

# X

CONGRESO COLEGIO COLOMBIANO  
DE HEMODINAMIA E INTERVENCIONISMO CARDIOVASCULAR

XXIV JORNADAS SOLACI - 8VAS. REGIÓN ANDINA



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DE HEMODINAMIA  
E INTERVENCIONISMO  
CARDIOVASCULAR



SOLACI  
SOCIEDAD  
LATINOAMERICANA  
DE CARDIOLOGIA  
INTERVENCIONISTA

TARIO  
de

## Insuficiencia Aórtica post TAVI



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Hospital Universitario Central de Asturias  
Universidad de Oviedo  
OVIEDO -- ESPAÑA

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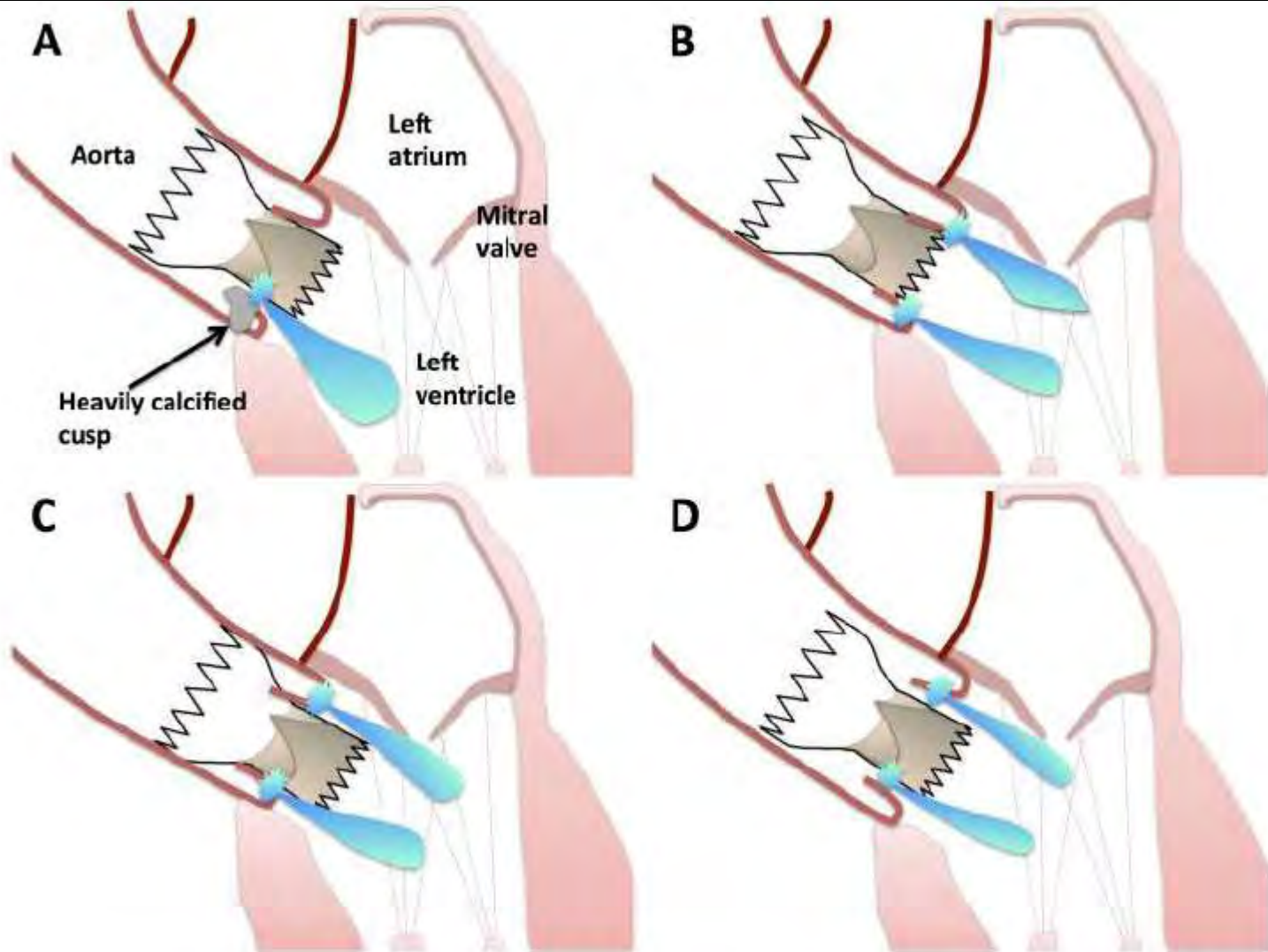
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## CONFLICTO DE INTERESES

- Proctor de Corevalve
- Miembro advisory board Medtronic

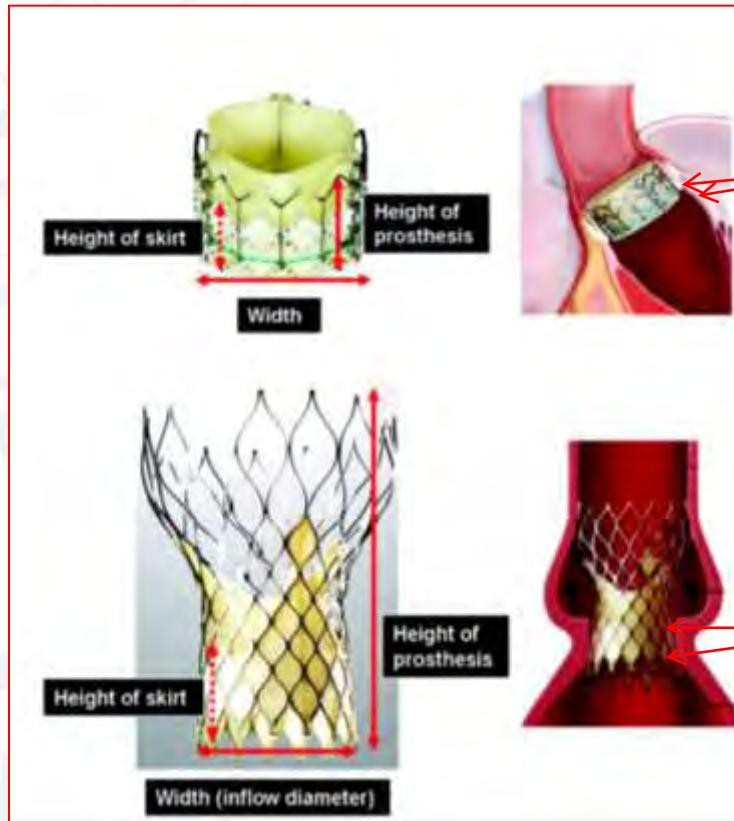
# ***PVR Etiology***

# Aortic Regurgitation. Corevalve



# Paravalvular Aortic Regurgitation

## Importance of Annular Seal



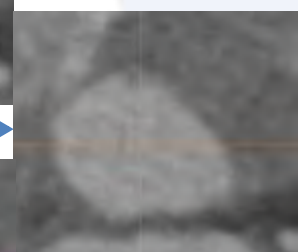
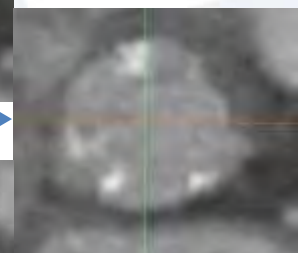
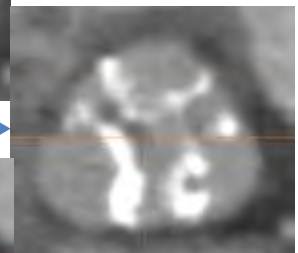
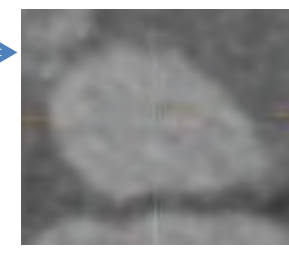
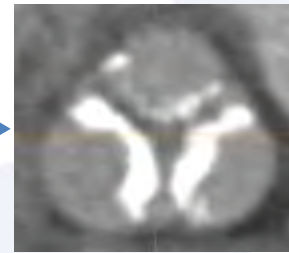
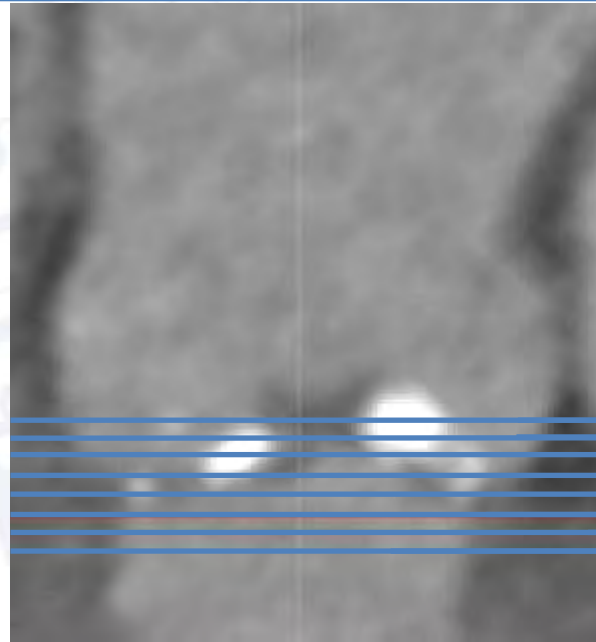
Seal Zone

*The seal zone is not necessarily a single plane at the annulus but includes the valve and the LVOT*

Seal Zone

Complete apposition of the skirt to the annulus prevents paravalvular leak

# Sealing Areas: Aortic Root, Annulus, and LVOT



Aortic  
Root

Annulus

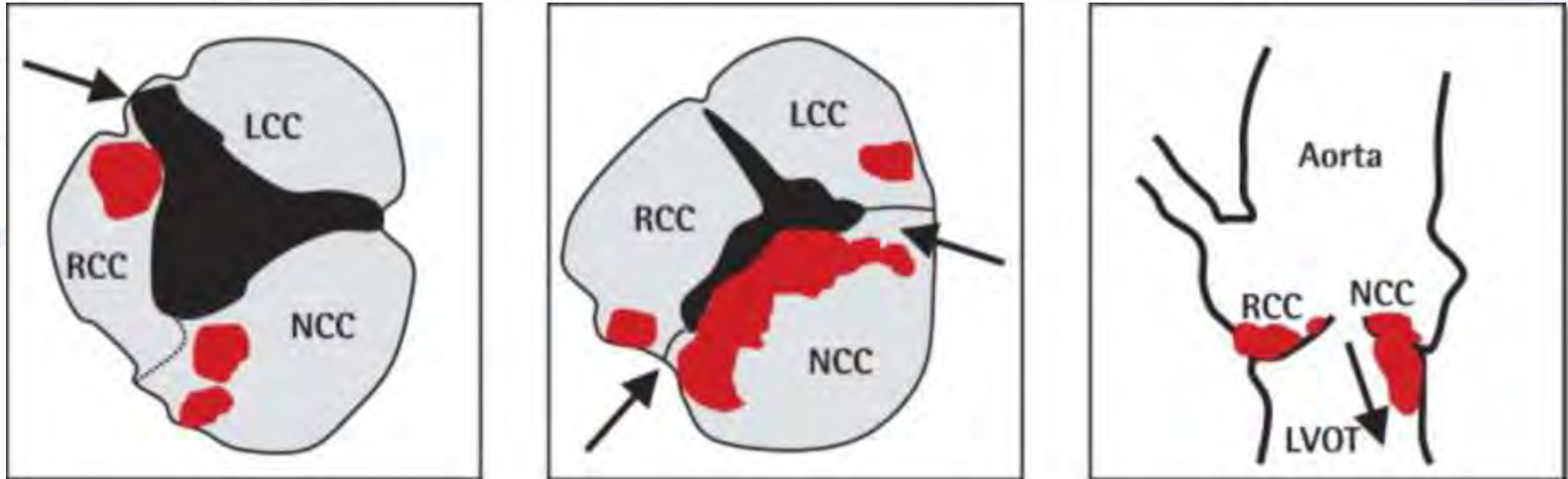
LVOT

Cross sections show  
multiple areas for  
sealing from the LVOT  
into the aortic root

\*Courtesy Medtronic

# Morphological Risk Factors for Post- Procedural Regurgitation

*Unbehaun A et al. J Am Coll Cardiol. 2012;59(3):211-221.*

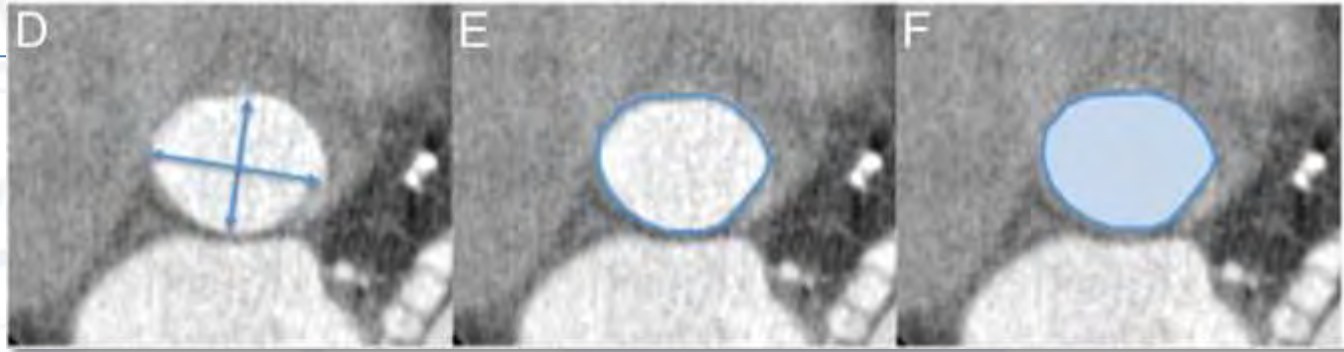


**Nonfused commissures  
in the neighborhood of  
bulky masses**

**Asymmetric distribution  
of calcified masses (red)  
within the cusps**

**Calcified structures in the  
left ventricular outflow  
tract (LVOT) (right) are  
anatomical regurgitation  
substrates**

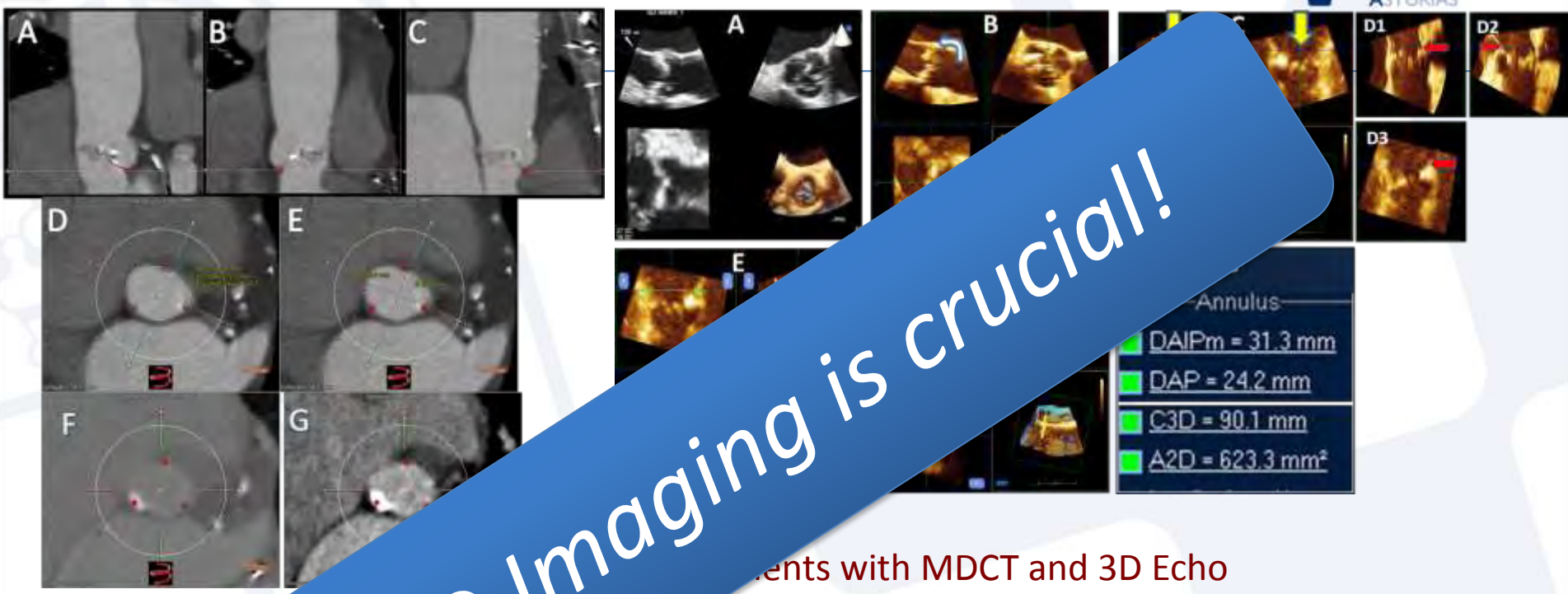
# Annular Sizing



1. The annulus is oval or elliptical
2. The sagittal plane (long-axis imaging plane) is the minimum diameter and the coronal plane is the maximum diameter
3. In systole, the annulus becomes less elliptical
4. Three D measurements(CT, MRI and 3D Echo) of mean diameter, perimeter or area, correlate well



# Direct Comparison of MDCT and 3D Echo



Patients with MDCT and 3D Echo

Agreement for  $\geq$  mild PVR was good for both MDCT (area under the curve for perimeter and area cover index = 0.715 and 0.709, respectively) and 3D-TEE (area under the curve for perimeter and area cover index = 0.709 and 0.694, respectively)

# Grading PVR

# Grading Aortic Regurgitation

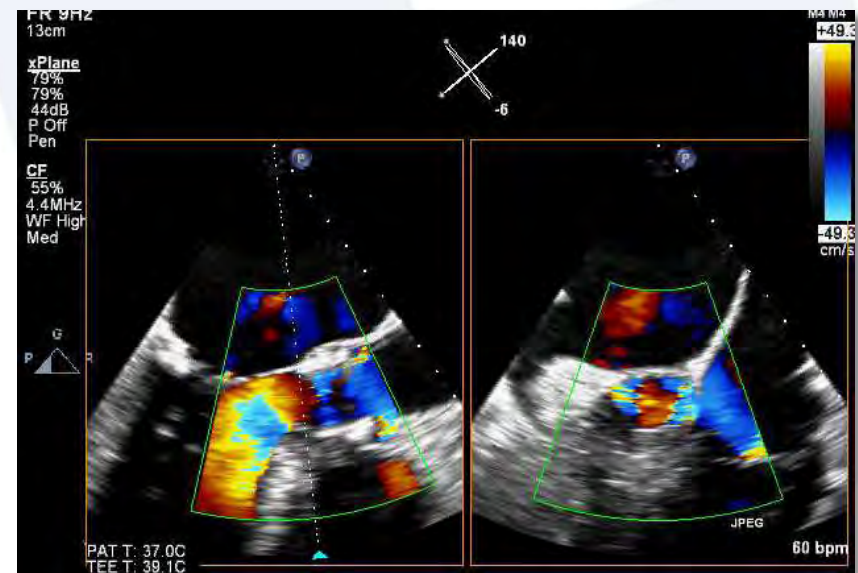
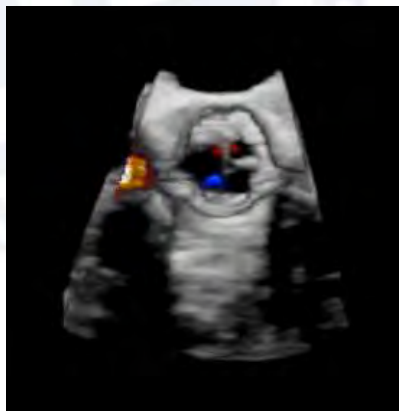
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- There is no standardized scale for grading aortic regurgitation
- Qualitative approach may overestimate severity of AR (especially if image incorrectly)
- An integrated approach using both qualitative and quantitative measures necessary

# Qualitative Assessment of Aortic Regurgitation



- Biplane echocardiography
- Short axis view just below stent ideal
- Small PVL jets common and often resolve on own



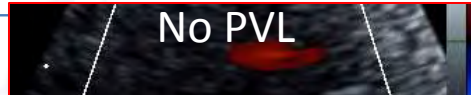
# ASE: Qualitative and quantitative parameters useful in grading aortic regurgitation severity in prosthetic valves

Parameter	Mild	Moderate		Severe
<b>Qualitative</b>				
Jet density (CW Doppler)	Incomplete/faint	Dense		Dense
Jet deceleration (PHT by CW))	Slow > 500	Medium 500-200		Steep < 200
Reversal of PW flow in the aorta	Brief, early diastolic reversal	Intermediate		Prominent holodiastolic Rev (>20 cm/s)
<b>Semi-quantitative</b>				
Vena contracta	< 0.3	0.3-0.60		>0.60
Jet width/LVOT Width (%)	<25	25-45	46-64	≥ 65
Jet area/LVOT CSA (%)	<5	5-20	21-59	≥ 60
Circum Extent/LVOT Circum (%)	<10	10-20		> 20
<b>Quantitative</b>				
Regurgitant Volume (ml/beat)	<30	30-44	45-59	≥ 60
Regurgitant Fraction (%)	<30	30-39	40-49	≥ 50
EROA (cm <sup>2</sup> )	<0.10	0.10-0.19	0.20-0.29	≥ 30

Zoghbi et al J Am Soc Echocardiogr 2003;16:777-802.

Lancellotti et al. Eur J Echocardiogr 2010;11;:223-244

# Grading of Paravalvular Regurgitation



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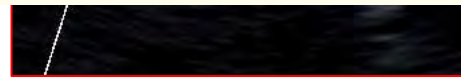
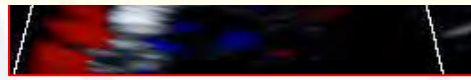
**EXPEDITED REVIEW** **Heart Valve Disease**

## Updated Standardized Endpoint Definitions for Transcatheter Aortic Valve Implantation

The Valve Academic Research Consortium-2 Consensus Document†

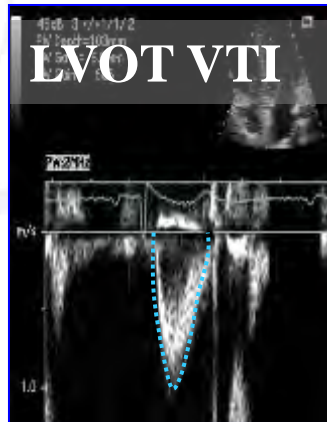
A. Pieter Kappetein,\* Stuart J. Head, Philippe Généreux, Nicolo Piazza, Nicolas M. van Mieghem, Eugene H. Blackstone, Thomas G. Brott, David J. Cohen, Donald E. Cutlip, Gerrit-Anne van Es, Rebecca T. Hahn, Ajay J. Kirtane, Mitchell W. Krucoff, Susheel Kodali, Michael J. Mack, Roxana Mehran, Josep Rodés-Cabau, Pascal Vranckx, John G. Webb, Stephan Windecker, Patrick W. Serruys, Martin B. Leon

*Rotterdam, the Netherlands*



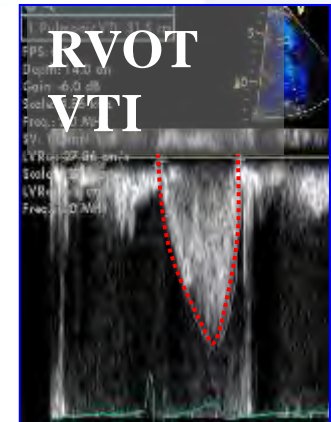
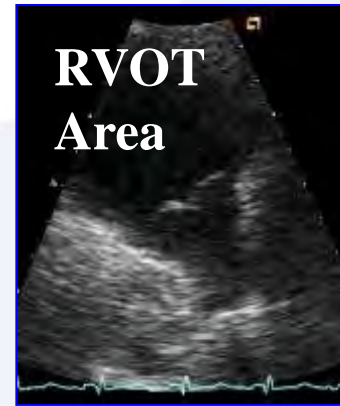
- Mild PVL <10% of the sewing ring
- Moderate PVL = 10-30% of the sewing ring
- Severe PVL >30% of the sewing ring

# Regurgitant Volume by Quantitative Doppler



## LVOT Stroke Volume

LVOT stroke volume = forward stroke volume + regurgitant volume



## RVOT Stroke Volume

RVO stroke volume = forward stroke volume

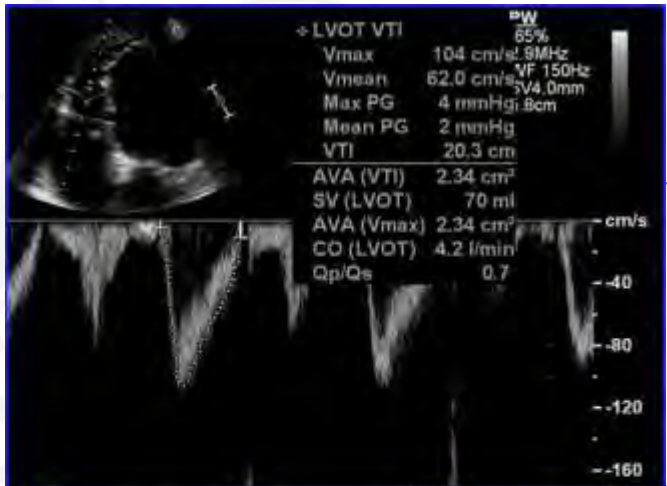
Regurgitant volume

=

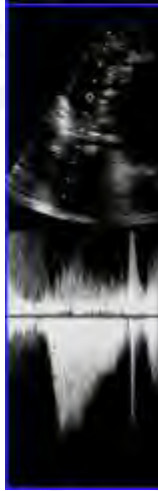
LVOT stroke volume

-

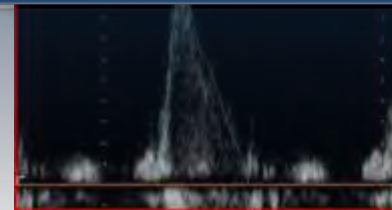
RVOT stroke volume



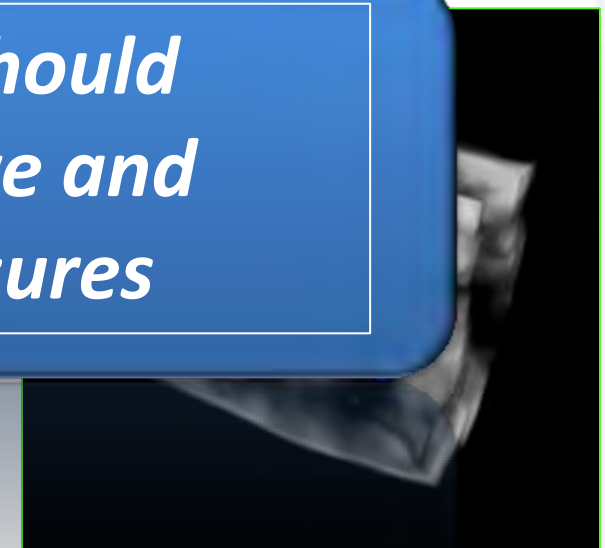
*Final Assessment Should Integrate Qualitative and Quantitative Measures*



LVOT SV = 70 cc  
 AV Area = 1.83 cm<sup>2</sup>



RVOT SV = 62 cc  
 AR RV = 8 cc  
 EROA = 6 mm<sup>2</sup>

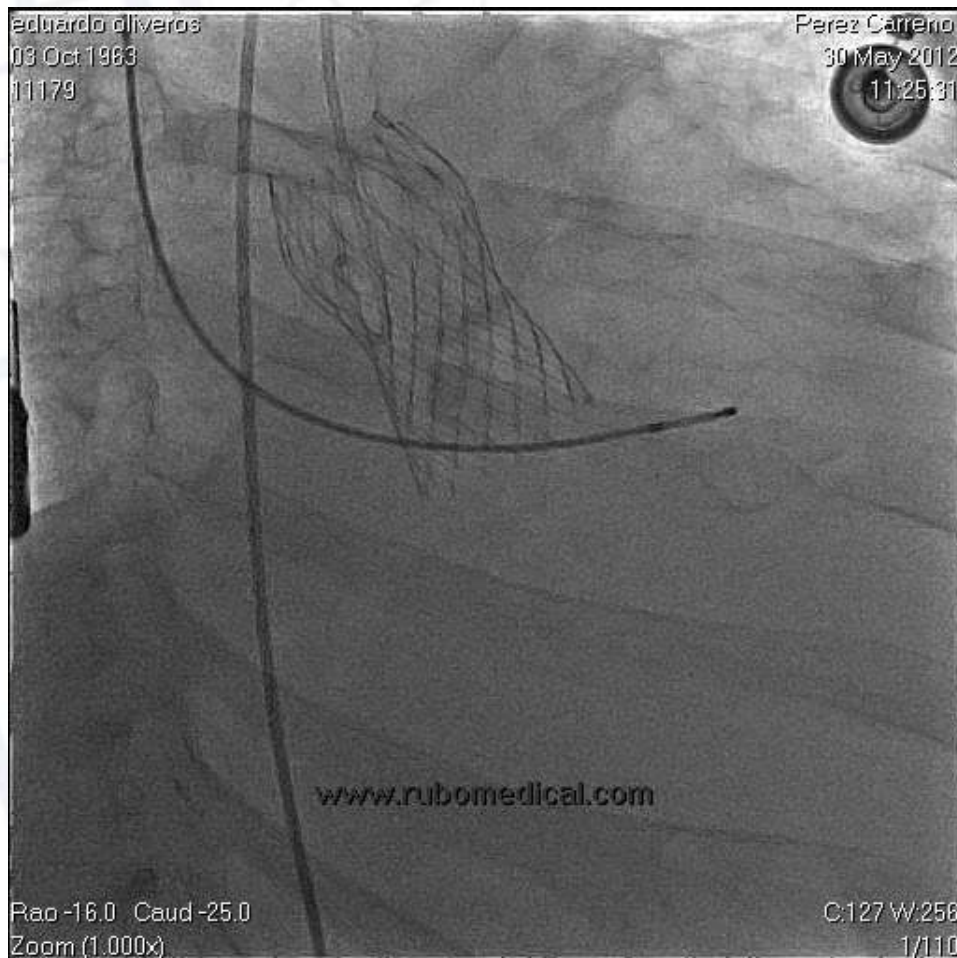


AR EROA = 7 mm<sup>2</sup>  
 AR RV = 10 cc

\* Courtesy R. Hahn



# What about angiography?



- Separating PVL from central AR (wire artifact or leaflet failure) difficult on angiography
- Biplane angiography may help
- Standard criteria applied

# Angiographic Graduation of Aortic Insufficiency (RAO 30° View)

## Paravalvular Insufficiency

ASTURIAS

*trivial*

*mild*

*significant*

**I**  
Regurgitation  
< 1/2 LV

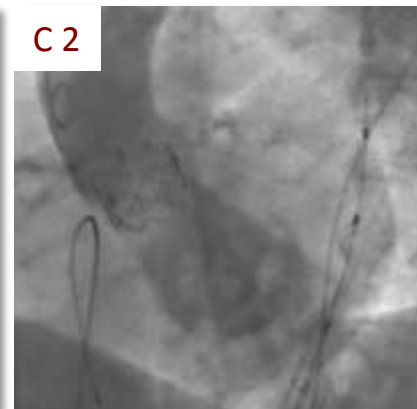
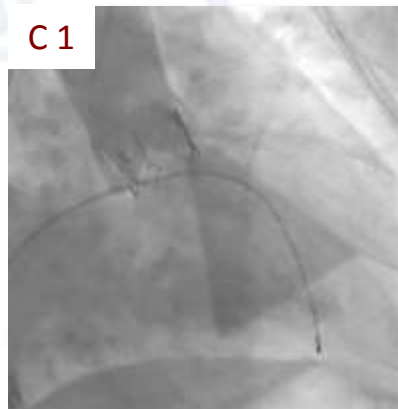
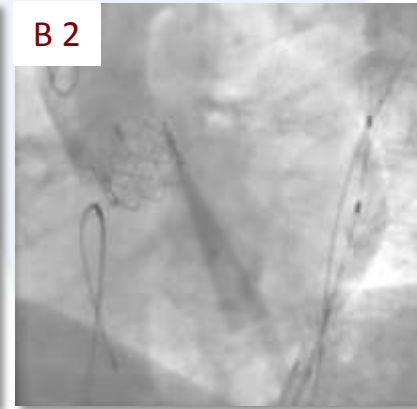
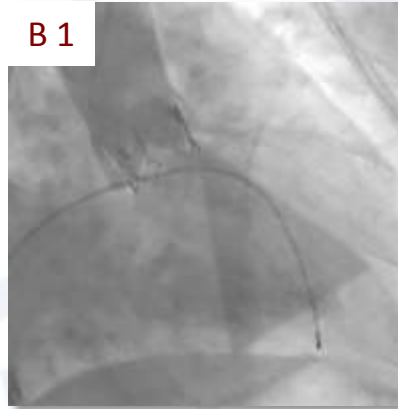
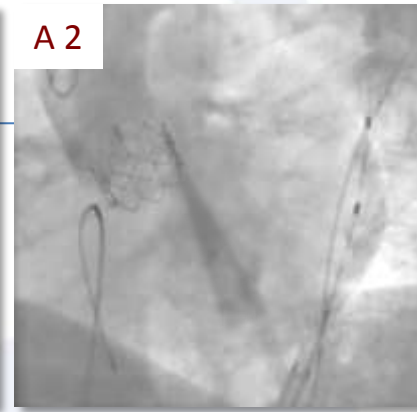
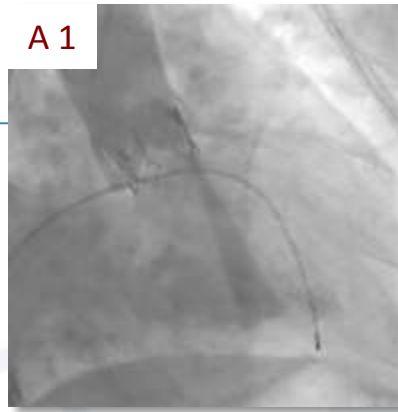
**II**  
Regurgitation  
> 1/2 LV

**III**  
Regurgitation  
complete LV, Contrast  
Aorta > LV

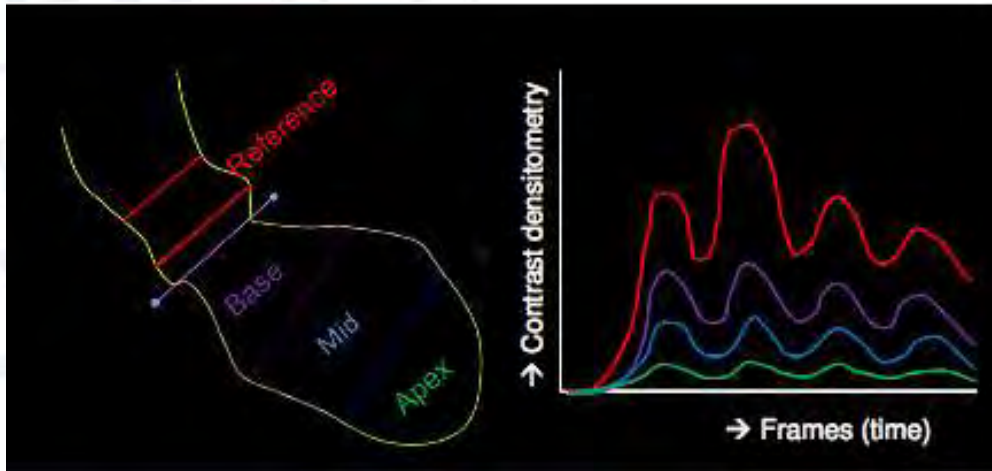
**IV**  
Regurgitation  
complete LV, Contrast  
Aorta < LV

RAO 30°

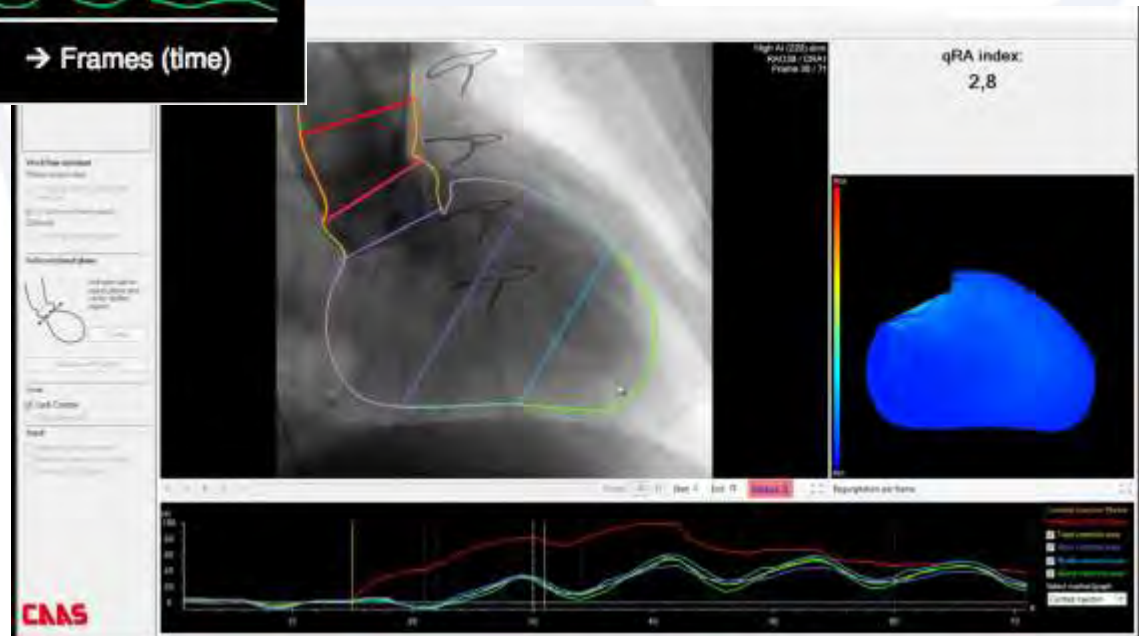
LAO 60°



# Paravalvular Leak: qRA quantitative Regurgitation Analyses

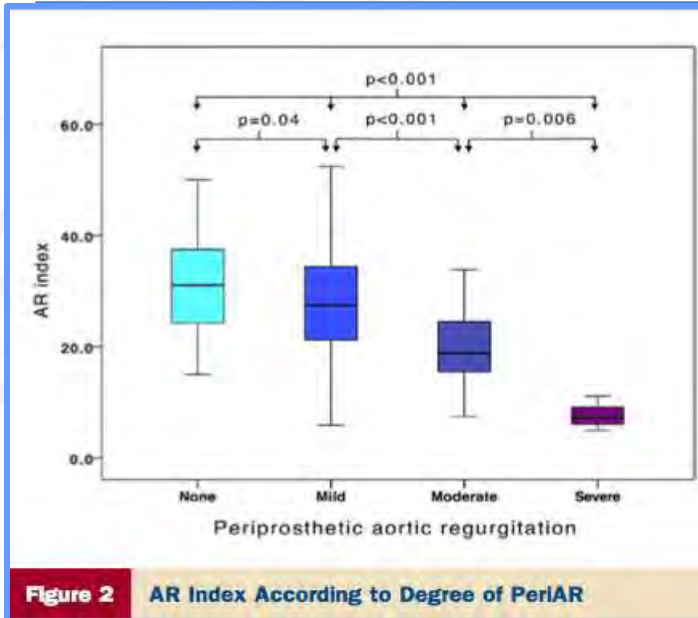


**qRA-Index Range:**  
0.0 (no AR) -> 4.0 (severe AR)



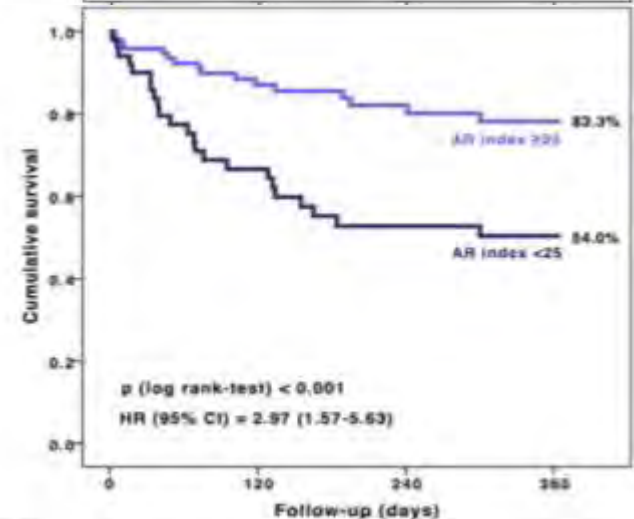
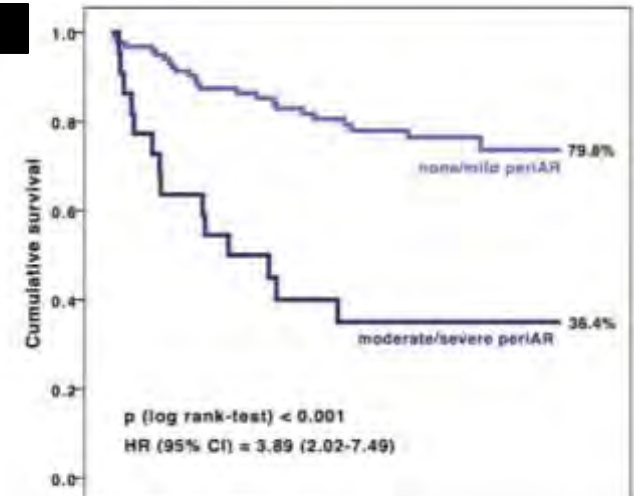
# Hemodynamic Assessment of AR

*Is there a role?*



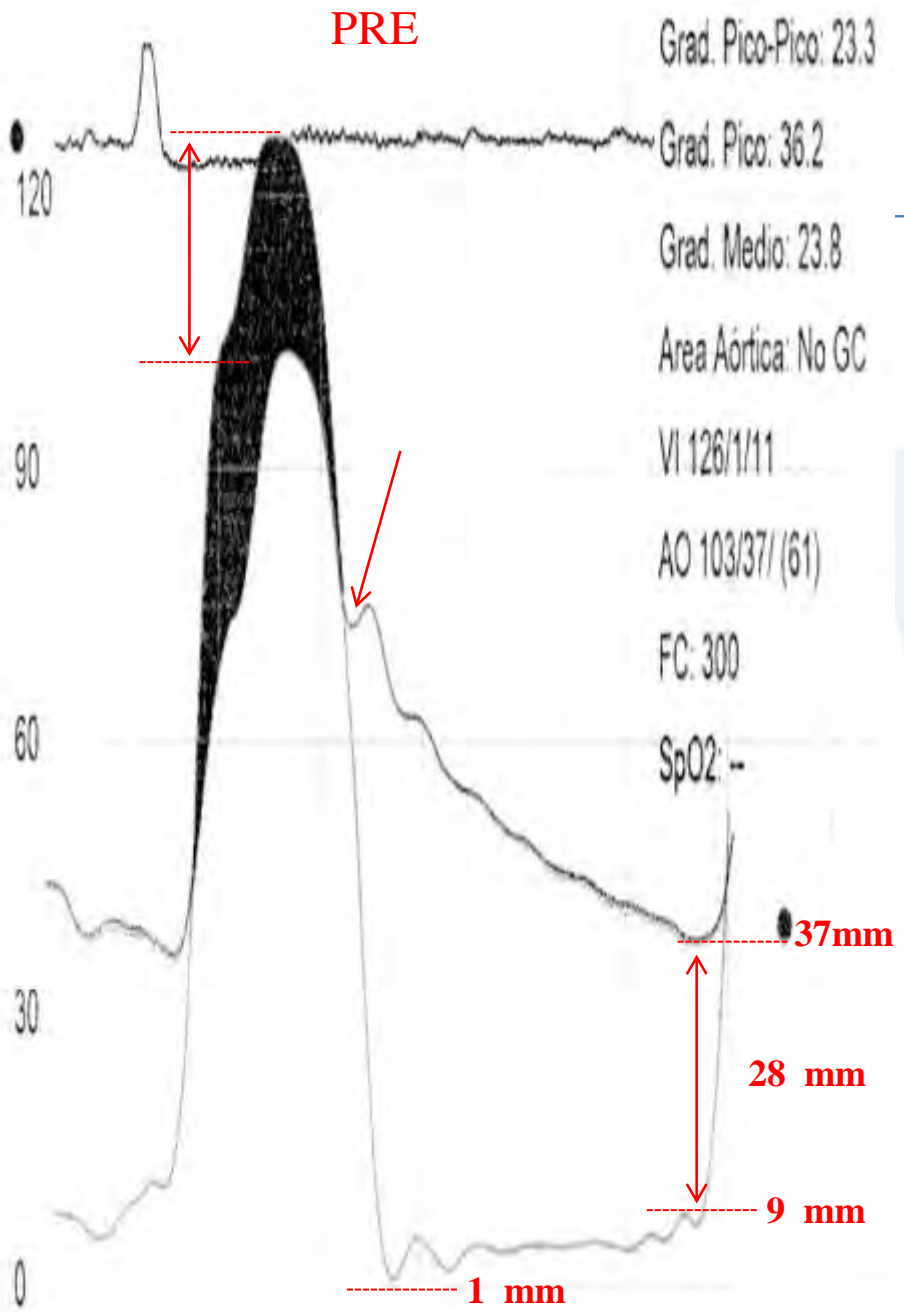
$$\text{AR Index} = (\text{DBP} - \text{LVEDP}) / \text{SBP}$$

Patients with AR index <25 had a significantly increased 1-year mortality risk compared with patients with AR index ≥25 (46.0% vs. 16.7%; p < 0.001).

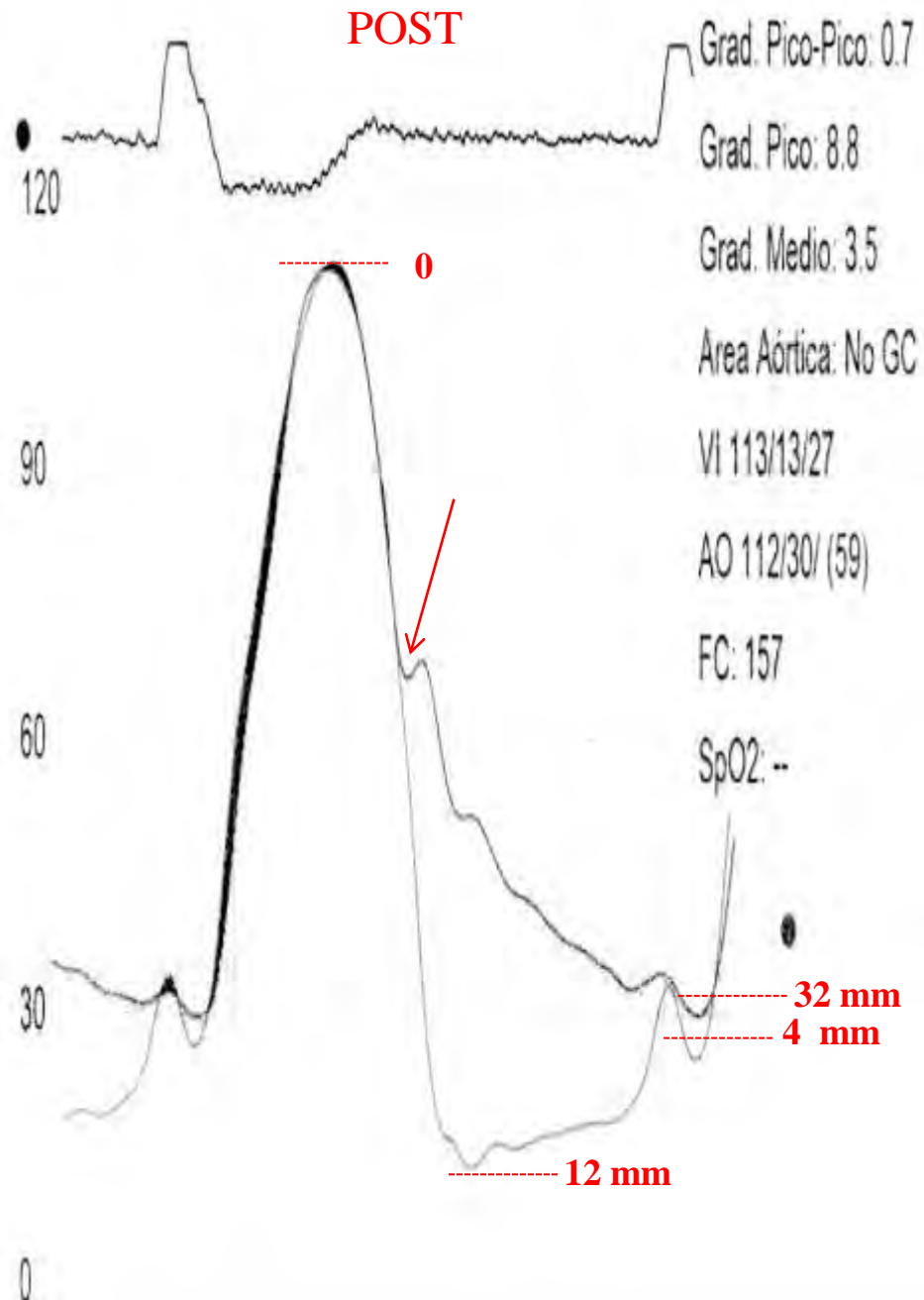


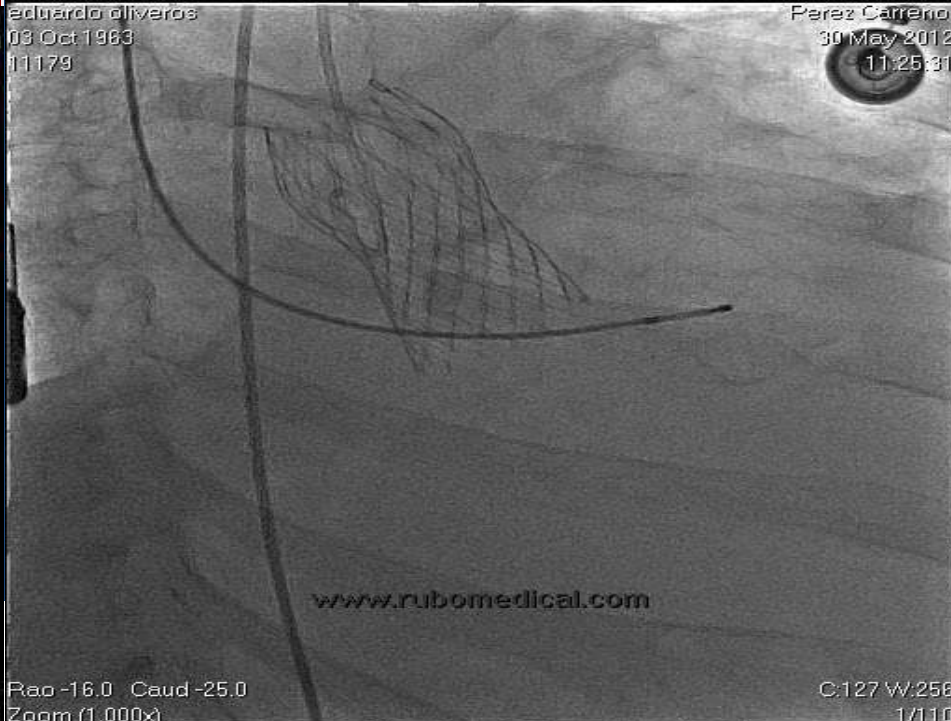
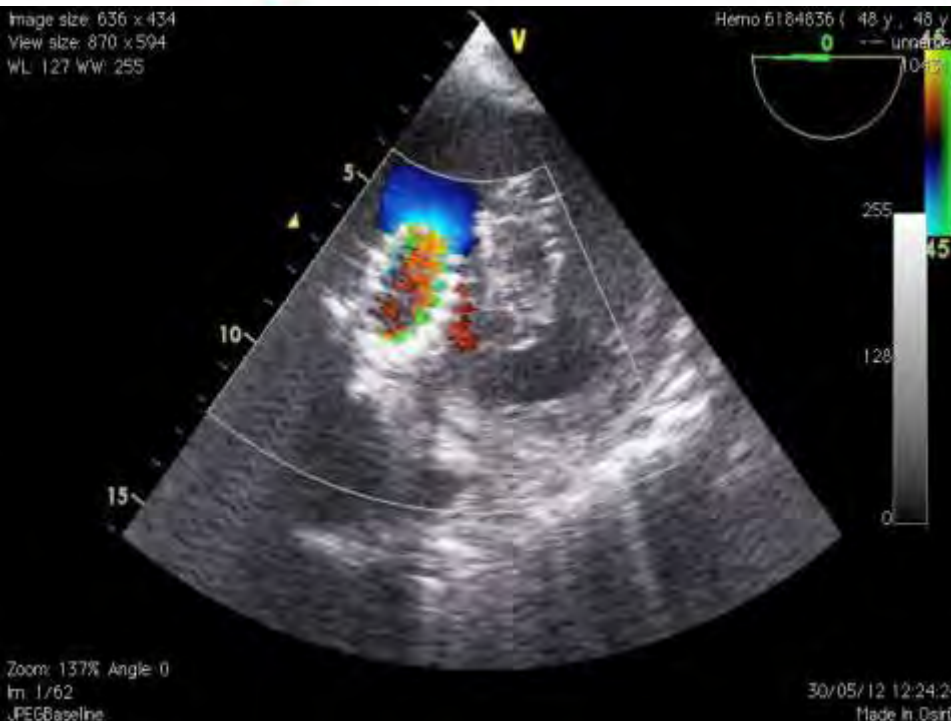
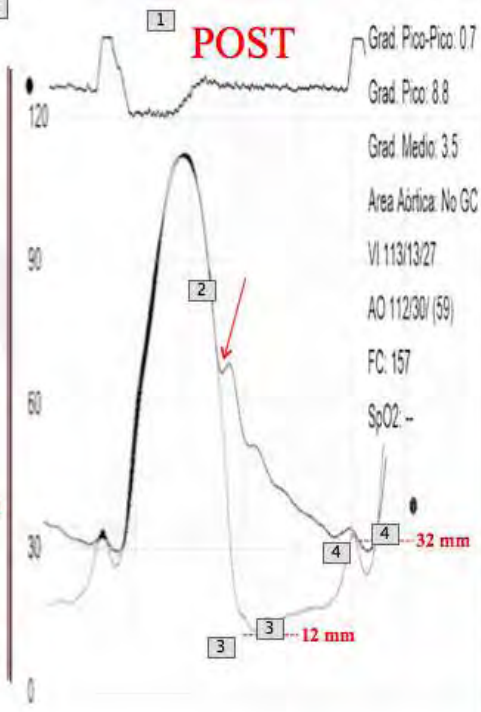
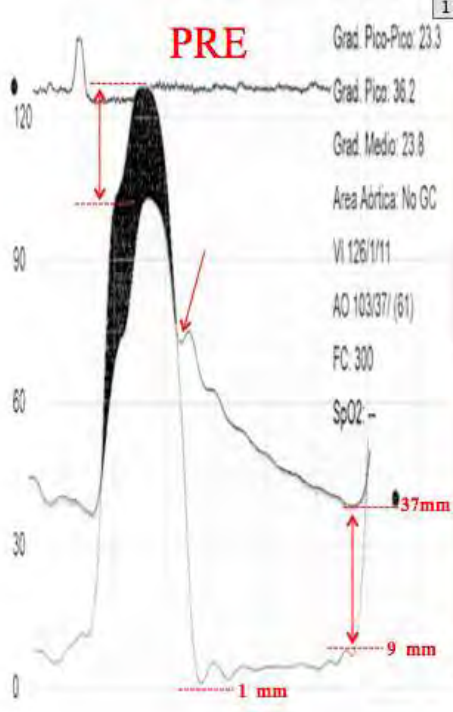
No. at risk	0	120	240	360
AR index ≥25	96	52	52	35
AR index <25	50	45	24	21
Total	146	137	86	56

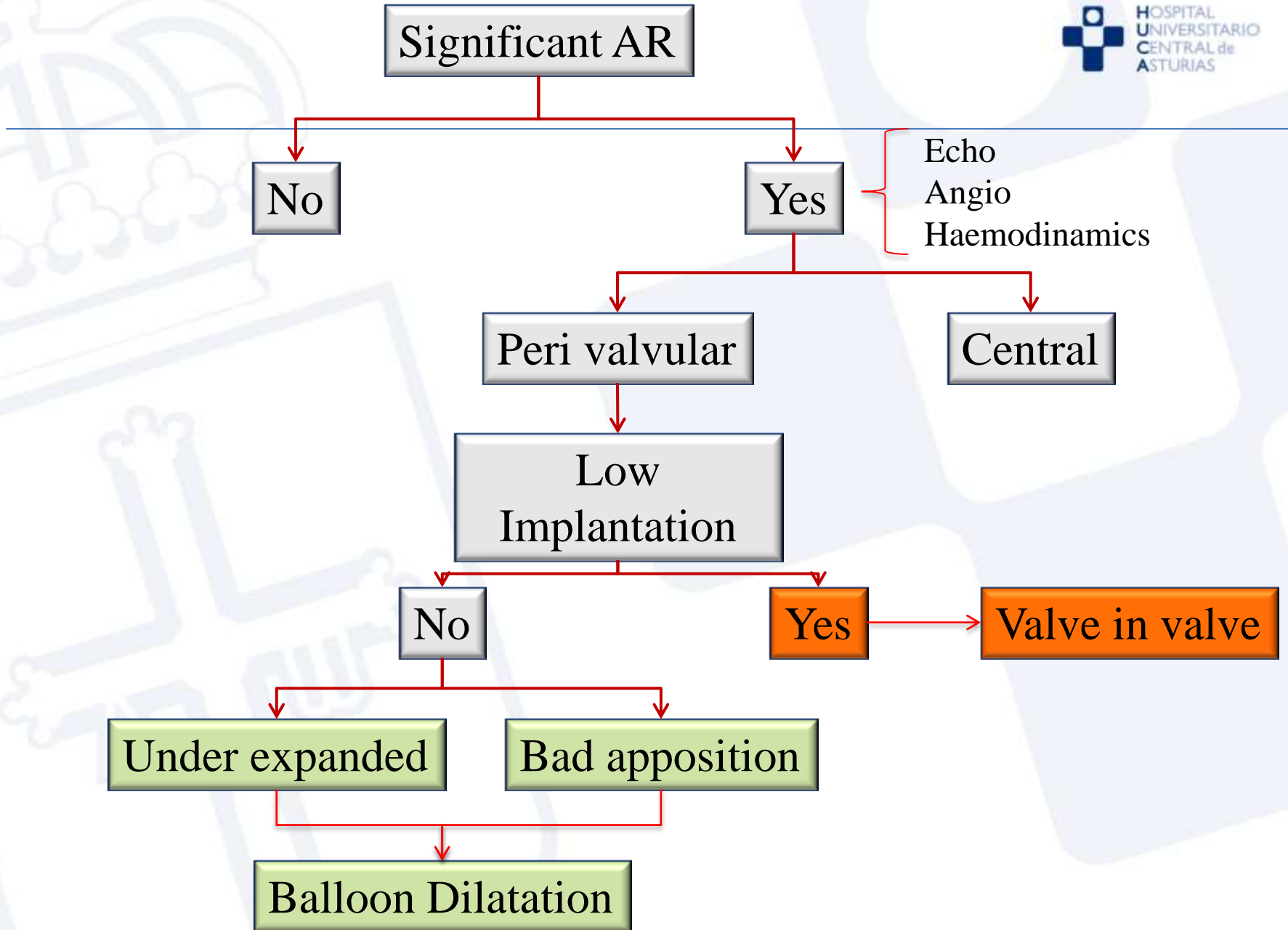
**PRE**

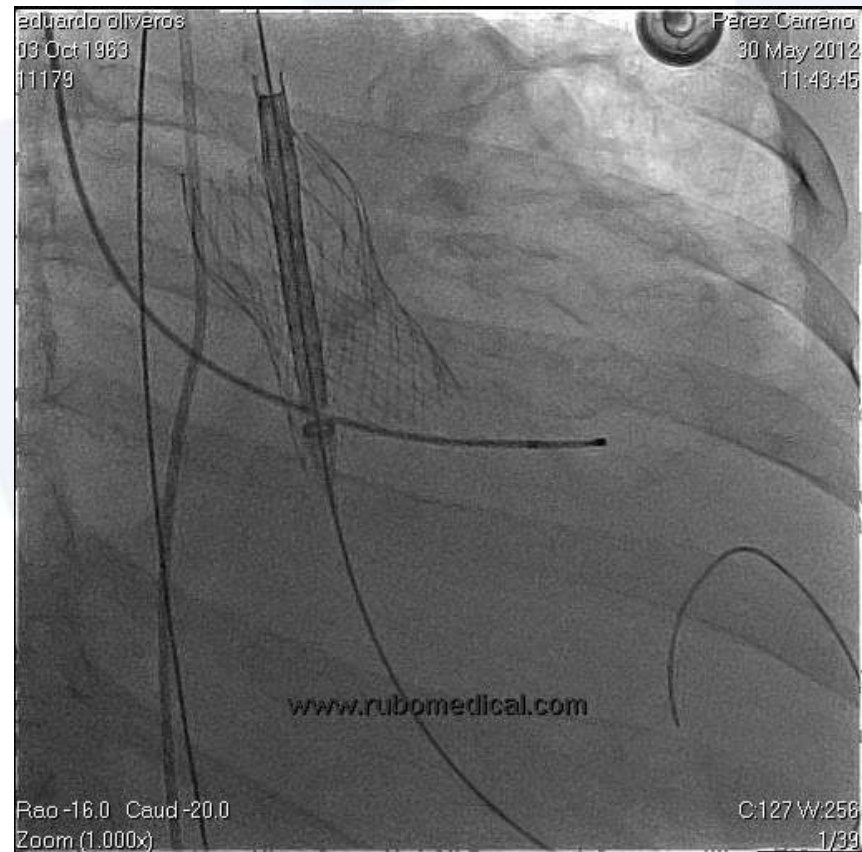


**POST**

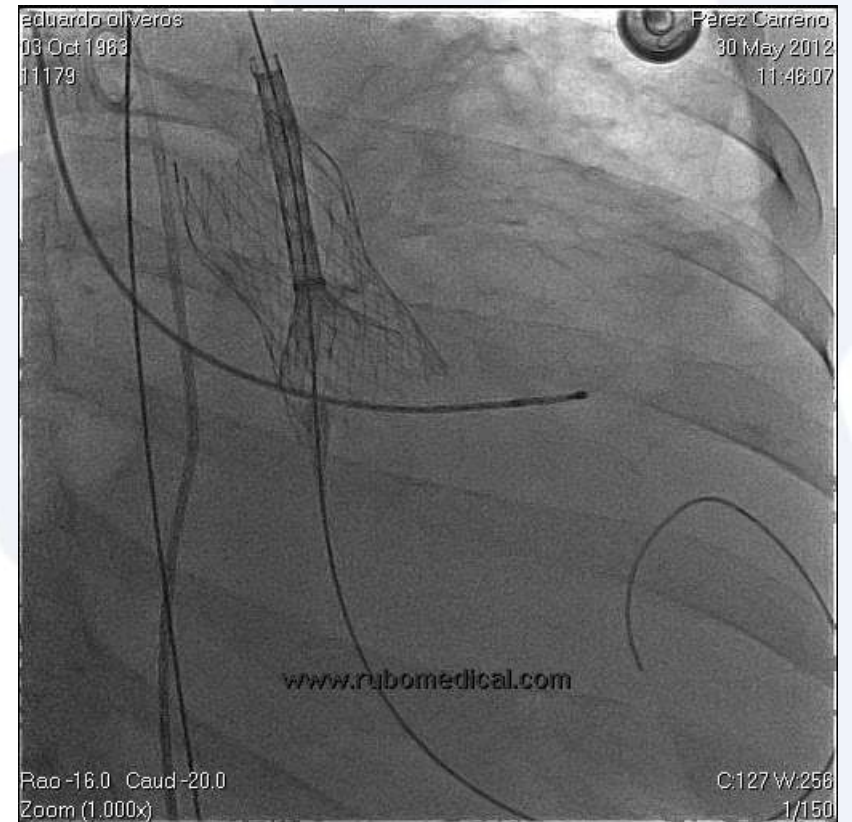
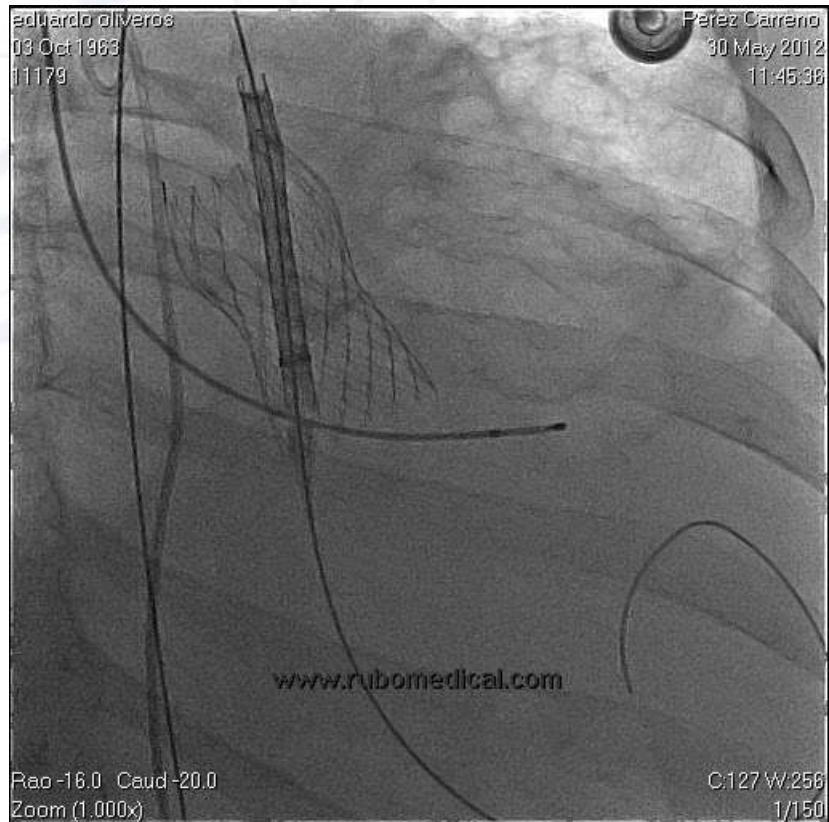


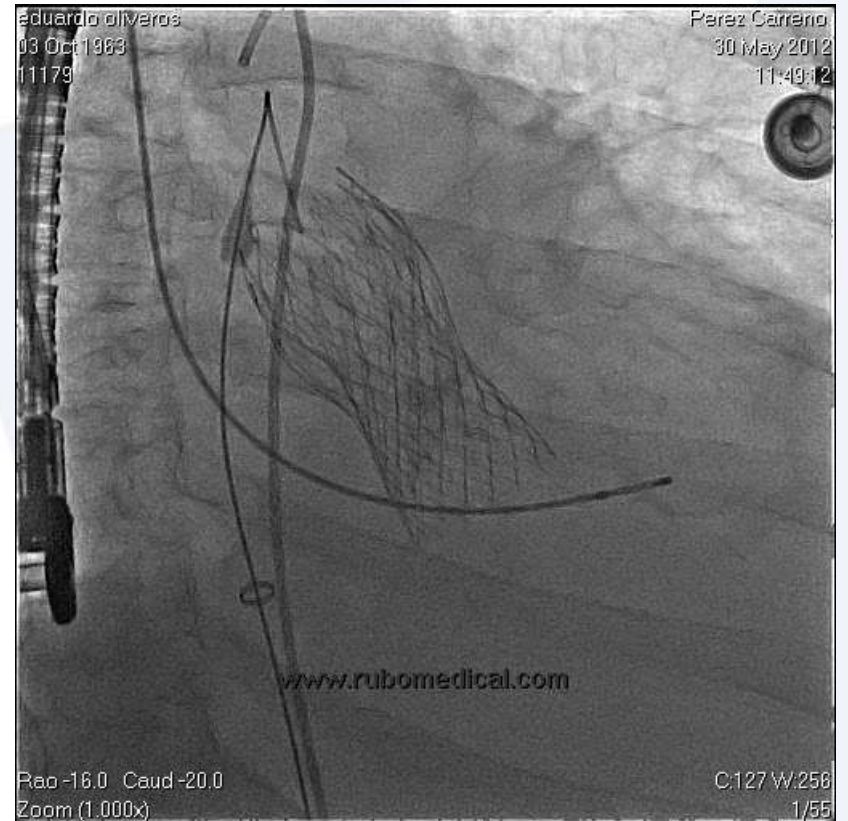
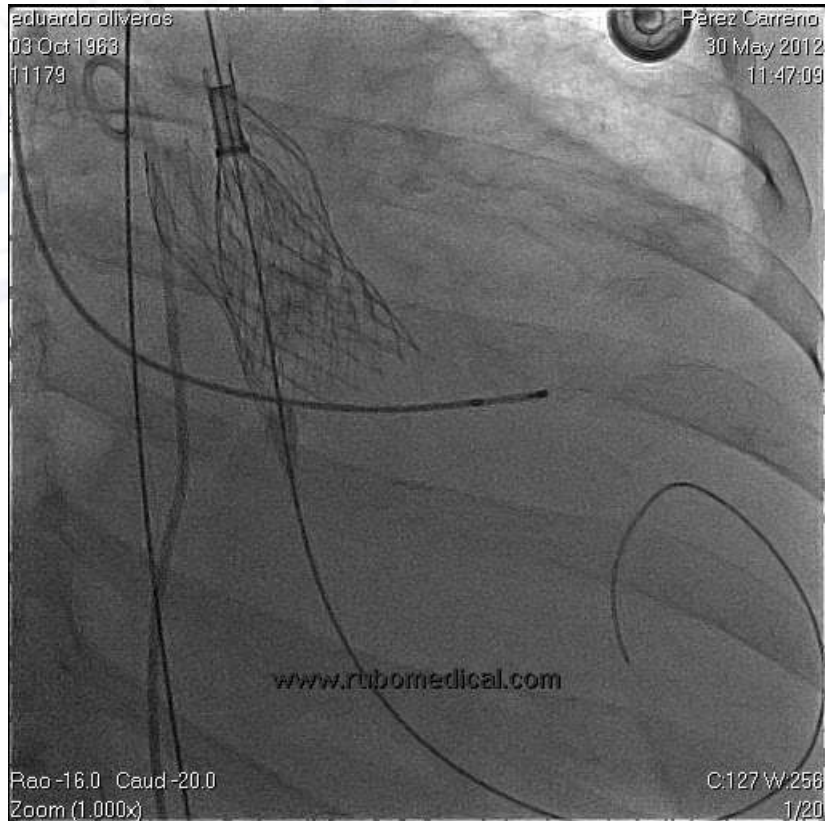




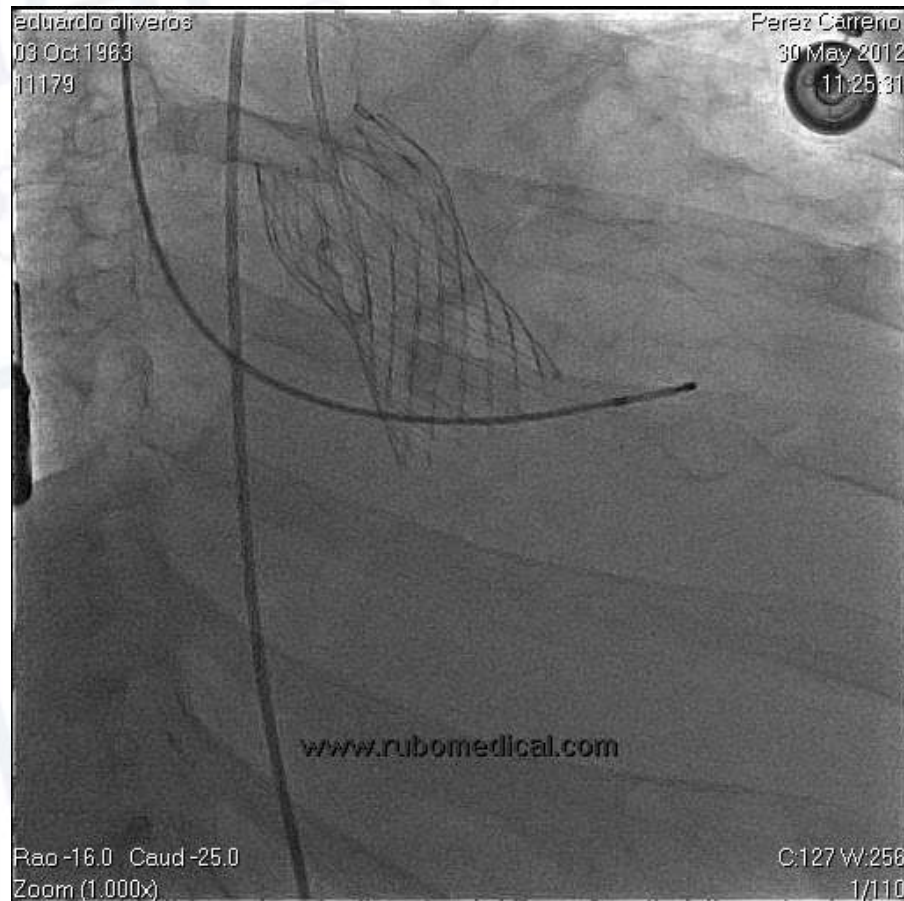








# Aortography



Pre  
TAVI

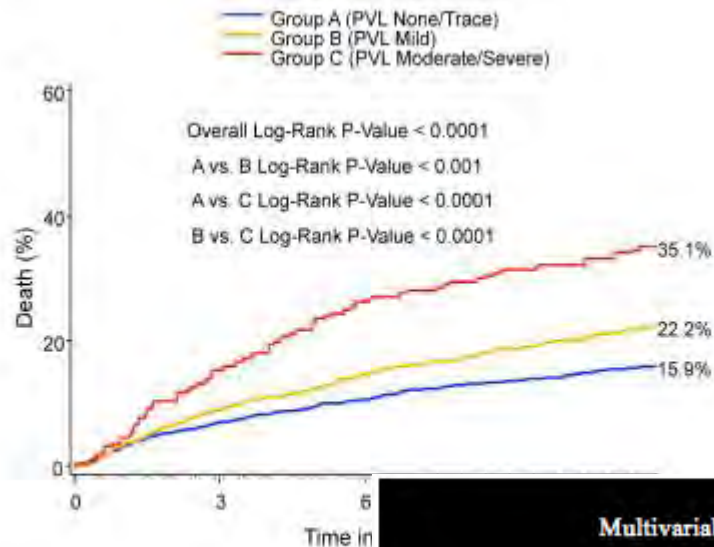


Post  
TAVI

# One Year Outcomes Stratified by PVL

## *PARTNER Trial*

A.

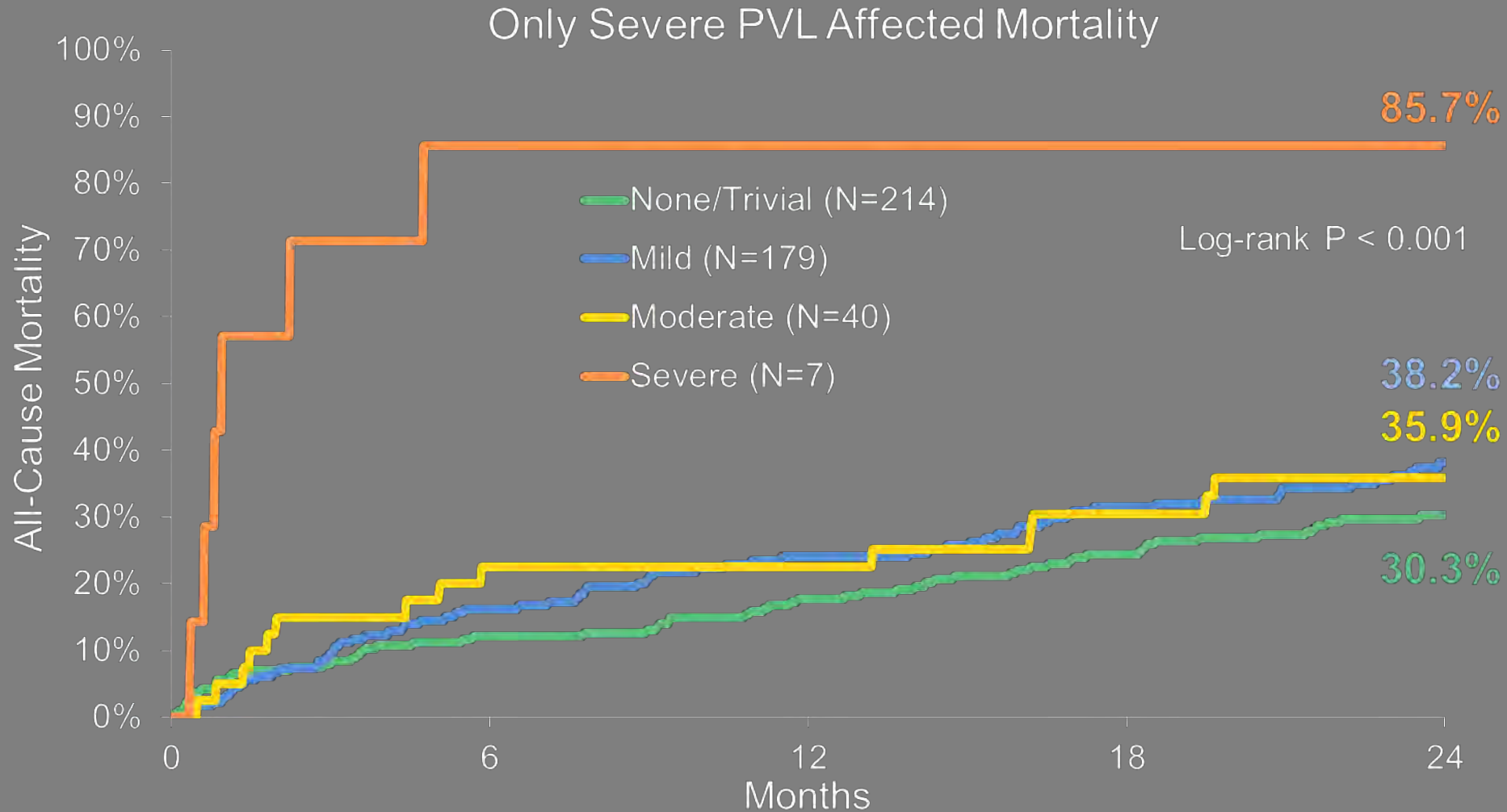


Number at risk	0	3	6
Group A	1,288	1,189	1,117
Group B	925	839	777
Group C	221	187	166

Multivariable Analysis – Baseline and Procedural Predictors of One Year Mortality

Variable	Hazard Ratio	95% Confidence Interval	p-value
<b>Major Arrhythmia</b>	1.41	1.13-1.76	0.0024
<b>TF vs. TA</b>	0.74	0.59-0.92	0.008
<b>AV Annulus Diameter (per 1 mm increase)</b>	1.06	1.02-1.11	0.002
<b>BMI (per 1 kg/m<sup>2</sup> increase)</b>	0.95	0.93-0.97	<0.0001
<b>Total Distance Walked (per 10m increase)</b>	0.97	0.96-0.98	<0.0001
<b>LV Mass (per 10g increase)</b>	1.02	1.00-1.03	0.035
<b>AV Mean Gradient (per 1 mmHg)</b>	0.98	0.97-0.99	<0.0001
<b>Paravalvular Regurgitation</b>			
None/Trace	Referent	-	-
Mild	1.37	1.07-1.76	0.012
Moderate/Severe	2.18	1.57-3.02	<0.0001
<b>Renal disease (CR ≥=2)</b>	1.39	1.08-1.80	0.012
<b>Baseline Moderate/Severe Total AR</b>	0.85	0.60-1.20	0.351

# PVL and All-Cause Mortality (CoreVALVE Extreme Risk)



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*Why is there conflicting data  
regarding mild PVL and its  
impact on mortality?*

# Challenges of PVL Assessment

## *ADVANCE*

27%

58%

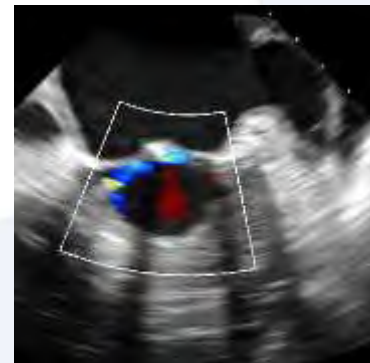
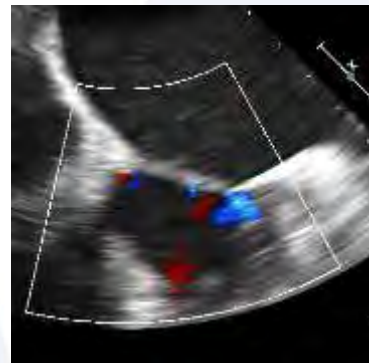
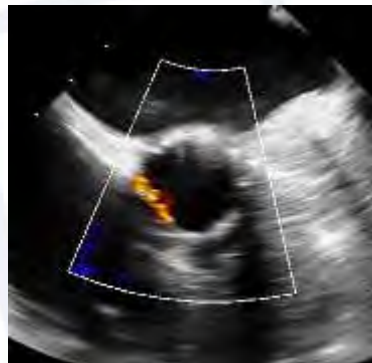
15%

*None*

*Mild*

*Moderate*

*Severe*



*0*

*1+*

*2+*

*3+*

*4+*

*ERO – 10mm<sup>2</sup>*  
*AR volume – 30cc*

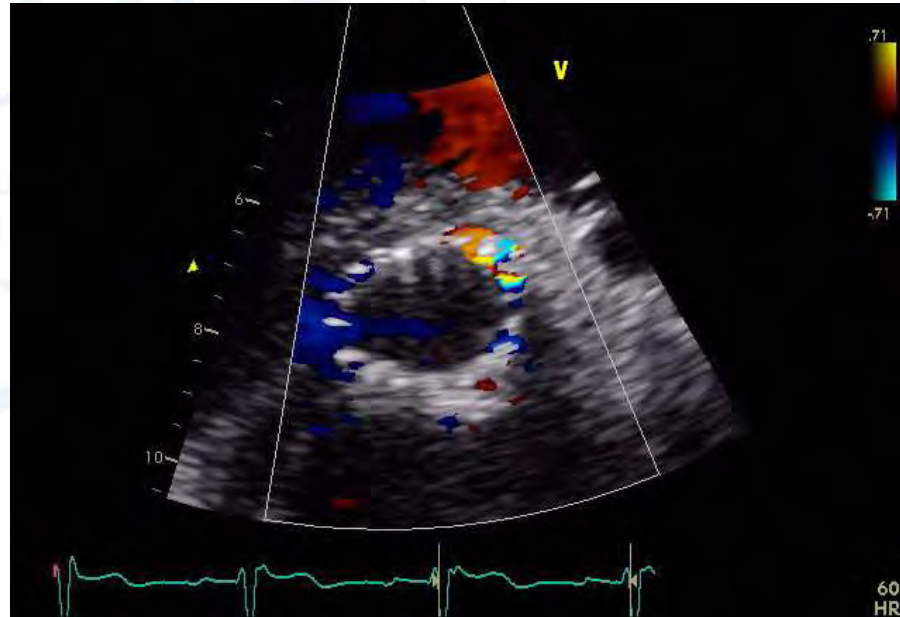
53%

38%

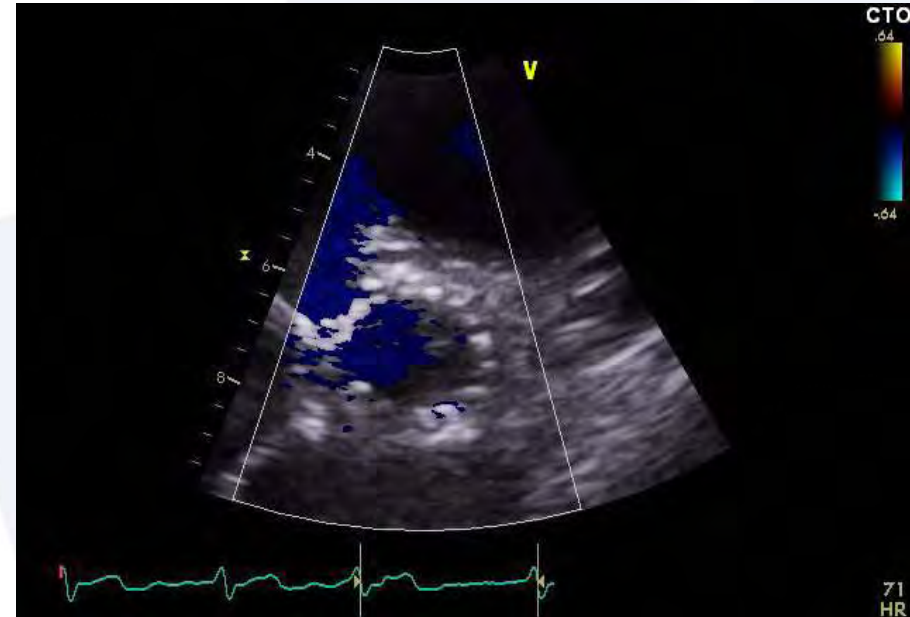
9%

*PARTNER*

# PVL Regresses Over Time with CoreValve



Discharge – Moderate PVL



1 year – Trace PVL

***Is this a real phenomenon?***

***...or is this just due to challenges with assessment***



# Conclusions

- PVR results from multiple factors including patient anatomy, procedural technique, poor sizing and potentially valve type
- Incidence of moderate/severe PVR for the two most common valves ranges from 10-20% - Next generation devices appear to have lower rates
- Grading of PVR remains challenging and standardization of grading schemes necessary to allow comparison between devices and trials
- Impact of PVR on mortality remains controversial and may be device specific
- Next generation devices, will make this less of an issue



**Muchas gracias por su atención**