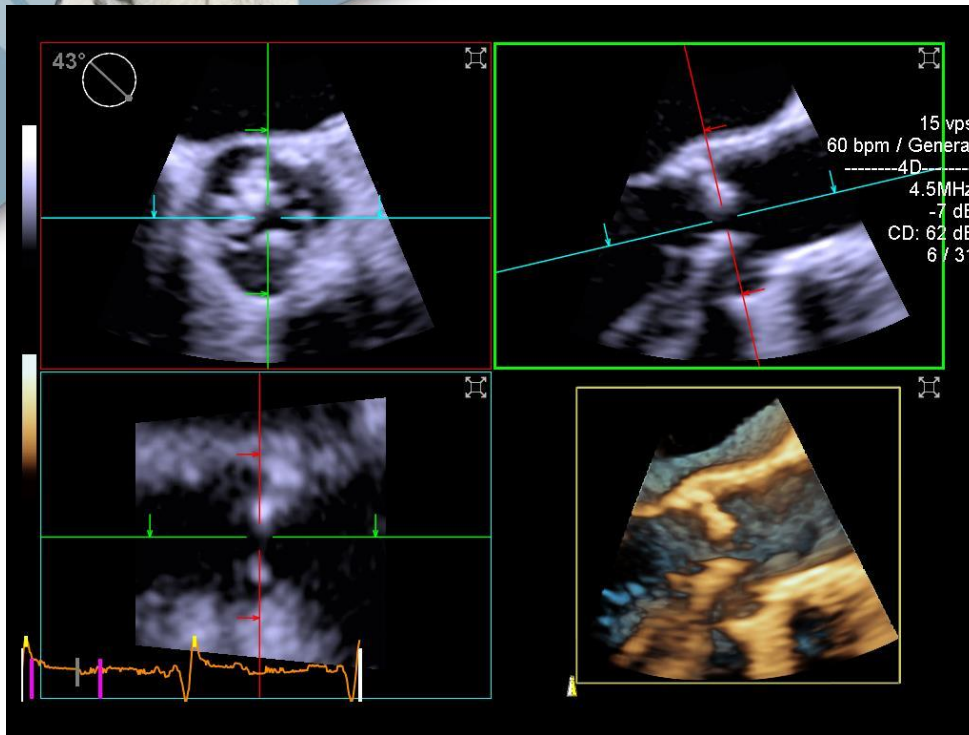


# Aortic Stenosis





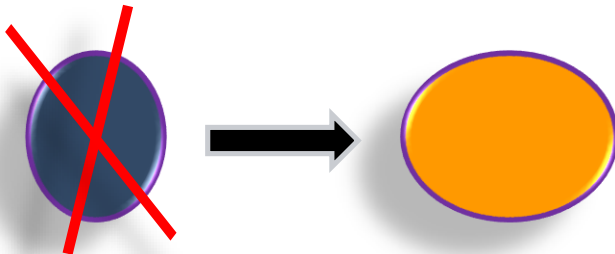
# Aortic Stenosis





# Aortic Stenosis

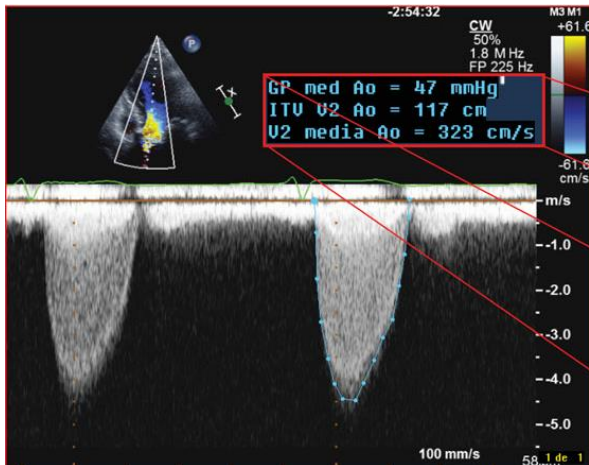
- ✓ 3DE imaging improves the accuracy of the quantification of aortic stenosis.
- ✓ Planimetry of the AV with RT3DE images showed good agreement with the standard 2D TEE technique, flow-derived methods, and cardiac catheterization data with the advantage of improved reproducibility.
- ✓ Analysis of 3DE revealed that in half of the subjects, the LV outflow tract cross section is not round but rather elliptical.



# Aortic Stenosis

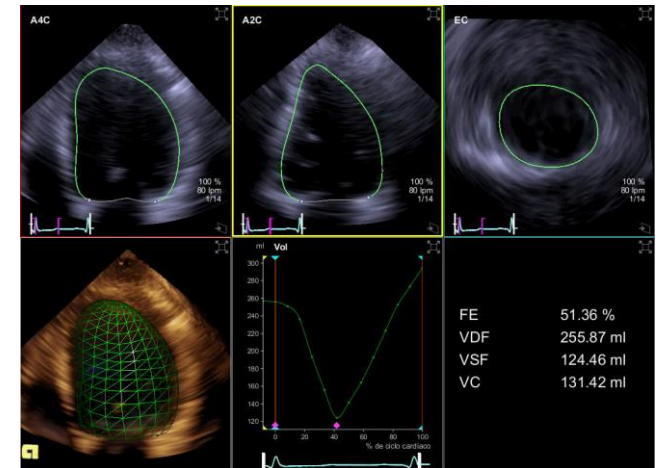
## AVA 3D-TTE SV

- ✓ Substitute the Doppler derived SV by SV directly obtained with RT3D
- ✓ Avoids LVOT measurement errors
- ✓ RT3D is more accurate than CE and than 2D volumetric methods to calculate area and to grade the severity of AS



$$\text{Aortic area} = \frac{SV_{3D}}{TVI_{Ao}}$$

GP med Ao = 47 mmHg  
 ITU V2 Ao = 117 cm  
 V2 media Ao = 323 cm/s





# Aortic Stenosis Severity assessment

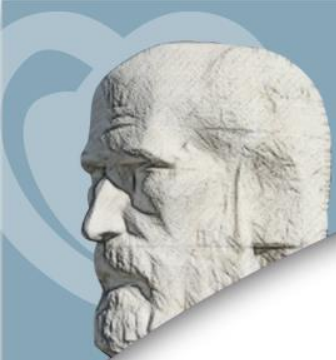
## Added value of 3D

- ✓ AVA planimetry
- ✓ LVOT tracing without geometrical assumptions
- ✓ AVA 3D-TTE SV avoids LVOT measurement errors



# TAVI



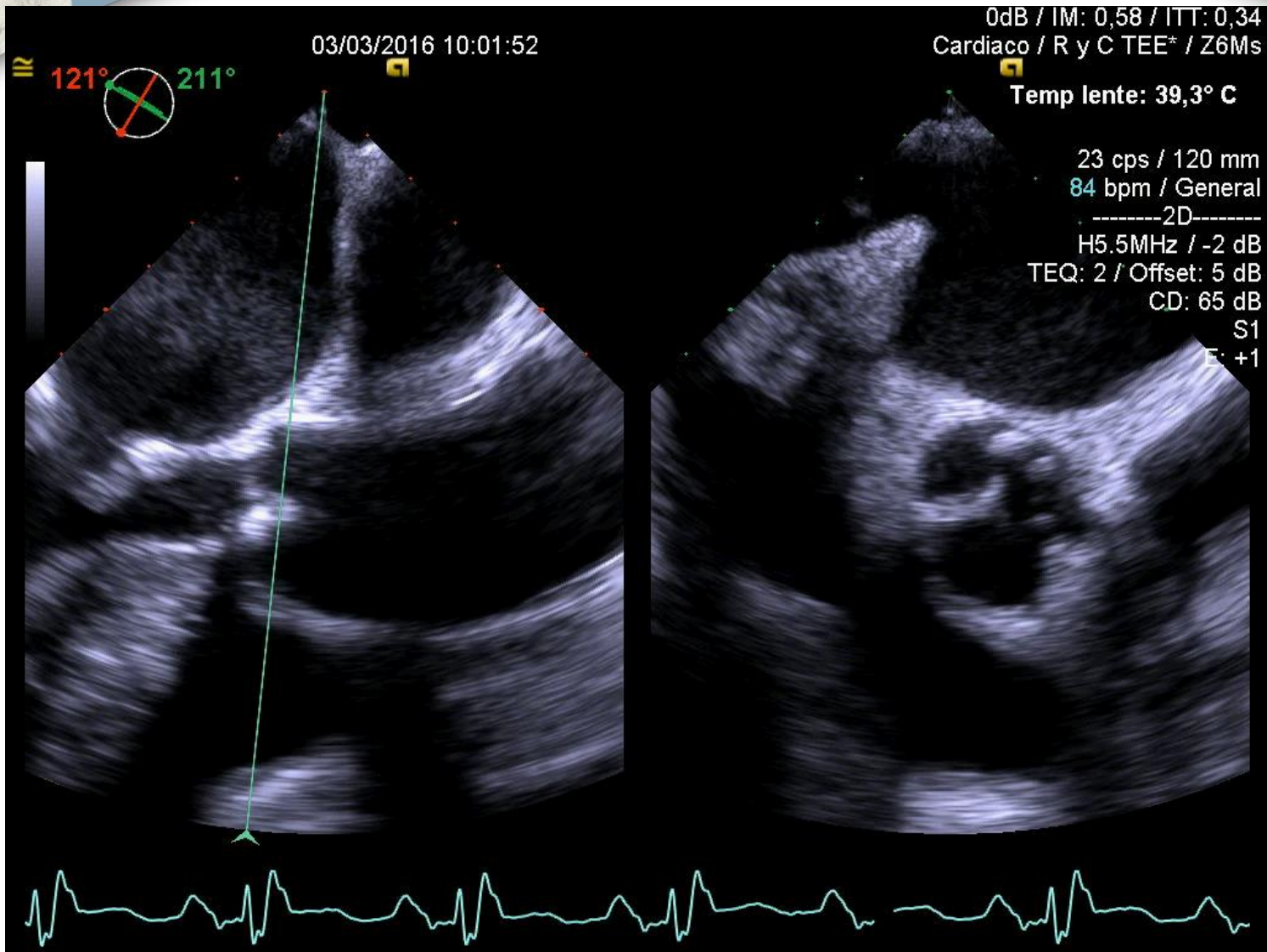


# TAVI

## CASE 2

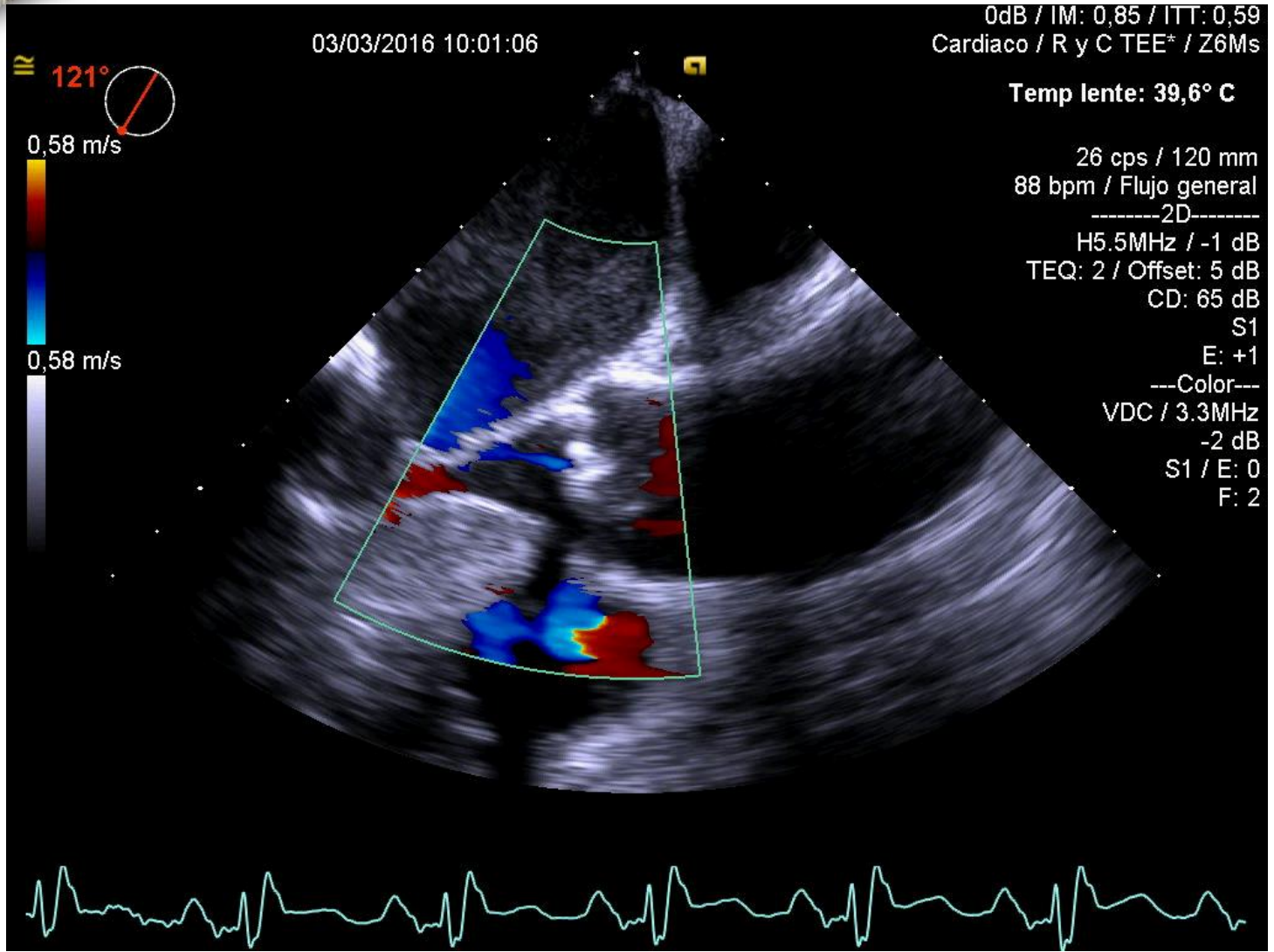
- 85 yo female with history of calcific severe AS
- Mild hypertension
- Chronic kidney disease
- Severe COPD
- NYHA III
- Accepted for TAVI

# TAVI



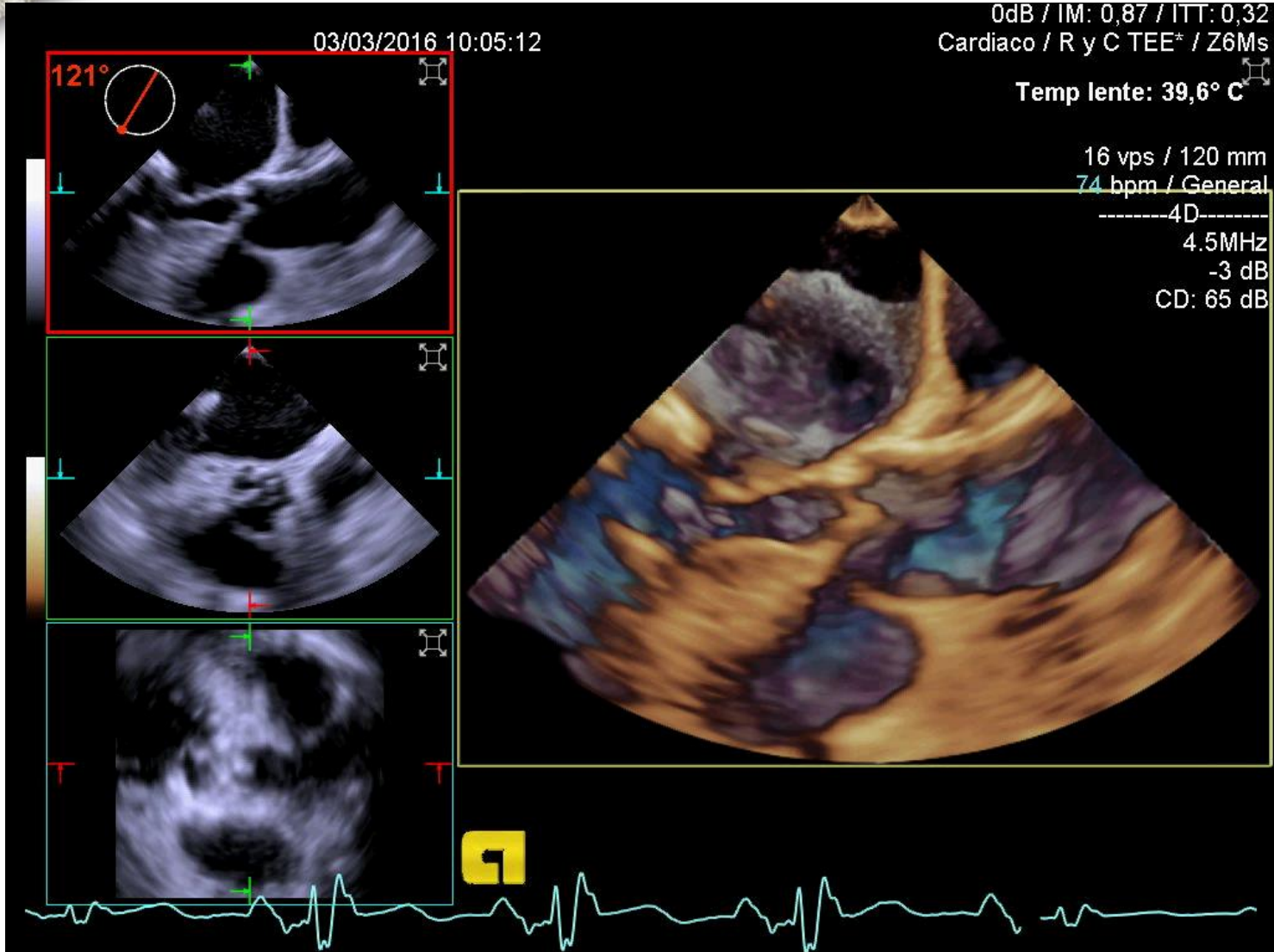


# TAVI

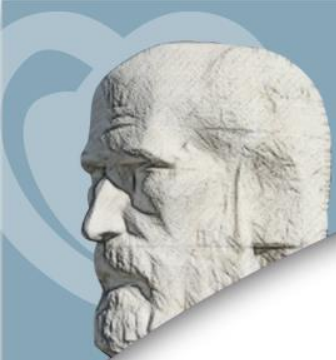




# TAVI

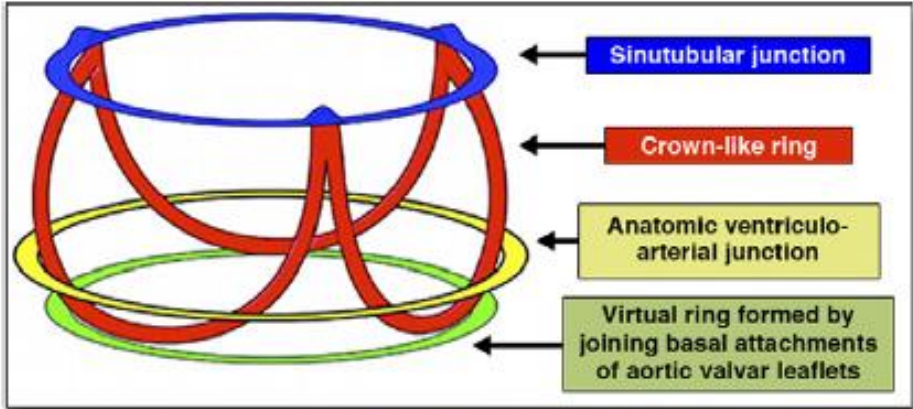




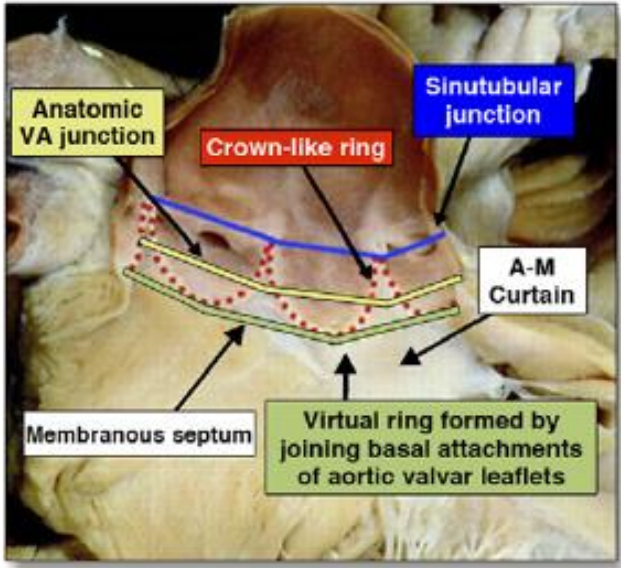


# TAVI

## Annular Sizing



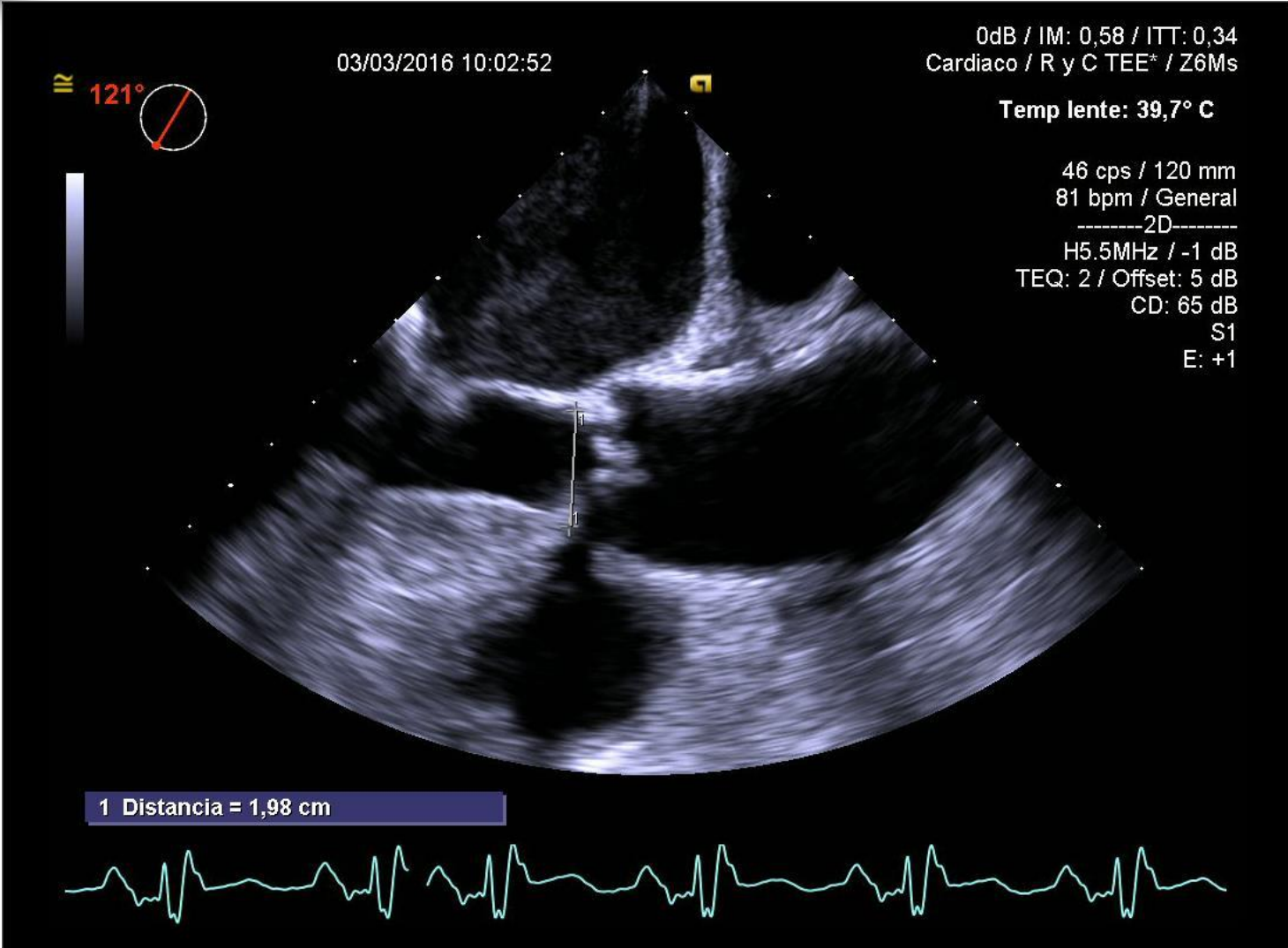
Correct annular sizing crucial for correct prosthesis selection and to minimize PVL.



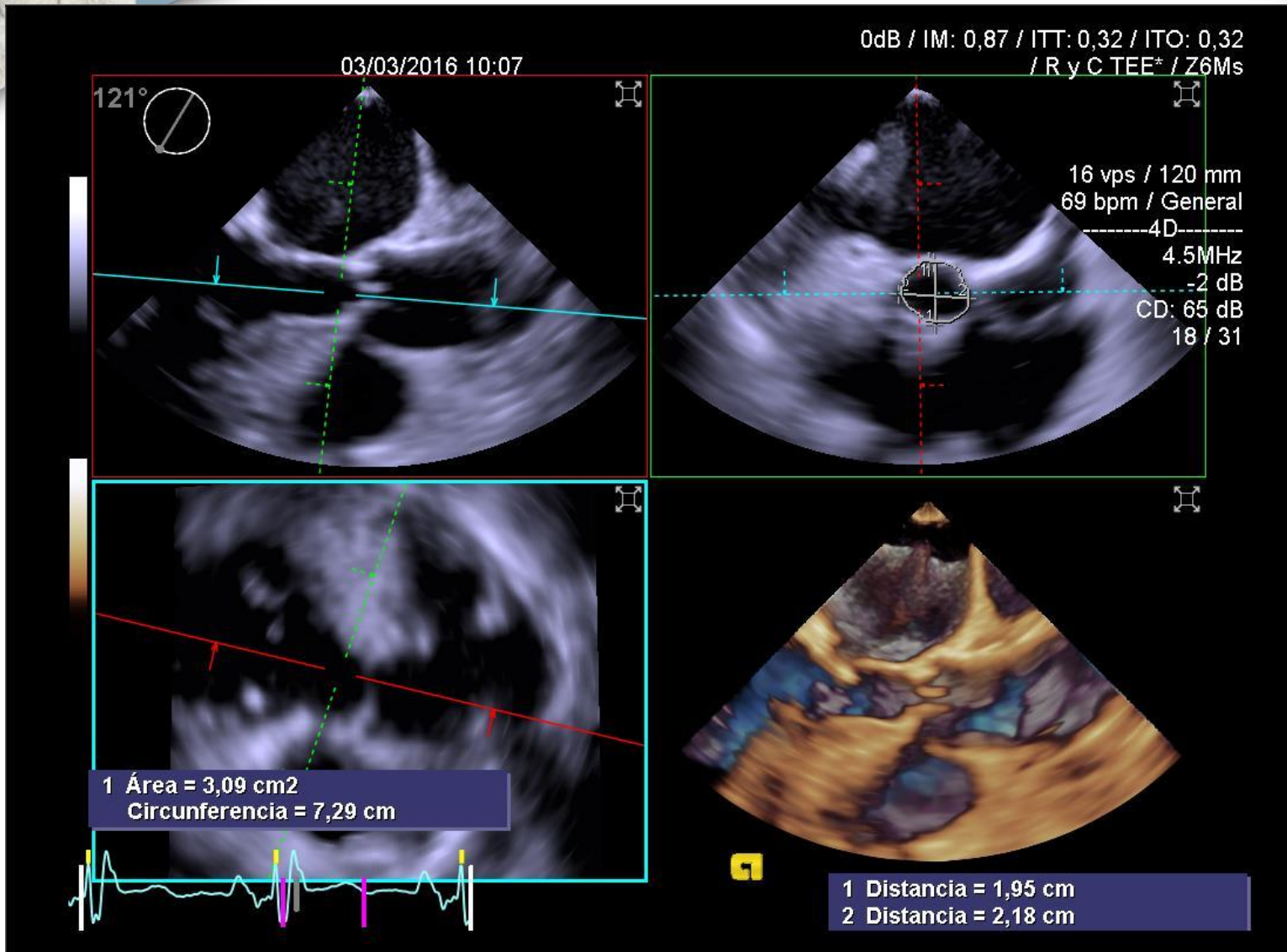




# TAVI



# TAVI

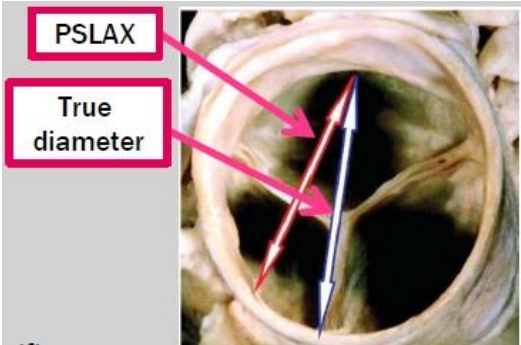




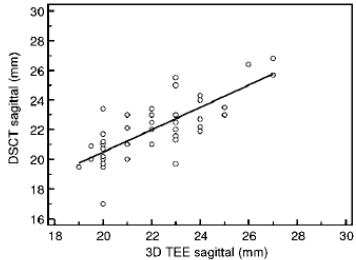
# TAVI

## Measuring the aortic annulus

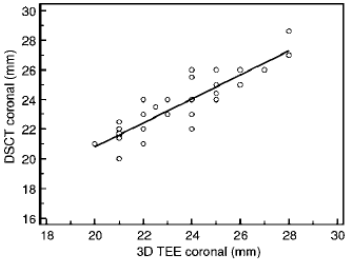
- ✓ 2D TEE underestimates AA
- ✓ 3D TEE provides dimensions similar to CT



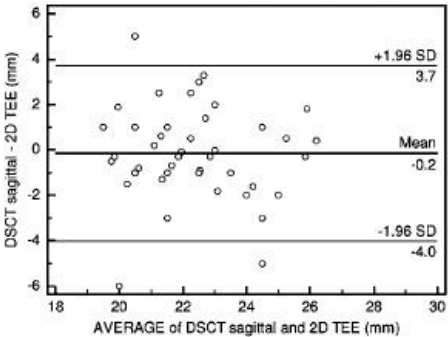
DSCT versus 3D TEE – sagittal view diameters



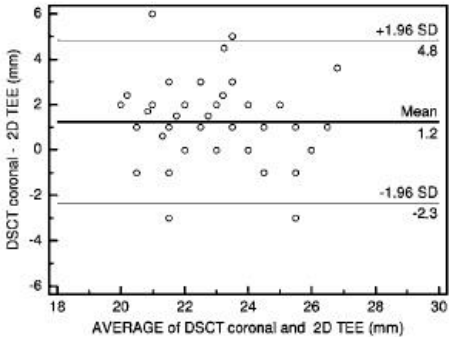
DSCT versus 3D TEE – coronal view diameters



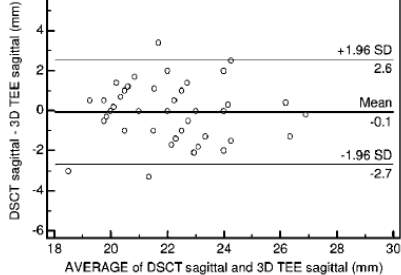
2D TEE versus sagittal view DSCT



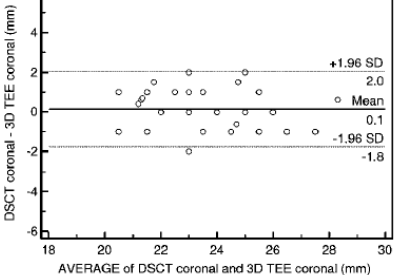
2D TEE versus coronal view DSCT



DSCT sagittal - 3D TEE sagittal (mm)



DSCT coronal - 3D TEE coronal (mm)





# TAVI

## eSieValve

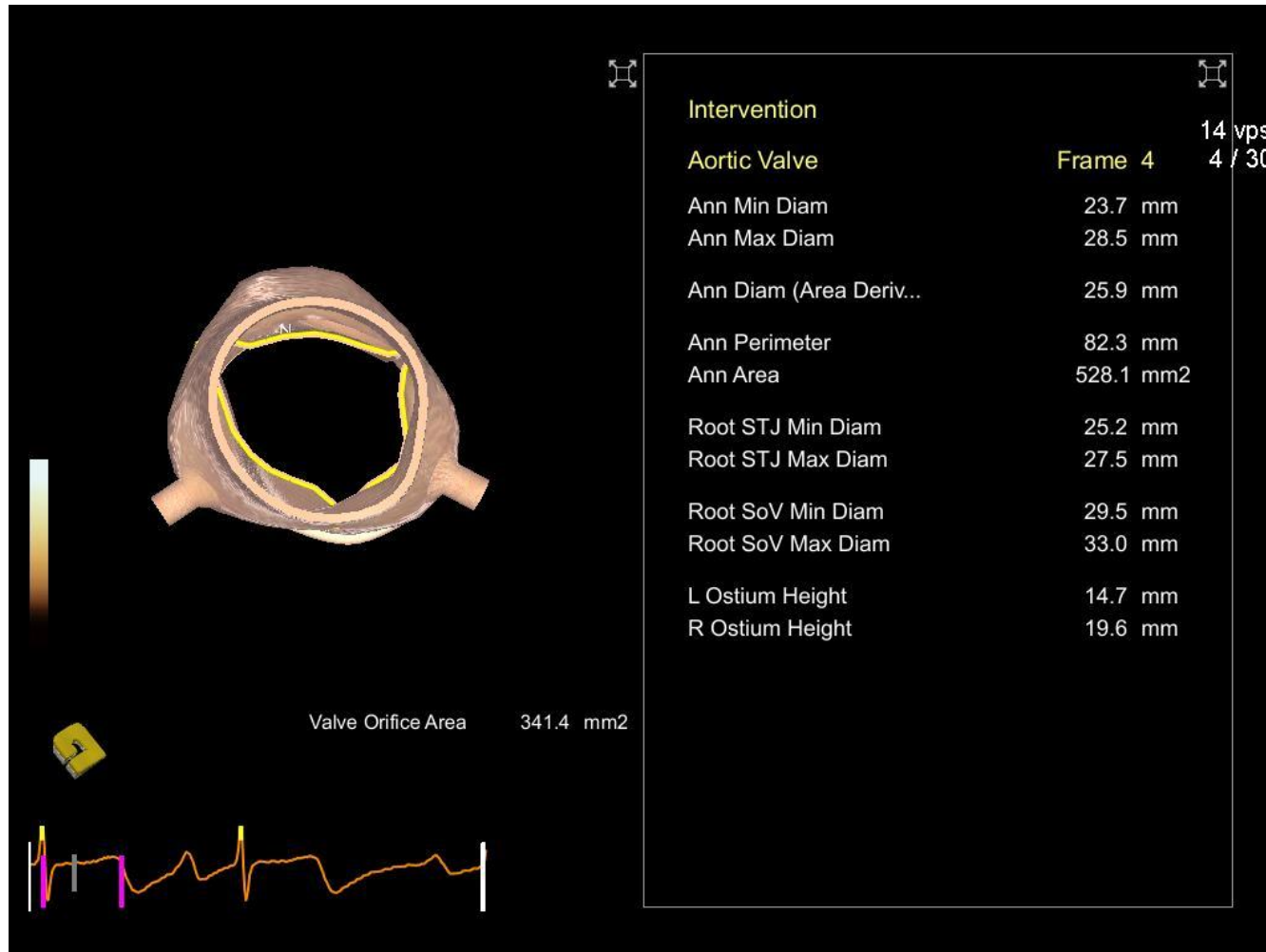
The screenshot displays the eSieValve software interface for TAVI. The main window is divided into several sections:

- Top Left:** A control panel with a "Review Only" dropdown, "Volume" and "Volume Review" sections, and "4D" and "eSie Valves" options.
- Top Center:** A date and time stamp: "05/15/2014 8:47 AM".
- Top Right:** Technical parameters: "0dB / MI: 0.64 / TIS: 0.51 / TIB: 0.51 / TEE1\* / Z6Ms".
- Center:** Three vertically stacked echocardiographic views of the aortic valve. The top view shows a 65-degree angle. The middle view is labeled "G". The bottom view is labeled "G".
- Right:** A "Transcatheter" panel showing a grid of 12 small thumbnail images of the valve in different orientations.
- Bottom Center:** A large, detailed 3D reconstruction of the aortic valve, showing its complex, leaflet-like structure in shades of blue and yellow.
- Bottom Right:** Technical parameters for the 3D view: "17 vps", "63 bpm / General", "4D", "4.5MHz", "0 dB", "DR: 62 dB", "15".
- Bottom:** A "Movie Controls" bar with various icons for navigation and playback. Below it are "Box Edit: On / Off", "Slice", "D'art: On / Off", and "Reset Orientation" buttons.
- Bottom Right:** A "Total 142" indicator.



# TAVI

## eSieValve







# TAVI

## eSieValve

U4/15/2014 9:32 AM

26Ms

13 vps  
21

0.68 m/s

0.68 m/s

Review Only

Review

Volume

Volume Review

eSie Valves

Dyn Range 65

4D Gain -4

Static

Dynamic

Track Beats 1

Analysis

Movie Controls

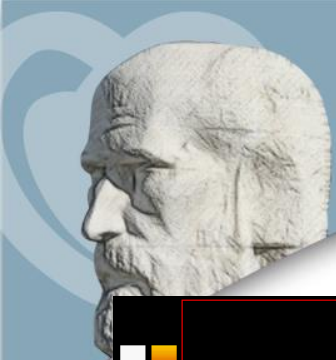
Slice

Reset Orientation

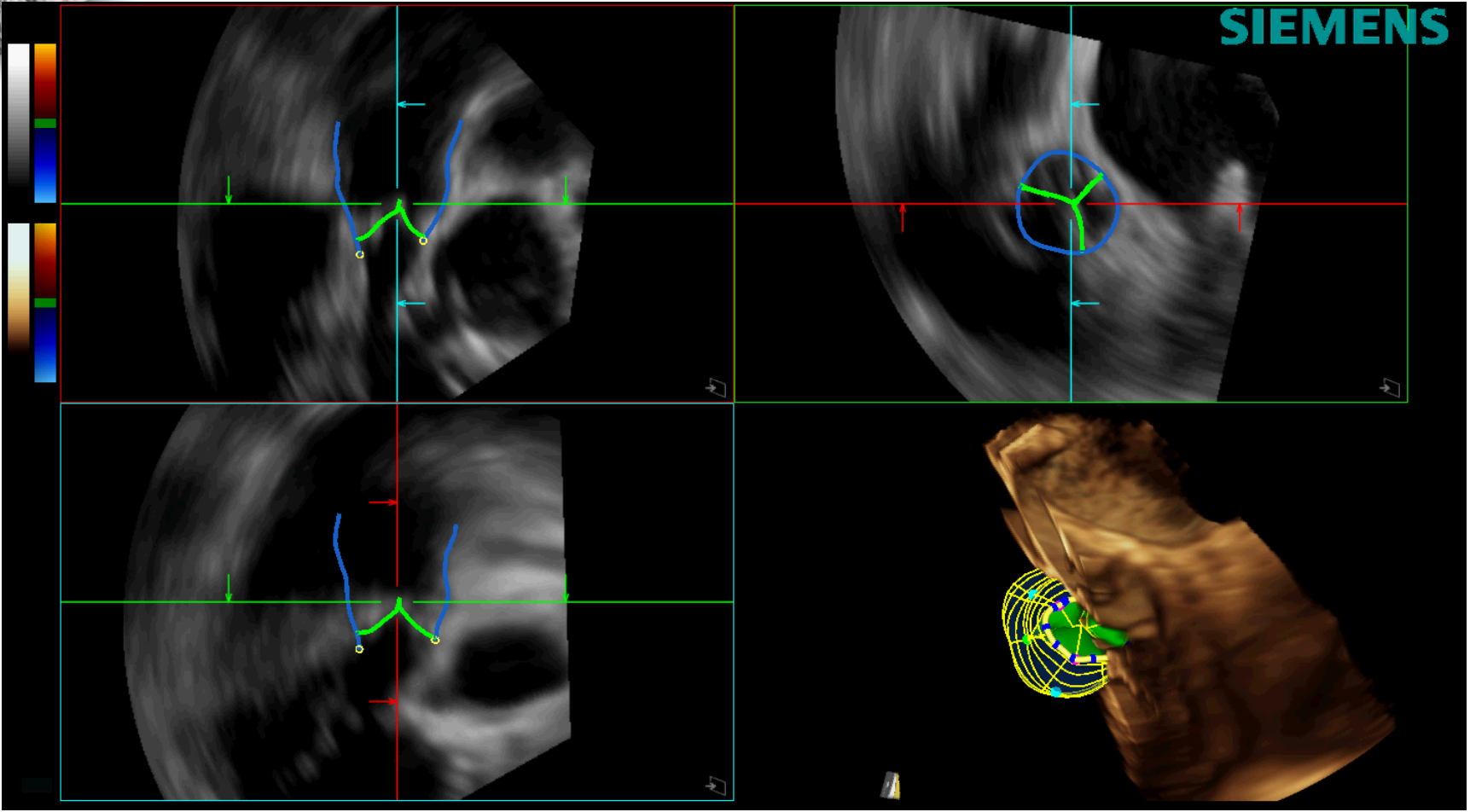
Function Step

1. Set ED frames to define R-Wave if Physio is not available
2. Select number of beats for tracking. (Max 3 beats allowed)
3. Use track controls to track Aortic or Mitral valve
4. Use edit button to activate Valve editing on MPR images
5. Select Layout option from the list box for editing
6. Edit Valve model using Left Mouse Down, Drag, Mouse Release operations
7. Select Analysis Step to view measurements

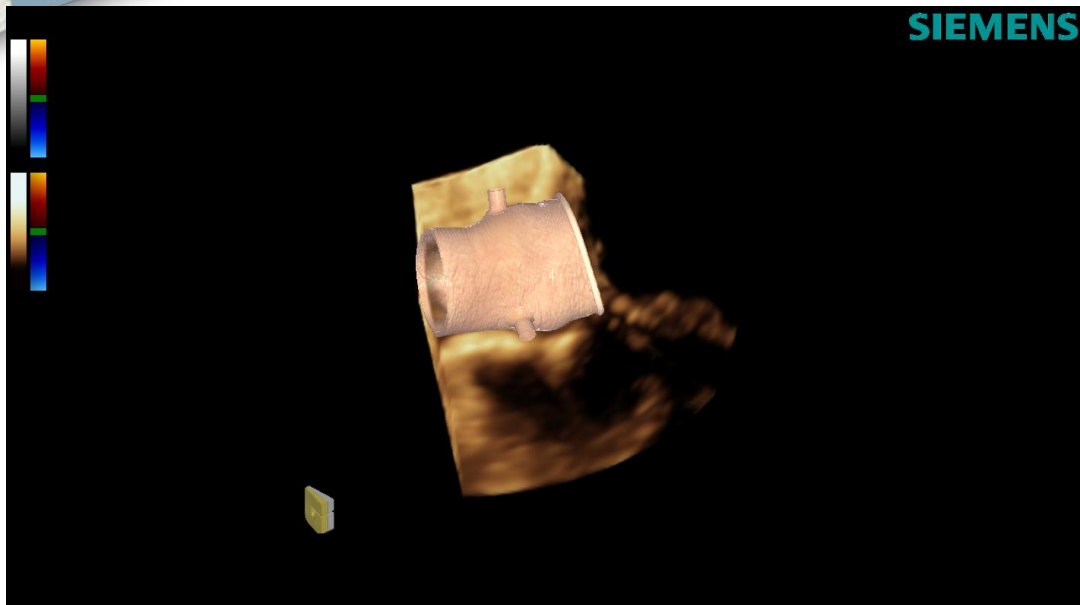
Activate Windows  
Go to PC settings to activate Windows.



# TAVI



# TAVI



Ann Min Diam	20 mm
Ann Max Diam	21.5 mm
Ann Perimeter	70.8 mm
Ann Area	310 mm <sup>2</sup>
L Ostium height	11 mm
R Ostium height	11.2 mm
AVA	0.6 cm <sup>2</sup>



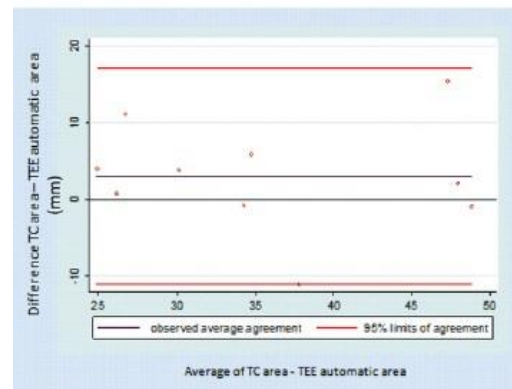
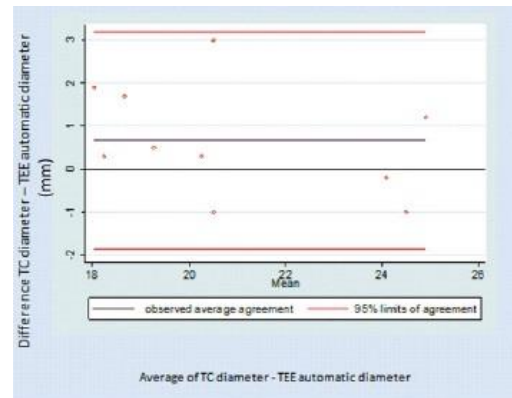
## Accuracy and reproducibility of novel echocardiographic three-dimensional automated software for the assessment of the aortic root in candidates for transcatheter aortic valve replacement

Ana García-Martín\*, Carla Lázaro-Rivera, Covadonga Fernández-Golfín, Luisa Salido-Tahoces, Jose-Luis Moya-Mur, Jose-Julio Jiménez-Nacher, Eduardo Casas-Rojo, Iolanda Aquila, Ariana González-Gómez, Rosana Hernández-Antolín, and José Luis Zamorano

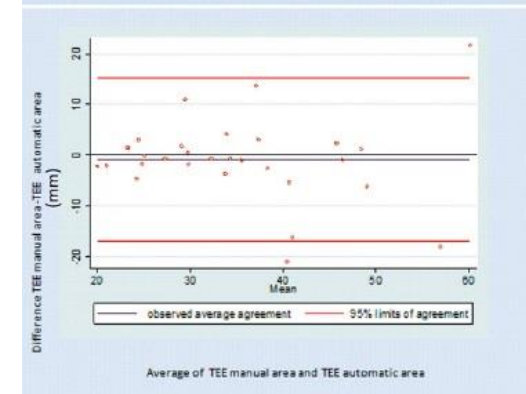
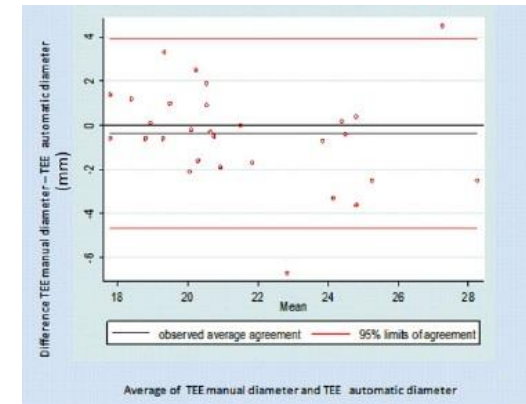
Department of Cardiology, Ramón y Cajal University Hospital, Ctra. Colmenar, km 9,100, Madrid 28034, Spain

## eSieValve

### vs CT



### vs Manual TEE





# TAVI

## eSieValve

- ✓ Accurate
- ✓ Reproducible
- ✓ Automatic
- ✓ Time saving
- ✓ Avoid contrast nephrotoxicity
- ✓ Useful in patients with atrial arrhythmias that make EKG gating in MDTC difficult.
- ✓ Attention to cumulative lifetime radiation in younger patients



# TAVI

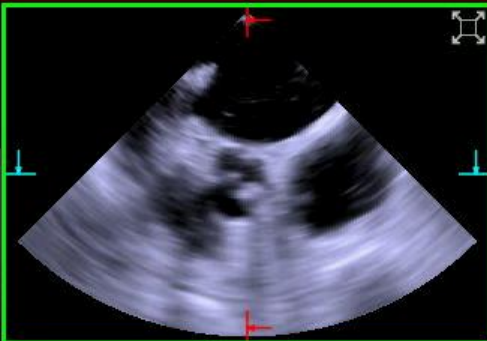
03/03/2016 10:34:34

0dB / IM: 0,93 / ITT: 0,32  
Cardiaco / R y C TEE\* / Z6Ms

Temp lente: 39,4° C

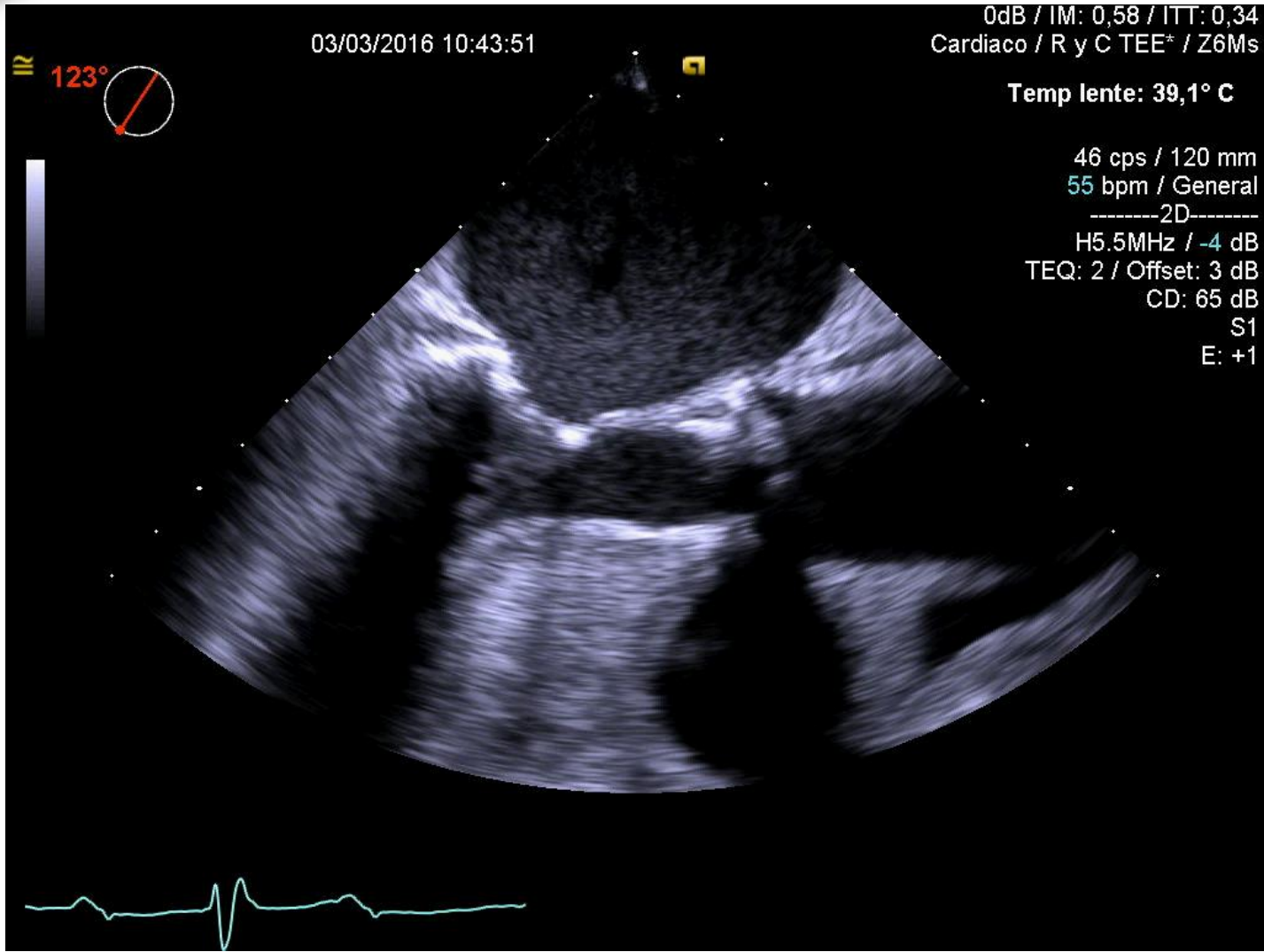
13 vps / 140 mm  
70 bpm / General

-----4D-----  
4.5MHz  
-1 dB  
CD: 65 dB





# TAVI





# AORTIC REGURGITATION



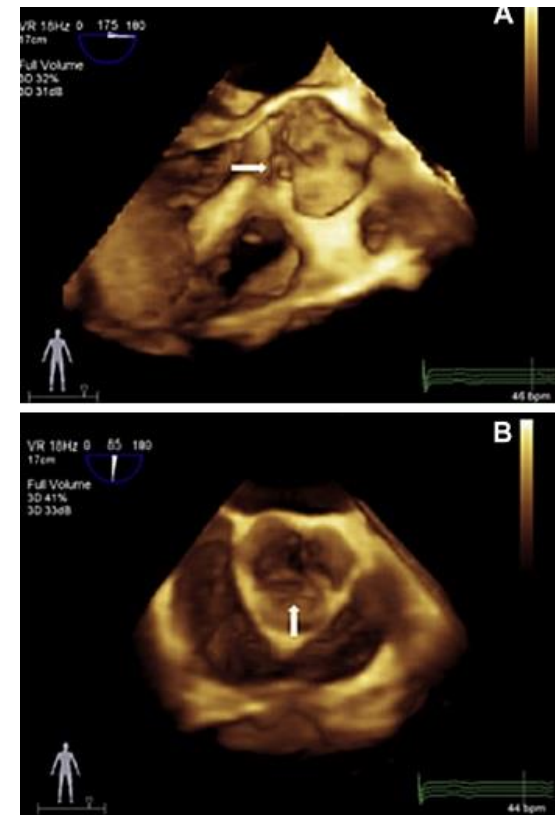
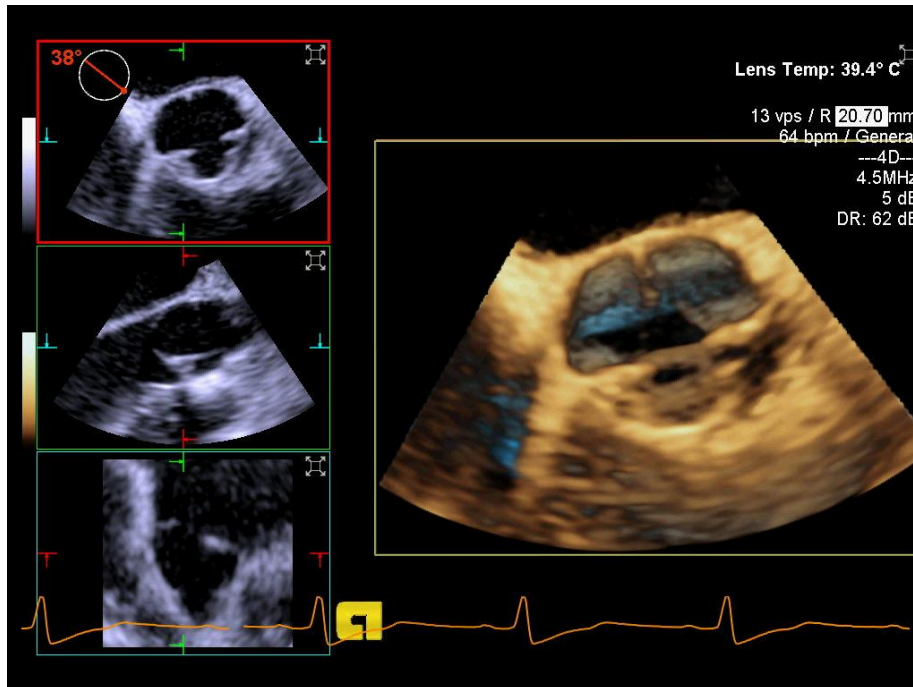
# Aortic Regurgitation

## Limitations of 2D

- ✓ **Evaluation of AV anatomy in detail**
- ✓ **Mechanism of AR sometimes unclear**
- ✓ **Accurate quantification is still challenging:**
  - VC is often irregular and VCW varies depending on cut-plane
  - PISA assumes the convergence zone is hemispheric
  - RV cannot be used in the presence of significant MR
  - Limitations magnified in eccentric jets

# Aortic Regurgitation 3D

- ✓ Evaluation of AV anatomy in detail
- ✓ Relation to near structures
- ✓ Help identify AR mechanism
- ✓ AV repair







# Aortic Regurgitation 3D

## Quantification of AR severity 3DE

3D color-Doppler echocardiography and chronic aortic regurgitation: A novel approach for severity assessment ☆

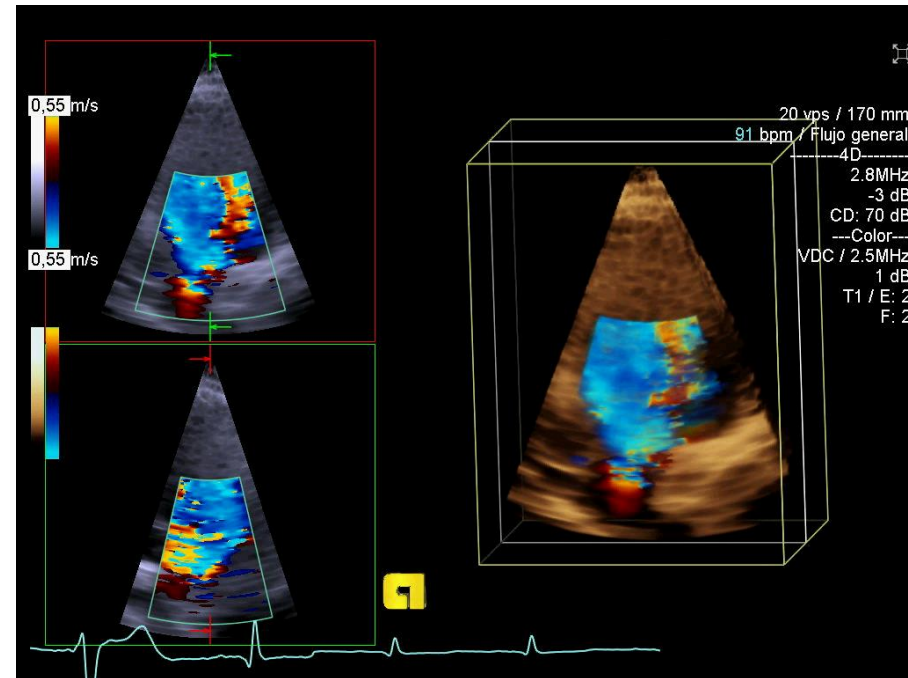
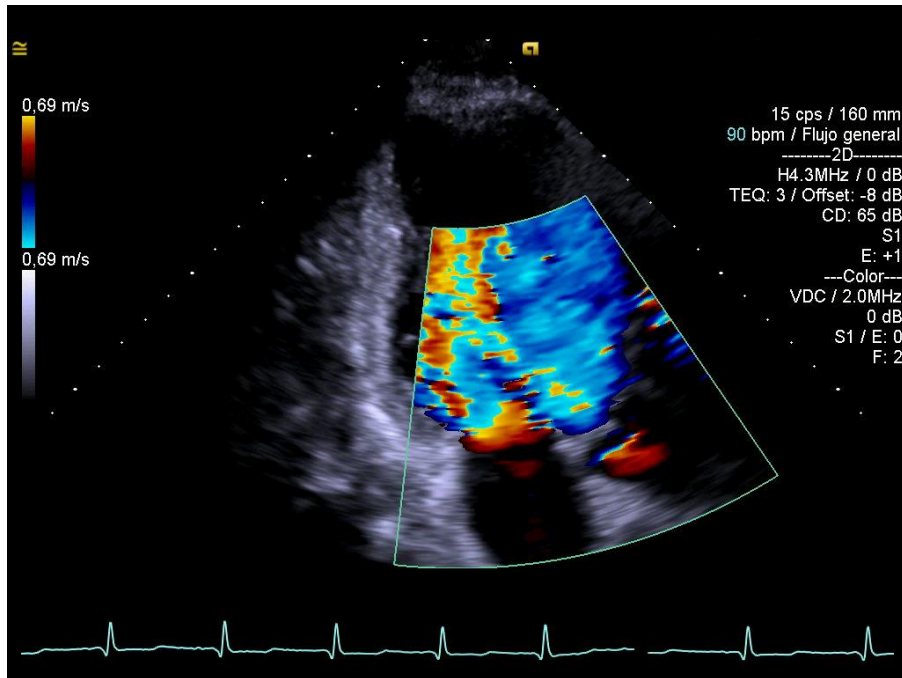
Leopoldo Perez de Isla \*, Jose Zamorano, Covadonga Fernandez-Golfin, Sara Ciocarelli, Cecilia Corros, Tibisai Sanchez, Joaquín Ferreirós, Pedro Marcos-Alberca, Carlos Almeria, Jose Luis Rodrigo, Carlos Macaya

- ✓ 3D color Doppler echo accurate and reproducible for AR severity estimation
- ✓ 3D better agreement with CMR than 2D conventional methods



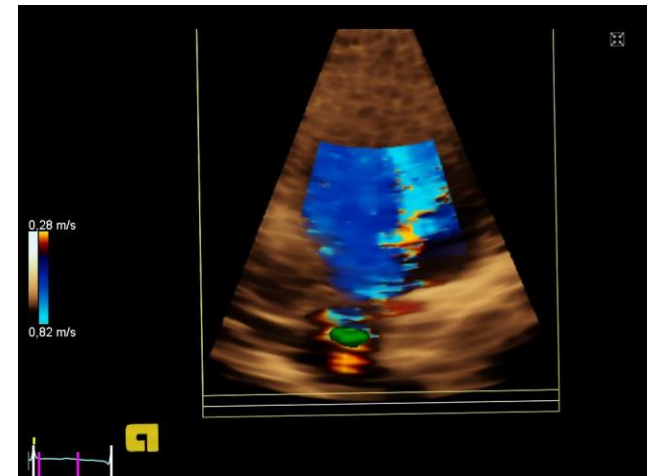
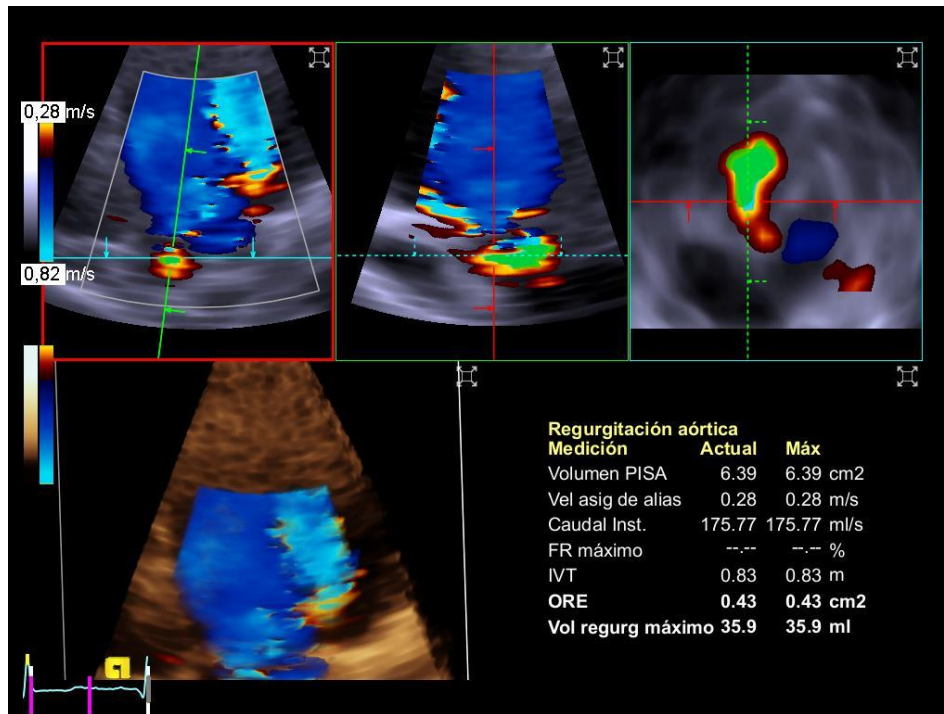
# Aortic Regurgitation 3D

## Quantification of AR severity 3D



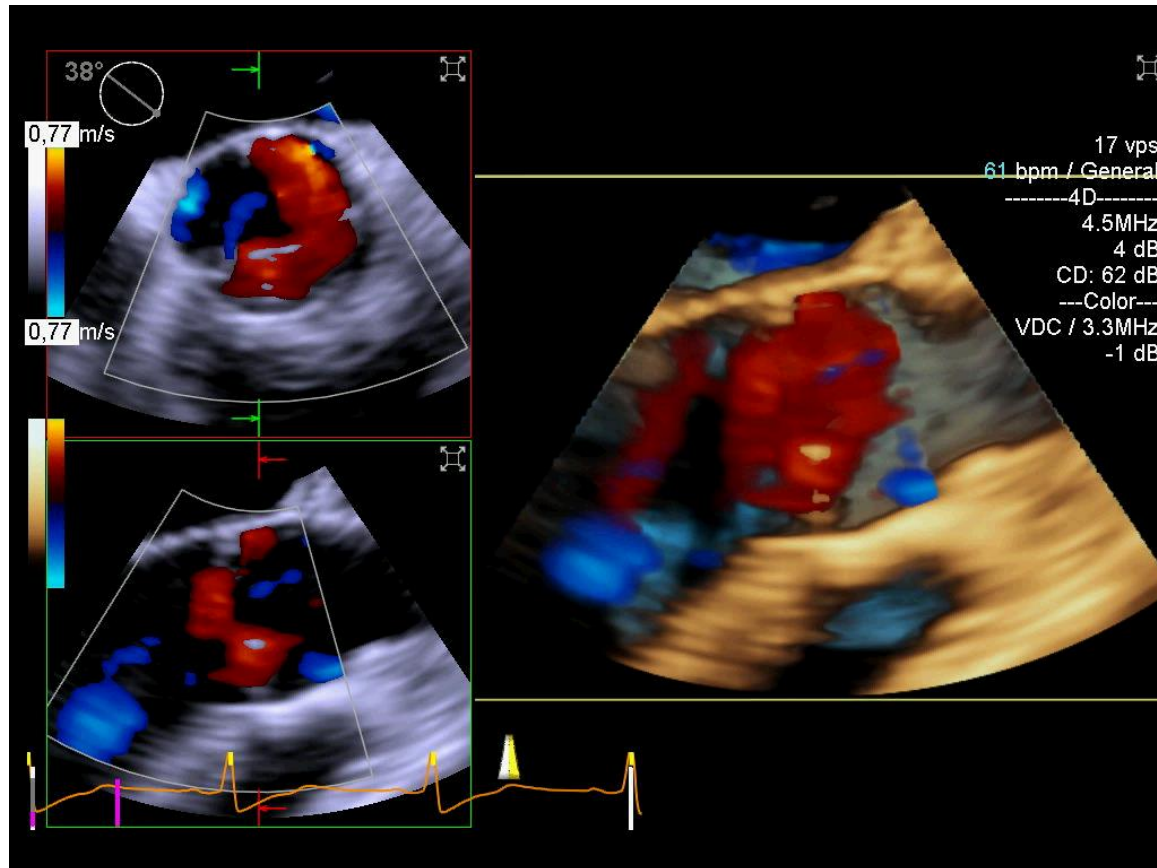
# Aortic Regurgitation 3D

## Quantification of AR severity 3D



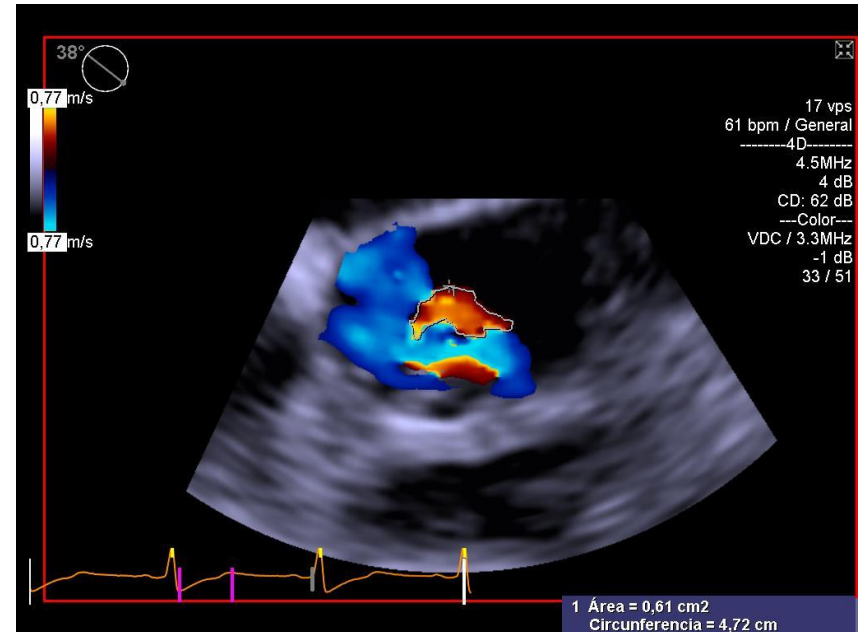
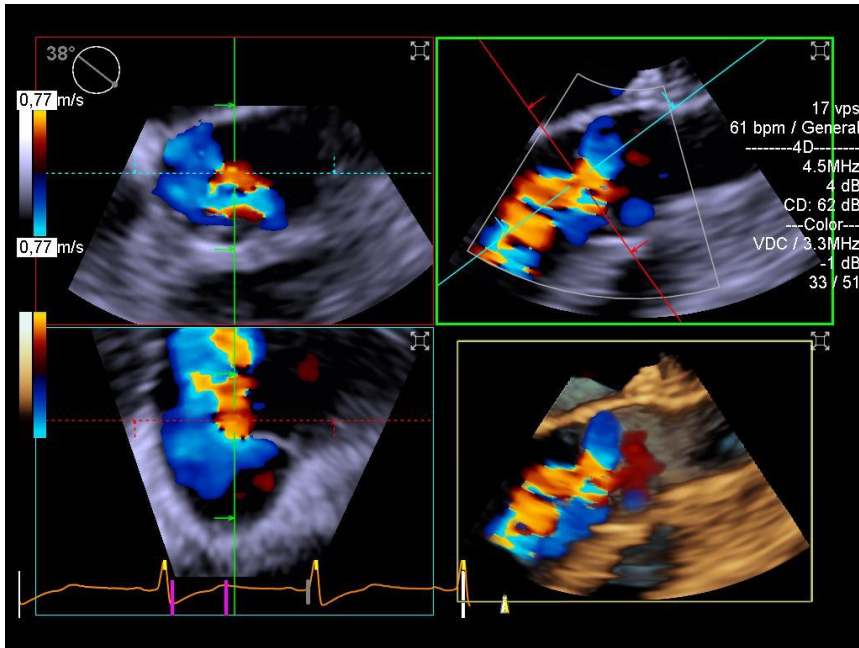
# Aortic Regurgitation 3D

## Quantification of AR severity 3DE VCA



# Aortic Regurgitation 3D

## Quantification of AR severity 3DE VCA





## Conclusions

Aortic Valve, do we need 3D???

YES

- ✓ Evaluation of AV anatomy in detail
- ✓ AS severity quantification
- ✓ AR severity/mechanism
- ✓ AV repair
- ✓ TAVI