

# EuroValve

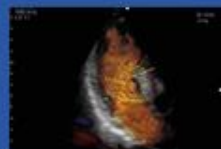
November 8-9, 2013



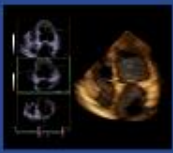
## IMAGING INNOVATIONS : Advance Imaging Is there a role for CT/CMR

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Leiden University Medical Center



[www.eurovalvecongress.com](http://www.eurovalvecongress.com)



## Faculty Disclosure

*Victoria Delgado*

*I disclose the following financial relationships:*

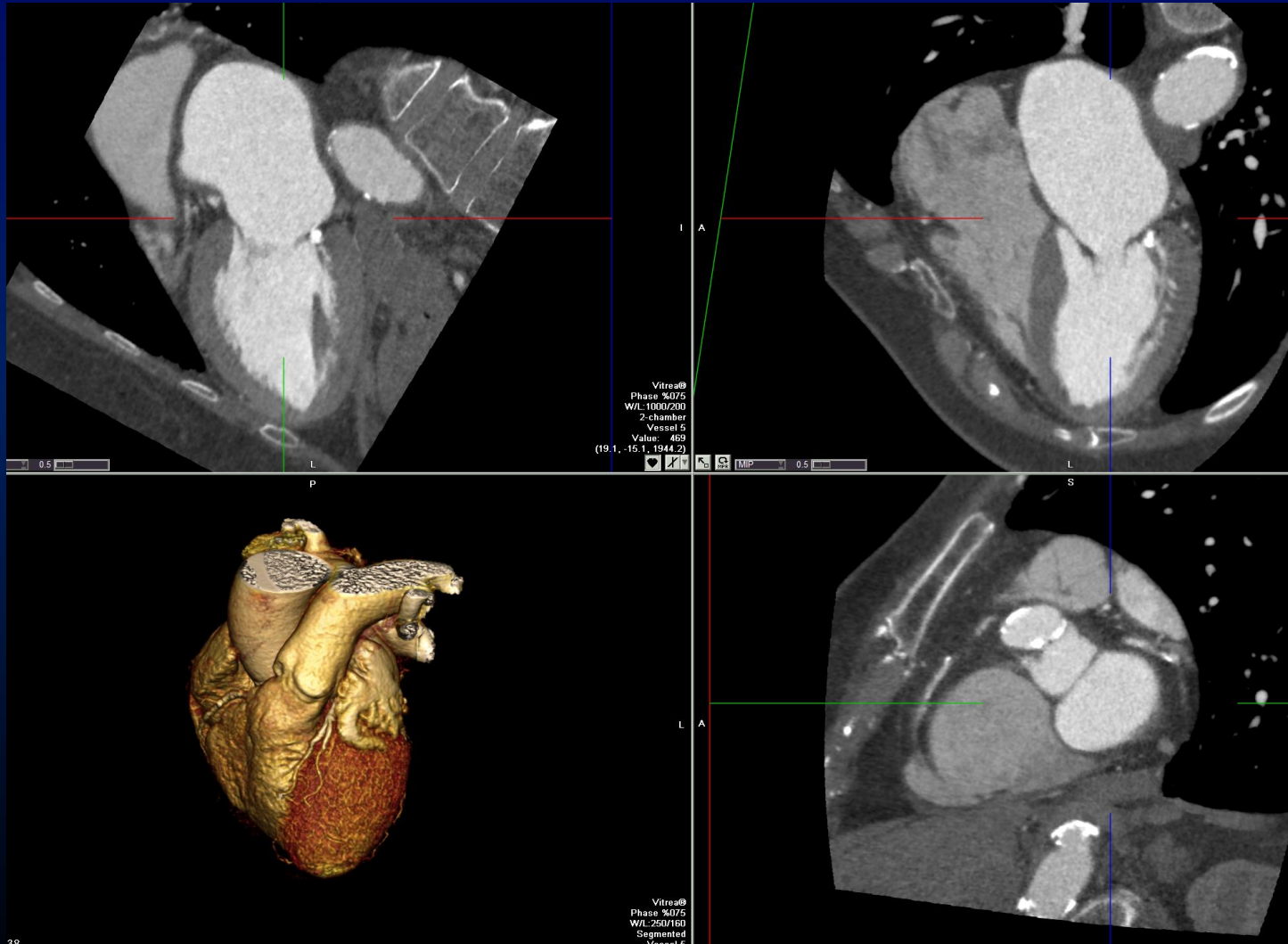
**Consultant** for Medtronic and St. Jude Medical

**Paid speaker** for Abbott

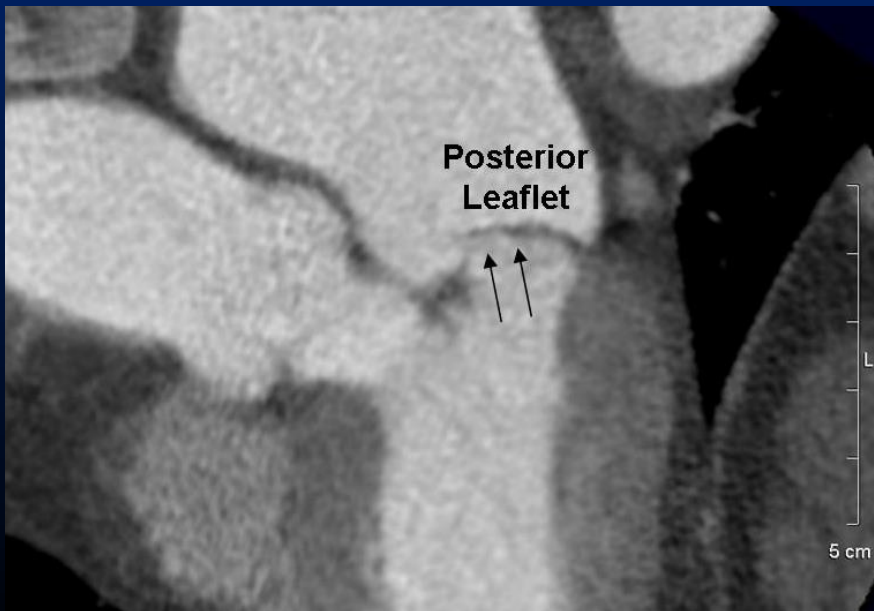
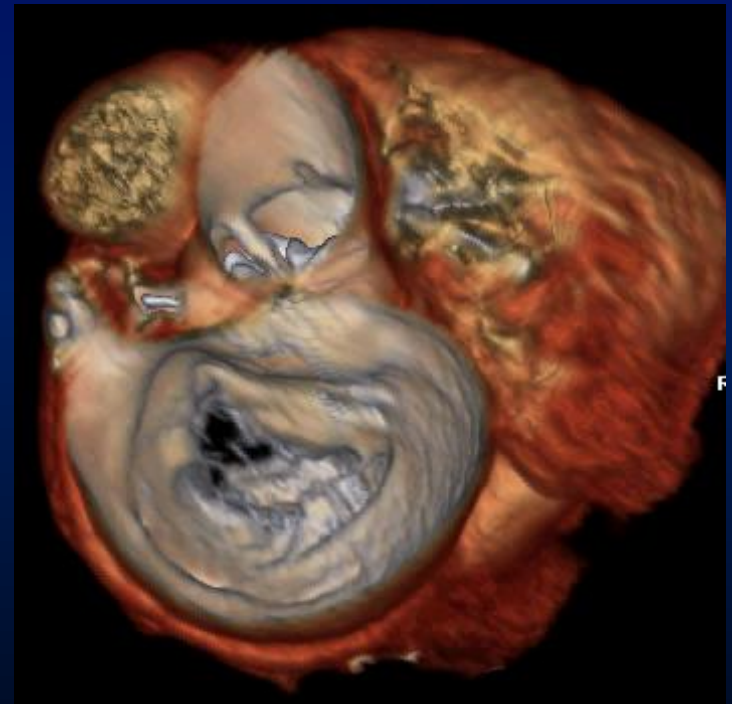
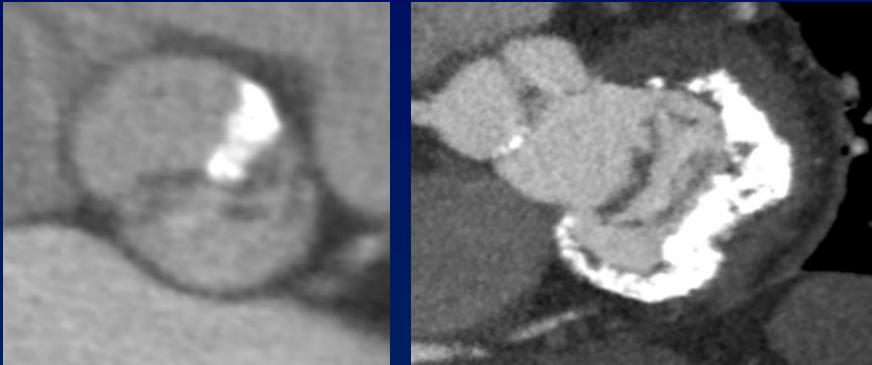
# Role of CT/MRI in valve heart disease

- Assessment of valvular morphology
- Assessment of valvular regurgitation
- In interventional cardiology

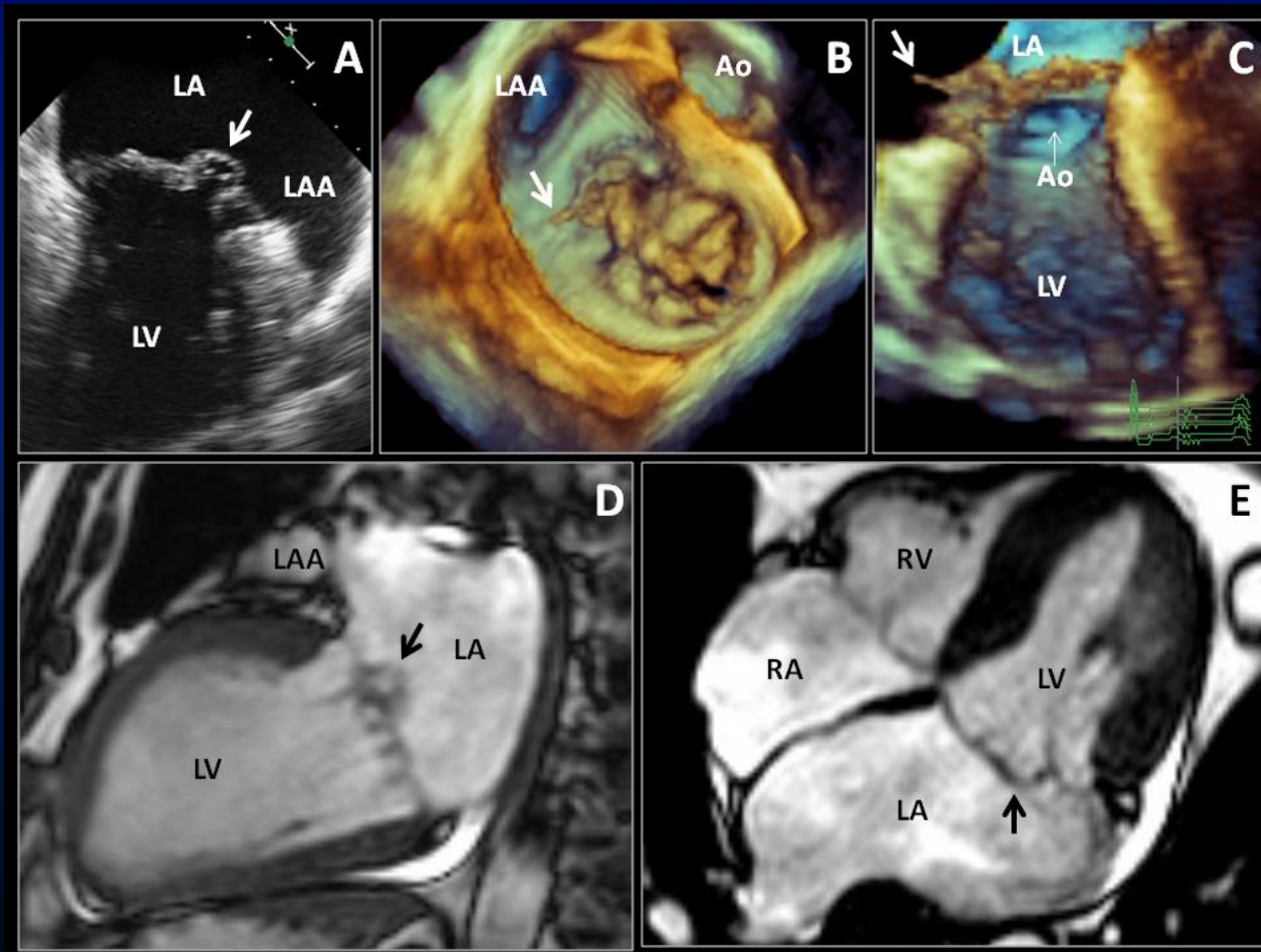
# Valvular morphology



# Valvular morphology - CT



# Valvular morphology-MRI





# Bicuspid aortic valve

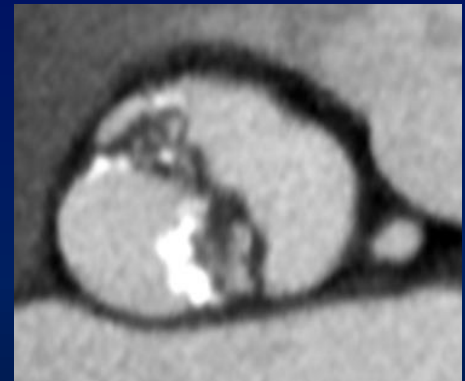
TTE



TEE



MDCT



# Bicuspid aortic valve

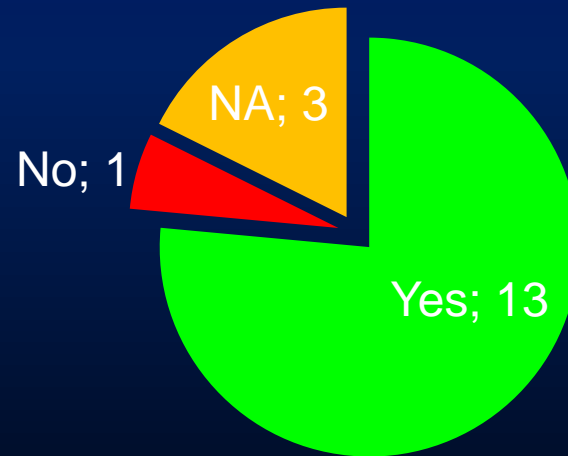
N = 50 severe AS  
17 bicuspid

CT



Sens 94% Spec 100%

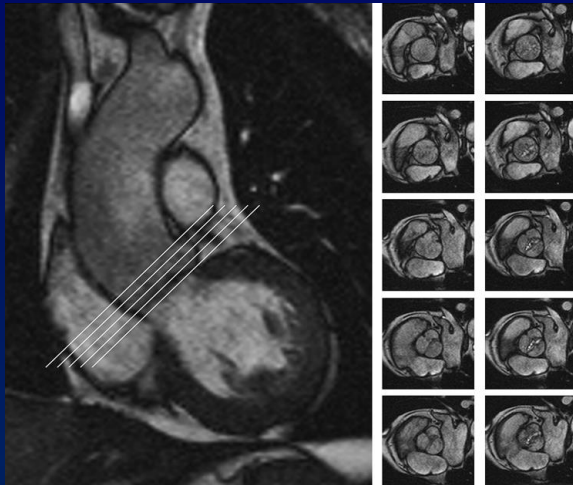
2D TTE



Sens 76% Spec 61%

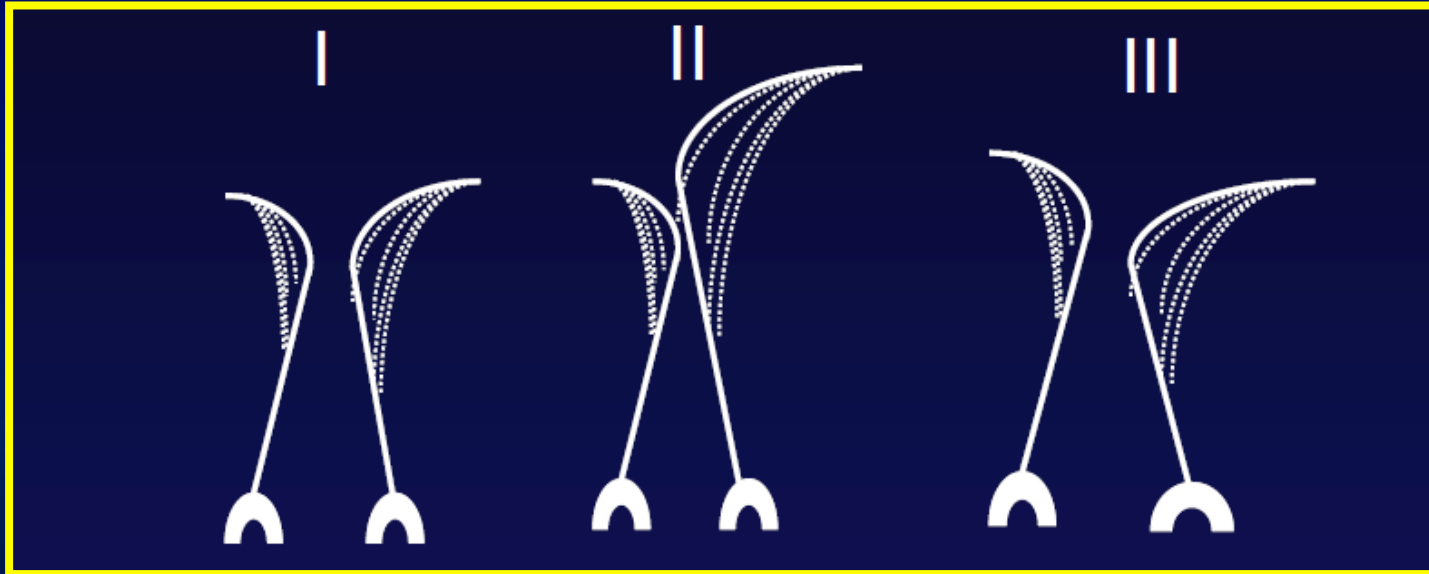


# Bicuspid aortic valve



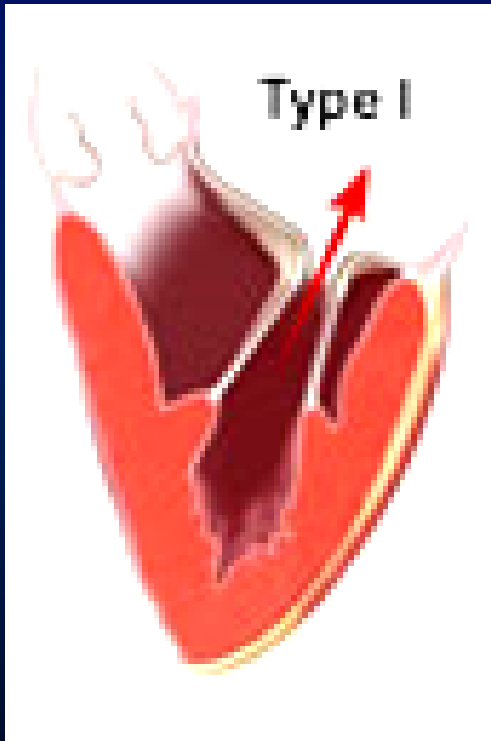
N=62	MRI	TEE
<b>Raphe visible</b>		
Yes	52	45
No	10	9
Uncertain	-	8
<b>BAV type</b>		
RCC-NCC	6	5
RCC-LCC	46	40
LCC-NCC	-	-
Lateral orientation	8	7
Ant-post orientation	2	2
Uncertain	-	8

# Mitral valve



- Type I: normal motion of the leaflets
- Type II: excessive motion
- Type III: restricted motion

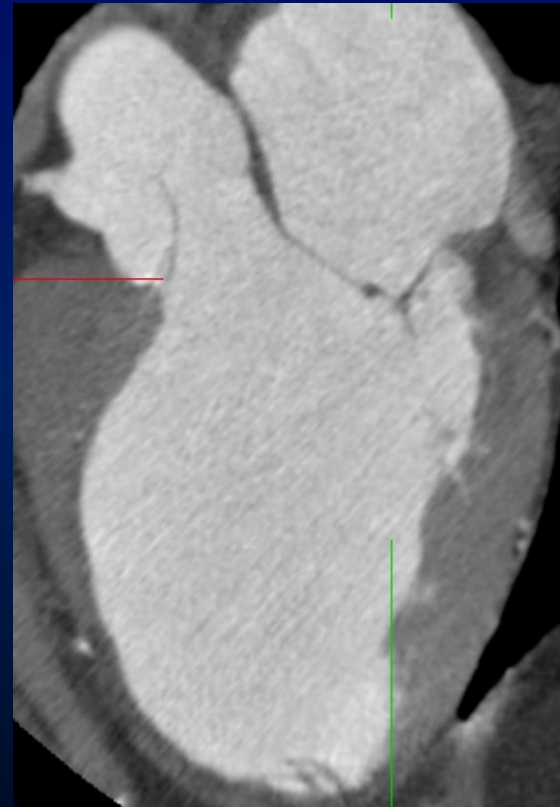
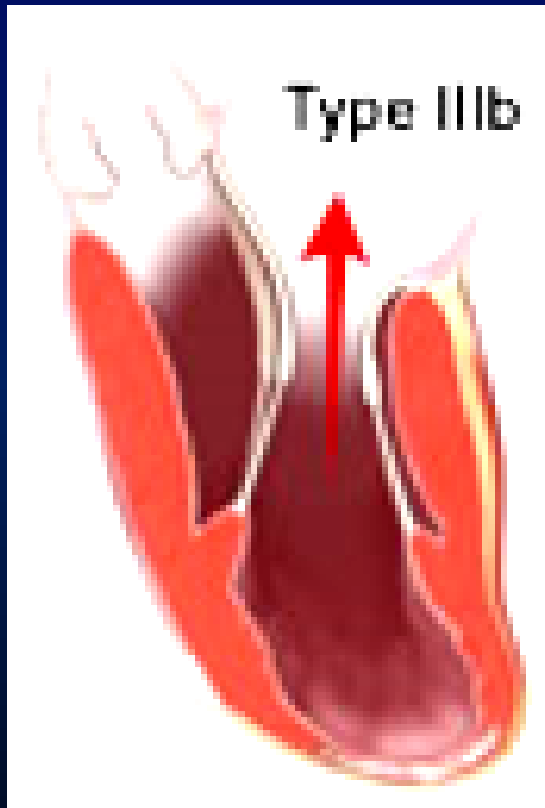
# Mitral valve



# Mitral valve

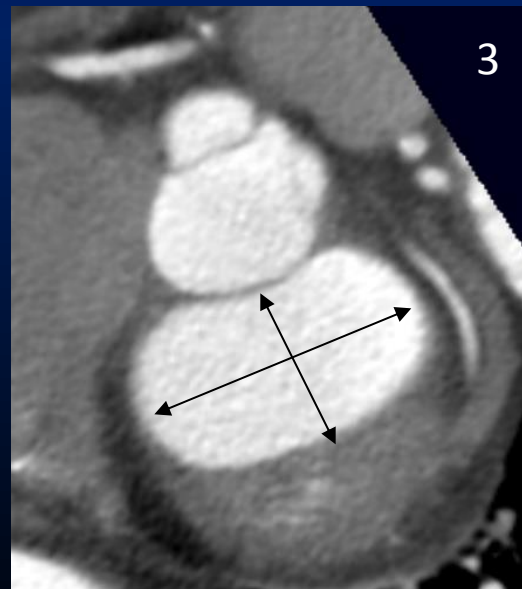
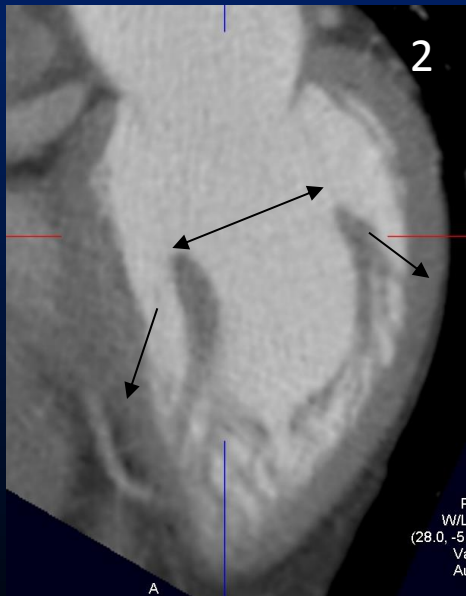
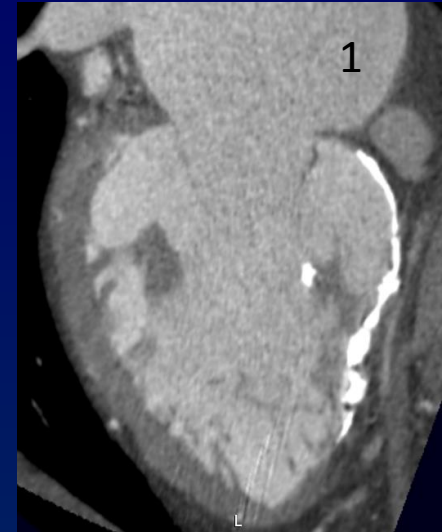


# Mitral valve

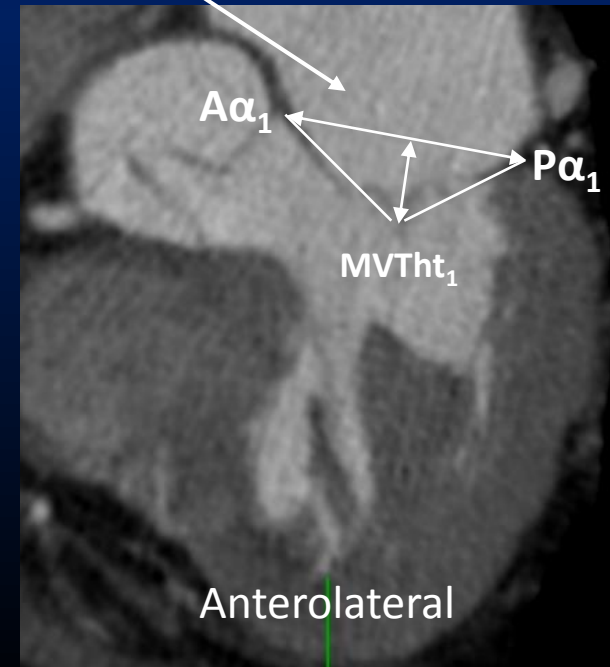
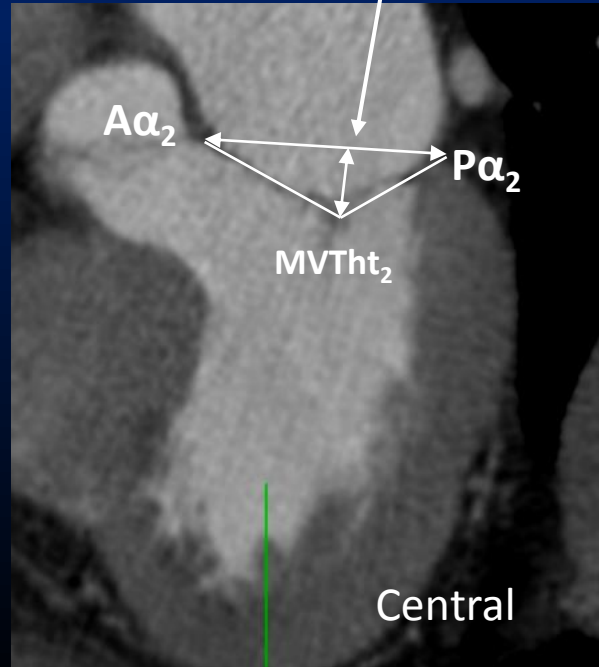
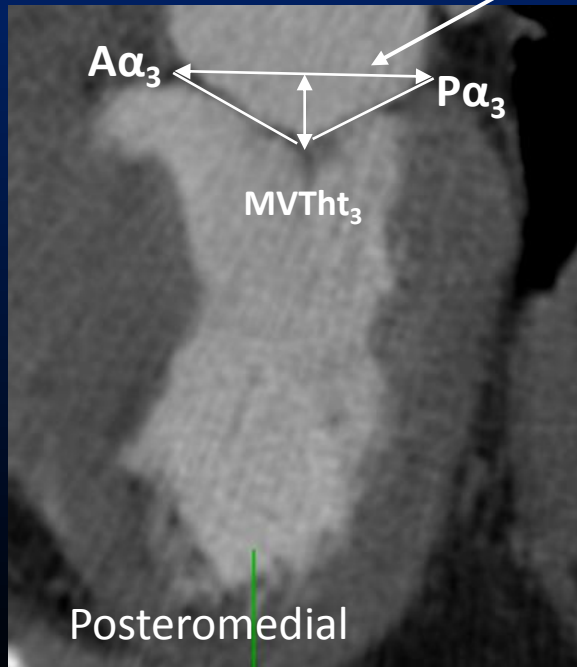
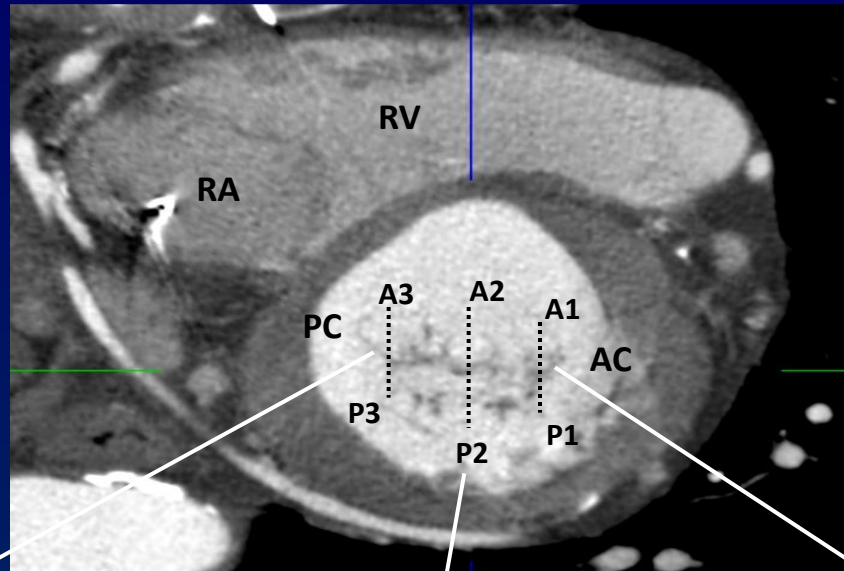


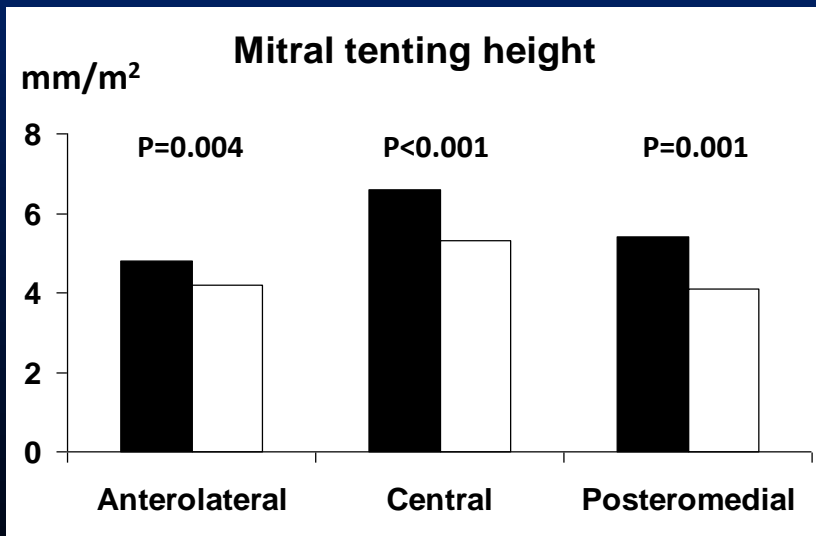
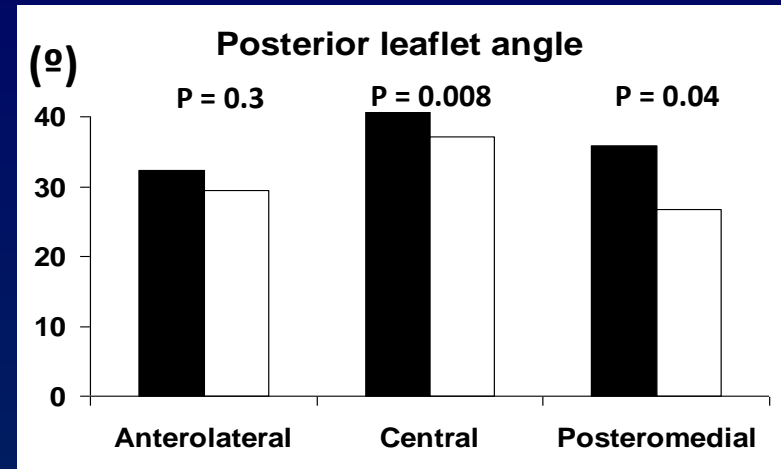
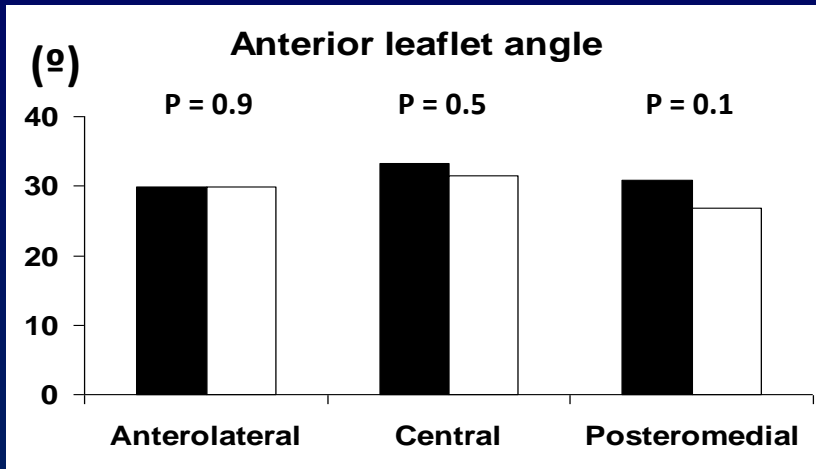
- **Multi-slice CT:**

1. Remodeling of left ventricle
2. Displacement of papillary muscles
3. Annular dilatation
4. Leaflet tethering

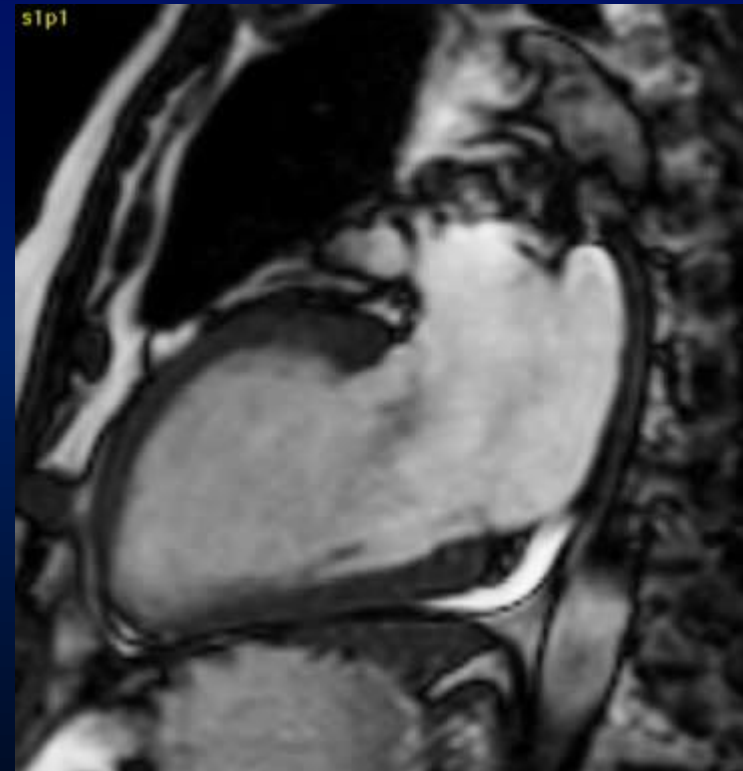
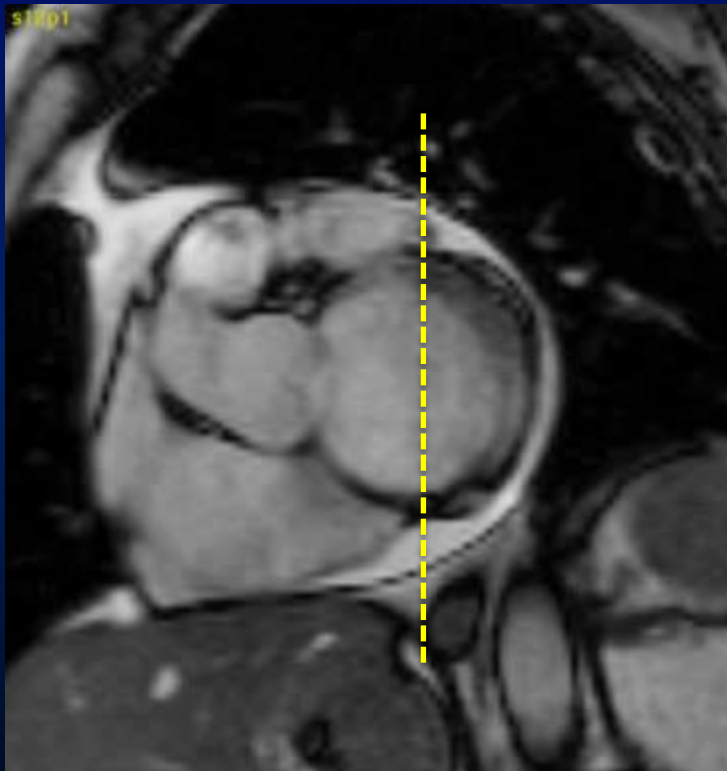




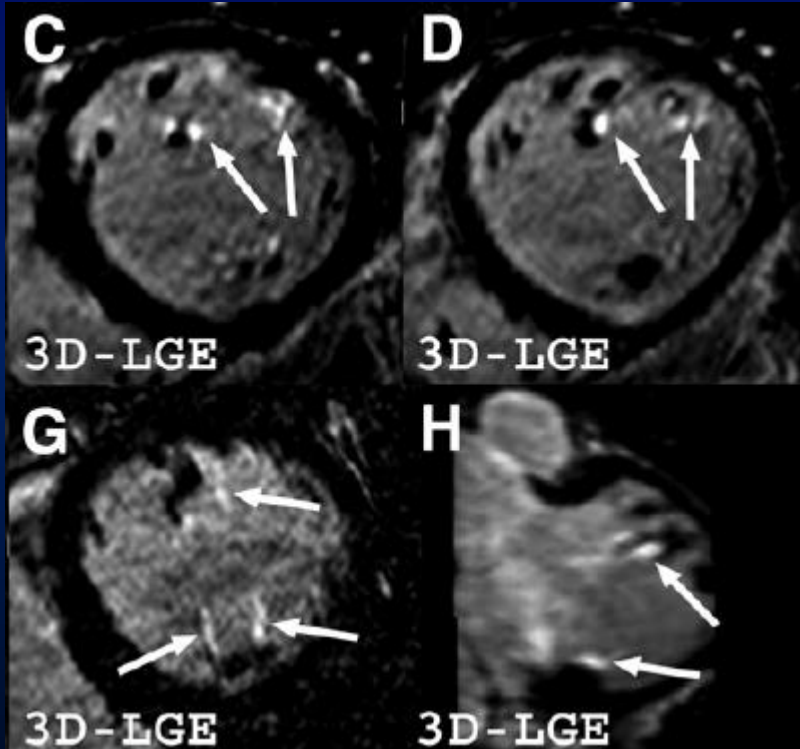




# Mitral valve



# Mitral valve



Presence of LGE in papillary muscles and association with complex ventricular arrhythmias

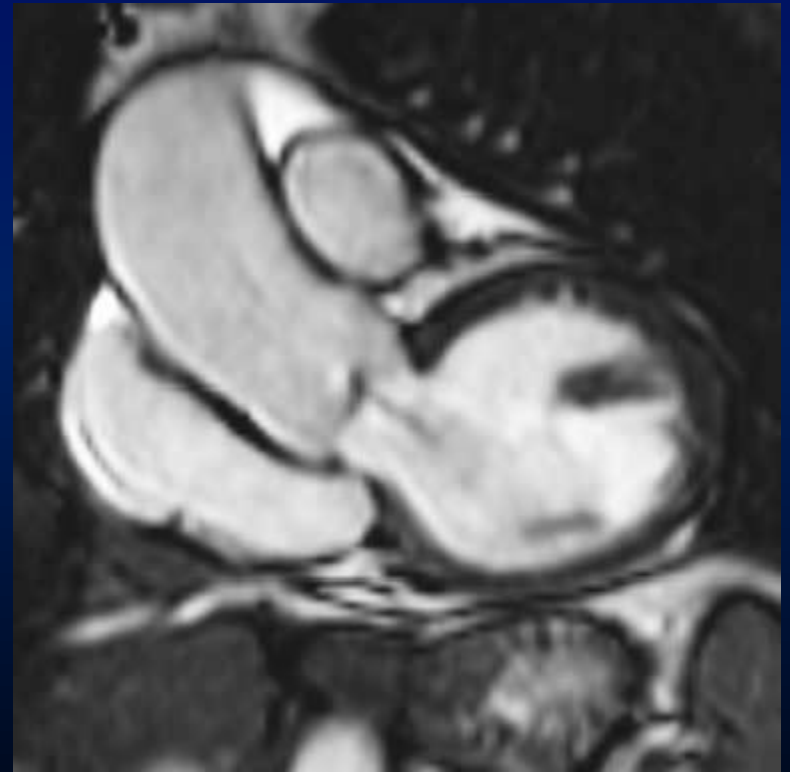
**N = 16 MV Prolaps**

LGE-Papillary muscles	VA	No-VA
Yes	8	2
No	0	6

# Role of CT/MRI in valve heart disease

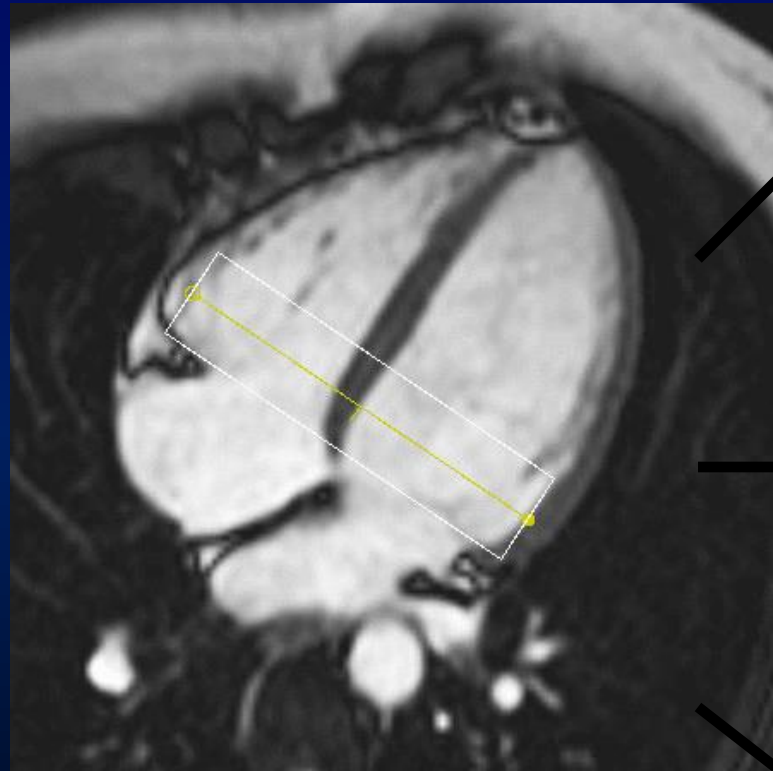
- Assessment of valvular morphology
- Assessment of valvular regurgitation
- In interventional cardiology

# MRI quantification of valvular regurgitation

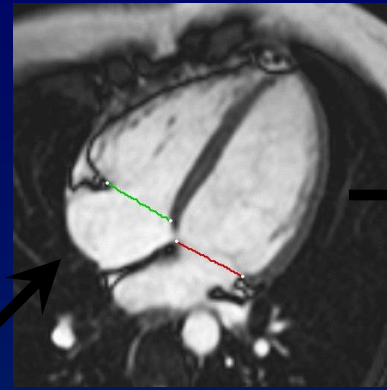




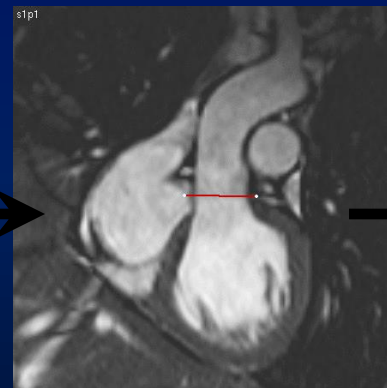
# 3D Flow Quantification in All Valves



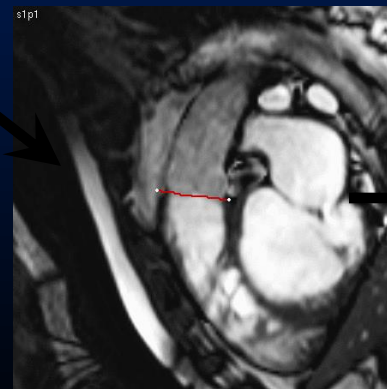
3D volume scan /w 3-dir  
velocity encoded MRI



MV & TV



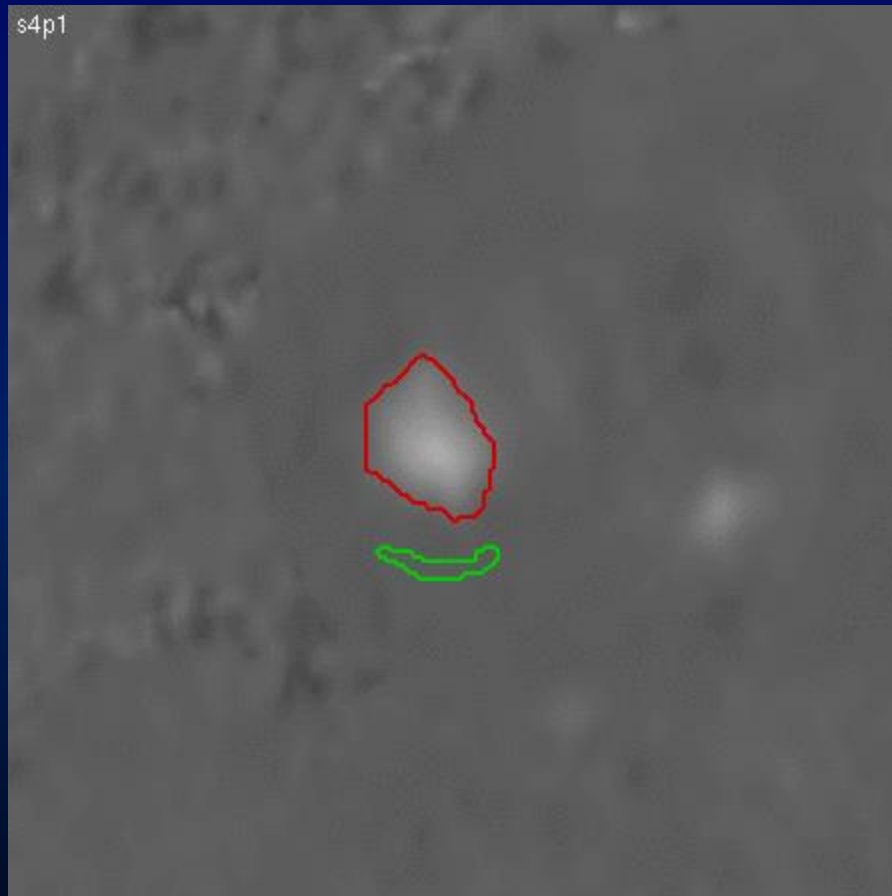
AV



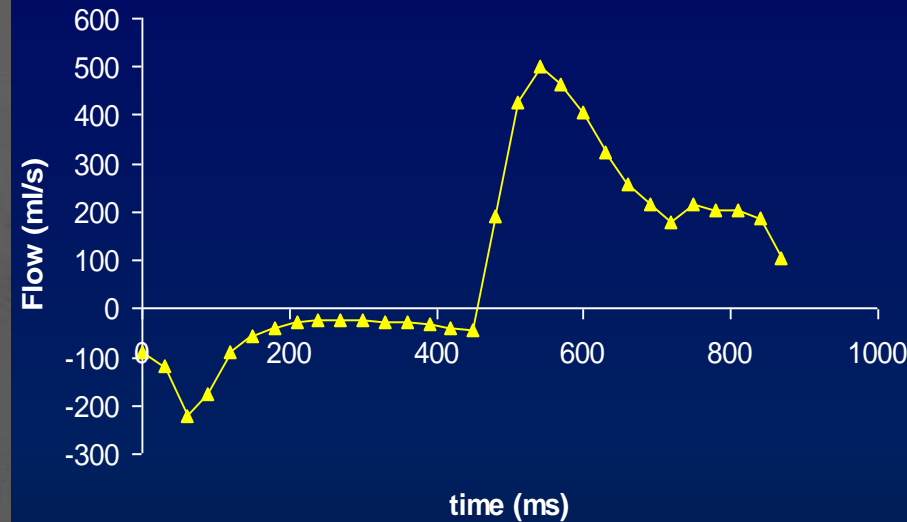
PV



# 3D Flow Quantification in All Valves



MV flow



$$V_{\text{forward}} = 116 \text{ ml}$$

$$V_{\text{back}} = 32 \text{ ml}$$

$$V_{\text{eff}} = 84 \text{ ml}$$

$$\text{Regurg. Fraction} = 27\%$$

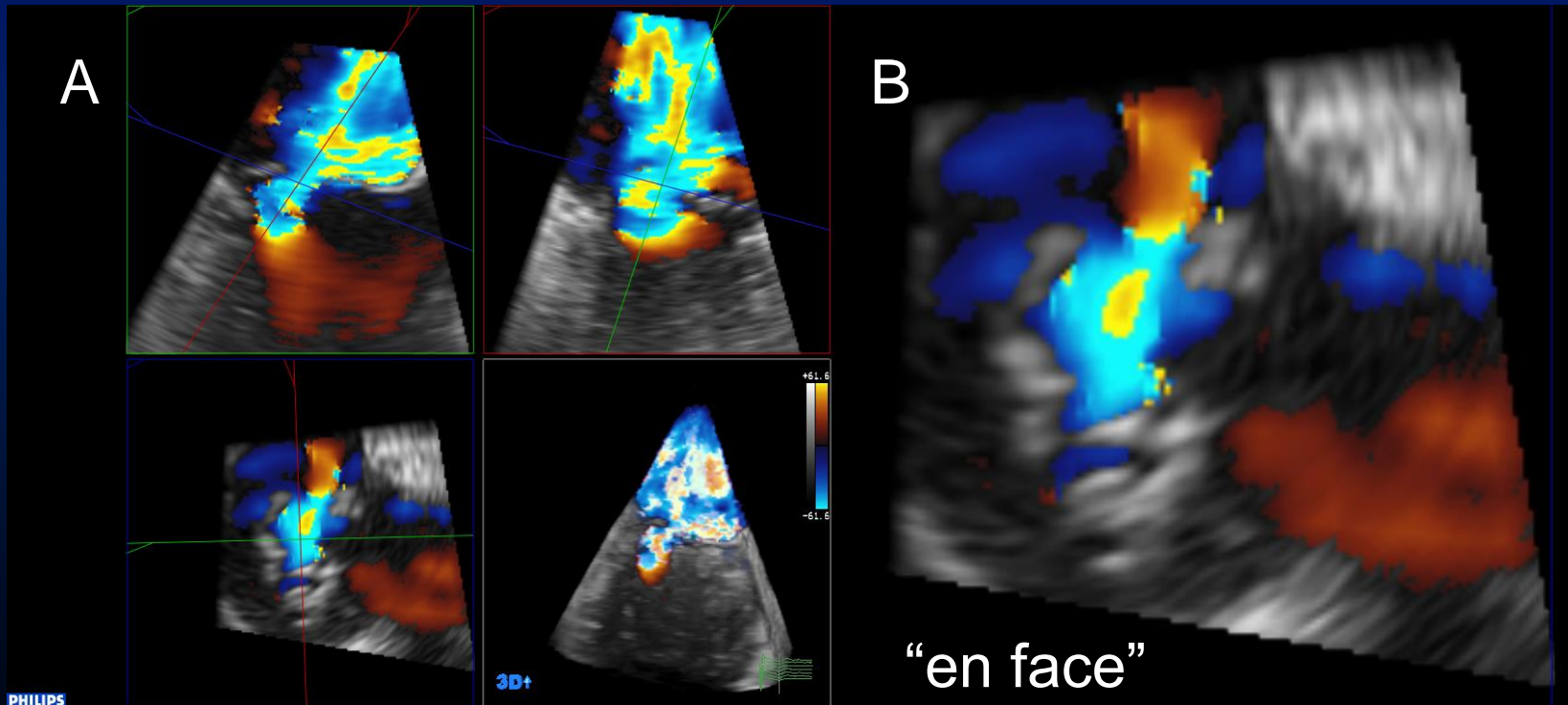
# MR quantification

N = 30

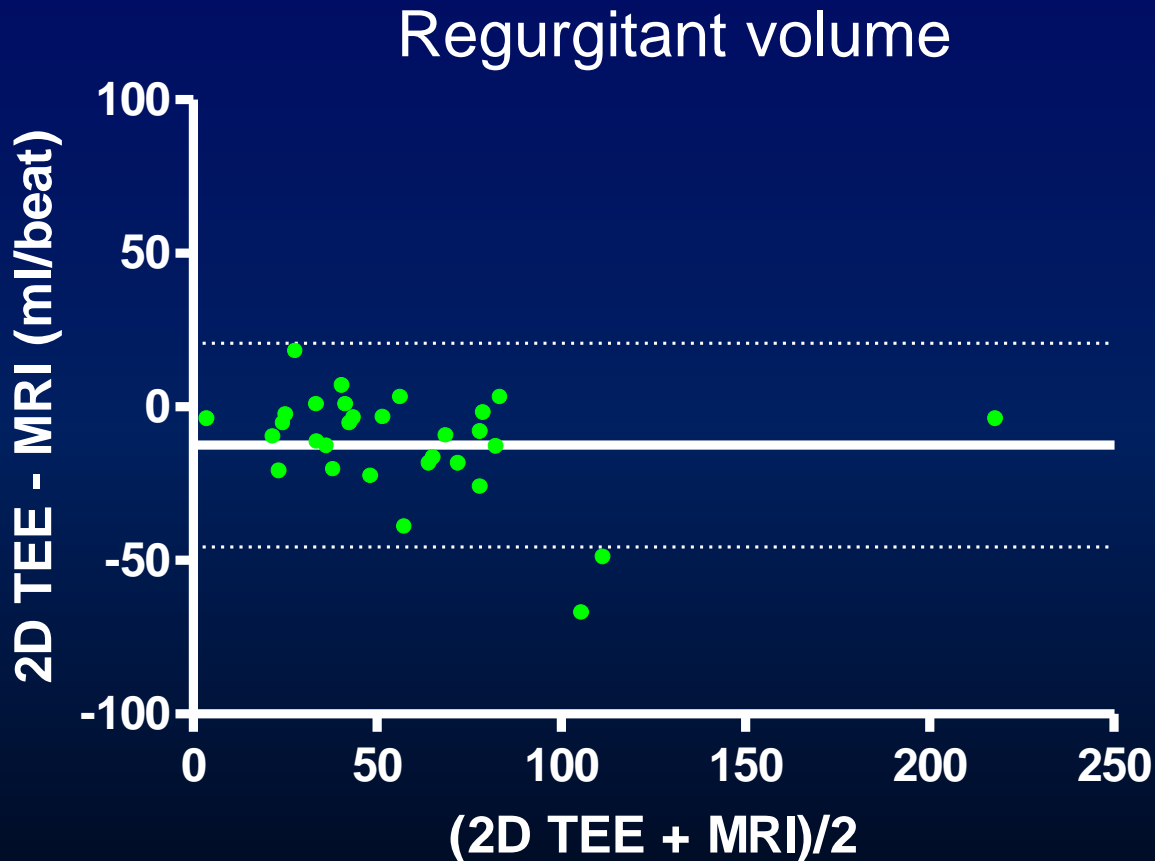
53.3% functional

46.7% organic

2D-TTE vs. 3D TEE vs. MRI

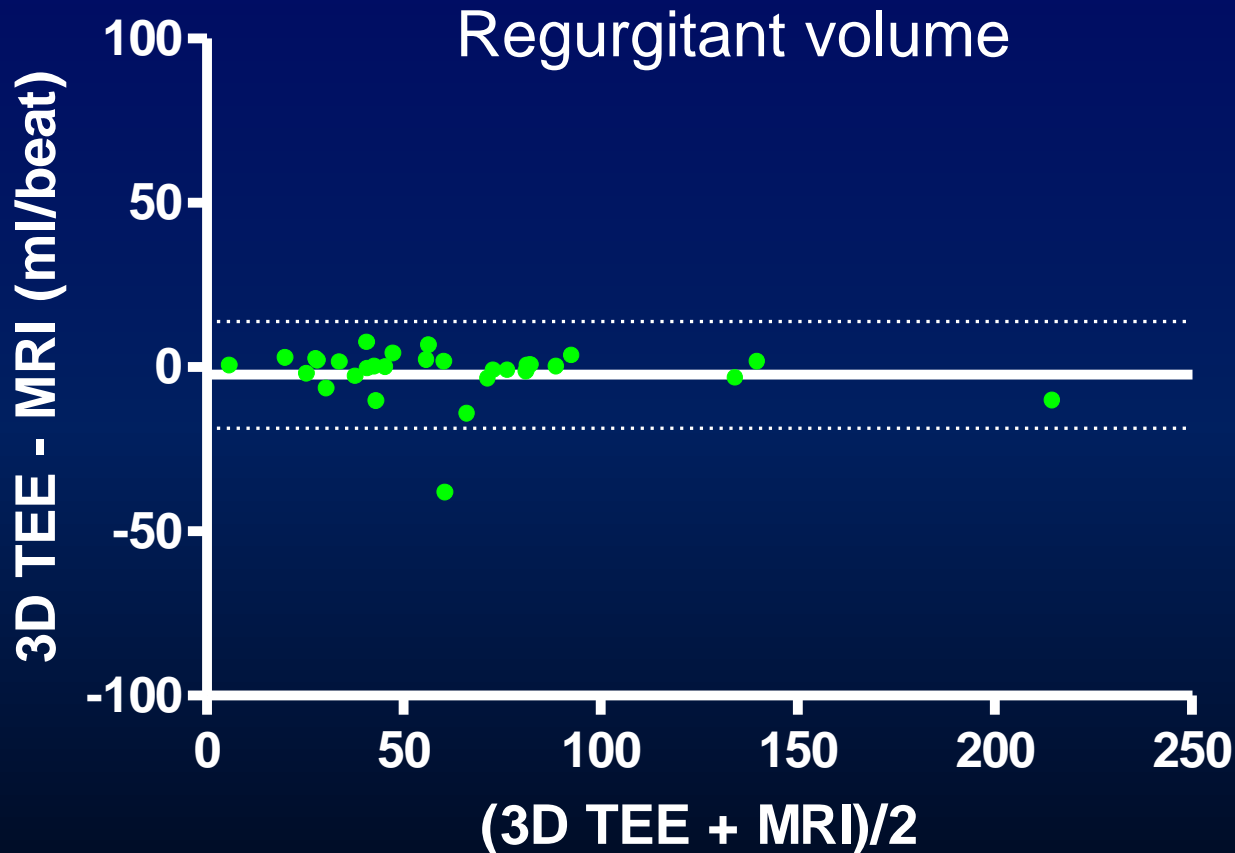


# MR quantification



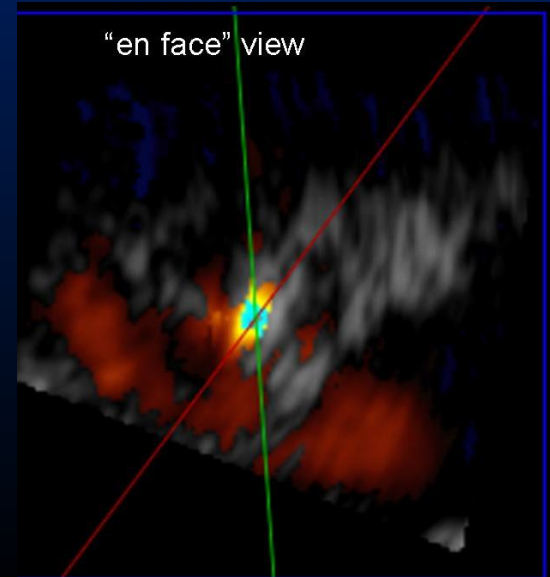
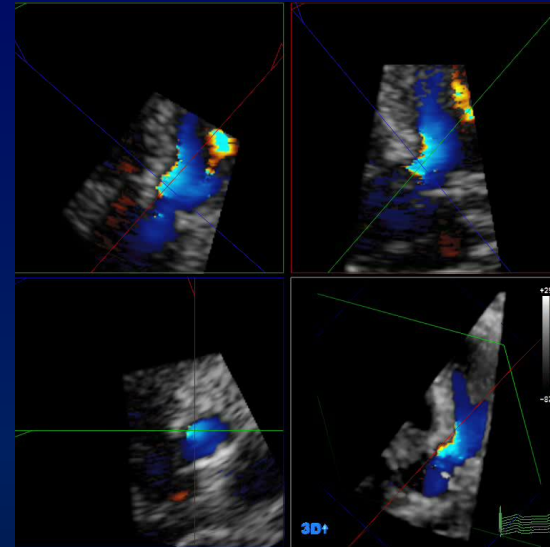
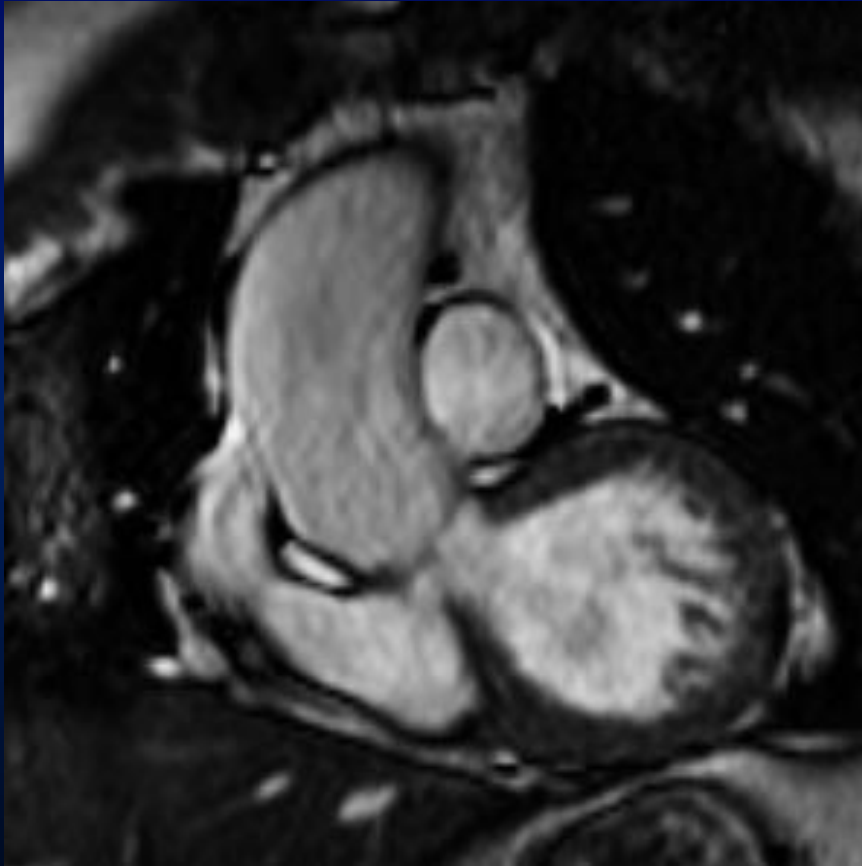
2D TEE underestimates RVol by 21.3% compared to MRI

# MR quantification



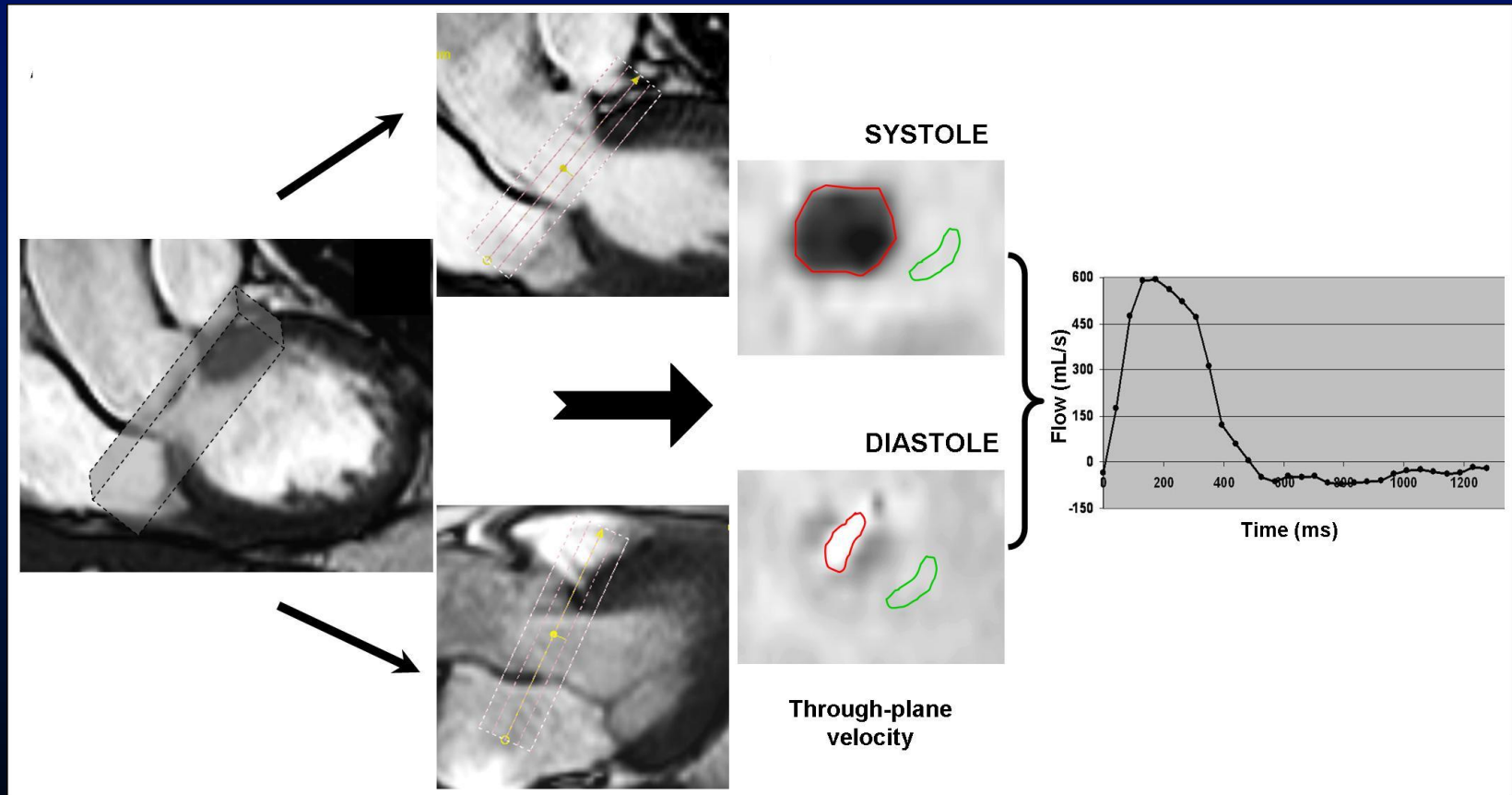
3D TEE underestimates RVol by 1.2% compared to MRI

# RT3DE vs. 3D velocity encoded MRI

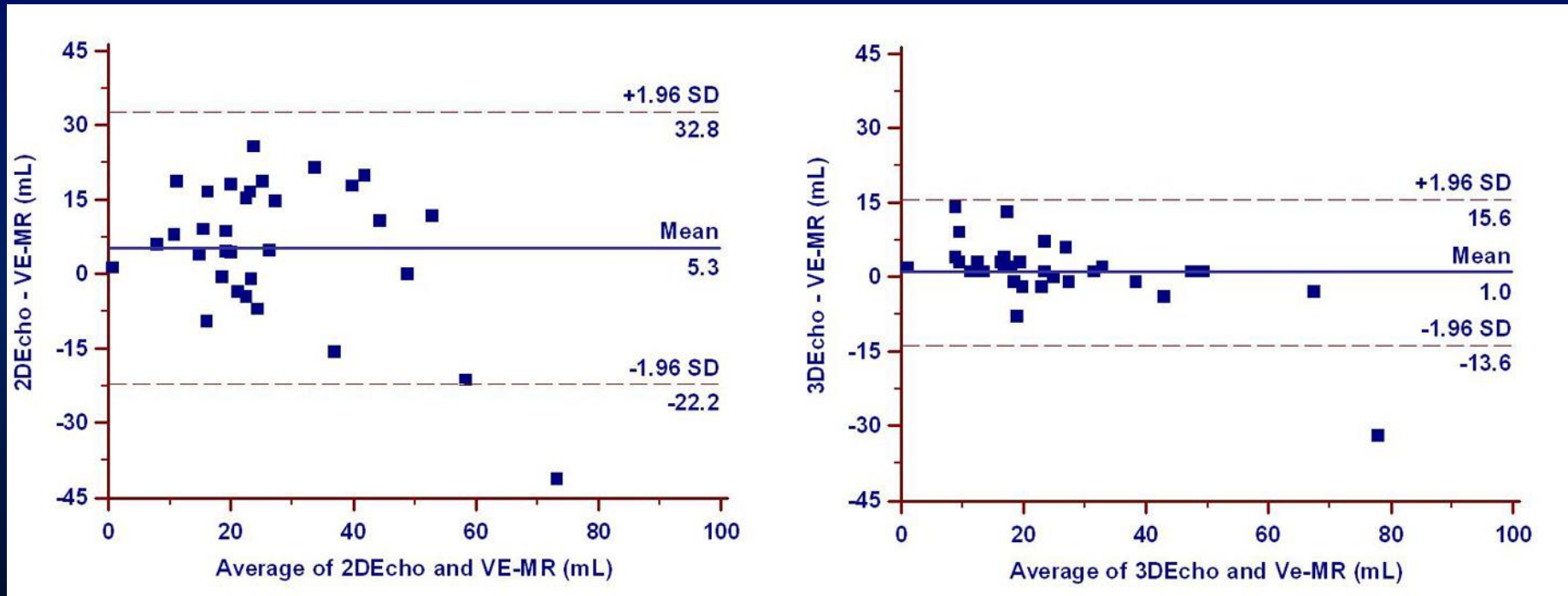




# RT3DE vs. 3D velocity encoded MRI

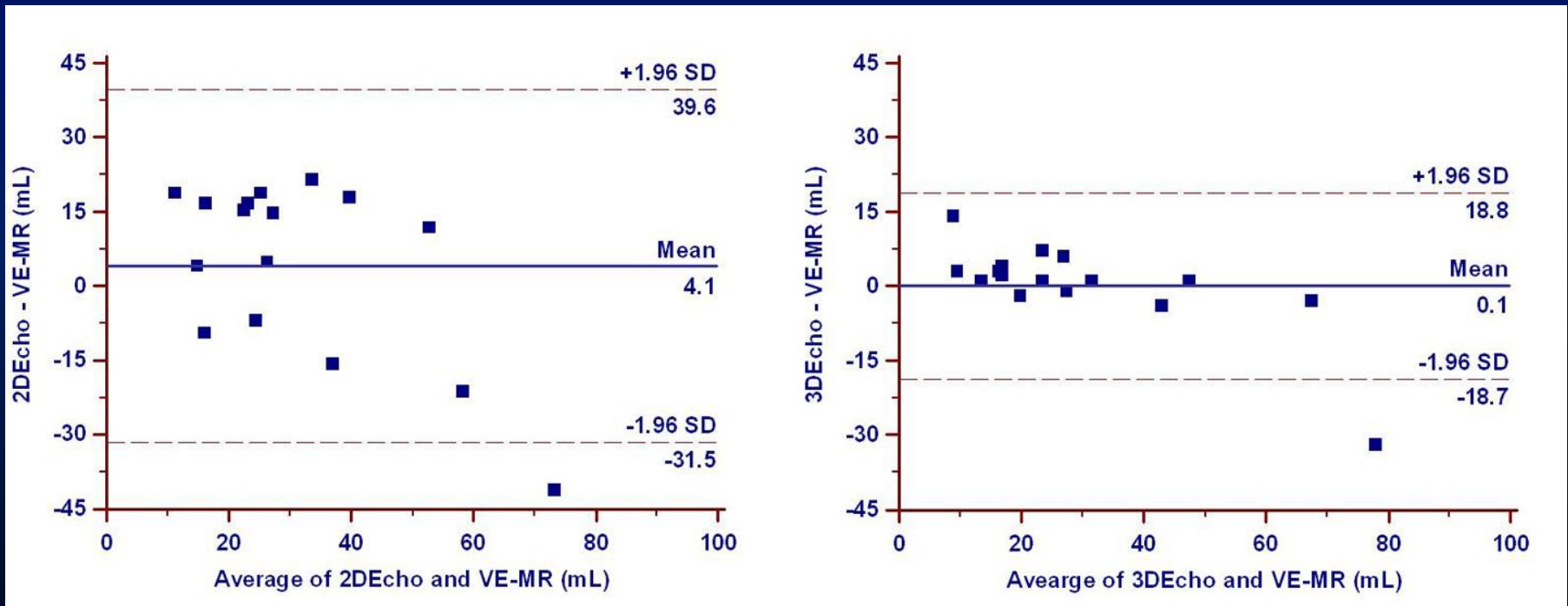


# RT3DE vs. 3D velocity encoded MRI



# RT3DE vs. 3D velocity encoded MRI

## Eccentric regurgitant jets

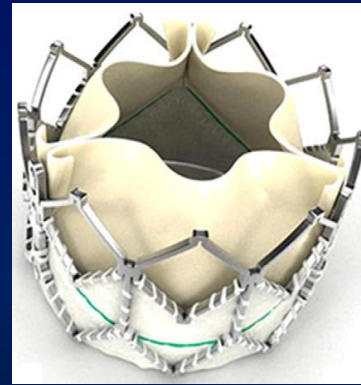
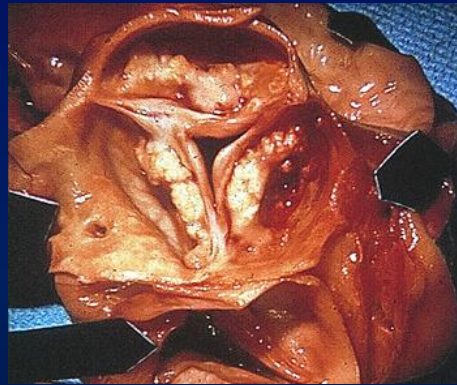


# Role of CT/MRI in valve heart disease

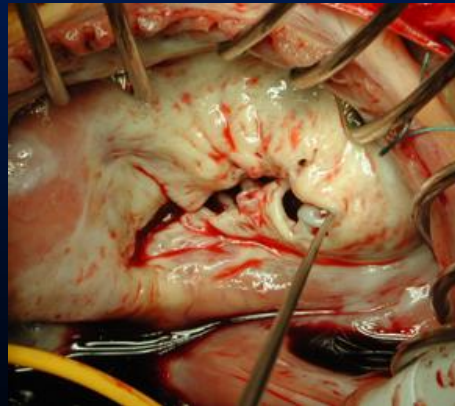
- Assessment of valvular morphology
- Assessment of valvular regurgitation
- In interventional cardiology

# Increasing number of percutaneous heart valve procedures

>100,000 TAVI



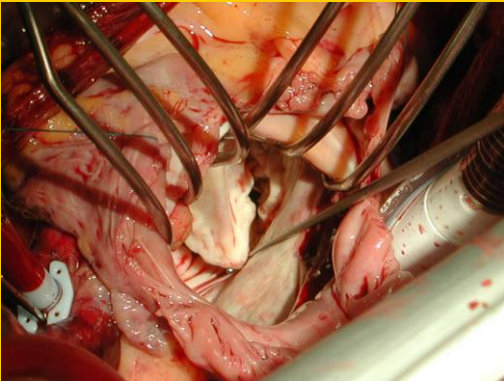
>10,000 MV  
procedures



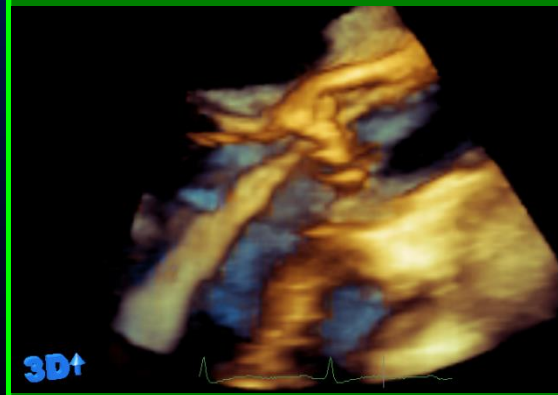
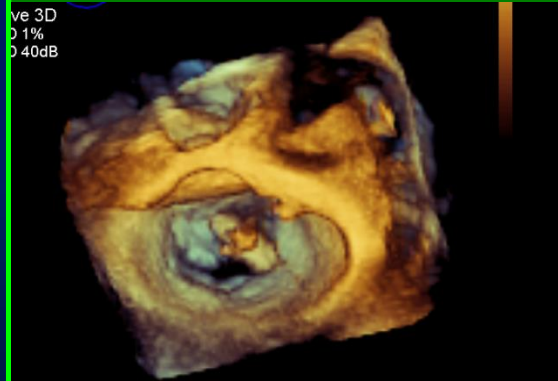


# Why do we need 3D imaging in cardiac interventions?

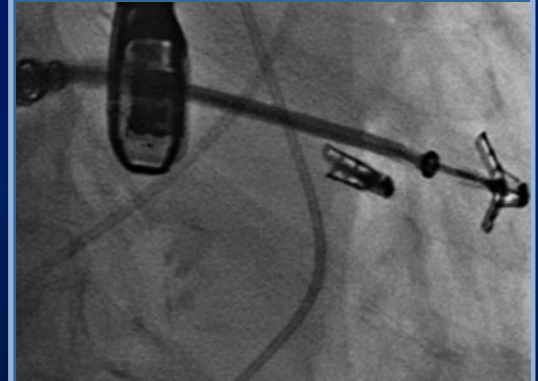
## Surgery



## 3D Imaging



## Transcatheter interventions



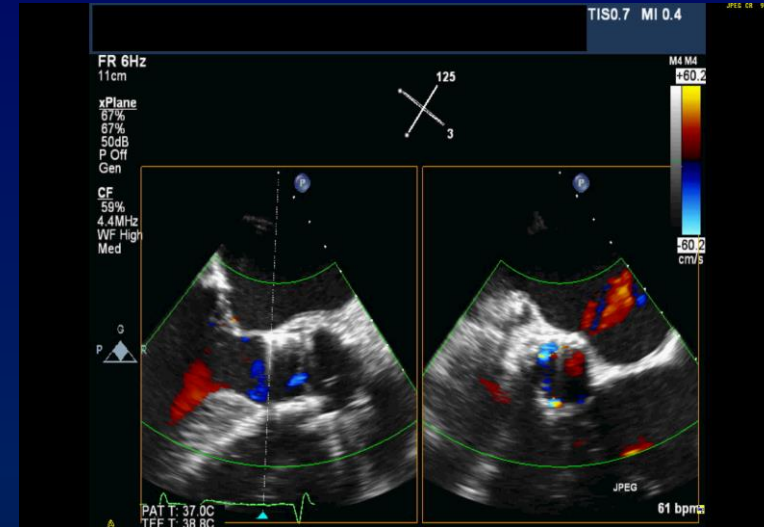
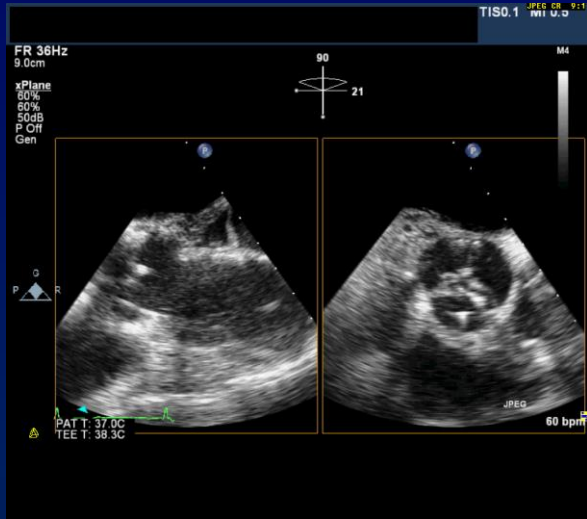
# Improving outcomes

- Advances in device technology
- Learning curve
- Patient selection
- Procedural planning
- Procedural guiding





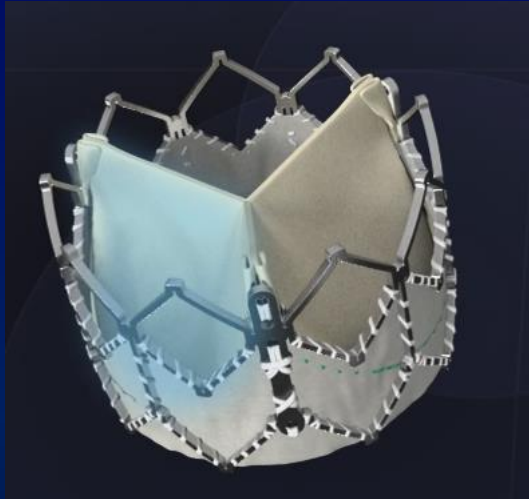
# TAVI



## Overall outcomes

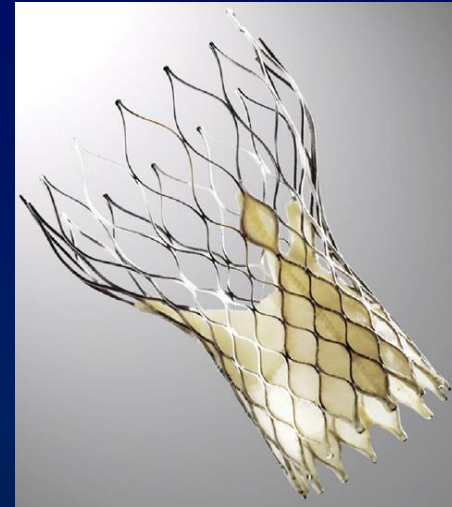
- 95% 30-day survival
- 69-85% 1-year survival
- 12% moderate to severe aortic regurgitation
- 19% vascular complications
- 20% acute kidney injury

# Aortic annulus sizing



**Edwards SAPIEN XT**

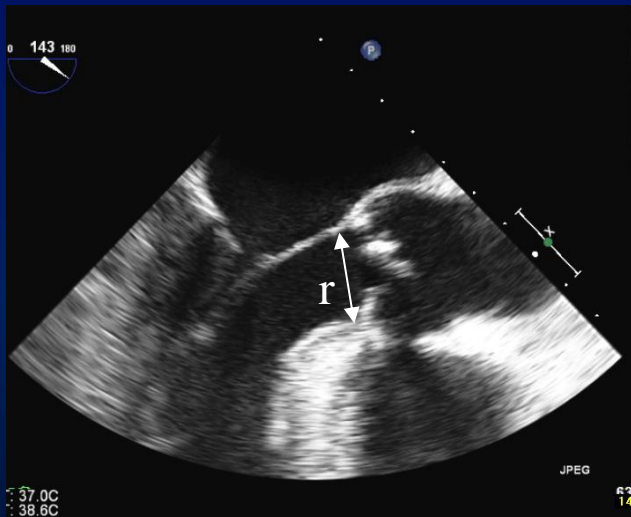
<b>20-mm</b>	<b>&lt;18 mm</b>
<b>23-mm</b>	<b>18-21 mm</b>
<b>26-mm</b>	<b>22-25 mm</b>
<b>29-mm</b>	<b>25-28 mm</b>



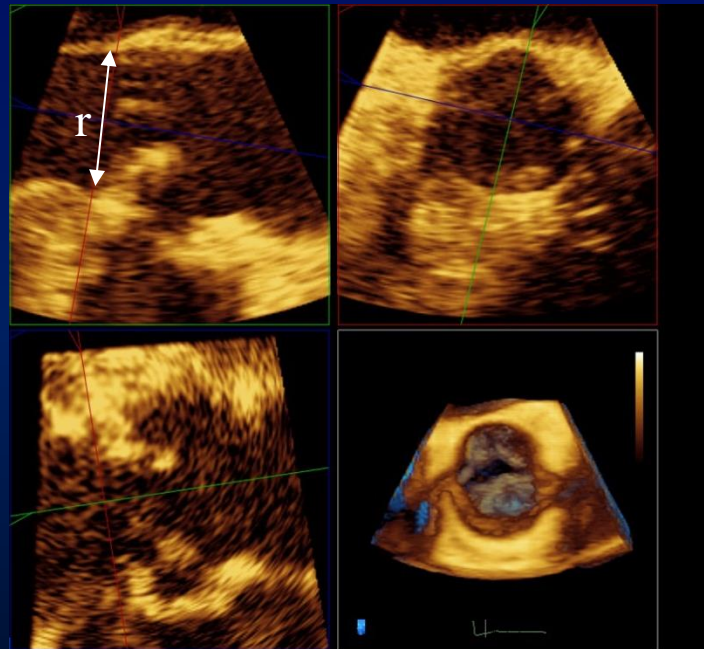
**Medtronic CoreValve**

<b>23-mm</b>	<b>18-20 mm</b>
<b>26-mm</b>	<b>20-23 mm</b>
<b>29-mm</b>	<b>23-27 mm</b>
<b>31-mm</b>	<b>26-29 mm</b>

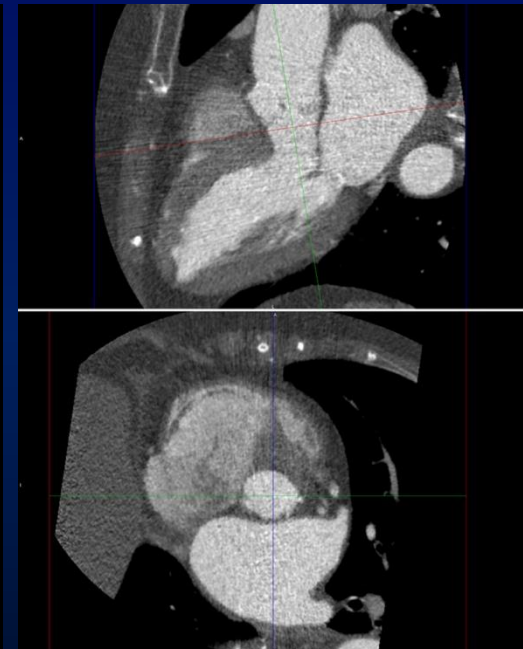
# Aortic valve annular dimensions 2D-TEE vs. 3D-TEE vs. MSCT



Circular area

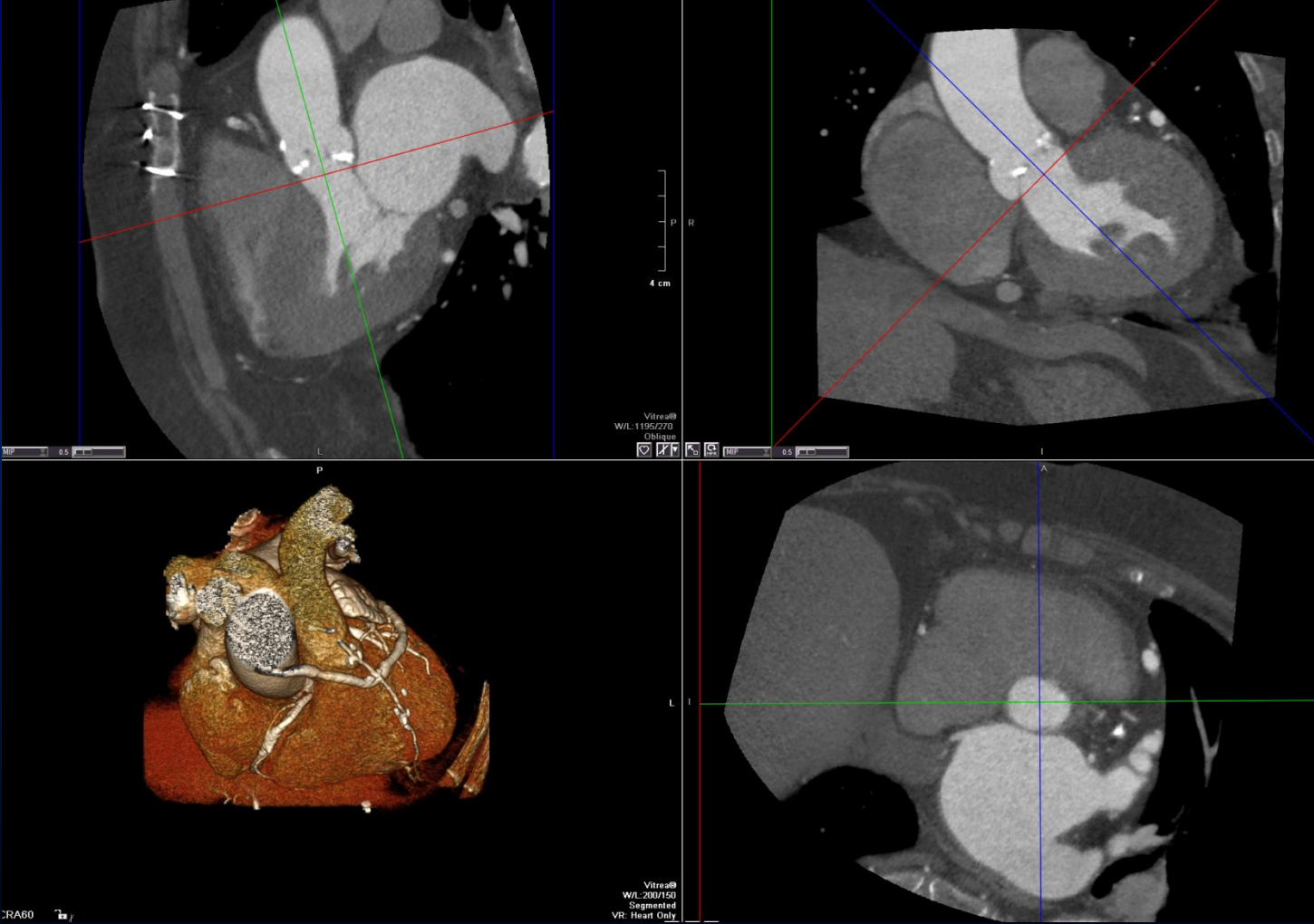


Circular area  
Planimetered area

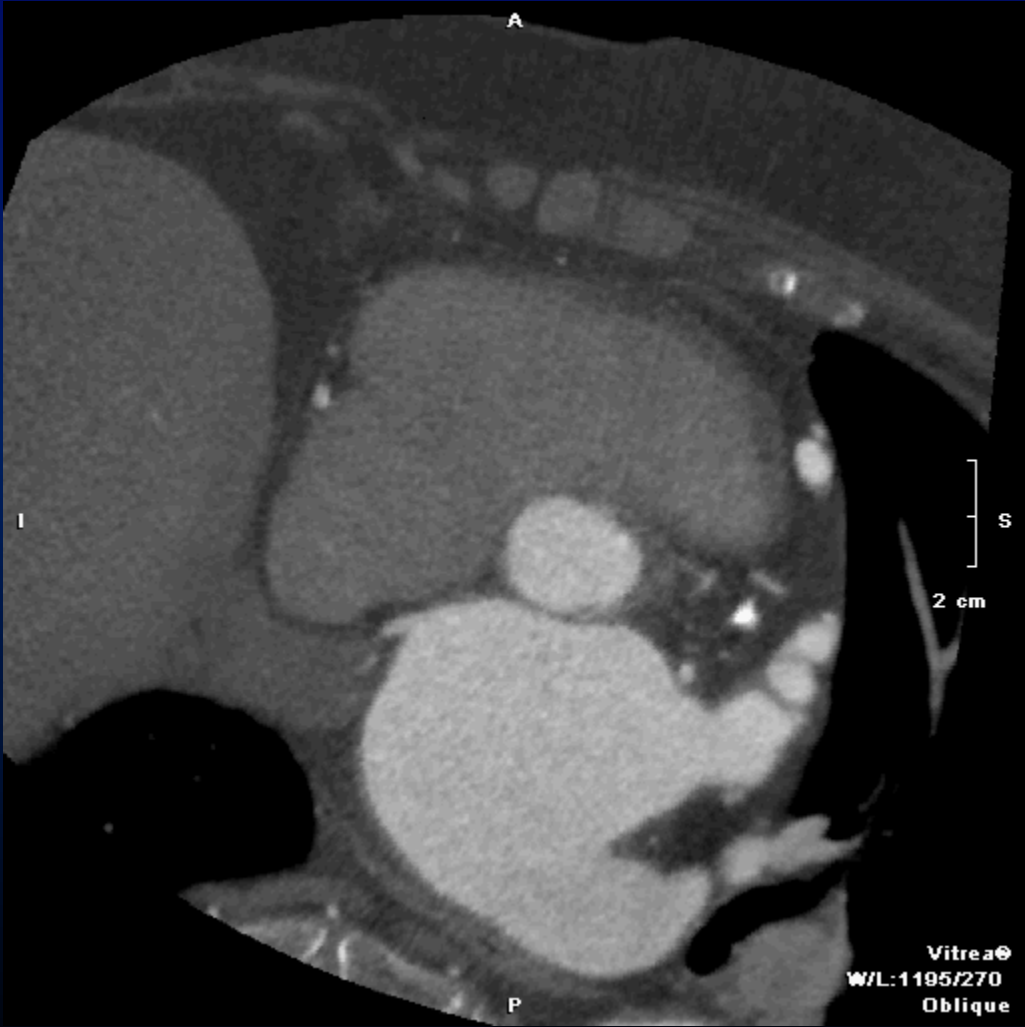


Planimetered area

# Aortic valve annular dimensions



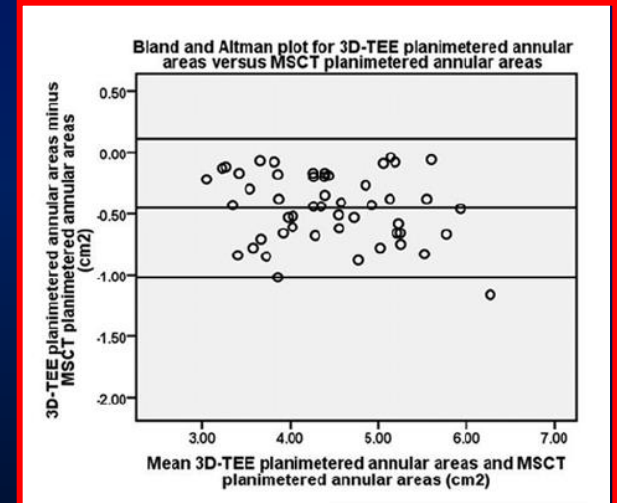
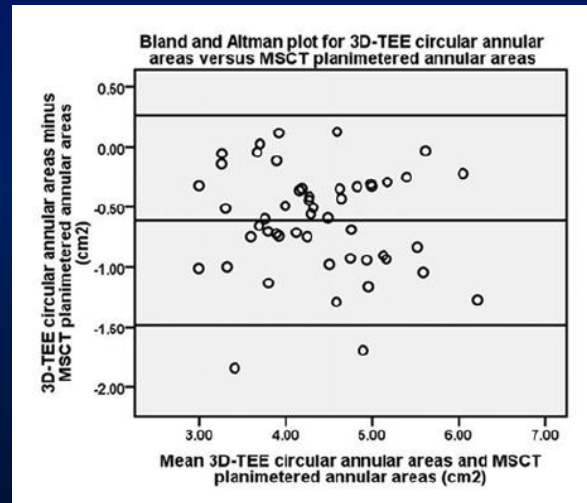
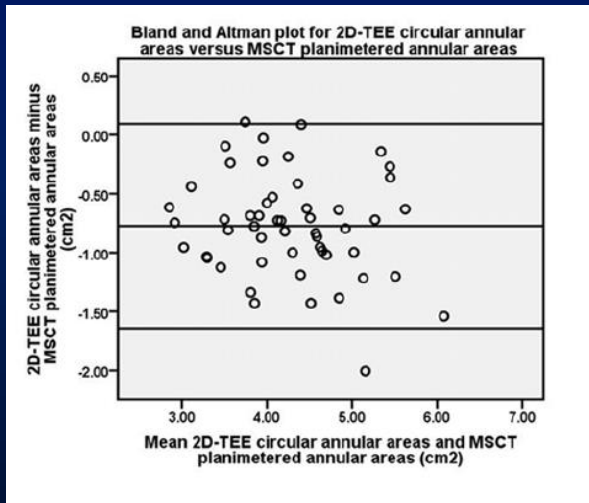
# Aortic valve annular dimensions



# Aortic valve annular dimensions 2D-TEE vs. 3D-TEE vs. MSCT

Circular area

Planimetered area



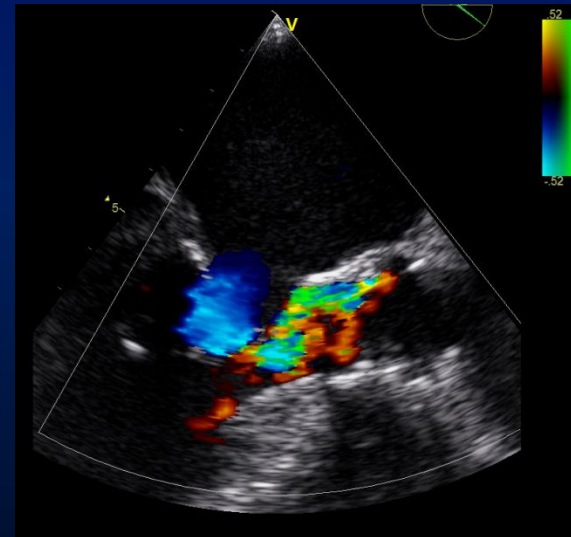
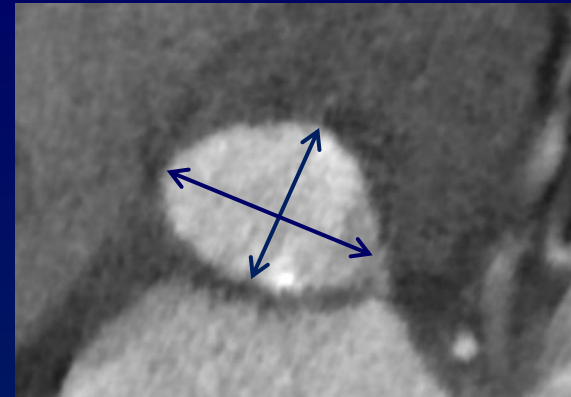
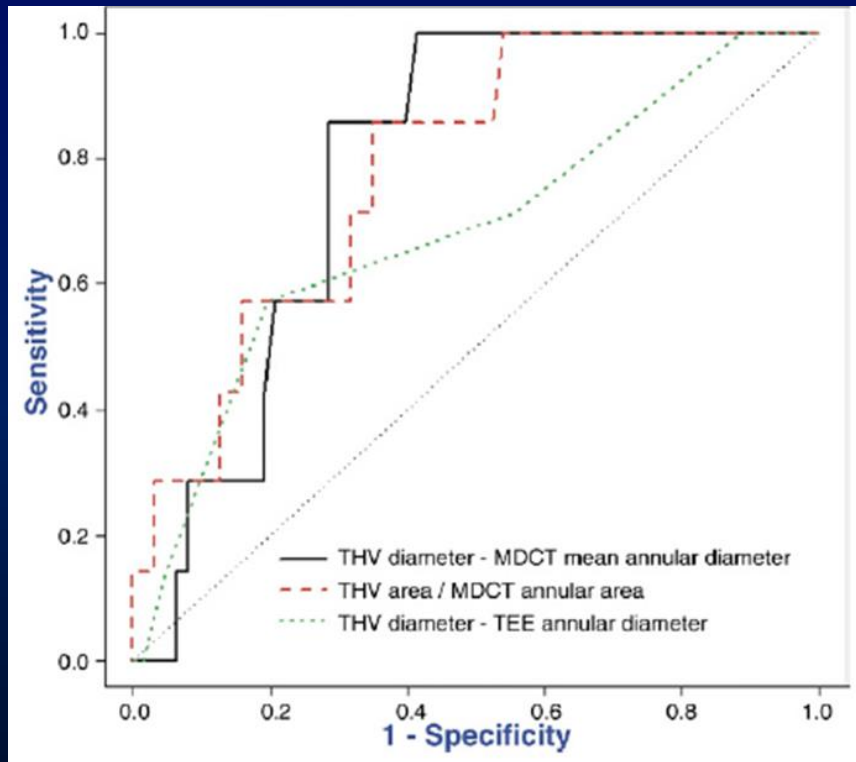
2D TEE vs. MSCT

3D TEE vs. MSCT

3D TEE vs. MSCT



# Aortic annulus dimensions and PVAR



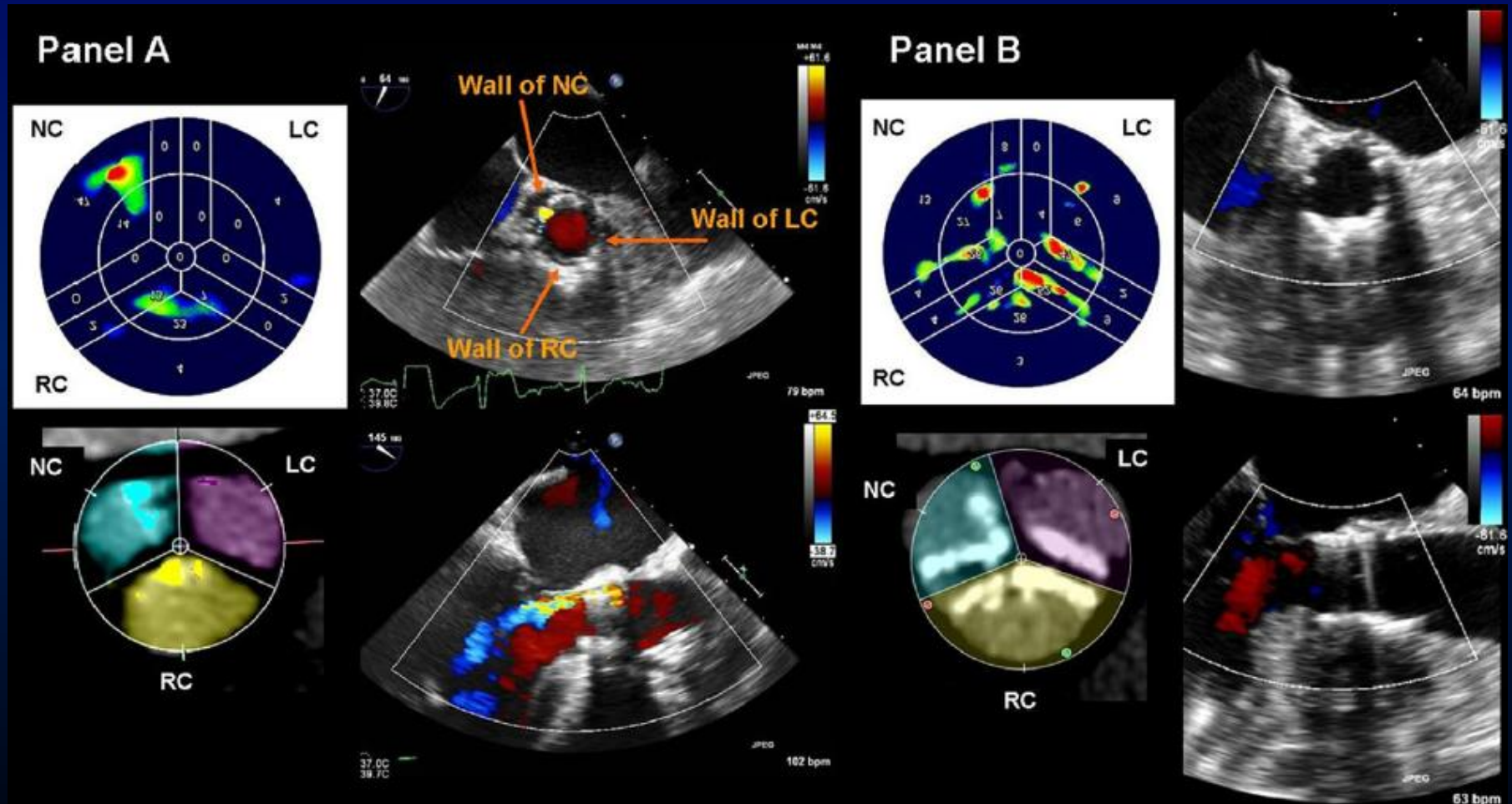
THV-MDCT mean annular diameter: 0.81 95% CI: 0.68-0.88  
THV-TEE annular diameter: 0.70 95% CI: 0.50-0.88

# Aortic valve calcifications and PVAR

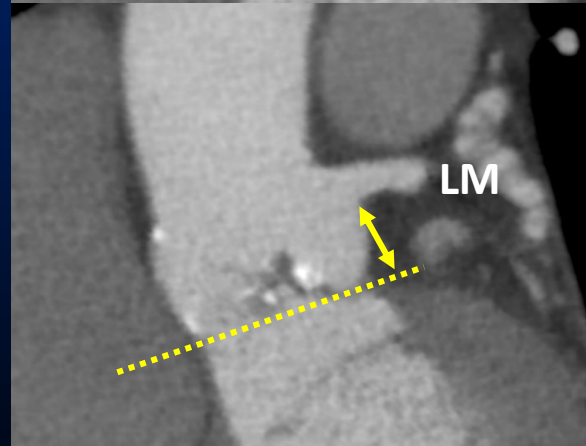
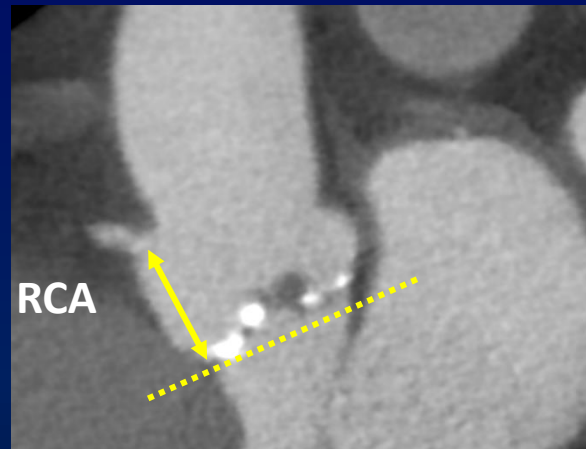
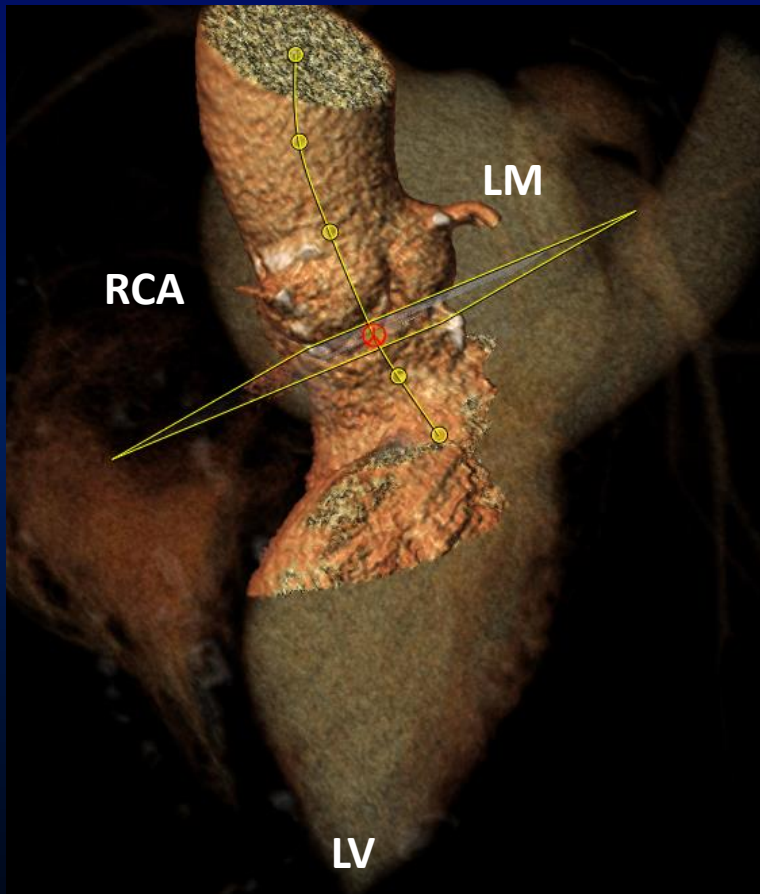




# Aortic valve calcifications and PVAR

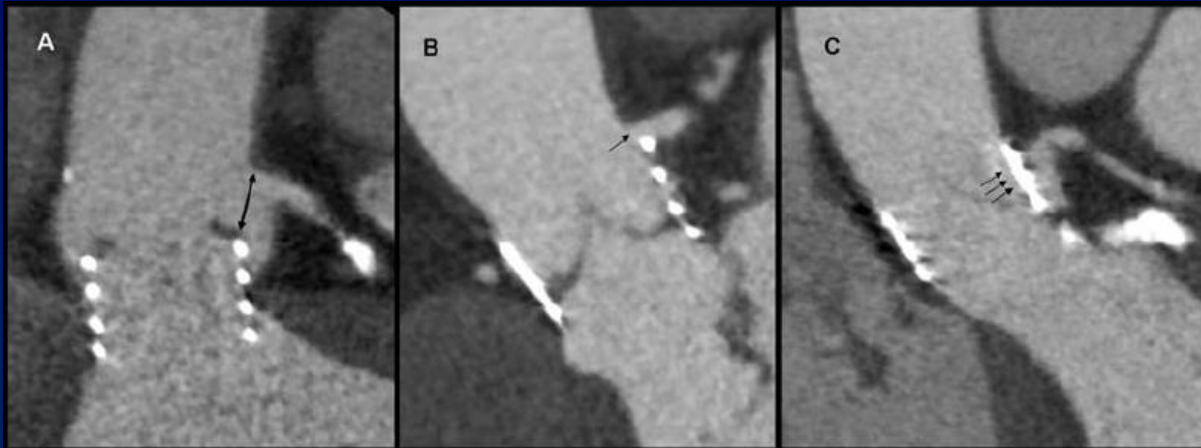


# Coronary ostia



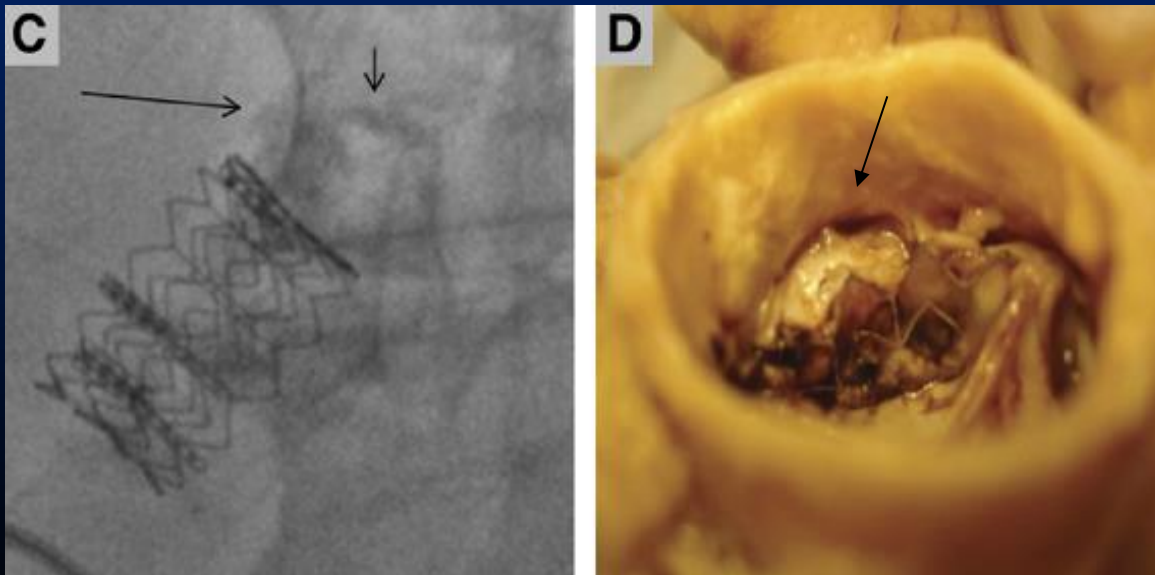
Distance relative to  
the annular plane  
 $\geq 10-11$  mm

# Coronary ostia



11% of patients  
the prosthesis device  
reaches coronary ostia

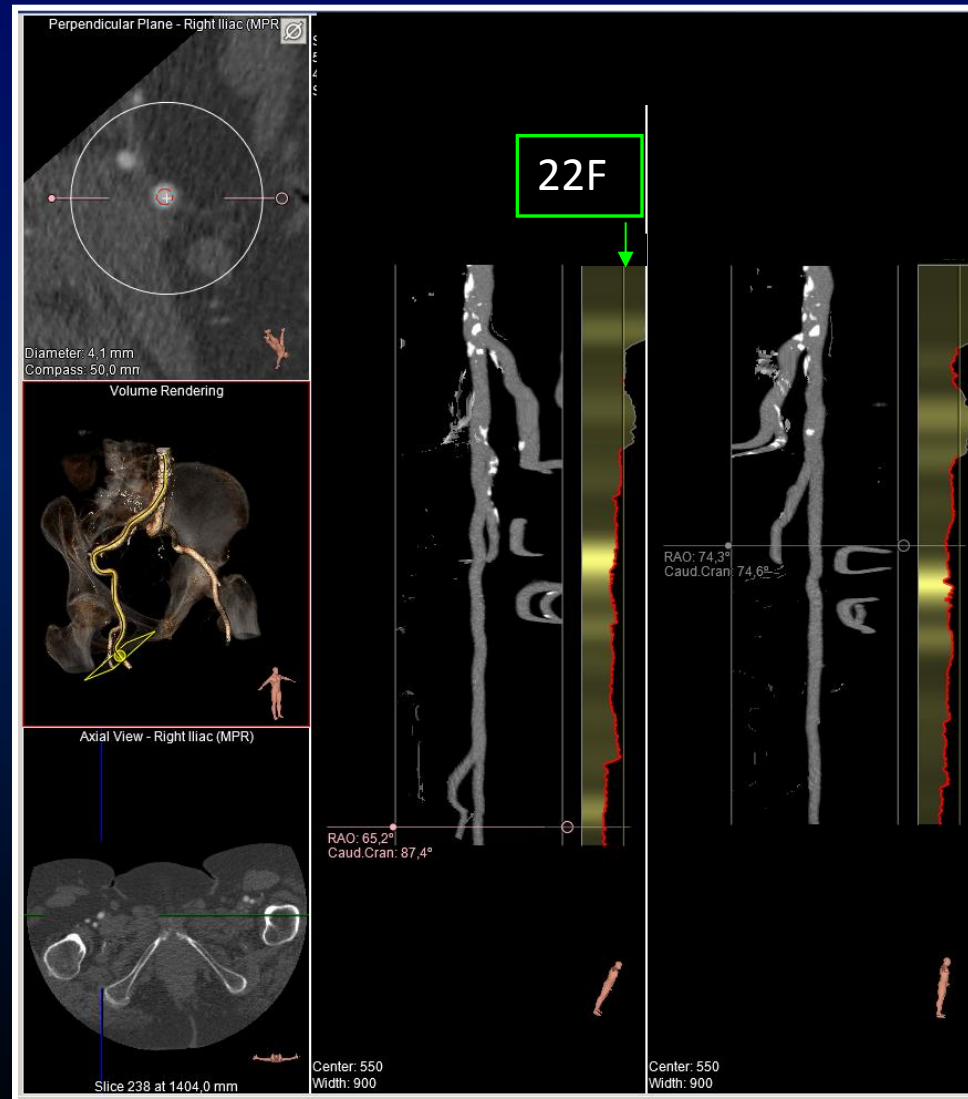
Delgado et al. EHJ 2010



Occlusion of coronary  
ostia by bulky calcified  
leaflets uncommon but  
fatal

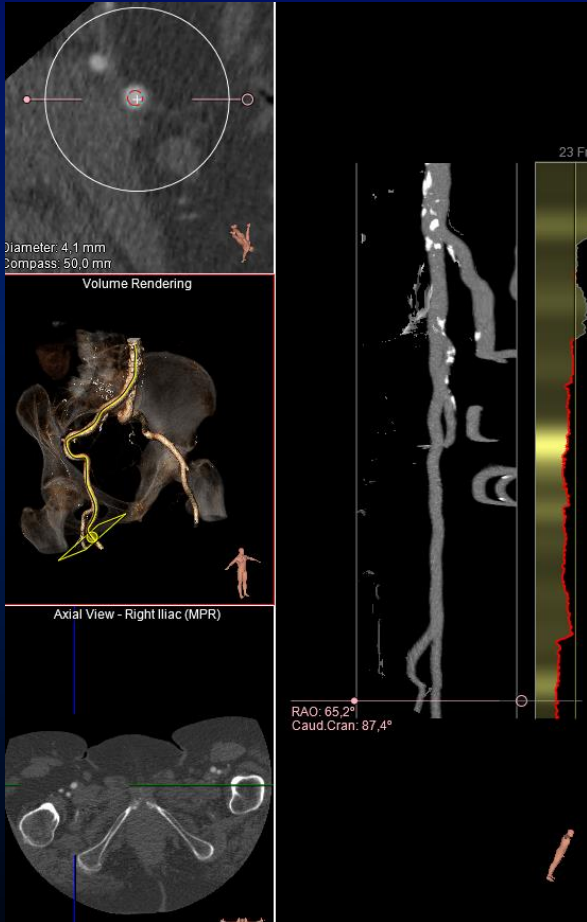
Masson et al. JACC Int 2009

# Peripheral arteries and aorta





# Anatomical requirements TAVI



**Edwards SAPIEN XT**

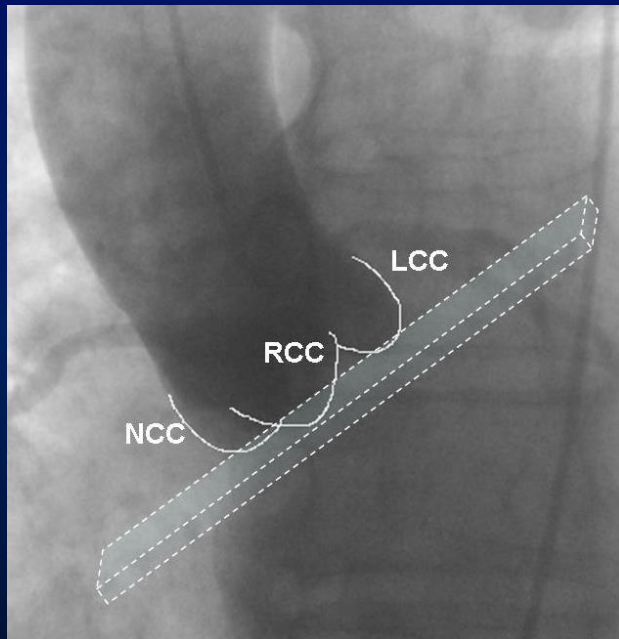
23-mm	≥6 mm
26-mm	



**Medtronic CoreValve**

26-mm	≥6 mm
29-mm	

# Setting the fluoroscopy planes



# 320-row CT acquisition for TAVI

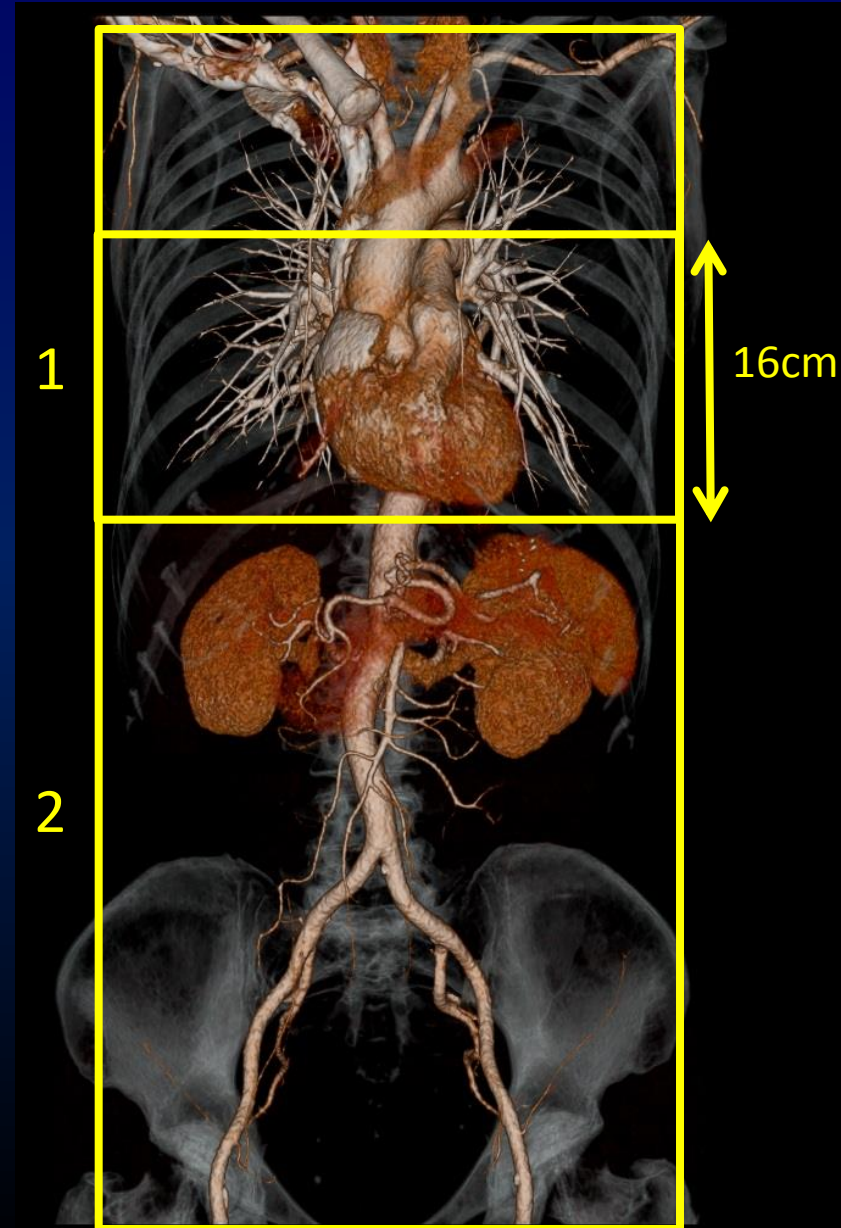
## 1. ECG-triggered volume scan (one beat):

- Aortic root
- Coronary anatomy
- Left ventricular geometry and function

## 2. Ultra Helical scan:

- Subclavian arteries
- Aorta
- Peripheral arteries

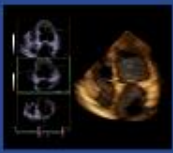
Fast, single breath hold acquisition with low radiation and contrast dose



# Procedural planning: check list

Parameters	MDCT view	Anatomical structure	Units
Aortic root dimensions	Double oblique transverse	Ascending aorta (1)	mm
		Sino-tubular junction (2)	mm
		Sinus of Valsalva (3)	mm
		Aortic valve annulus (4)	mm
Left ventricle	Double oblique transverse	Outflow tract (5)	mm
Aortic valve	Double oblique transverse	Valve calcifications(6)	Score (1-4)
Relative distance of the coronary ostia to the aortic valve annular plane	Sagittal	Left main ostium(7)	mm
	Sagittal	Right coronary ostium (8)	mm
Peripheral arteries and thoracic aorta	Cross sectional	Luminal diameter (9)	mm
	Stretched view	Calcifications (10)	Score
	Stretched view	Tortuosity (10)	Score (Y/N) Angle°





## Conclusions

- CT and MRI have a complementary role to 3D echocardiography in the evaluation of patients with valvular heart disease
  - Valvular morphology
  - Valvular regurgitation assessment
  - Selection of patients candidates for transcatheter valve repair/replacement