

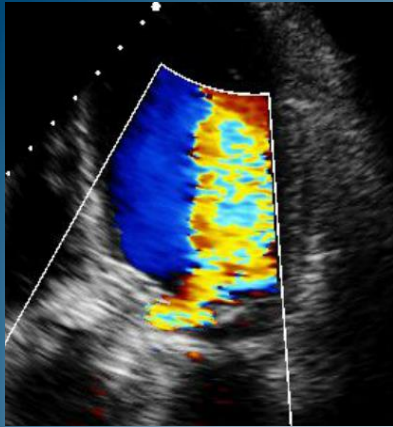
# Annular Sizing Algorithm with MDCT

**Sung-Han Yoon, MD**

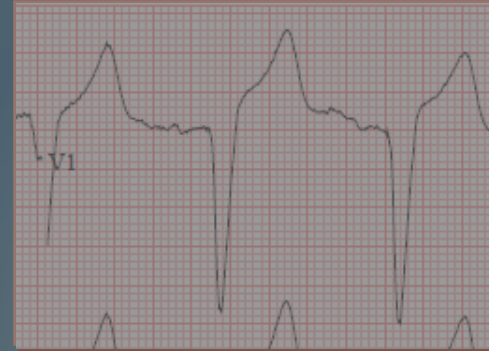
Asan Medical Center, Heart Institute,  
University of Ulsan College of Medicine, Seoul, Korea

# Current Limitations of TAVI

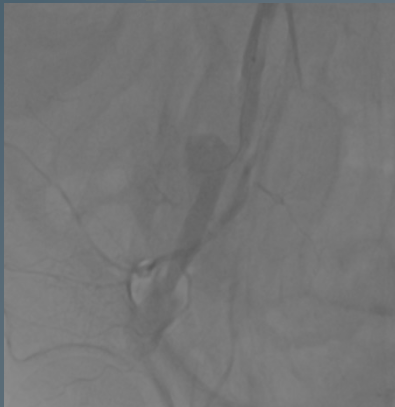
## Paravalvular Leak



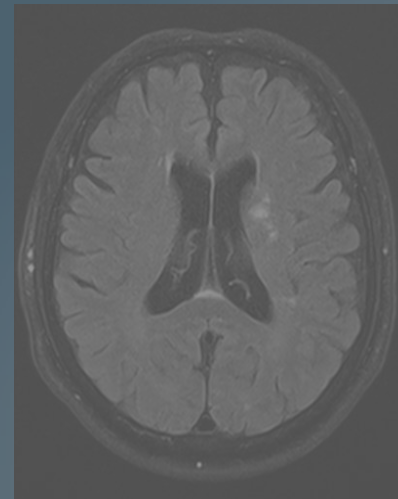
## Conduction Disturbance



## Vascular Complication



## Stroke



# Incidence of PVL

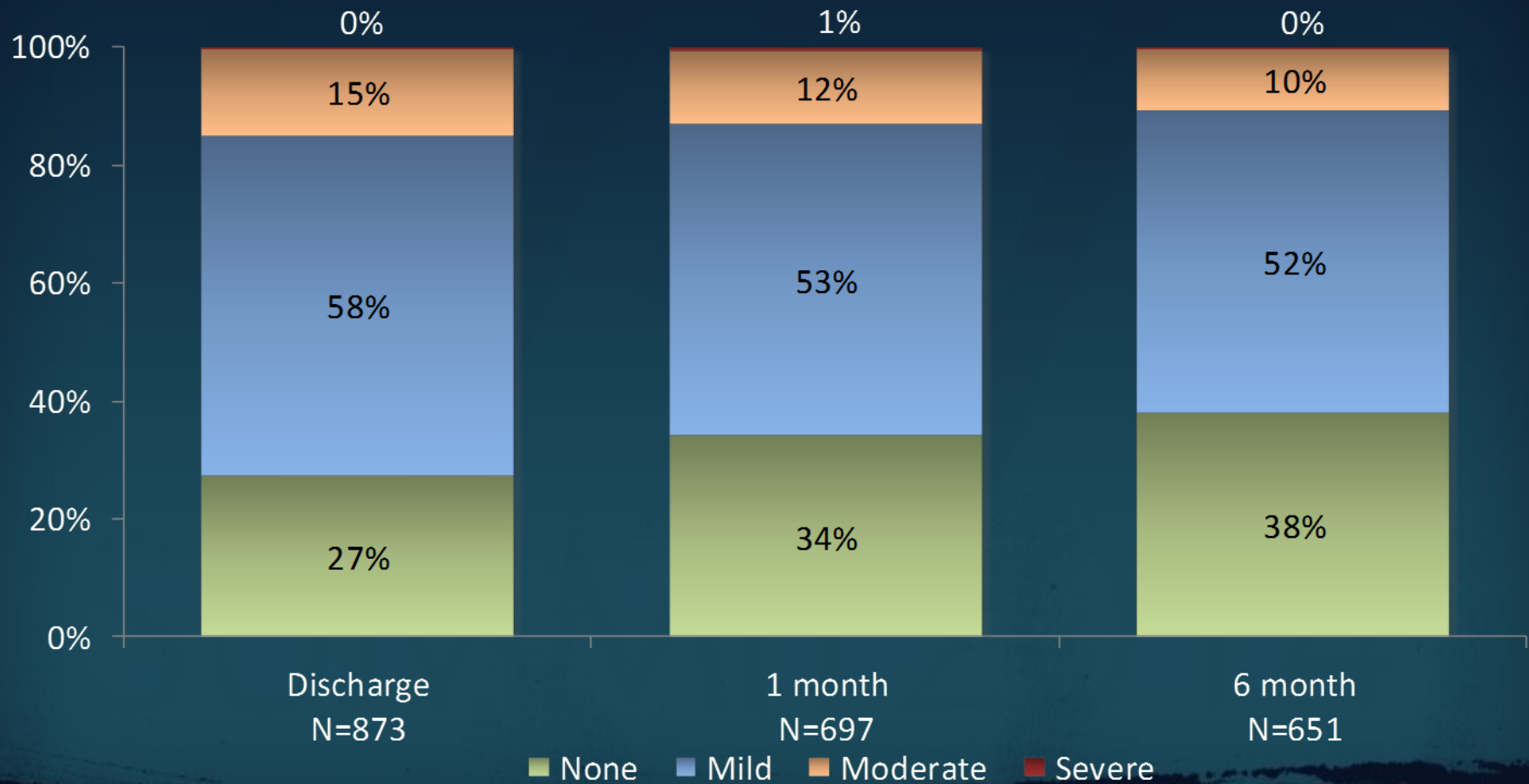
## PARTNER A trial Edward SAPIEN



# Incidence of PVL

## ADVANCE Registry CoreValve

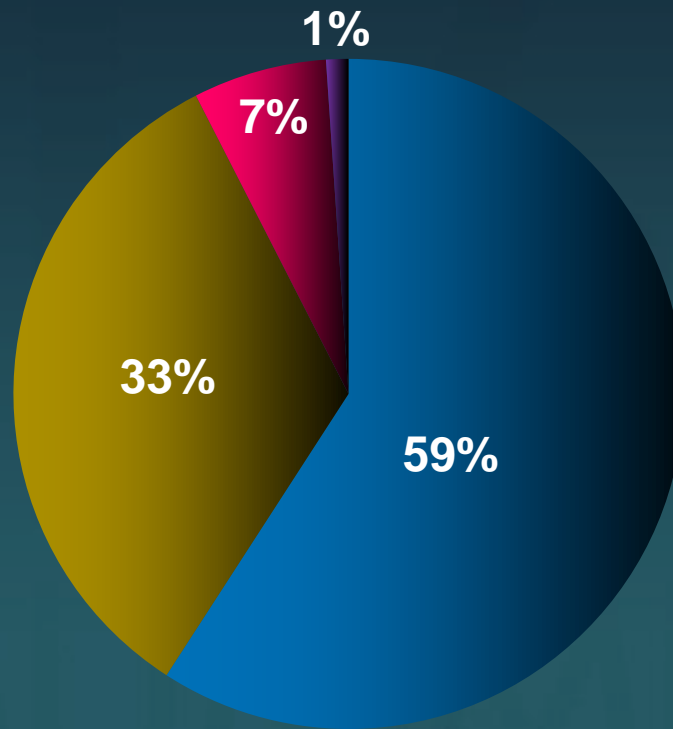
*echo assessment*



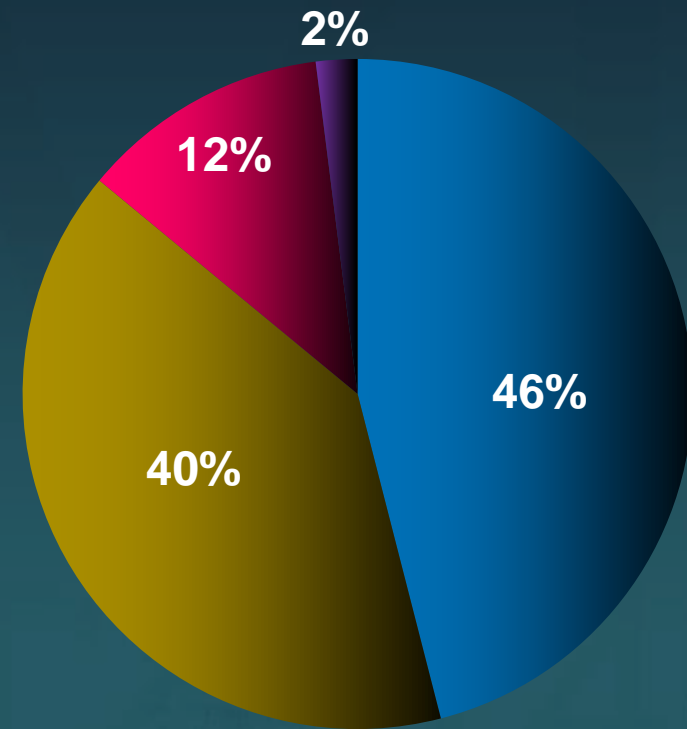
# Incidence of AR

## Asian TAVI Registry

### SAPIEN

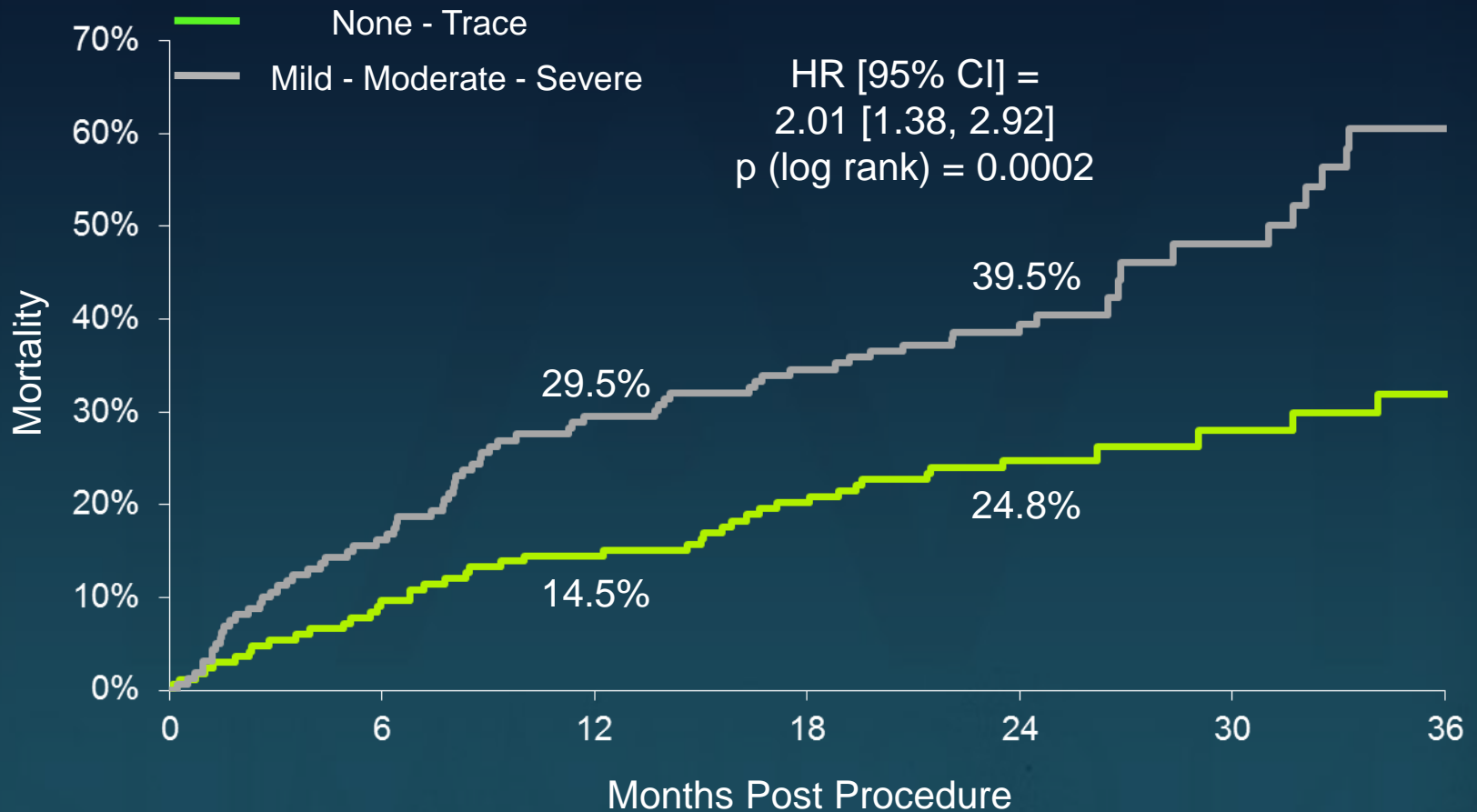


### CoreValve



# PVL and Mortality

## PARTNER A trial Edward SAPIEN

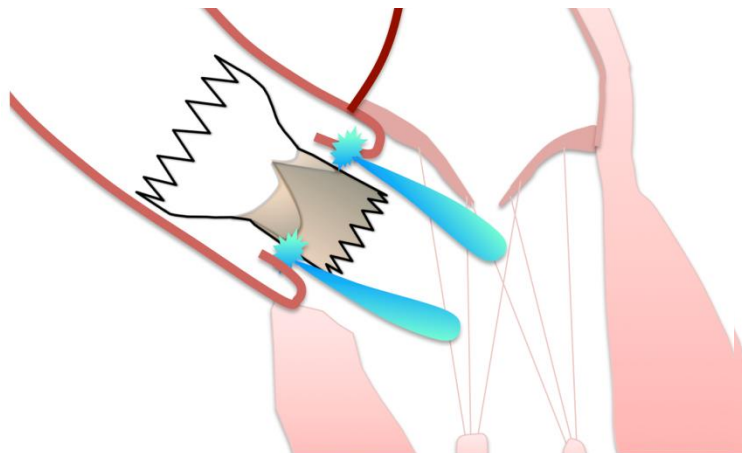


### Numbers at Risk

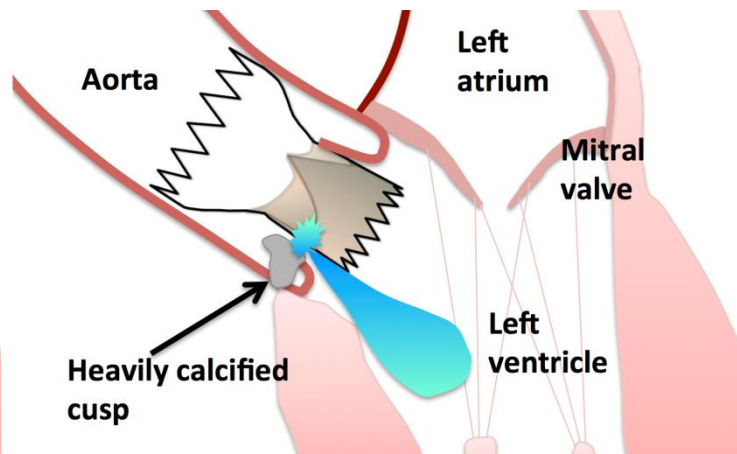
	0	6	12	18	24	30	36
None-Tr	167	149	140	126	87	41	16
Mild-Mod-Sev	160	134	112	101	64	26	12

# Mechanism of Paravalvular Leak

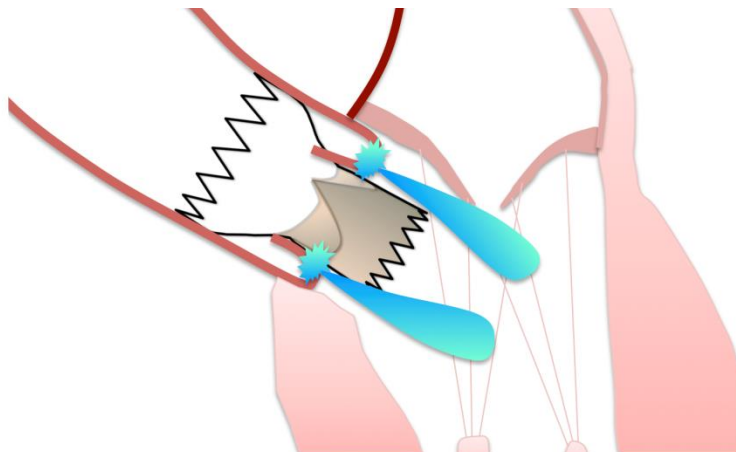
## Undersizing



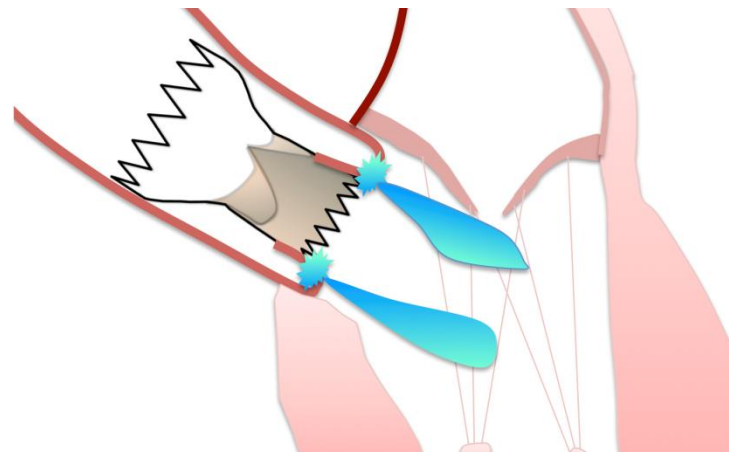
## Calcification



## Too low

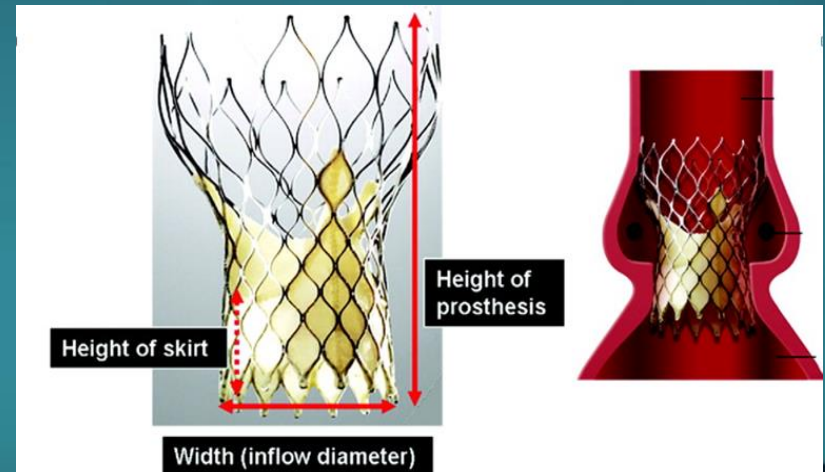
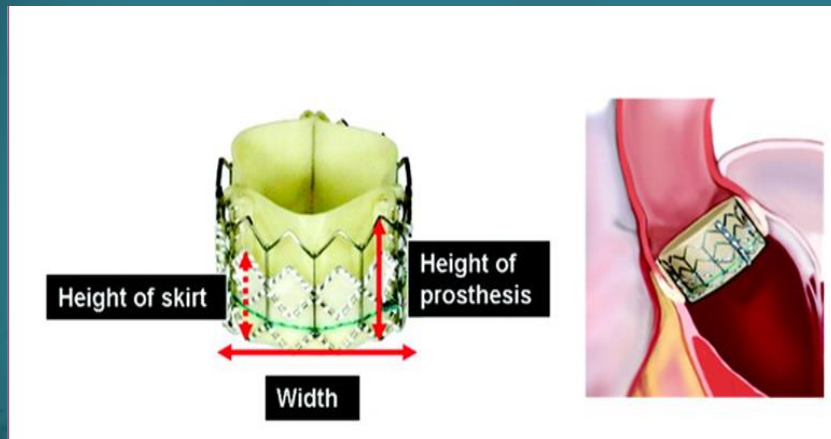


## Too high



# Previous Device Size Selection

	Diameter	Height	Height of skirt	Annulus diameter (TEE)
Edward SAPIEN™	23	14.5	10.1	18 – 22
	26	16	11.4	21 – 25
Core Valve Revalving™	26	55	12	20 – 23
	29	53	12	23 – 27



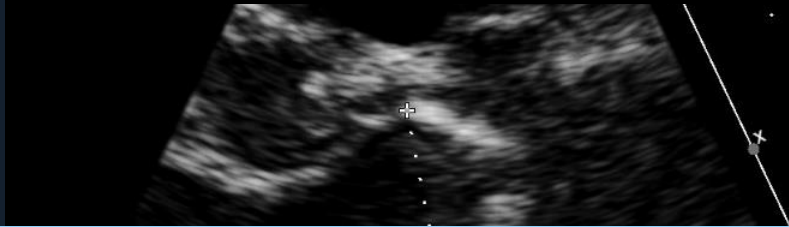


# Medtronic CoreValve Case

- 79 y/o female with severe AS
- Chief complaint: Chest pain, DOE (NYHA class III)
- Medical history: Hypertension, hyperlipidemia, and CAD, s/p PCI (LCX)
- Tricuspid AV
- Severe degenerative AS
- Peak / mean PG = 82 / 47 mm Hg
- LVEF = 68%

# Echocardiography

TTE



0 151 180



TEE



Medtronic CoreValve **26mm** was selected  
(*12% diameter oversizing*)



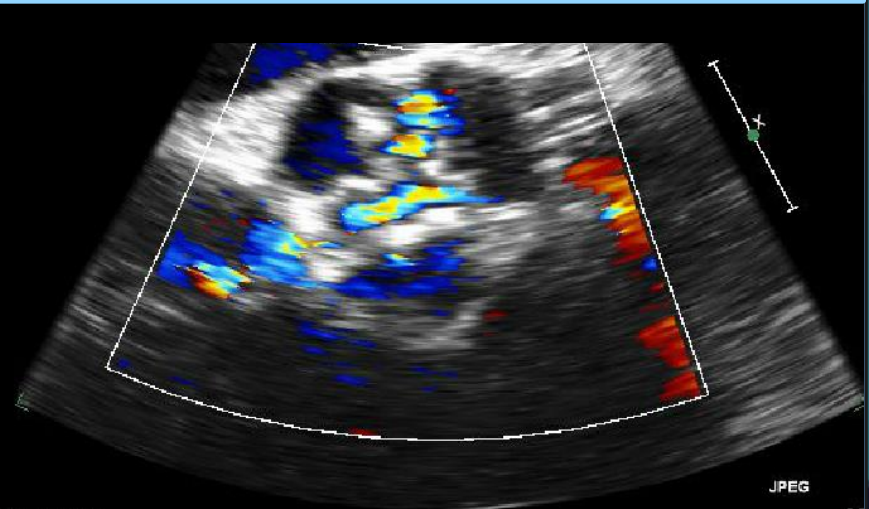
%  
MHz  
High

G  
H

JPEG

71

PAT T: 37.0C  
TEE T: 39.1C



JPEG

90

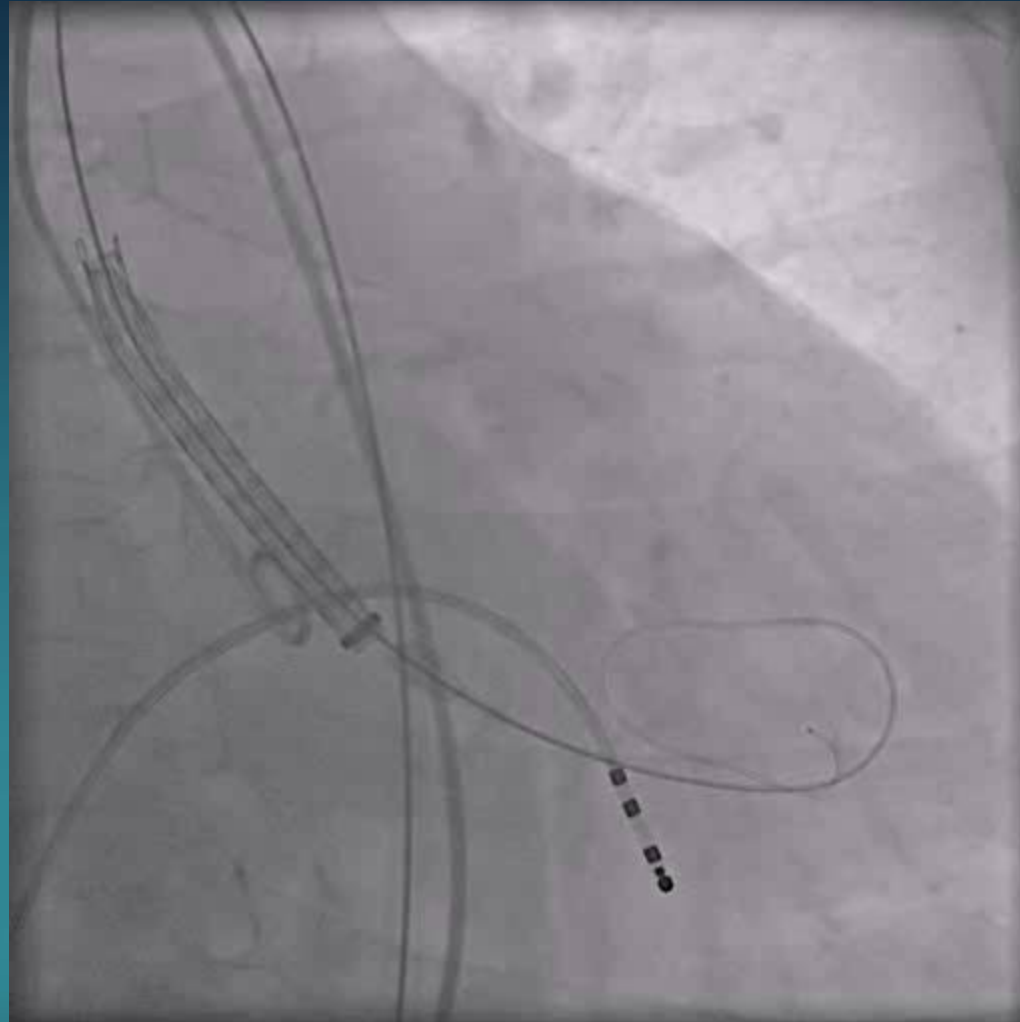
# Medtronic CoreValve case

## Balloon Aortic Valvuloplasty



# Medtronic CoreValve case

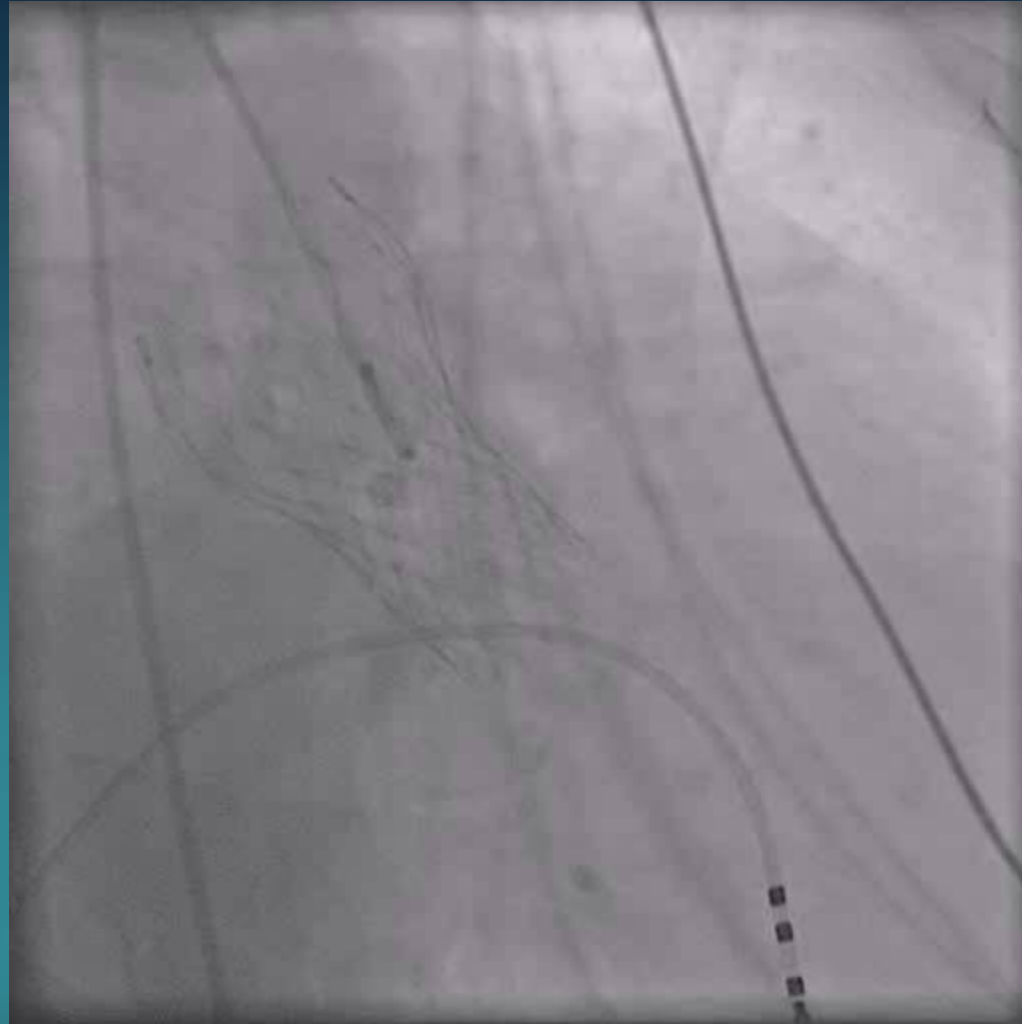
## Valve Implantation



*Optimal Position*

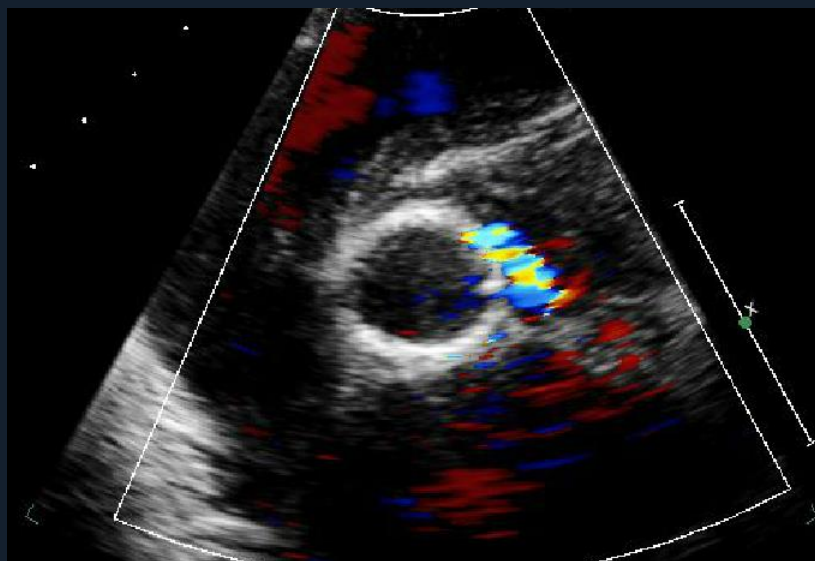
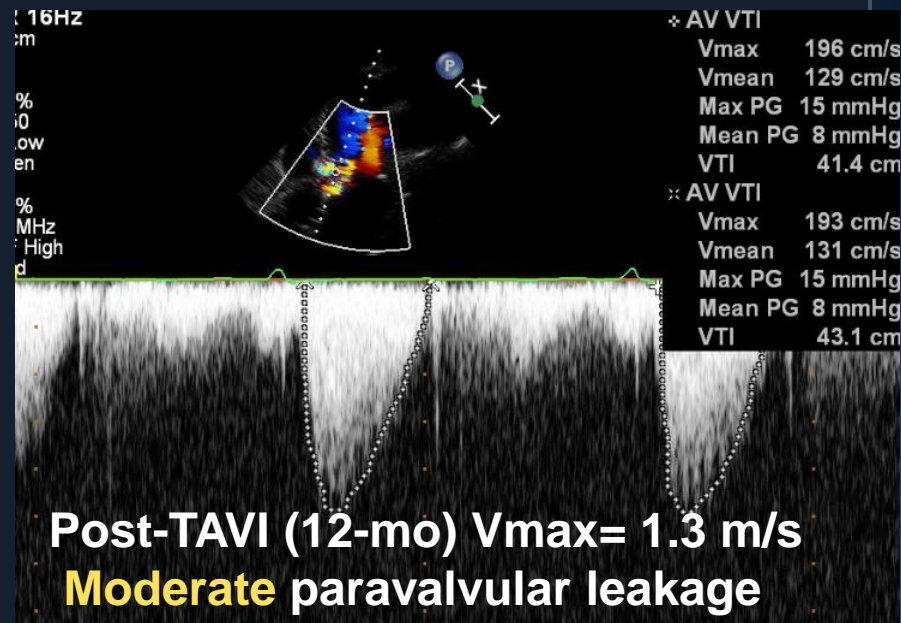
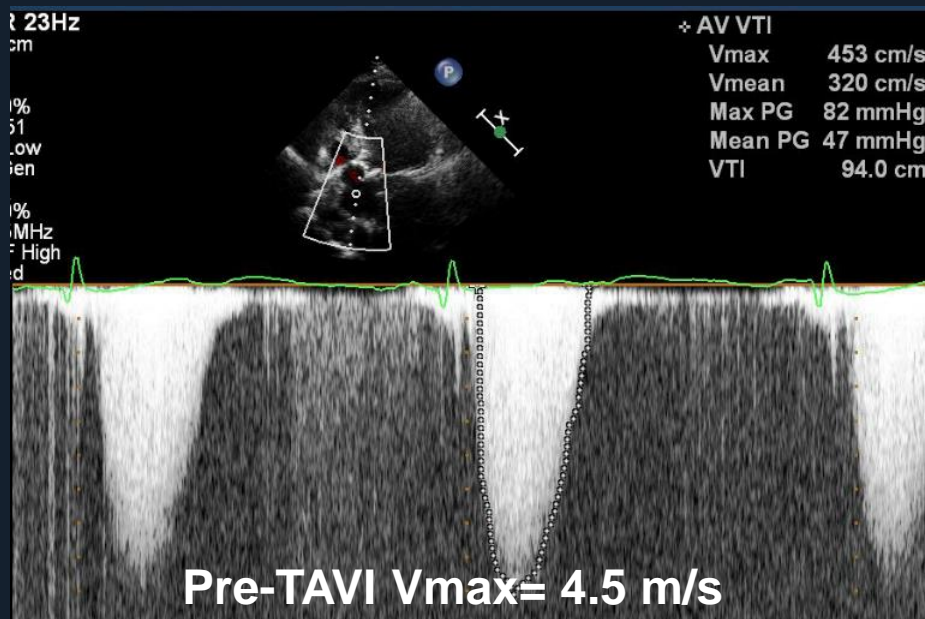
# Medtronic CoreValve case

## Final Aortography



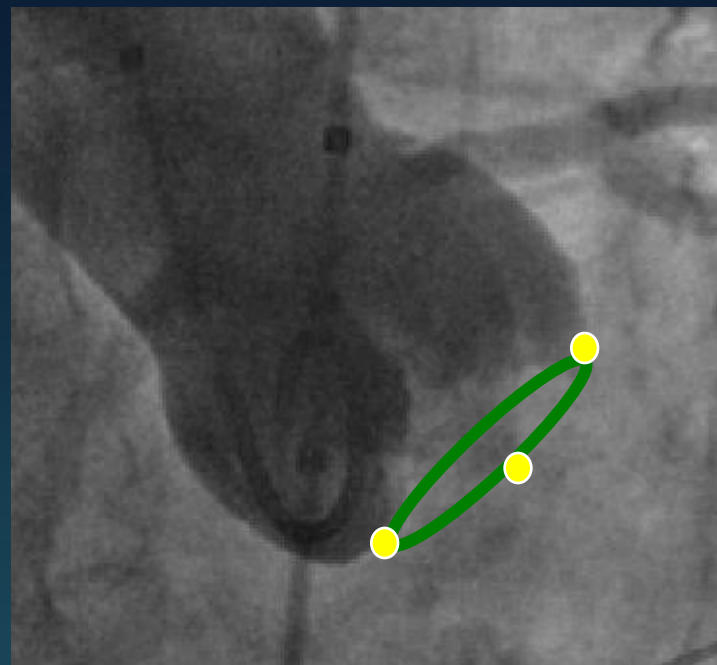
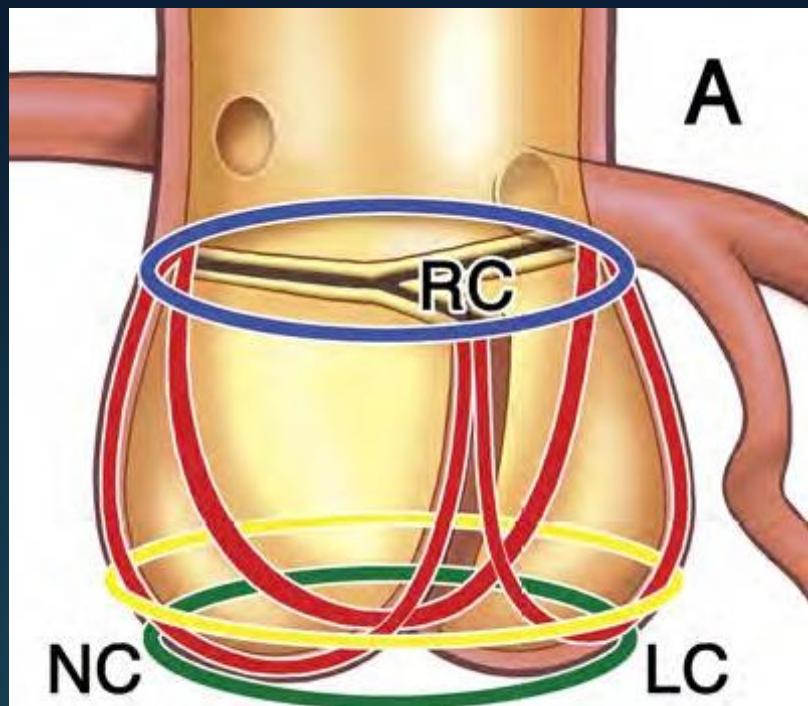
***Moderate AR***

# Residual Paravalvular Leak



# Virtual Basal Ring

## Correct Assessment of Annulus Size



— Sinotubular junction

— Aortic leaflets

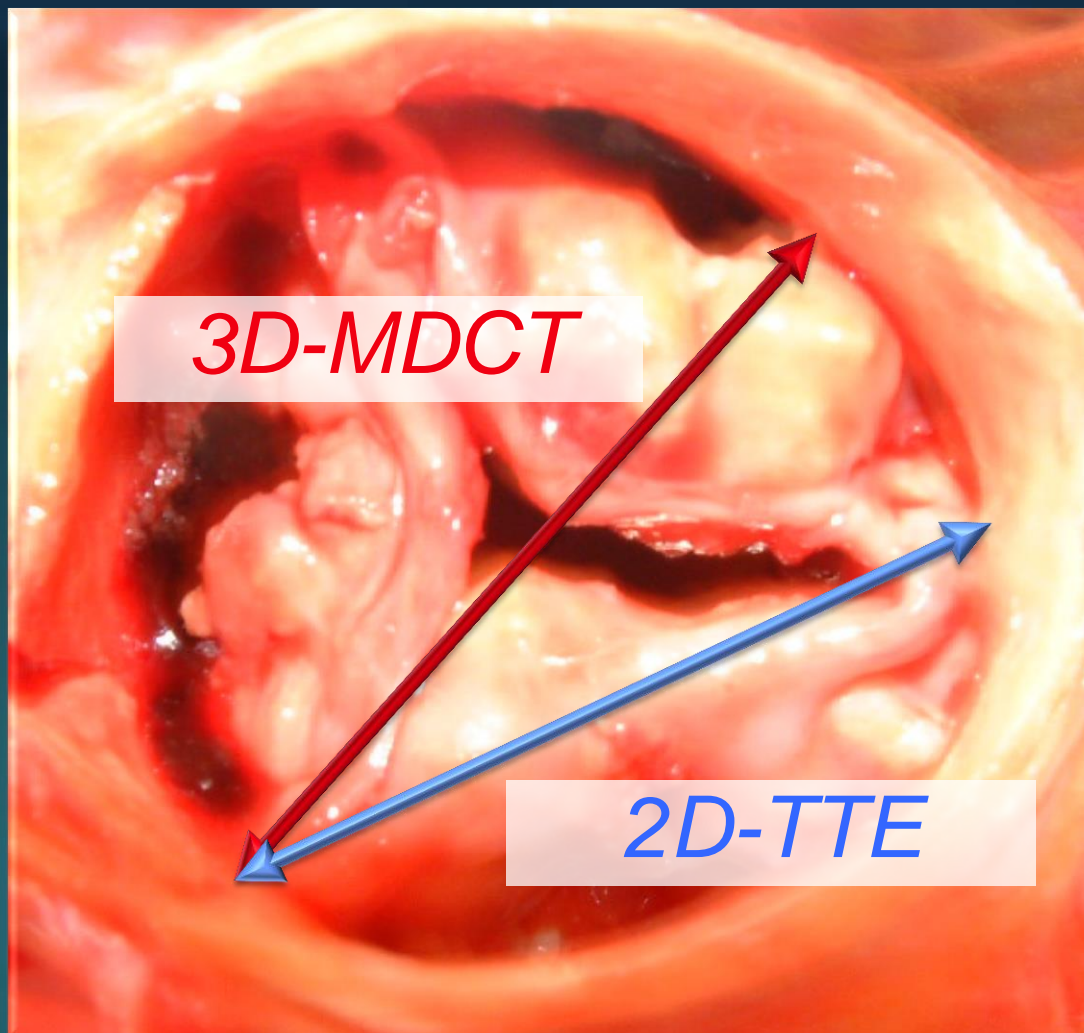
— Aortic Annulus

— Aortic Annular Diameter

RC = Right coronary cusp; NC = Non-coronary cusp;  
LC = Left coronary cusp

# Virtual Basal Ring

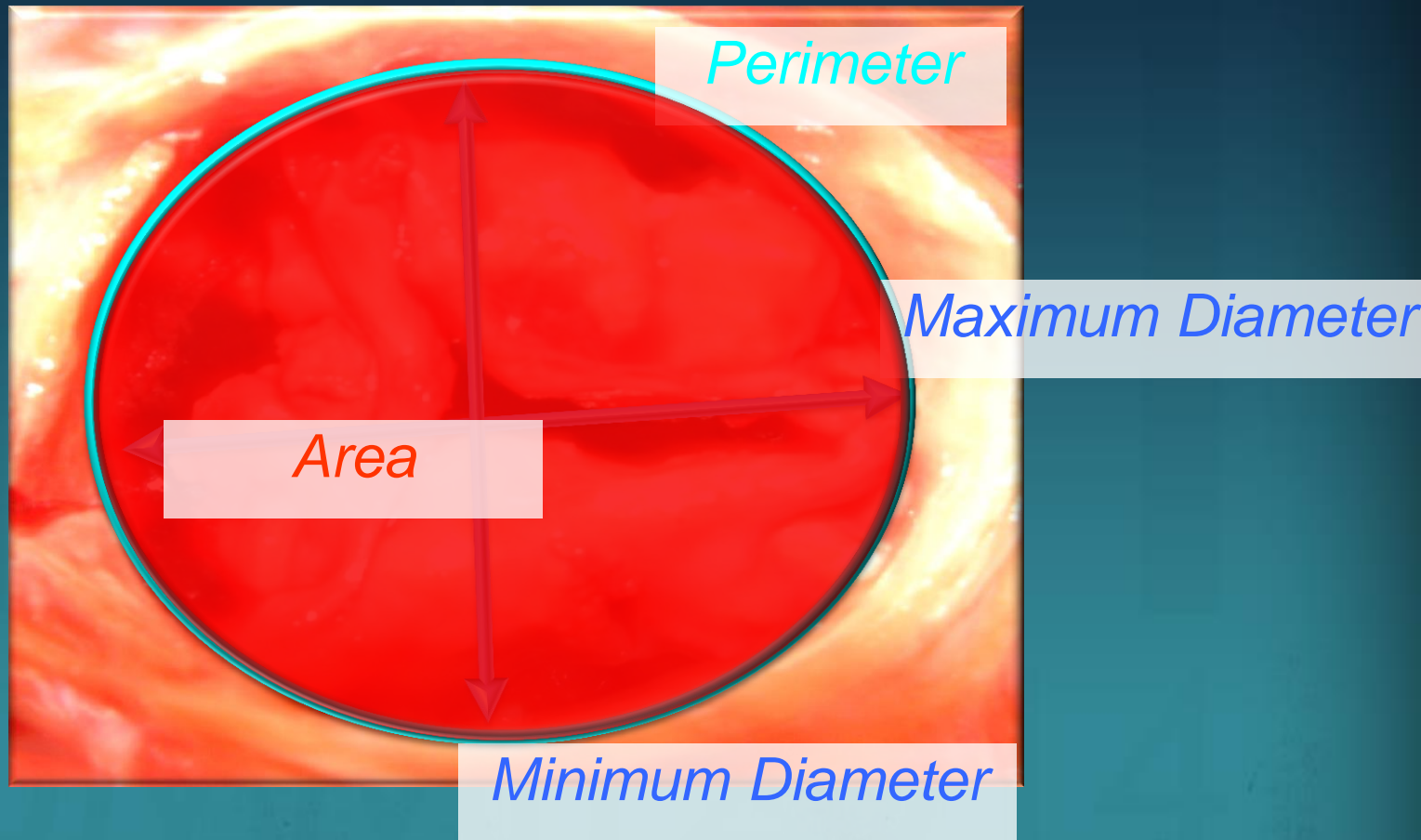
## Correct Assessment of Annulus Size





# Virtual Basal Ring

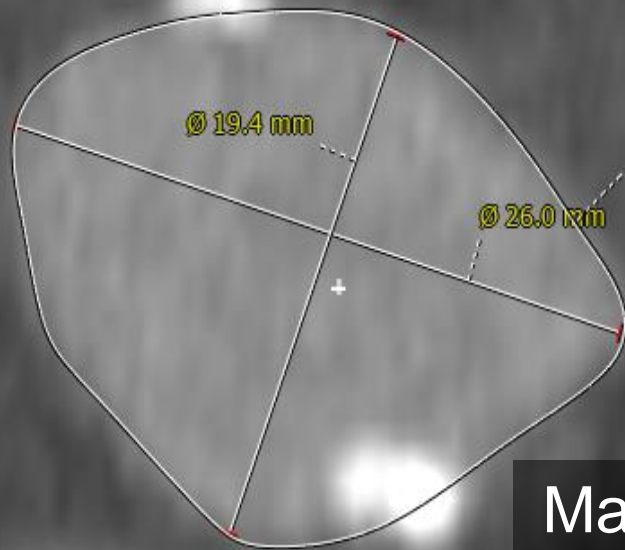
## Correct Assessment of Annulus Size



# Virtual Basal Ring

## MDCT Measurement of Annulus

Minimal D : 19.4 mm



Area : 350.7 mm<sup>2</sup>  
Area derived D : 21.1 mm

Perimeter: 69.0 mm  
Perimeter derived D: 22.0 mm

Maximal D : 26.0 mm

# Predictor Analysis for PVL

## AMC SAPIEN Registry



## AMC CoreValve Registry

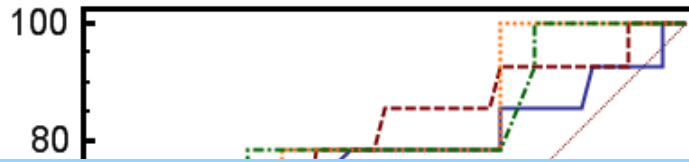


Feb 2010 to Apr 2014

<b>Total</b> <b>131</b>	<b>SAPIEN</b> <b>61</b>	<b>CoreValve</b> <b>70</b>
----------------------------	----------------------------	-------------------------------

# MDCT measurements and CoreValve

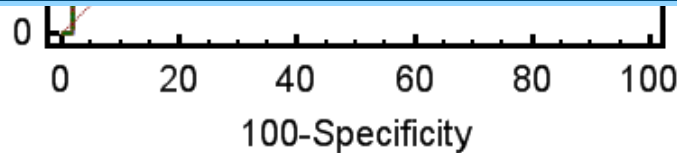
## AMC CoreValve Registry



**MDCT measurements are predictive of PVL**

***Perimeter oversizing (> 9%)***

***Area oversizing (> 25%)***



	AUC	95% CI
$\Delta$ Valve D – Maximum D, mm	0.68	0.56 – 0.79
$\Delta$ Valve D – Min D, mm	0.71	0.59 – 0.82
Perimeter oversizing, %	0.77	0.65 – 0.86
Area oversizing, %	0.77	0.64 – 0.86

# Retrospective MDCT Measurement



Aortic Annulus parameters	
Annulus short diameter	22.3 mm
Annulus long diameter	27.3 mm
Annulus mean diameter	24.8 mm
Annulus area	485 mm <sup>2</sup>
Annulus area-driven diameter	24.9 mm
Annulus perimeter	78.9 mm
Annulus perimeter-driven diameter	25.1 mm

**CoreValve 29mm** should be selected  
→ **Area 36%, Perimeter 15% oversize**



# Device Size Selection

## CoreValve



### Annulus Area (mm<sup>2</sup>)

314	416	530	573	661
-----	-----	-----	-----	-----

### Perimeter (mm)

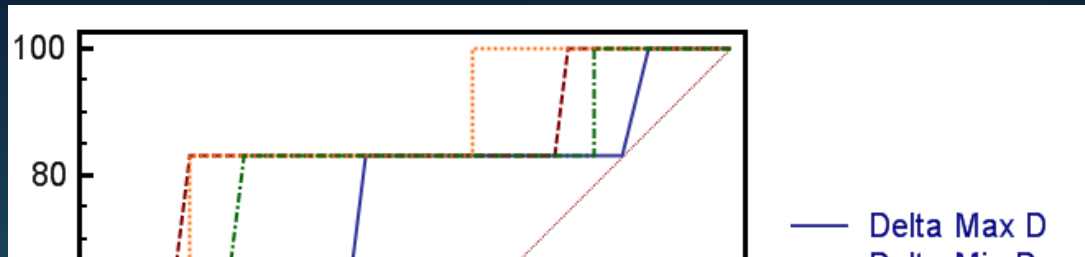
62.8	72.3	81.7	84.8	91.1
------	------	------	------	------

### AsAo Width (mm)

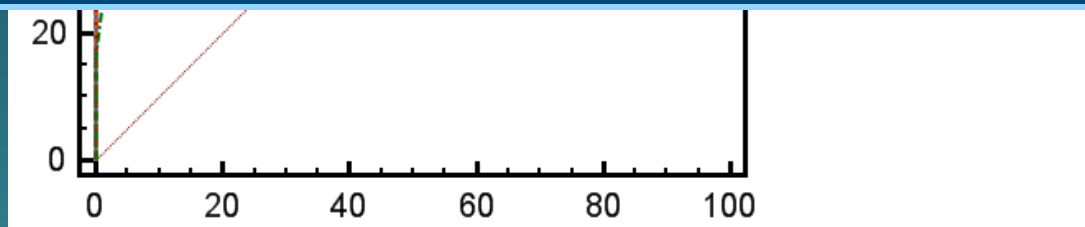
40 ≤	43 ≤	43 ≤
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# MDCT measurements and SAPIEN

## AMC SAPIEN/ XT Registry



**Area oversizing strongly predict PVL**  
***Cut-off point 6%***



	AUC	95% CI
$\Delta$ Valve D – Maximum D, mm	0.75	0.61 – 0.86
$\Delta$ Valve D – Min D, mm	0.83	0.71 – 0.92
Perimeter oversizing, %	0.80	0.67 – 0.90
Area oversizing, %	0.86	0.74 – 0.94

# Device Size Selection

## SAPIEN XT

Annulus Area (mm<sup>2</sup>)

300	380	415	490	530	620
-----	-----	-----	-----	-----	-----

<b>23 mm</b> (415mm <sup>2</sup> )	<b>26 mm</b> (530mm <sup>2</sup> )	<b>29 mm</b> (660mm <sup>2</sup> )
---------------------------------------	---------------------------------------	---------------------------------------



**Undersizing**

**Extreme Oversizing**

**Undersizing**

**Extreme Oversizing**

*Finalize annular sizing through BAV and aortography*



# Edwards SAPIEN case # 2

- 86 y/o female with severe AS
- Chief complaints: DOE (NYHA class III), presyncope
- Medical history: Hypertension, hyperlipidemia, diabetes (oral medication)
- Tricuspid AV
- Severe degenerative AS
- Peak / mean PG = 96 / 64 mm Hg
- LVEF = 63%

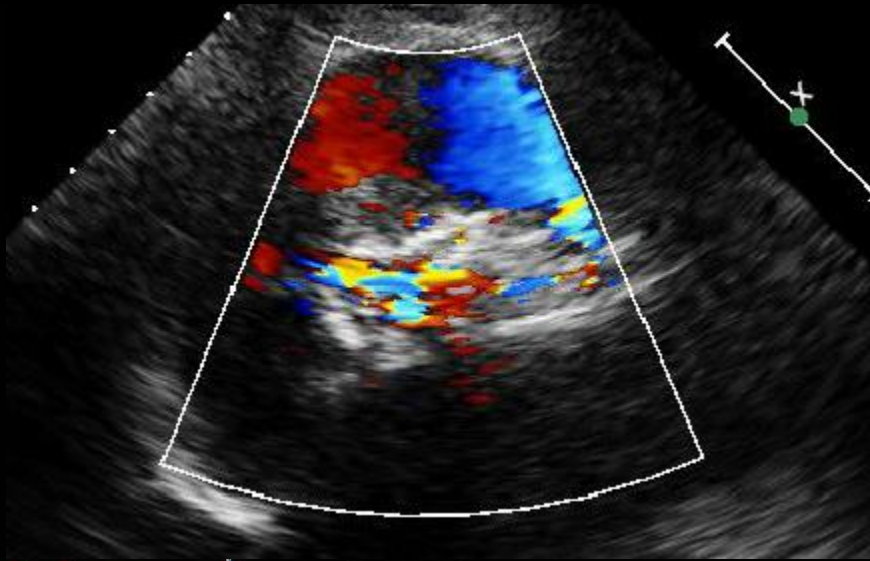
# Echocardiography

TTE

oom  
n  
29  
/0  
nm/s



Annulus diameter = 18.3mm



TEE

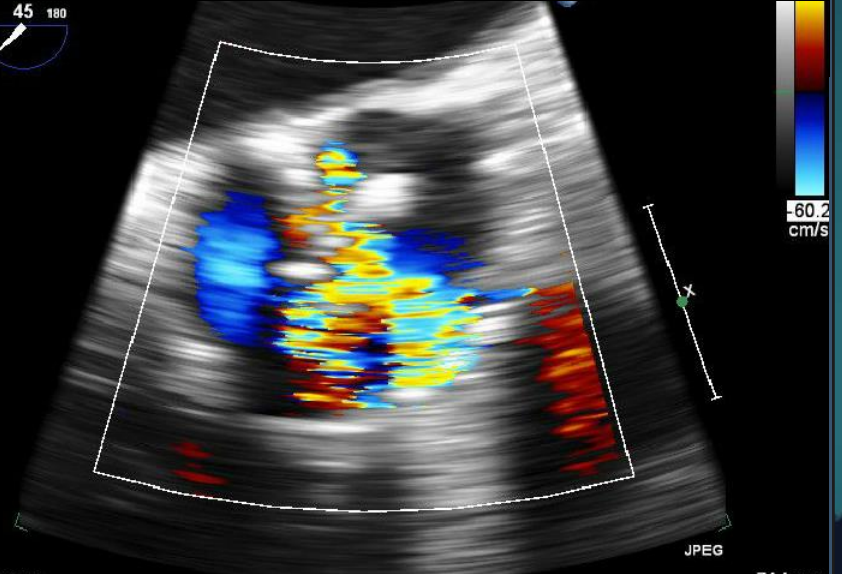
Dist 1.83 cm  
Dist 3.25 cm  
Dist 2.65 cm



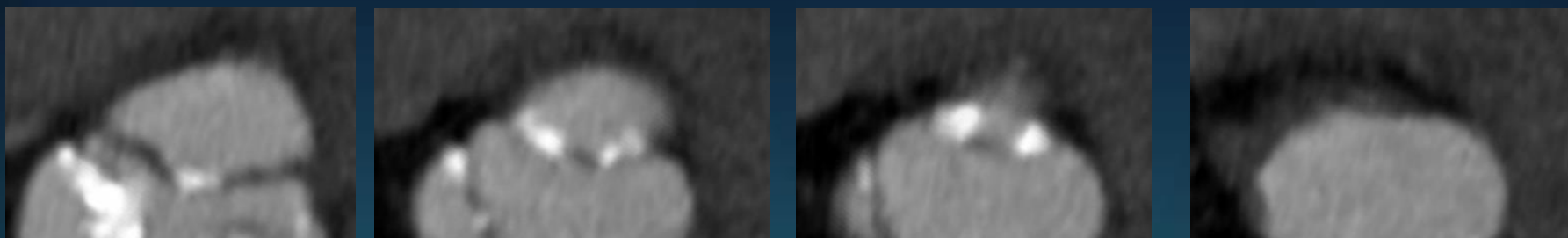
12 PM



Annulus diameter = 20.6mm



# MDCT Measurement



Edwards SAPIEN **26mm** was selected

Area **115%**

Perimeter **107%**

Annulus mean diameter	23.2 mm
Annulus area	459.6 mm <sup>2</sup>
Annulus area-driven diameter	24.2 mm
Annulus perimeter	76.2 mm
Annulus perimeter-driven diameter	24.3 mm

# Edwards SAPIEN case

## Valve Implantation



# Edwards SAPIEN case

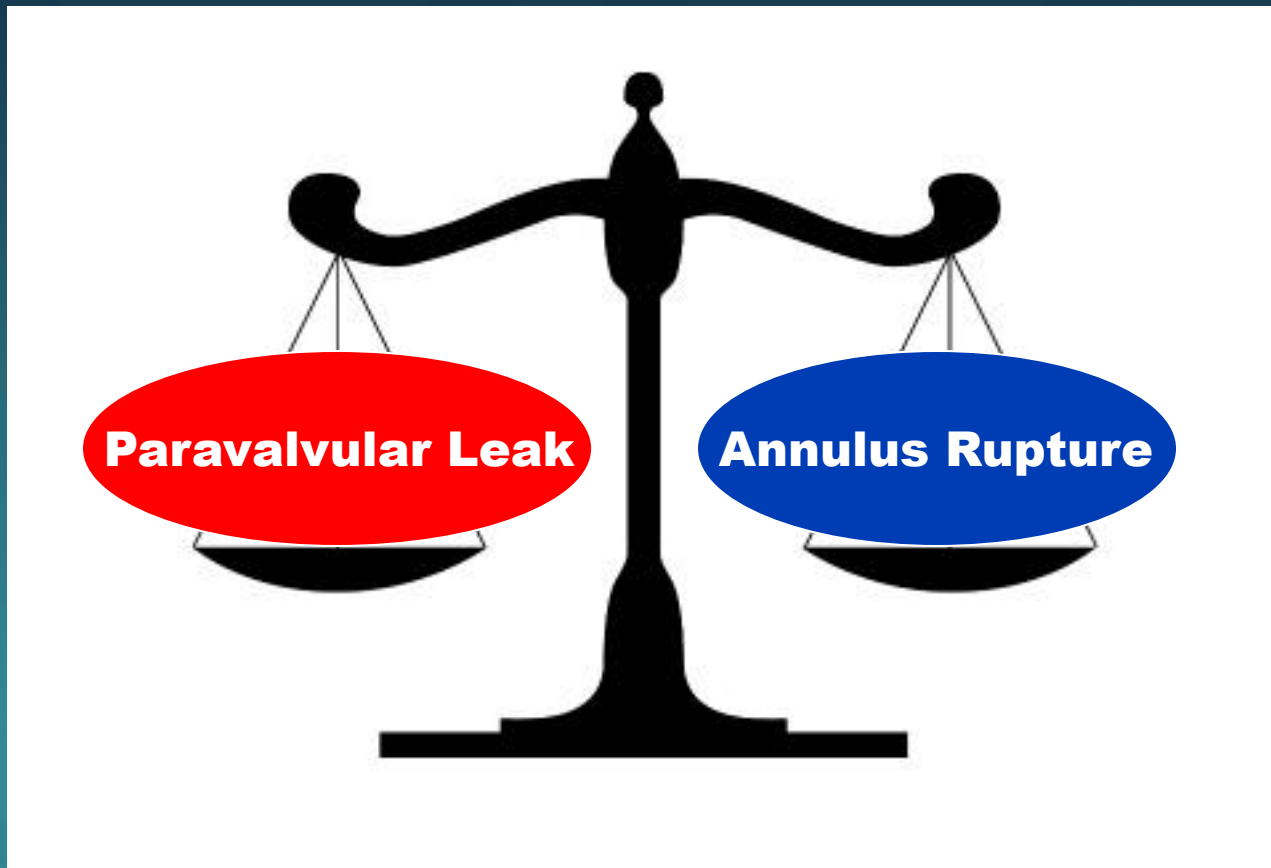
## Final Aortography



*Trivial AR*

# Device Size Selection

## Oversizing is better but ...



# Aortic Root Rupture

**Circulation**  
Cardiovascular Interventions



**Prosthesis Oversizing in Balloon-Expandable Transcatheter Aortic Valve Implantation Is Associated With Contained Rupture of the Aortic Root**

Philipp Blanke, Jochen Reinöhl, Christian Schlensak, Matthias Siepe, Gregor Pache, Wulf Euringer, Annette Geibel-Zehender, Christopher Bode, Mathias Langer, Friedhelm Beyersdorf and Manfred Zehender

*Circ Cardiovasc Interv.* 2012;5:540-548; originally published online August 7, 2012;

doi: 10.1161/CIRCINTERVENTIONS.111.967349

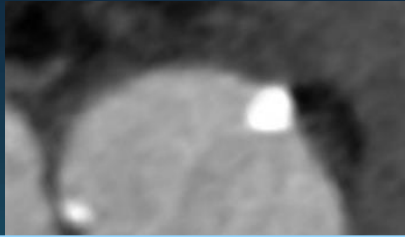
*Circulation: Cardiovascular Interventions* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

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Print ISSN: 1941-7640. Online ISSN: 1941-7632

Extreme oversizing prosthesis (diameter oversize > 20%) is associated with aortic rupture after SAPIEN valve implantation

# CT findings – Aortic annulus view



**26mm**

Area 93%,  
perimeter 97%

**29mm**

Area 116%  
Perimeter 106%

Edwards SAPIEN **29mm** was selected

Area **116%**

Perimeter **106%**

Annulus mean diameter	26 mm
Annulus area	570 mm <sup>2</sup>
Annulus area-driven diameter	26.9 mm
Annulus perimeter	86 mm
Annulus perimeter-driven diameter	27.4 mm



# Edwards SAPIEN case # 3

## Balloon Aortic Valvuloplasty



**25 mm**

# Edwards SAPIEN case # 3

## Valve Implantation



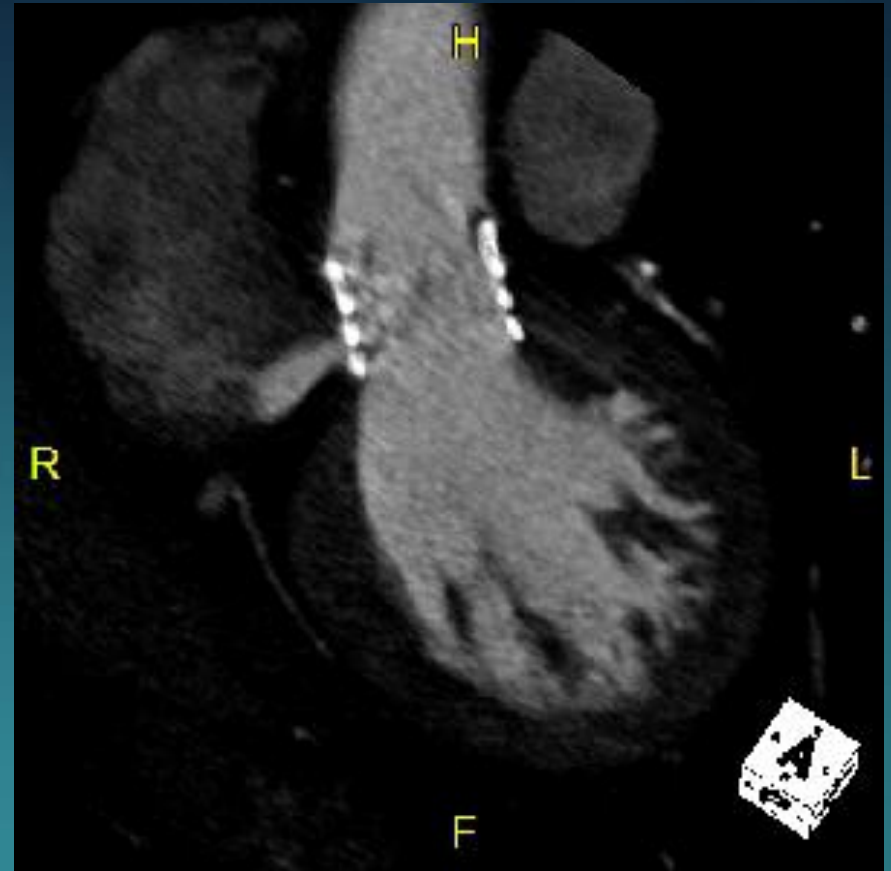
# Edwards SAPIEN case # 3

## Final Aortography



*Mild AR*

# Left to right shunt



# Small Aortic Root



**Don't focus on annulus dimension only  
Pay attention to all the aortic valve complex !**



**Width of sinus : 29.5mm**



**Extensively filled aortic root**

# Balloon underfilling

- Extreme area oversizing (> 20%)
- Oversizing (10 -15%) with small aortic root or heavily calcified annulus/ LVOT

	Balloon volume	1ml underfilled	2ml underfilled	3ml underfilled
23mm	17ml	22mm	21mm	20mm
26mm	22ml		25mm	
29mm	33ml			28mm

# Conclusion

- Oversized valve should be selected based on MDCT measurements of aortic annulus
- Consider all the aortic valve complex (Sinus, LVOT and calcification etc)
- Appropriate oversizing degree vary according to individual anatomic features
- Finalize annular sizing through BAV and simultaneous aortography
- Balloon underfilling strategy help the difficult sizing case