2016 ASE State of the Art Echocardiography Course | Tucson, AZ

Cases: TAVR Complications – What Should I Be Looking For?

Sunday, February 14, 2016 | 12:15 – 12:30 PM | 15 min

NYU SCHOOL OF MEDICINE

MUHAMED SARIĆ, MD, PHD

Director of Echocardiography Lab

Director of Operations, Noninvasive Cardiology

Associate Professor of Medicine

New York University Langone Medical Center

Disclosures

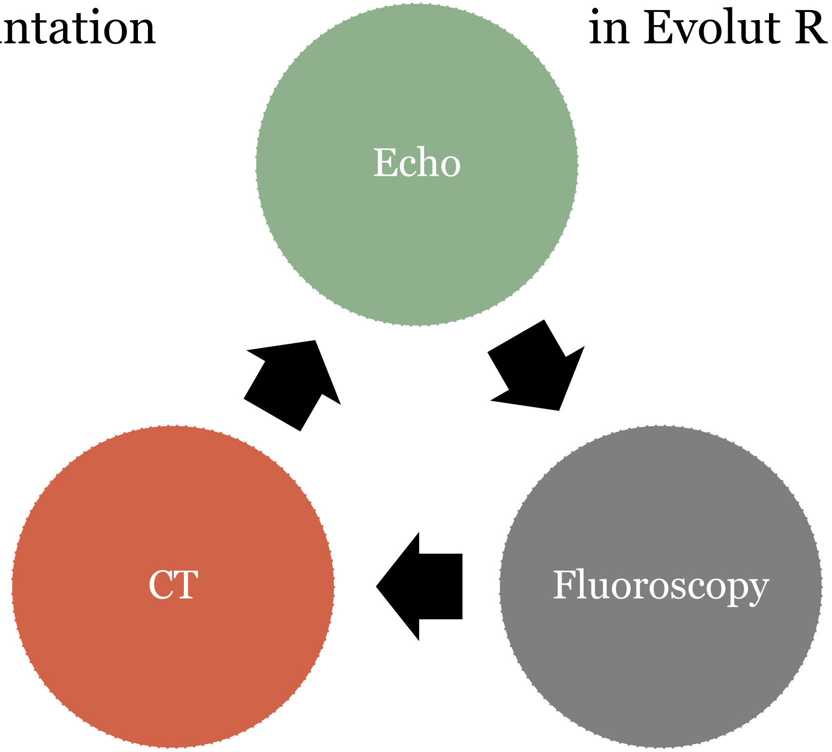
Speakers Bureau

Philips, Medtronic

IMAGING IN PATIENTS UNDERGOING TAVR

Role of various imaging modalities **before, during and after** Evolut R implantation

Role of **echocardiography** relative to other imaging modalities in Evolut R implantation cases



IMAGING IN PATIENTS UNDERGOING TAVR

BEFORE
Evolut R
Implantation

DURING
Evolut R
Implantation

AFTER
Evolut R
Implantation

BEFORE Evolut R Implantation

ECHOCARDIOGRAPHY
: Primary means of establishing diagnosis, severity and subtype of aortic stenosis
: Secondary means of Evolut R sizing

CHEST CT
: Primary means of Evolut R sizing

DURING Evolut R Implantation

ECHOCARDIOGRAPHY
: Primary means of assessing for paravalvular leak, overall valve function and possible complications.

FLUOROSCOPY / CINE
: Primary means of Evolut R implantation guidance

AFTER Evolut R Implantation

ECHOCARDIOGRAPHY
: Primary means of assessing for prosthetic and overall cardiac function.

Saric M, Williams MR. **Transthoracic echocardiography guidance for TAVR.**
J Am Coll Cardiol Img. 2015;8(3):363-67.

JACC: CARDIOVASCULAR IMAGING
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Recommendations for Comprehensive Intraprocedural Echocardiographic Imaging During TAVR

Rebecca T. Hahn, MD,* Stephen H. Little, MD,† Mark J. Monaghan, PhD,‡ Susheel K. Kodali, MD,* Mathew Williams, MD,§ Martin B. Leon, MD,* Linda D. Gillam, MD, MPH||

ABSTRACT

Recent multicenter trials have shown that transcatheter aortic valve replacement is an alternative to surgery in a high risk population of patients with severe, symptomatic aortic stenosis. Echocardiography and multislice computed tomographic imaging are accepted tools in the pre-procedural imaging of the aortic valve complex and vascular access. Transesophageal echocardiography can be valuable for intraprocedural confirmation of the landing zone morphology and measurements, positioning of the valve and post-procedural evaluation of complications. The current paper provides recommendations for pre-procedural and intraprocedural imaging used in assessing patients for transcatheter aortic valve replacement with either balloon-expandable or self-expanding transcatheter heart valves. (J Am Coll Cardiol Img 2015;8:261–87) © 2015 by the American College of Cardiology Foundation.

DEBATES IN IMAGING

Optimal Imaging for Guiding TAVR: Transesophageal or Transthoracic Echocardiography, or Just Fluoroscopy?

Itzhak Kronzon, MD, Vladimir Jelnin, MD, Carlos E. Ruiz, MD, PhD, Muhamed Saric, MD, PhD, Mathew Russell Williams, MD, Albert M. Kasel, MD, Anupama Shivaraju, MD, Antonio Colombo, MD, Adnan Kastrati, MD
Section Editor: Partho P. Sengupta, MD

THE FOLLOWING iFORUM DEBATE FEATURES 3 VIEWPOINTS related to the most practical and effective imaging strategy for guiding transcatheter aortic valve replacement (TAVR). Kronzon, et al. provide evidence that enhanced analysis of aortic valve anatomy and improved appreciation of complications mandate the use of transesophageal echocardiography as front-line imaging modality for ALL patients undergoing TAVR. On the other hand, Saric and colleagues compare and contrast the approach of performing TAVR under transthoracic guidance. Lastly, Kasel and co-workers provide preliminary evidence that TAVR could be performed under fluoroscopic guidance without the need for additional imaging technique. Although the use of less-intensive sedation or anesthesia might reduce the procedural time, we need more randomized data to establish the most cost-effective approach in guiding TAVR.

J Am Coll Cardiol Img. 2015;8(3):363-67.

Evolution of Anesthesia & Echo Imaging for TAVR

INITIAL TAVR EXPERIENCE	SUBSEQUNT TAVR EXPERIENCE
General anesthesia	Moderate sedation
Endotracheal intubation	No endotracheal intubation
TEE guidance	TTE guidance

Review

Seminars in Cardiothoracic and Vascular Anesthesia
1–11

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A Practical Approach to Managing Transcatheter Aortic Valve Replacement With Sedation

Peter J. Neuburger, MD[1], Muhamed Saric, MD, PhD[1], Conan Huang, BS[1], and Mathew Russell Williams, MD[1]

Abstract

Transcatheter aortic valve replacement is increasingly performed as a minimally invasive treatment option for aortic valve disease. The typical anesthetic management for this procedure was traditionally similar to surgical aortic valve replacement and involved general anesthesia and transesophageal echocardiography. In this review, we discuss the technological advances in transcatheter valve systems that have improved outcomes and allow for use of sedation instead of general anesthesia. We describe an anesthetic protocol that avoids general anesthesia and utilizes transthoracic echocardiography for procedural guidance.

Semin Cardiothorac Vasc Anesth. **2016** Jan 19. [Epub ahead of print]

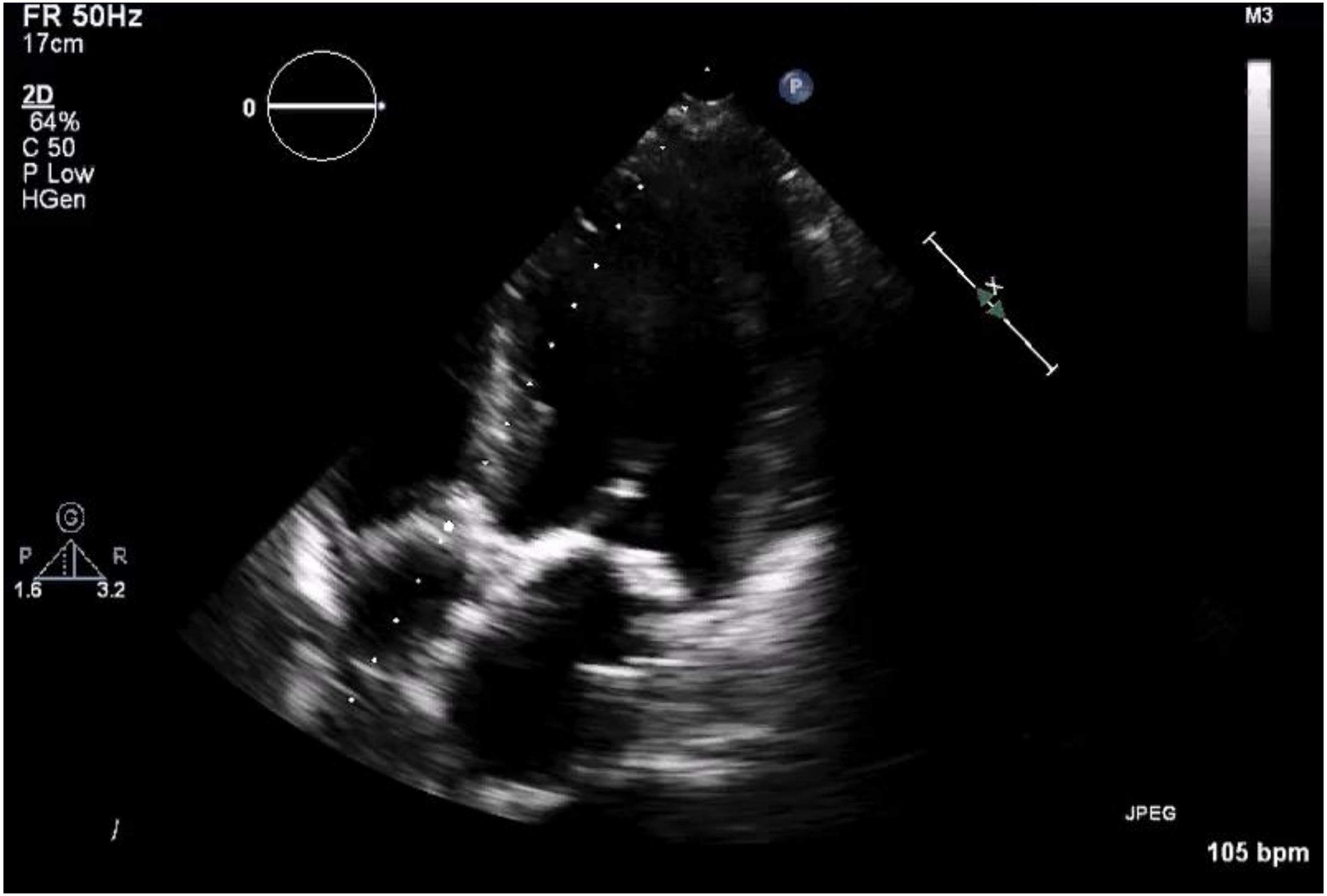
Assessment of Aortic Stenosis

ECHOCARDIOGRAPHY BEFORE EVOLUT R IMPLANTATION

: Primary means of establishing diagnosis, severity and subtype of aortic stenosis
: Secondary means of Evolut R sizing

C: Asymptomatic severe AS					
C1	**Asymptomatic severe AS**	• Severe leaflet calcification or congenital stenosis with severely reduced leaflet opening	• Aortic V_{max} ≥4 m/s or mean ΔP ≥40 mm Hg • AVA typically is ≤1.0 cm^2 (or AVAi ≤0.6 cm^2/m^2) • Very severe AS is an aortic V_{max} ≥5 m/s or mean ΔP ≥60 mm Hg	• LV diastolic dysfunction • Mild LV hypertrophy • Normal LVEF	• None: Exercise testing is reasonable to confirm symptom status
C2	**Asymptomatic severe AS with LV dysfunction**	• Severe leaflet calcification or congenital stenosis with severely reduced leaflet opening	• Aortic V_{max} ≥4 m/s or mean ΔP ≥40 mm Hg • AVA typically ≤1.0 cm^2 (or AVAi ≤0.6 cm^2/m^2)	• LVEF <50%	• None
D: Symptomatic severe AS					
D1	**Symptomatic severe high-gradient AS**	• Severe leaflet calcification or congenital stenosis with severely reduced leaflet opening	• Aortic V_{max} ≥4 m/s or mean ΔP ≥40 mm Hg • AVA typically ≤1.0 cm^2 (or AVAi ≤0.6 cm^2/m^2) but may be larger with mixed AS/AR	• LV diastolic dysfunction • LV hypertrophy • Pulmonary hypertension may be present	• Exertional dyspnea or decreased exercise tolerance • Exertional angina • Exertional syncope or presyncope
D2	**Symptomatic severe low-flow/low-gradient AS with reduced LVEF**	• Severe leaflet calcification with severely reduced leaflet motion	• AVA ≤1.0 cm^2 with resting aortic V_{max} <4 m/s or mean ΔP <40 mm Hg • Dobutamine stress echocardiography shows AVA ≤1.0 cm^2 with V_{max} ≥4 m/s at any flow rate	• LV diastolic dysfunction • LV hypertrophy • LVEF <50%	• HF • Angina • Syncope or presyncope
D3	**Symptomatic severe low-gradient AS with normal LVEF or paradoxical low-flow severe AS**	• Severe leaflet calcification with severely reduced leaflet motion	• AVA ≤1.0 cm^2 with aortic V_{max} <4 m/s or mean ΔP <40 mm Hg • Indexed AVA ≤0.6 cm^2/m^2 and • Stroke volume index <35 mL/m^2 • Measured when patient is normotensive (systolic BP <140 mm Hg)	• Increased LV relative wall thickness • Small LV chamber with low stroke volume • Restrictive diastolic filling • LVEF ≥50%	• HF • Angina • Syncope or presyncope

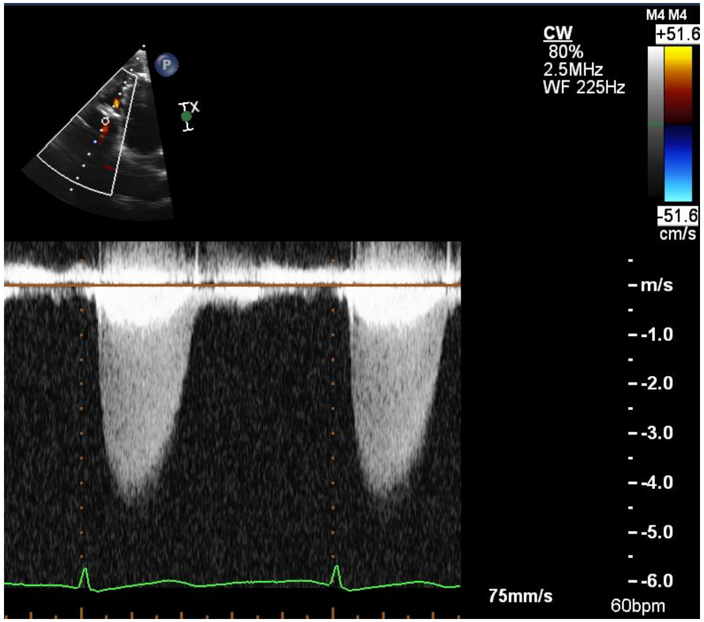
Severe Aortic Stenosis

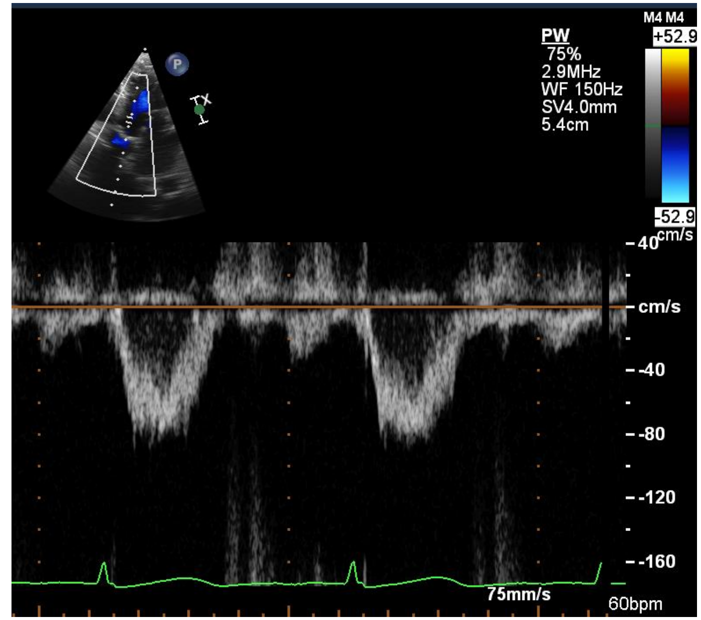


TTE: Apical 5-chamber View

Severe Aortic Stenosis

Continuous Wave (CW) Doppler	Pulsed Wave (PW) Doppler





Aortic Valve

VTI = 134 cm
Vmax = 4.3 m/sec
Peak/Mean Gradient 74/43 mm Hg

LVOT

VTI = 24 cm
Vmax = 0.8 m/sec
Area 3.14 cm^2

Dimensionless Index = 24 / 134 = 0.18 | **Aortic Valve Area = 0.6 cm^2**

ECHOCARDIOGRAPHY **BEFORE** TAVR

: Primary means of establishing diagnosis, severity and subtype of aortic stenosis
: Secondary means of Evolut R sizing

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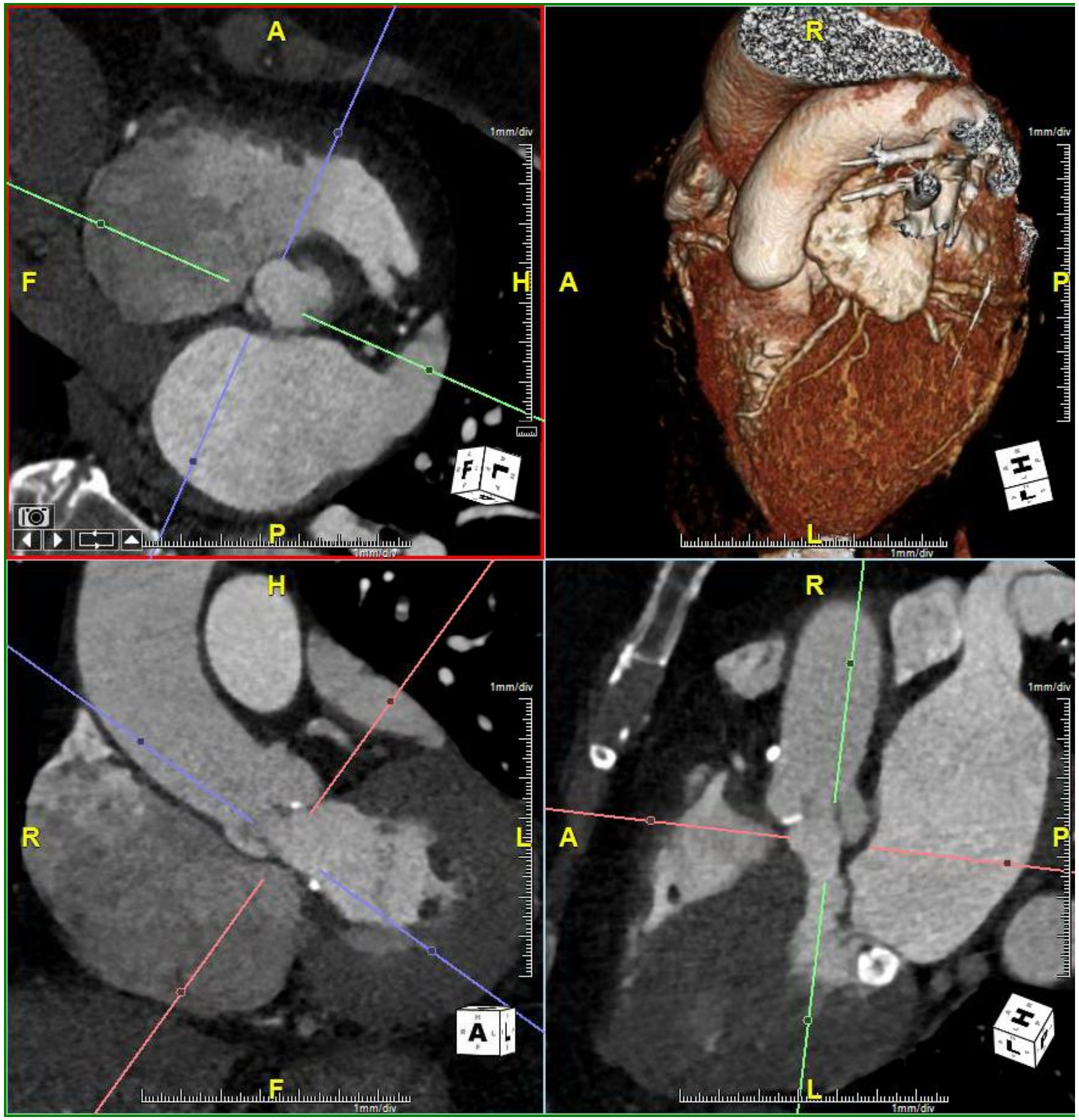
Annular Sizing

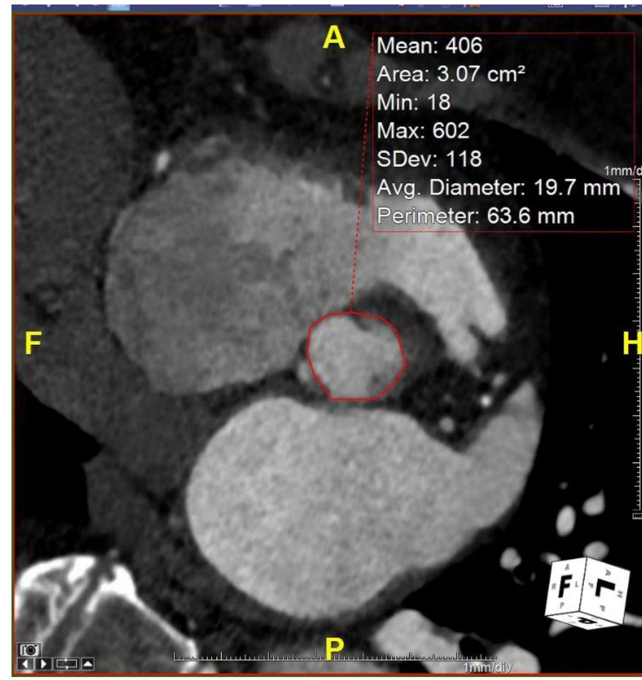
TAVR-related Aortic Root Measurements

Some interventionalists prefer **CT measurements** of aortic root over echocardiographic measurements…

…because calcifications interfere with echo but not CT imaging.

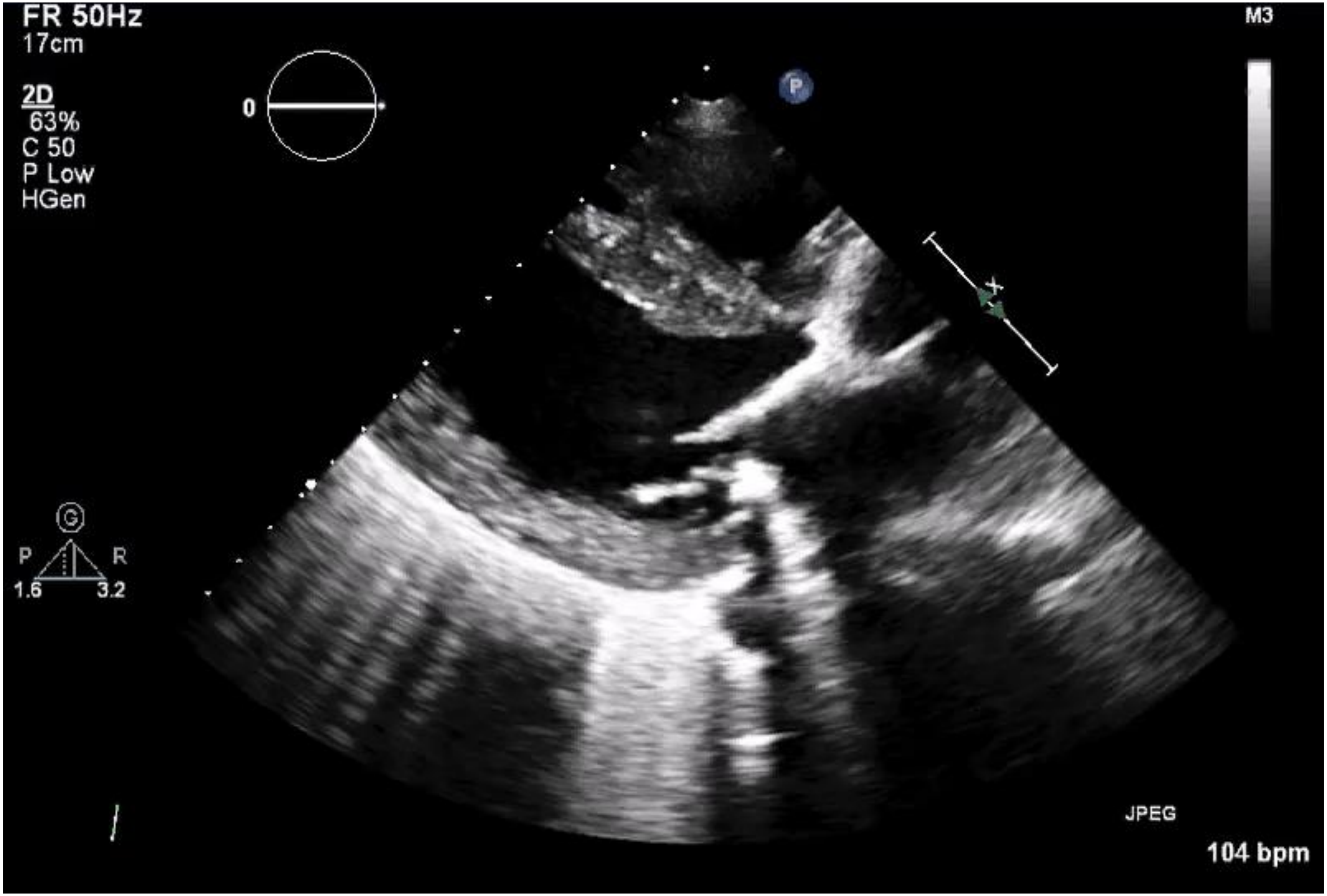
AORTIC ANNULAR SIZING | CT



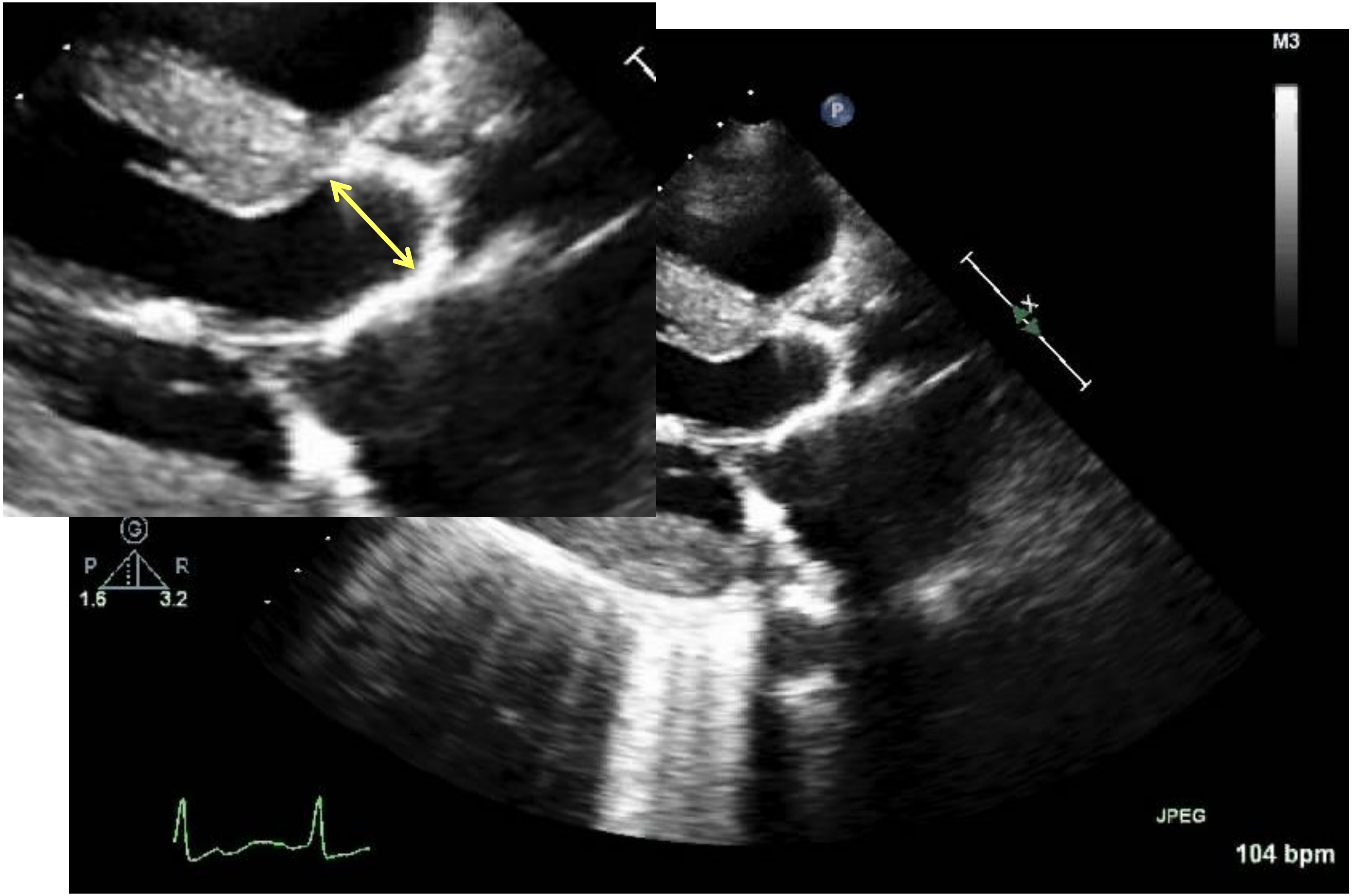


*Aortic annular **perimeter** by CT*

Aortic Annulus Sizing by TTE



Aortic Annulus Sizing by TTE



Aortic Annulus Sizing by Echo

CoreValve Classic

CoreValve Evolut R

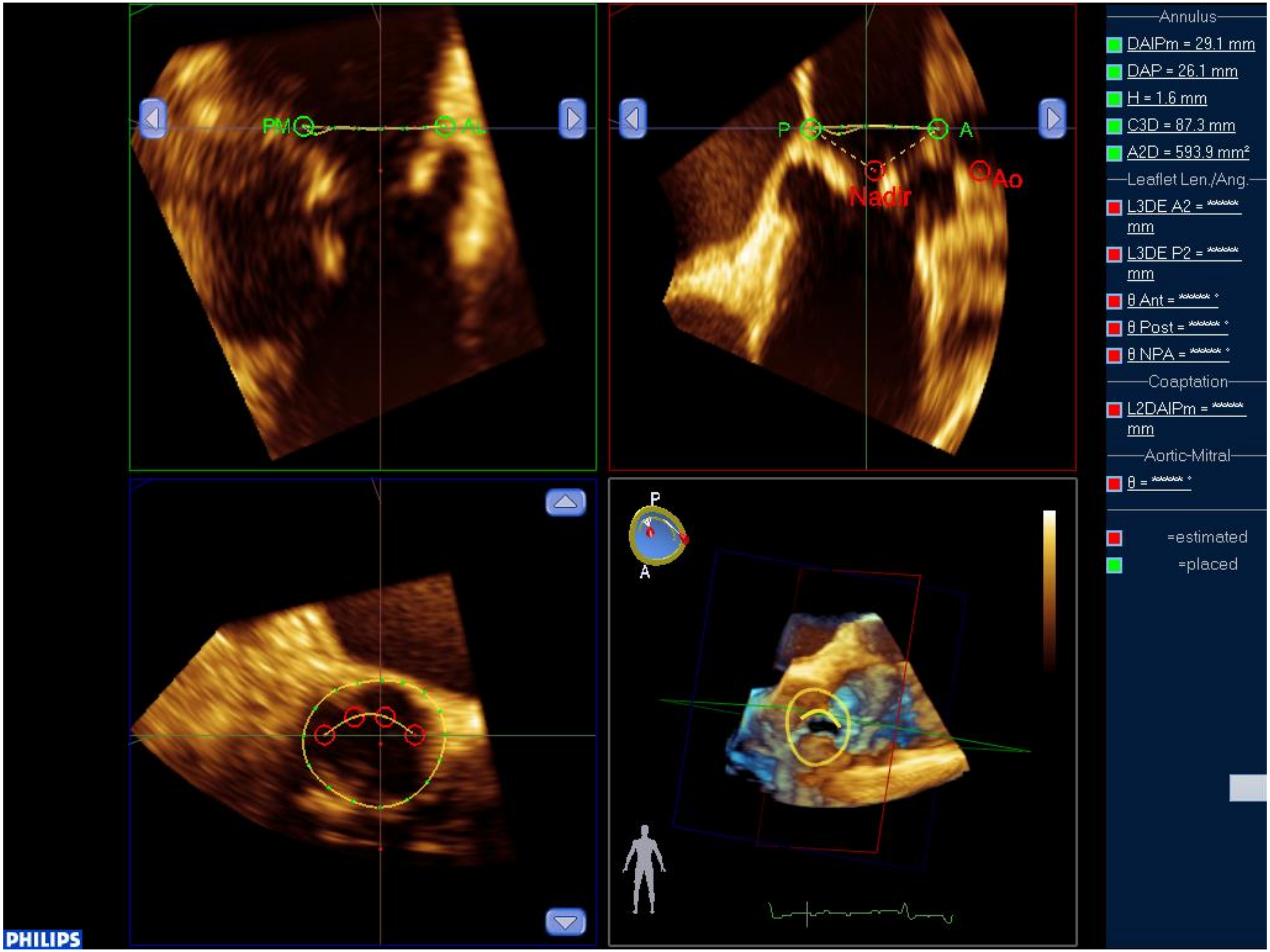
Diameter (mm)	23	26	29	31
Annulus Range				
TEE (mm)[b]	17 - 19	19 - 22	22 - 26	25 - 28
CT MD (mm)[a]	18 - 20	20 - 23	23 - 27	26 - 29
CT Area (mm²)[a]	254.5 - 314.2	314.2 - 415.5	415.5 - 572.6	530.9 - 660.5
CT Perimeter (mm)[a]	56.5 - 62.8	62.8 - 72.3	72.3 - 84.8	81.7 - 91.1
AsAo Width (mm)[a]	≤34	≤40	≤43	≤43
Sinus Height (mm)[a]	15	15	15	15
Sinus Width (mm)[a]	25	27	29	29
	CoV 23	CoV 26	CoV 29	CoV 31

BAV 20 mm (between CoV 23 and CoV 26)

BAV 23 mm (between CoV 26 and CoV 29)

BAV 26 mm (between CoV 29 and CoV 31)

Aortic Annular Sizing | 3D TEE



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STATE-OF-THE-ART PAPER

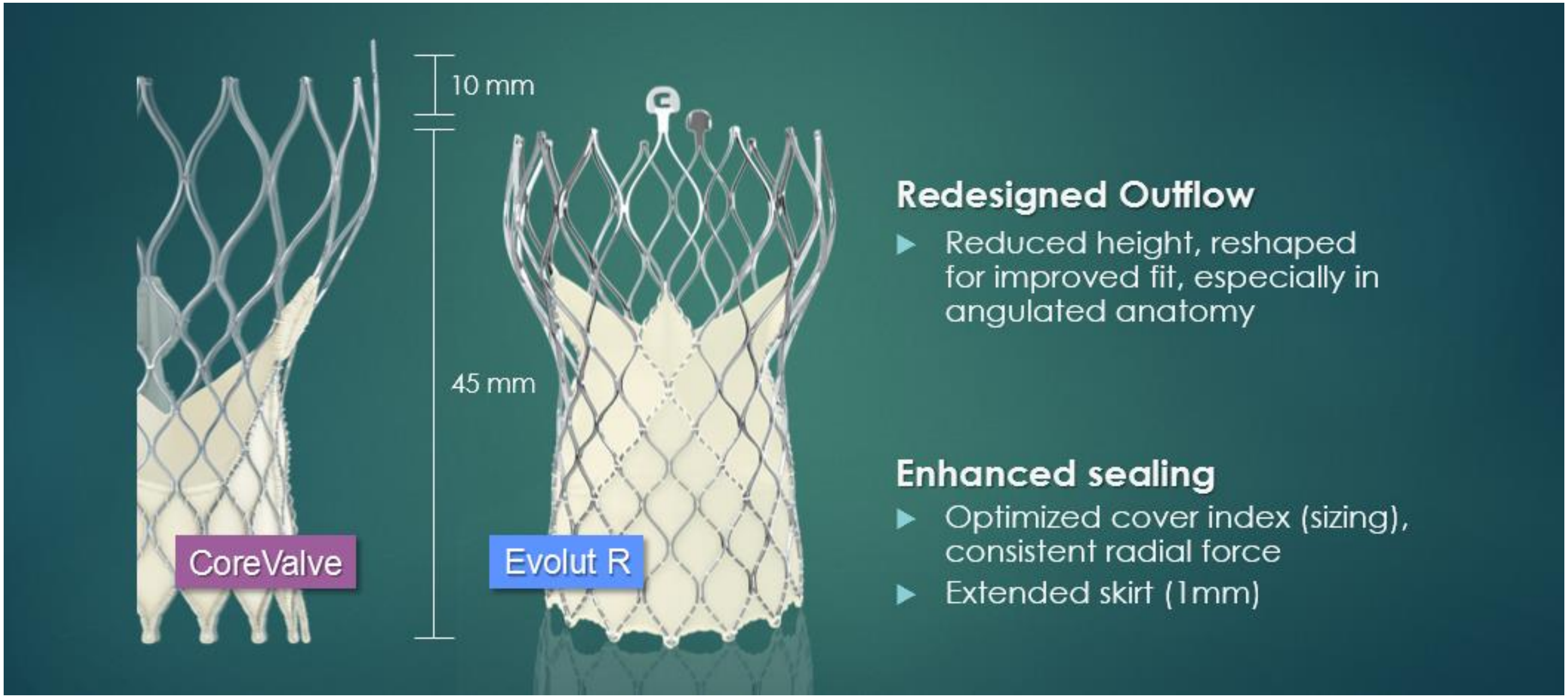
Standardized Imaging for Aortic Annular Sizing

Implications for Transcatheter Valve Selection

Albert M. Kasel, MD,* Salvatore Cassese, MD,* Sabine Bleiziffer, MD,†
Makoto Amaki, MD, PhD,‡ Rebecca T. Hahn, MD,§ Adnan Kastrati, MD,*
Partho P. Sengupta, MD‡
Munich, Germany; and New York, New York

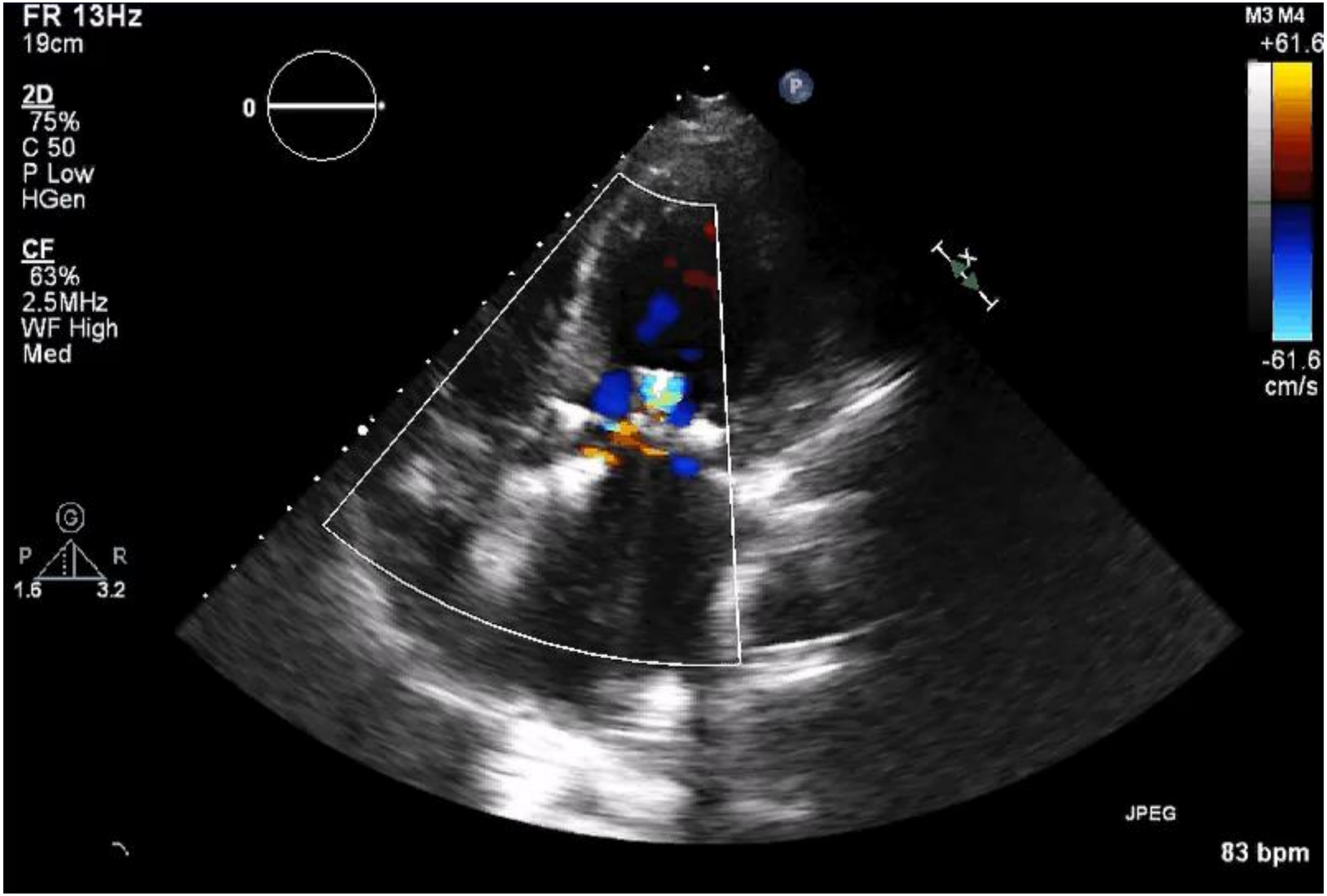
Echocardiography During TAVR

CoreValve Classic vs. Evolut R



CoreValve Evolut R

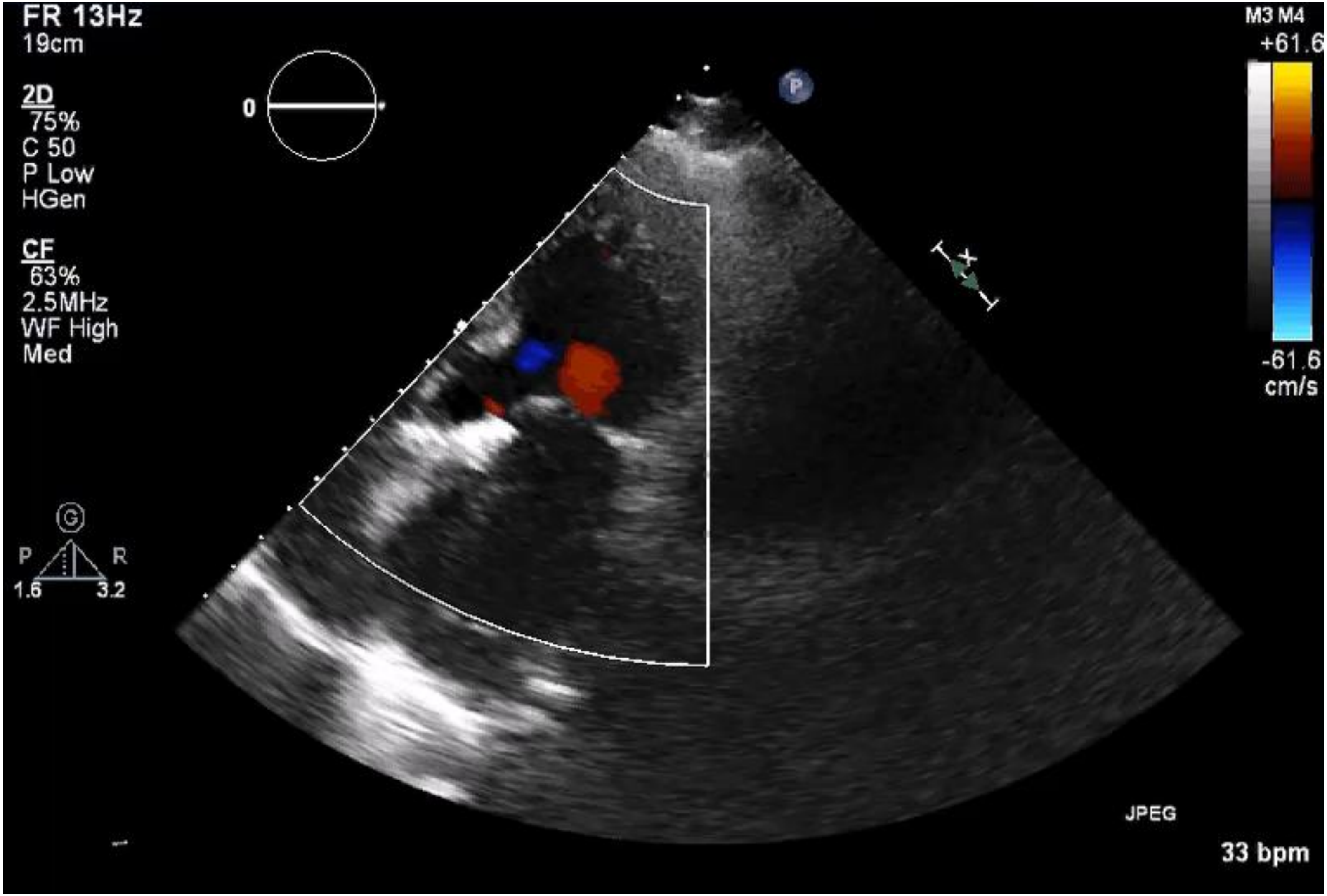
CoreValve Evolut R | Immediately Post Implantation



TTE: Apical 5-chamber View

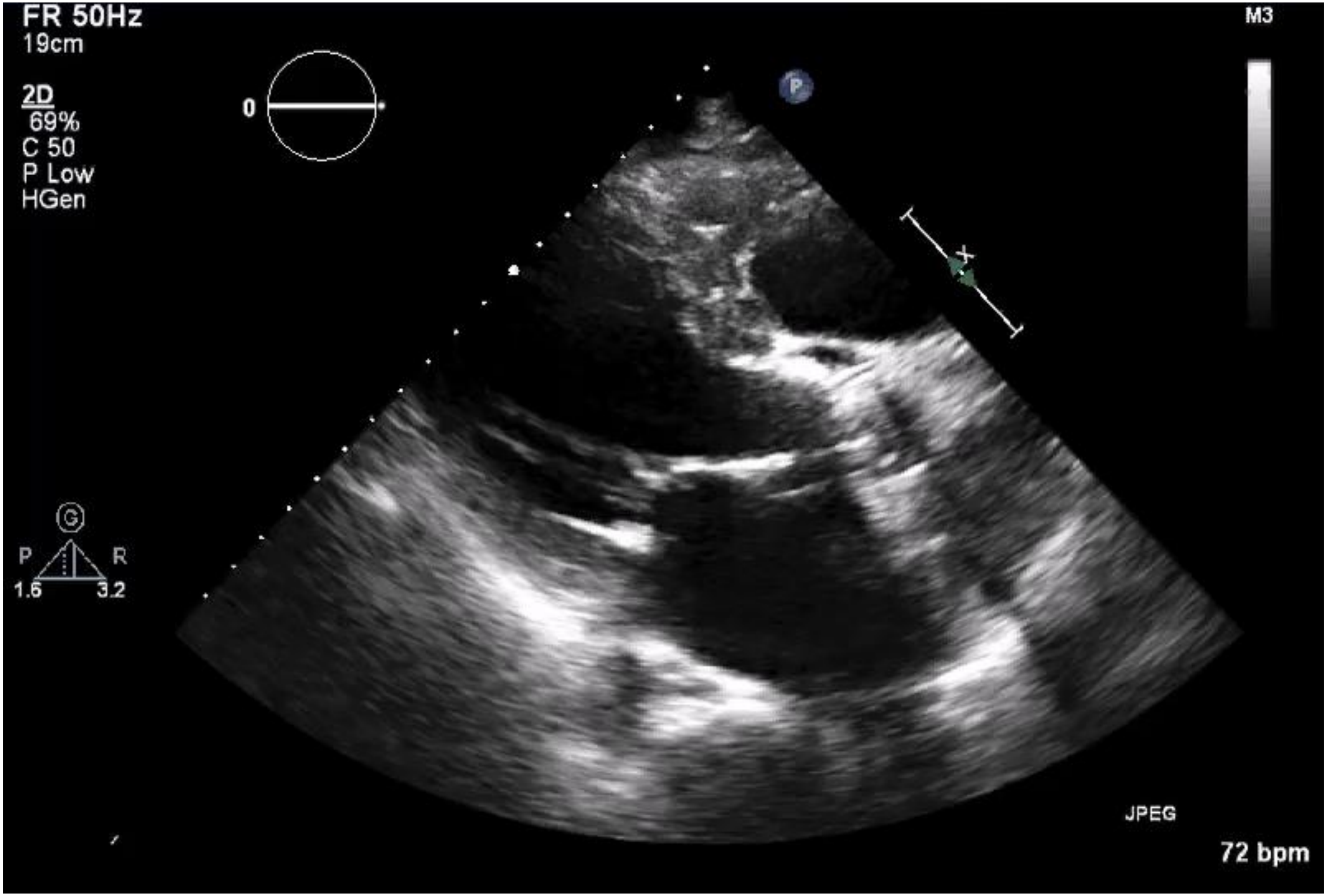
After Few Minutes…

CoreValve Evolut R | Post Implantation



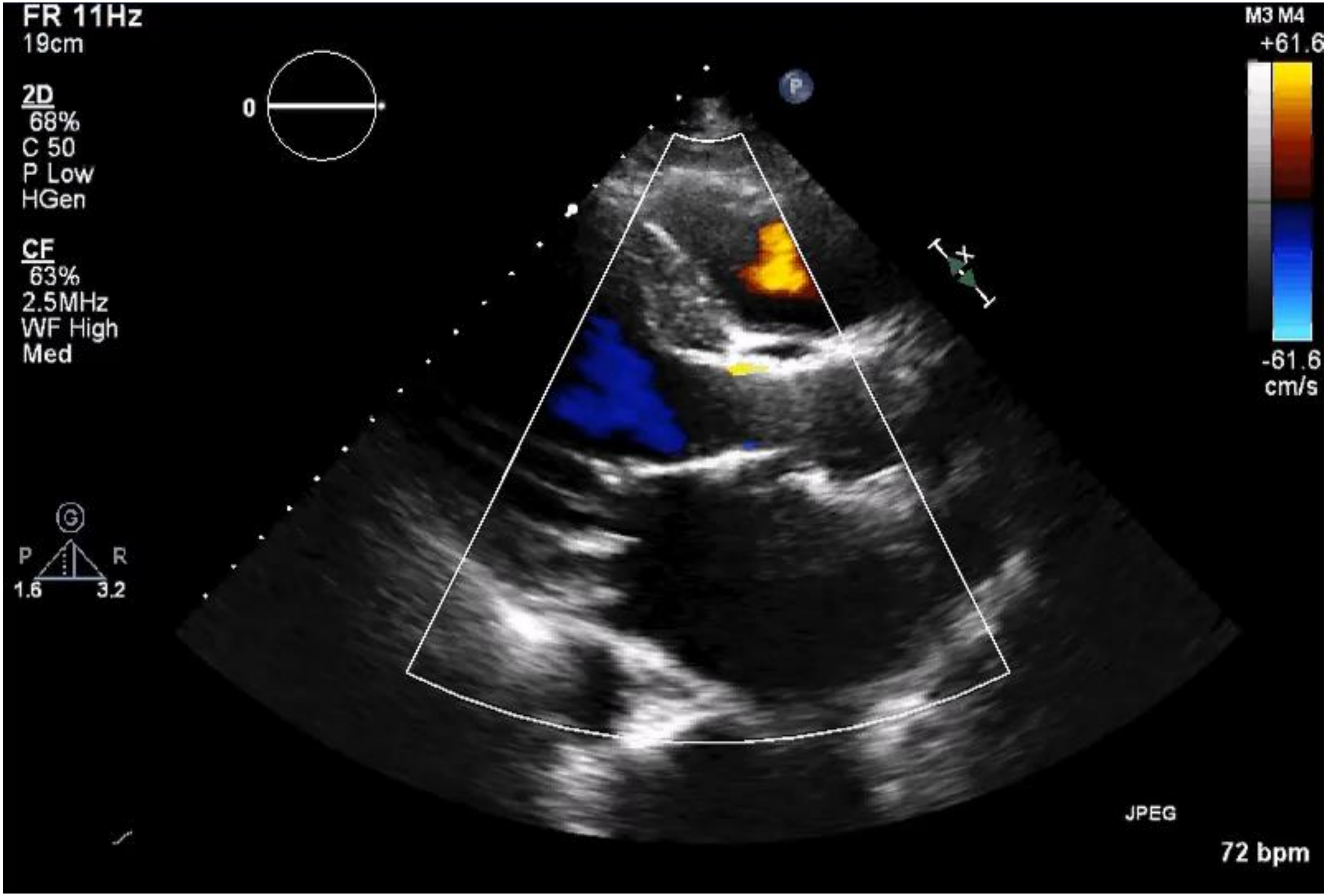
TTE: Apical 5-chamber View

CoreValve Evolut R | Post Implantation



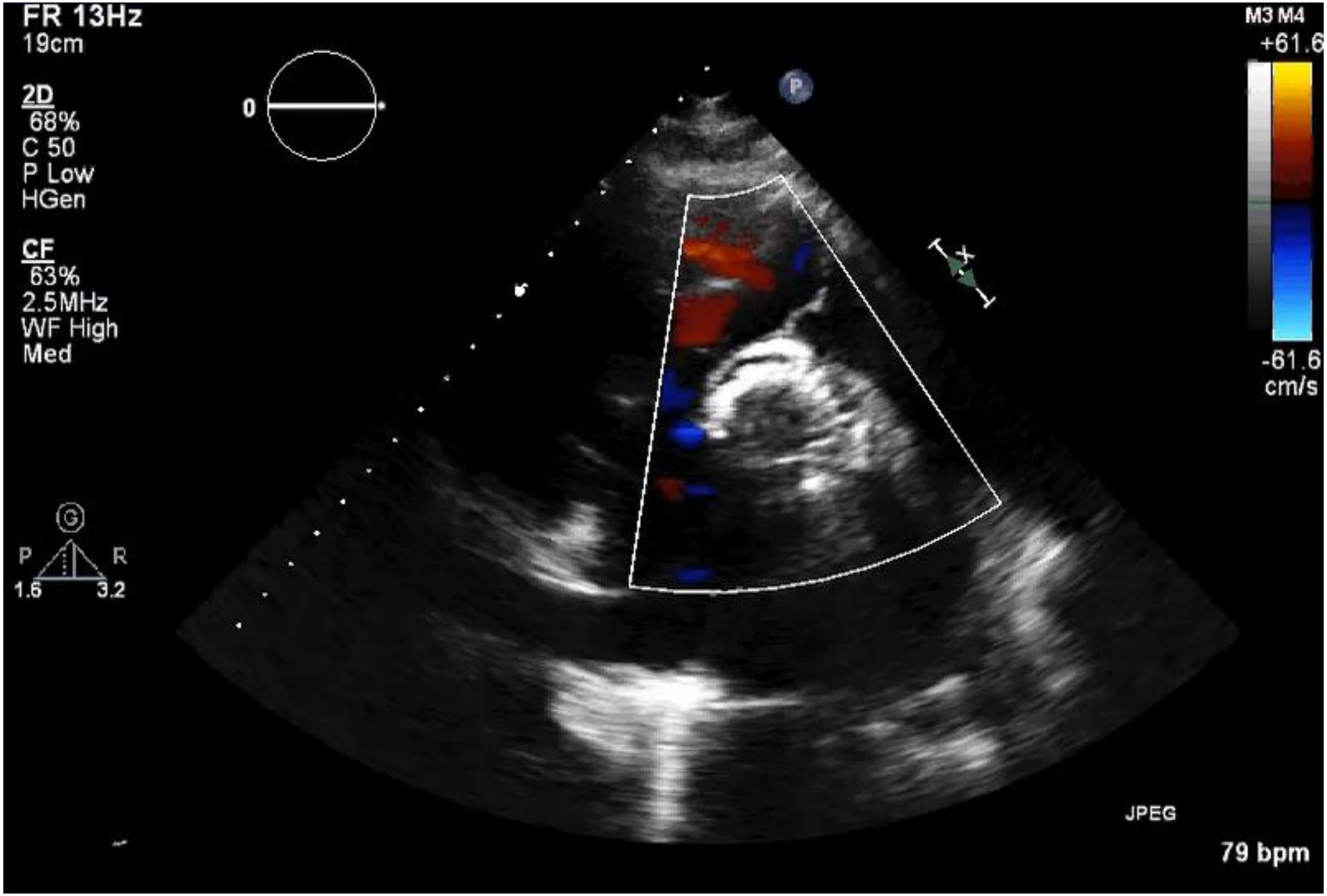
TTE: Parasternal Long-Axis View

CoreValve Evolut R | Post Implantation



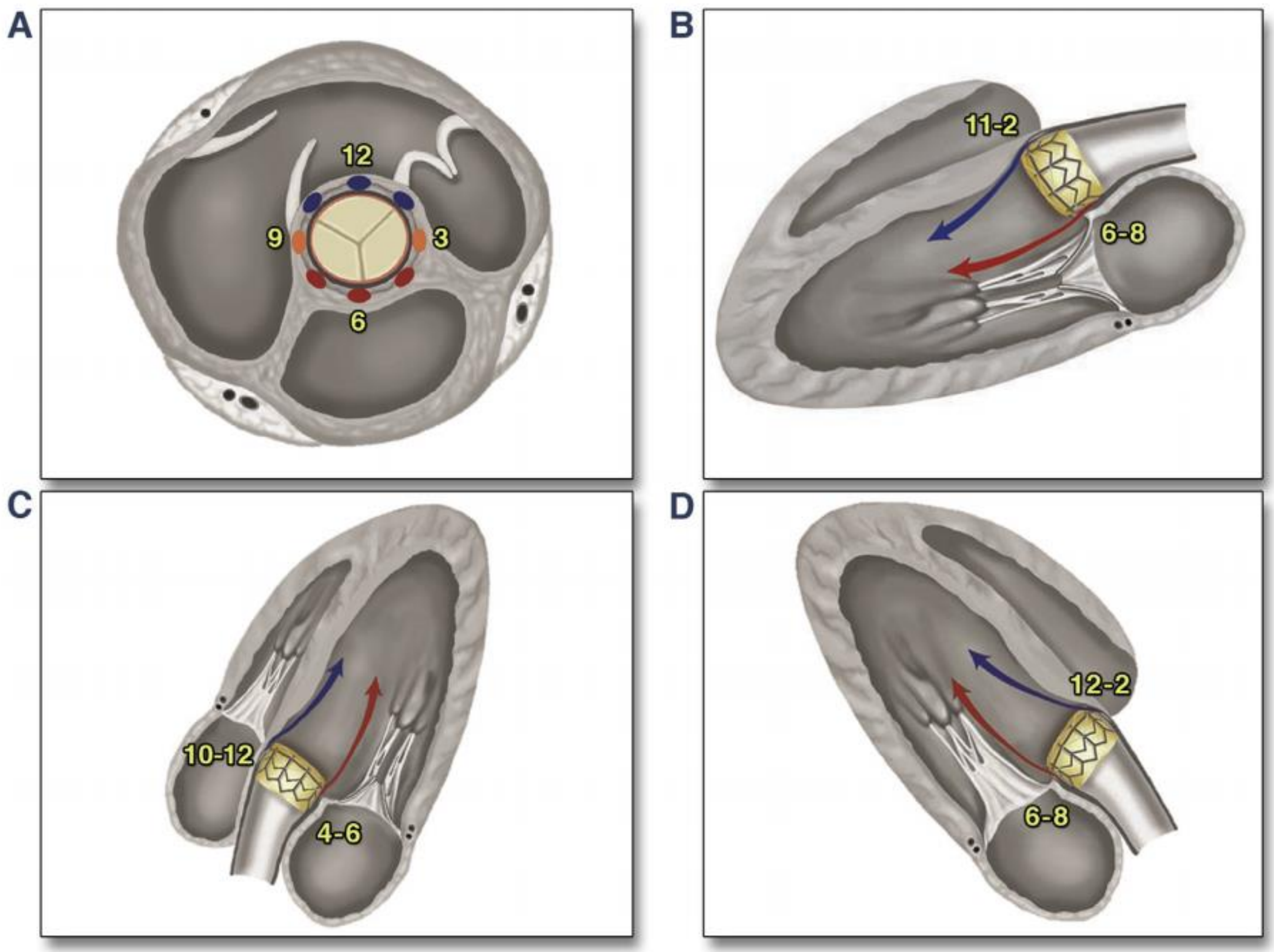
TTE: Parasternal Long-Axis View

CoreValve Evolut R | Post Implantation

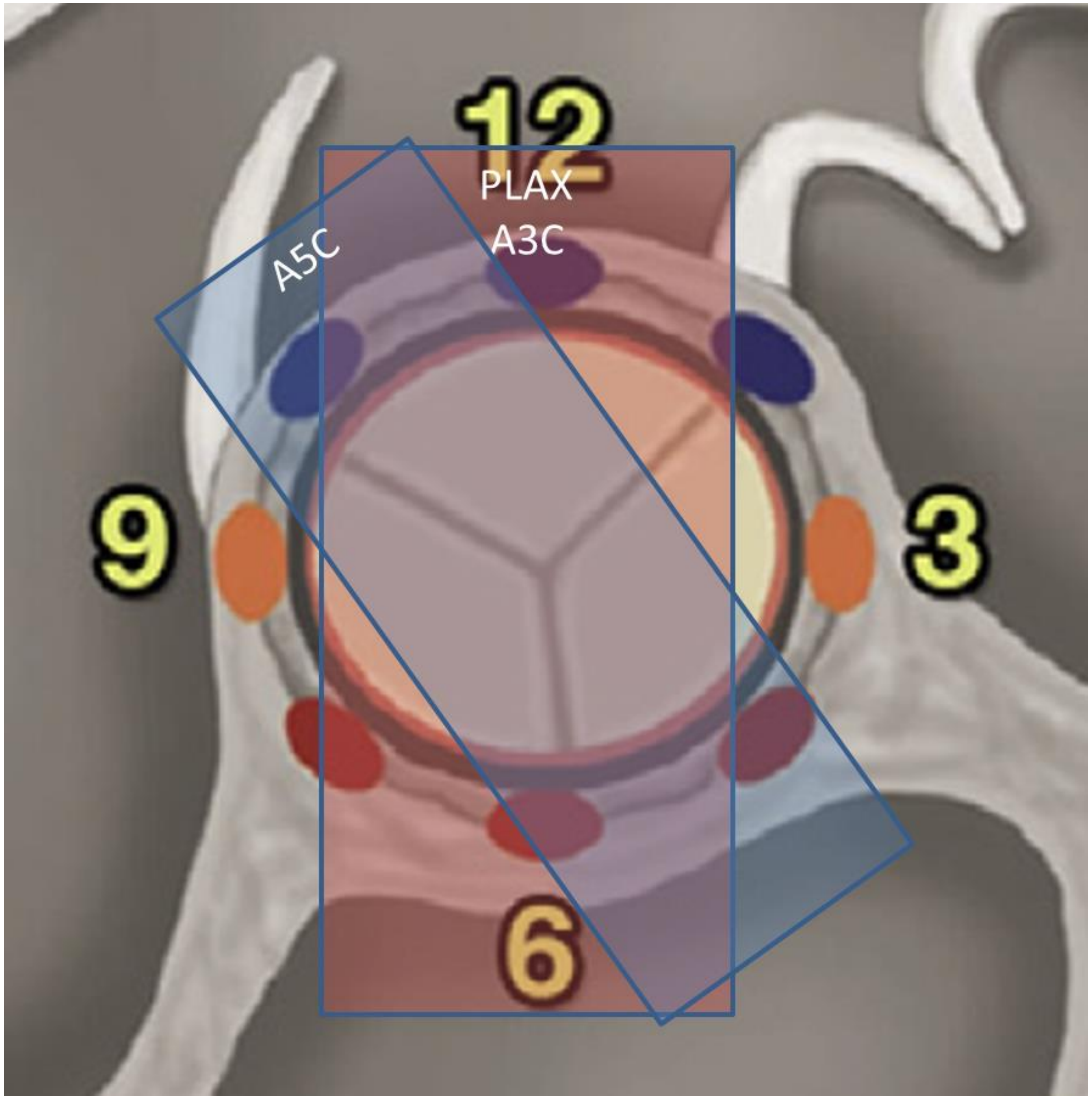


TTE: Parasternal Short-Axis View

FIGURE 3 Location of the PVR Jets in the Different Transthoracic Echocardiographic Views



JACC Cardiovasc Imaging. 2015 Mar;8(3):340-60.


12
PLAX
A3C
A5C
9
3
6

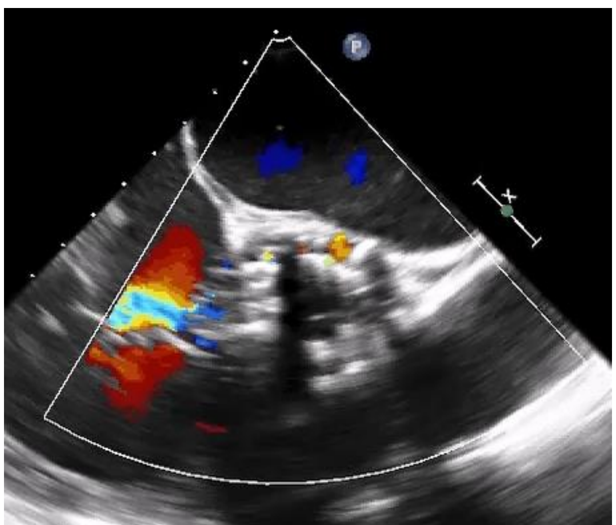
PARAVALVULAR AORTIC REGURGITATION POST TAVR

No easy way to grade it

Table 4 VARC II Recommendations for Evaluation of Aortic and/or Paravalvular Regurgitation After TAVR

	Mild	Moderate	Severe
Semiquantitative parameters			
Diastolic flow reversal in the descending aorta—pulsed wave	Absent or brief early diastolic	Intermediate	Prominent, holodiastolic
Circumferential extent of prosthetic valve paravalvular regurgitation (%)*	<10	10–29	≥30
Quantitative parameters†			
Regurgitant volume (ml/beat)	<30	30–59	≥60
Regurgitant fraction (%)	<30	30–49	≥50
Effective regurgitant orifice area (cm^2)	0.10	0.10–0.29	≥0.30

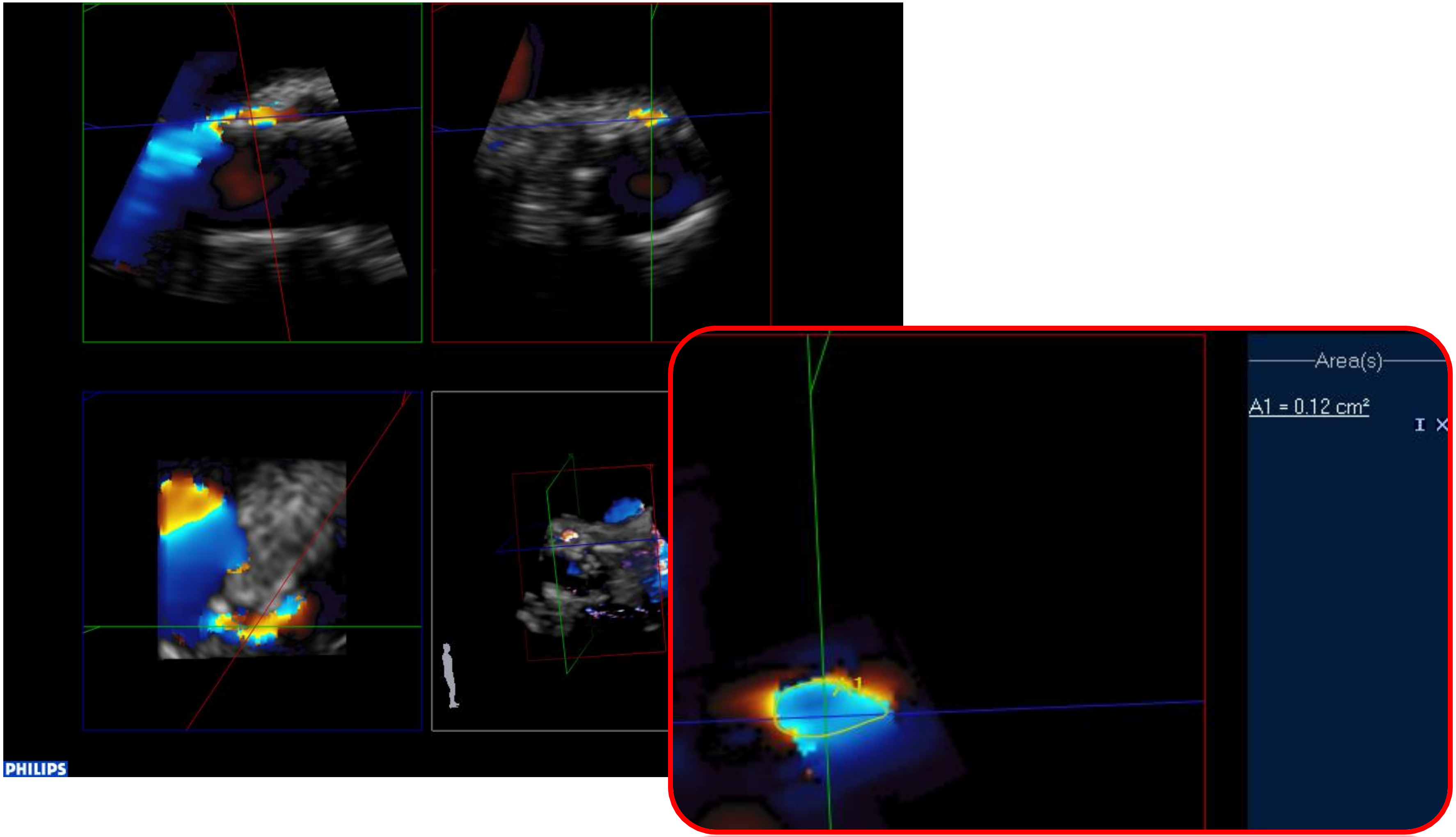
*Not well validated and may overestimate severity compared with quantitative Doppler. †For LVOT >2.5 cm, significant stenosis criteria is <0.20. Adapted with permission from Kappetein et al. (66).
VARC = Valve Academic Research Consortium; other abbreviations as in Table 1.



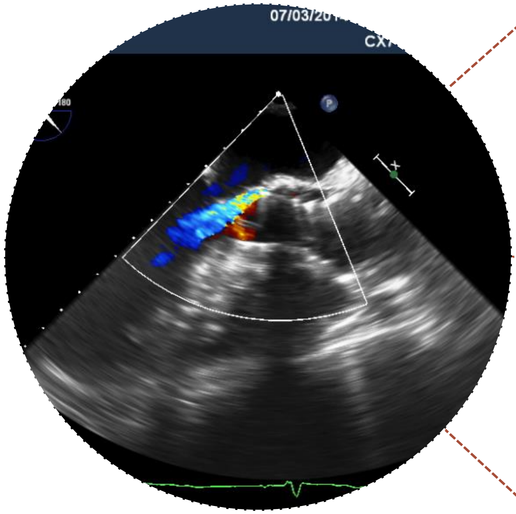
VARC II Criteria

An expert consensus without empiric validation

Paravalvular AR Post TAVR | EROA By 3D Echo



PARAVALVULAR AR POST TAVR | MECHANISMS



Undersized TAVR Valve

Meticulous annular sizing pre-TAVR minimizes this risk.

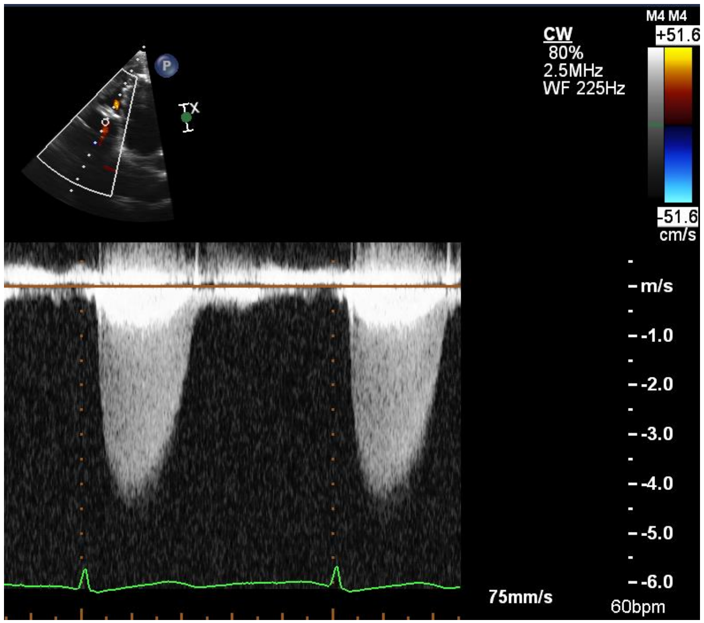
Maldeployed TAVR Valve

Reposition existing TAVR or do valvuloplasty or place valve-in-valve TAVR

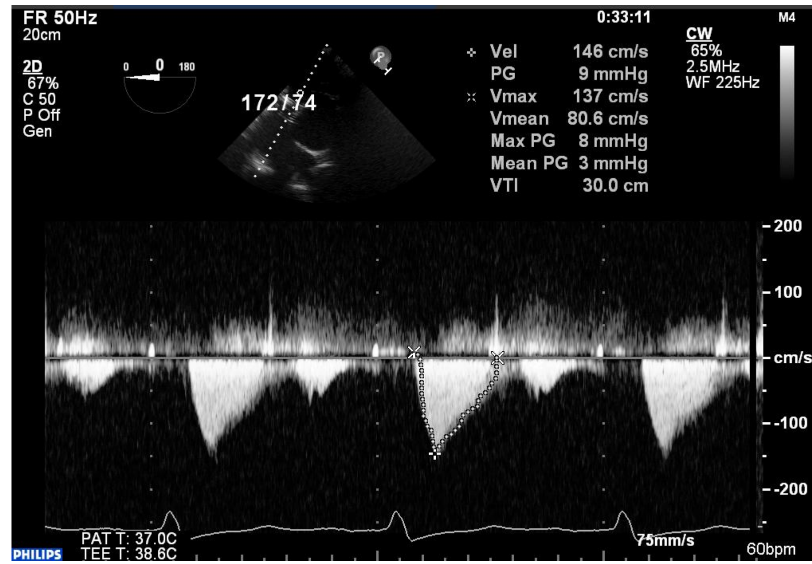
Excessive Aortic Root Calcium

New TAVR prosthesis designs

Aortic Valve Gradients | Pre & Post TAVR



Before TAVR
(Severe native valve stenosis)



After TAVR
(Minimal aortic valve gradients)

Vmax = **4.3** m/sec
Peak/Mean Gradient **74/43** mm Hg
Time to peak gradient
140 msec (late peaking)

Vmax = **1.4** m/sec
Peak/Mean Gradient **9/3** mm Hg
Time to peak gradient
95 msec (early peaking)

NYU TAVR Team

Mathew Williams, MD, prepares to insert the compressed replacement valve into the catheter. Dr. Williams has performed more TAVRs than any surgeon in the U.S.

Using 3-D echocardiography, Muhamed Saric, MD, PhD (left), guides the positioning and deployment of the replacement valve in real time.

Guided by X-ray fluoroscopy, interventional cardiologist James Slater, MD, the Robert and Marc Bell Professor of Cardiology, inserts a catheter in an artery in the groin and threads it up into the heart.

A Team Approach for Replacing Heart Valves

One of the procedures made possible by NYU Langone Medical Center's state-of-the-art hybrid OR—equipped for both surgery and catheterization—is transcatheter aortic valve replacement (TAVR). TAVR allows a narrowed, stiffened valve to be replaced through a catheter, a minimally invasive approach requiring moderate sedation and two small incisions. About 250,000 Americans are estimated to suffer from severe aortic stenosis, which limits blood flow from the heart. Without a valve replacement, half will not survive more than two years after the onset of symptoms.

The artificial valve, enveloped in a metal scaffold, or stent, collapses to the width of a pencil, allowing it to fit inside an artery.

Spring 2015 / NYU Langone News&Views 8

Thank You!

New York University Medical Center