EUROVALVE

& STRUCTURAL CARDIOMYOPATHIES

NH PALERMO

SAVE THE DATE

OCTOBER 24&25,2024

How should we manage?

Patient-prosthesis mismatch after SAVR

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Current Topics

The Problem of Valve Prosthesis-Patient Mismatch

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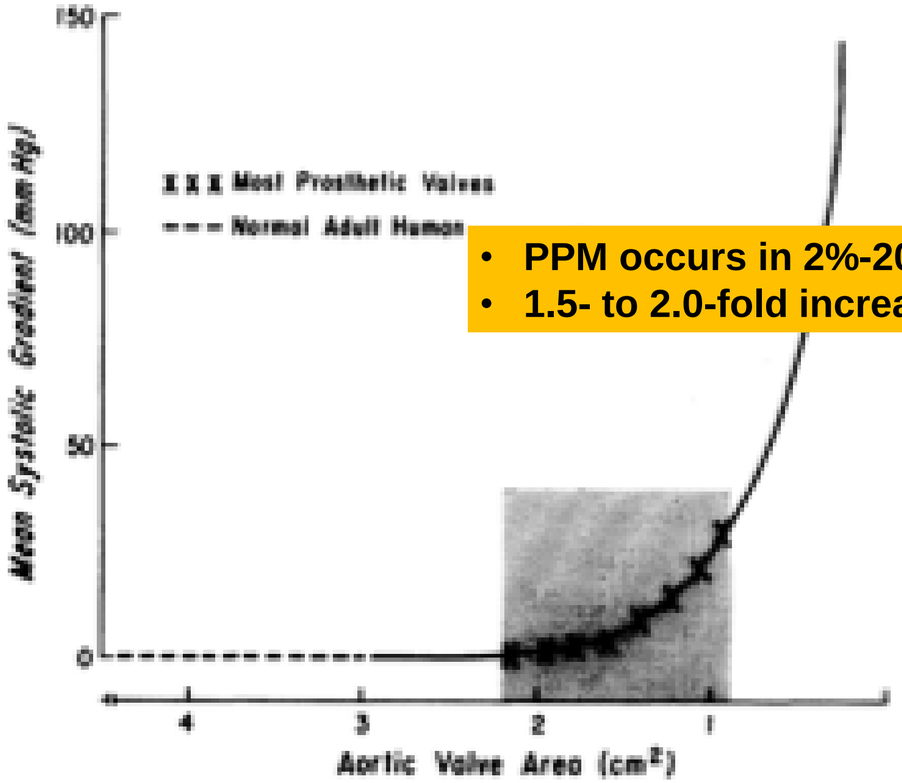
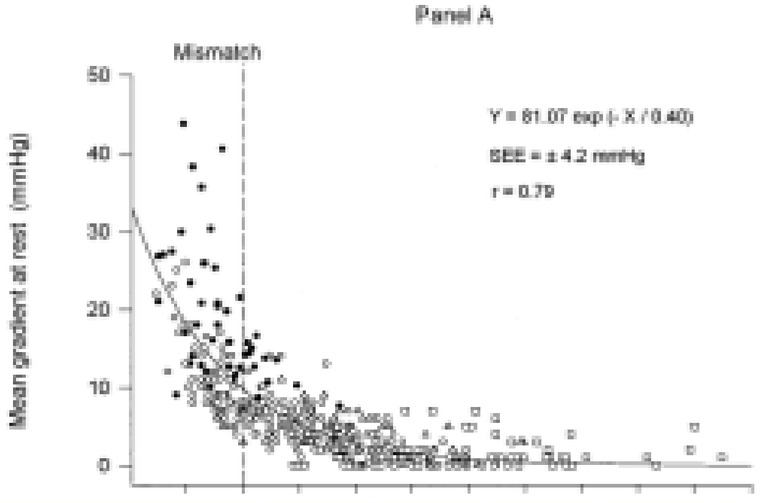
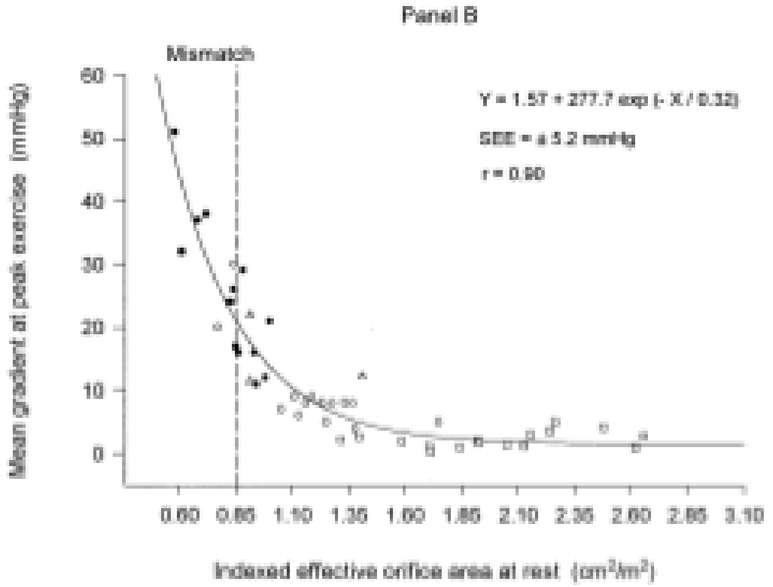
SUMMARY Valve prostheses have played an important part in the past two decades in the management of patients with valvular heart disease. However, many of the devices used in valve replacement have introduced new clinical problems. This



- **PPM occurs in 2%-20% of SAVR**
- **1.5- to 2.0-fold increase in the risk of mortality and heart failure rehospitalization**





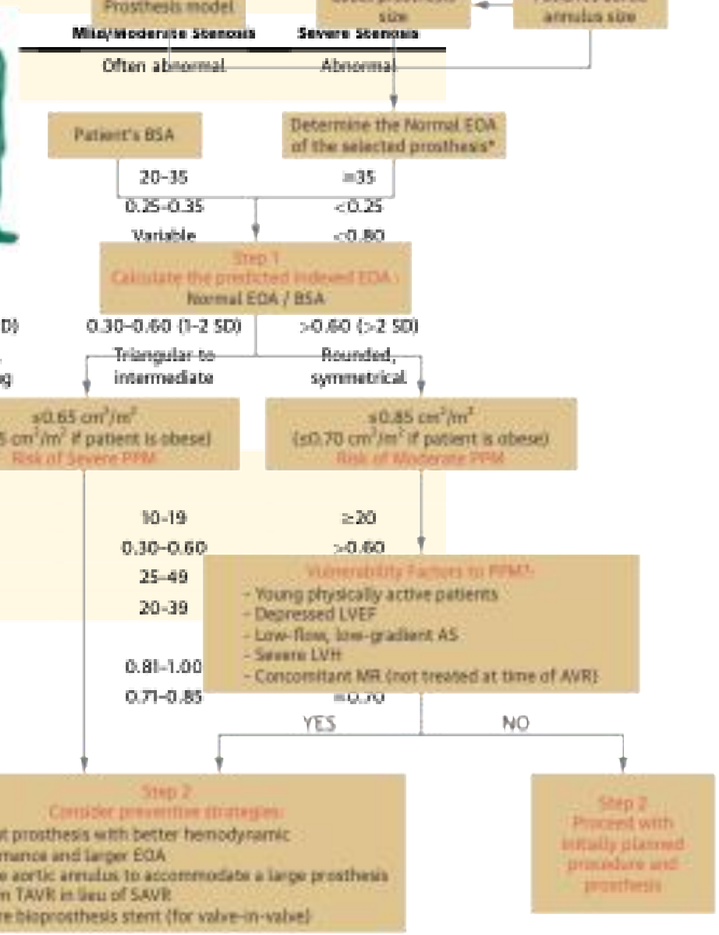
Rahimtoola Circulation 1978

Pibarot P, JACC 2020

How to chose the right prosthesis?

TABLE 1 Imaging Criteria for the Differential Diagnosis of Normal Prosthetic Valve Function vs. PPM vs. Valve Stenosis

	Normal	Moderate PPM	Severe PPM	Mild/Moderate Stenosis	Severe Stenosis
Leaflet morphology and mobility by TTE/TEE or MDCT*	Normal	Normal	Abnormal	Often abnormal	Abnormal
Doppler echo parameters					
Peak velocity, m/s	<3	3-3.5	>4		
Mean gradient, mm Hg	<20	20–30	>35		
Dimensionless index	≥0.35	≥0.30	≥0.25	0.25–0.35	<0.25
EOA, cm^2	>1.00	>1.00	>0.80	Variable	<0.80
Indexed EOA, cm^2/m^2	>0.85	0.66–0.85	≤0.65		
If BMI ≥30 kg/m^2	>0.70	0.56–0.70	≤0.55		
Difference (normal EOA − measured EOA), cm^2	<0.30 (<1 SD)	<0.30 (<1 SD)	<0.30 (<1 SD)	0.30–0.60 (1–2 SD)	>0.60 (>2 SD)
Contour of the transprosthetic jet†	Triangular, early peaking	Triangular, early peaking	Triangular, early peaking	Triangular to intermediate	Rounded, symmetrical
Acceleration time, ms†	<80	<80			
Acceleration time/LV ejection time ratio†	<0.32	<0.32			
Changes in Doppler echo parameters during follow-up					
Increase in mean gradient, mm Hg	<10	<10	<10	10–19	≥20
Decrease in EOA, cm^2	<0.30	<0.30	<0.30	0.30–0.60	>0.60
Percent decrease in EOA, %	<25	<25	<25	25–49	
Percent decrease in DVI, %	<20	<20	<20	20–39	
Hybrid (Doppler CT) parameters					
Indexed hybrid EOA, cm^2/m^2	>1.00		≤0.80	0.81–1.00	
If BMI ≥30 kg/m^2	>0.85		≤0.70	0.71–0.85	



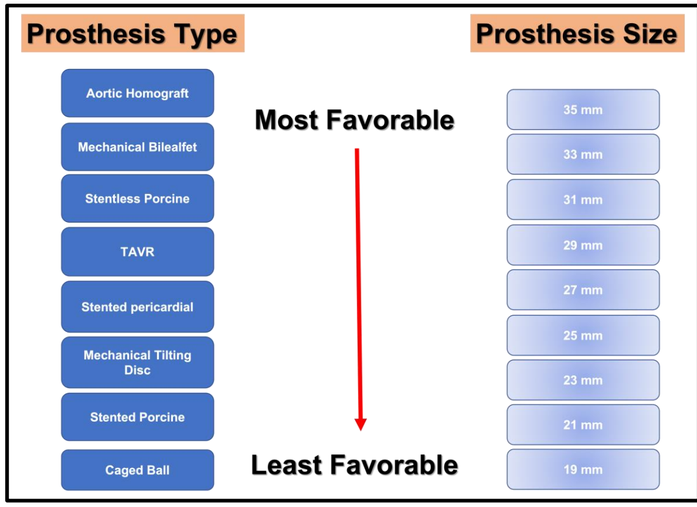
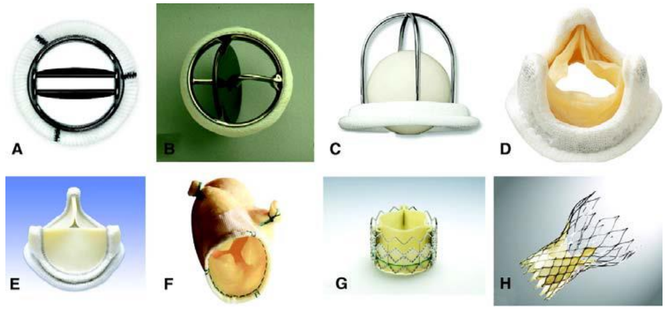


Table 2. Normal Effective Orifice Areas for the Most Currently Used Prosthetic Valves

Prosthetic Valve Size (mm)	19	21	23	25	27	29	Reference no.
Stented Bioprosthetic valves							
Medtronic Intact	0.85	1.02 ± 0.10	1.27 ± 0.11	1.40 ± 0.20	1.66 ± 0.16	2.04 ± 0.23	(2)
Medtronic Mosaic	—	1.22 ± 0.27	1.38 ± 0.23	1.65 ± 0.39	1.59 ± 0.33	1.65 ± 0.37	(95)
Hancock II	—	1.18 ± 0.11	1.33 ± 0.16	1.46 ± 0.15	1.55 ± 0.18	1.60 ± 0.15	(3)
Carpentier-Edwards SAV 2650	—	1.16 ± 0.14	—	—	—	—	(96)
Carpentier-Edwards Pericardial 2900	1.10	1.30	1.50	1.80	1.60	—	(97)
Stentless bioprosthetic valves							
Medtronic Freestyle	1.15	1.35 ± 0.21	1.48 ± 0.33	2.00 ± 0.39	2.32 ± 0.48	—	(39)
	1.29 ± 0.19	1.46 ± 0.32	1.79 ± 0.33	2.34 ± 0.69	2.67 ± 0.75	—	(98)
St. Jude Medical Toronto SPV	—	1.30	1.50	1.70	2.00	2.50	(SJM†)
	—		1.49 ± 0.45	1.70 ± 0.78	2.12 ± 0.66	2.70 ± 1.03	(99)
Prima Edwards	0.80	1.10	1.50	1.80	2.30	2.80	(100)
Mechanical valves							
Medtronic Hall	1.19 ± 0.21*	1.34 ± 0.15	—	—	—	—	(96)
Carbomedics Standard	1.00 ± 0.40	1.54 ± 0.31	1.63 ± 0.30	1.98 ± 0.41	2.41 ± 0.46	2.63 ± 0.38	(93)
	1.11 ± 0.13	1.52 ± 0.22	1.84 ± 0.25	2.12 ± 0.31	2.65 ± 0.21	—	(14)
St. Jude Medical Standard	—	1.73 ± 0.38	2.13 ± 0.61	—	—	—	(101)
	—	1.76 ± 0.47	2.11 ± 0.63	—	—	—	(26)
	1.04 ± 0.19	1.38 ± 0.22	1.52 ± 0.26	2.08 ± 0.41	2.65 ± 0.58	3.23 ± 0.30	(13)
St. Jude Medical Hemodynamic Plus	1.30 ± 0.30	—	—	—	—	—	(102)
	—	2.01 ± 0.17	—	—	—	—	(101)
	—	2.15 ± 0.29	—	—	—	—	(26)

Pibarot P, JACC 2020

Pibarot JIMG 2019



New murmur and/or congestive HF symptoms
In a patient with prosthetic valve
It might be an incidental finding.

Causes of Elevated Gradients Across Prosthesis

- **Pathologic Obstruction**
  - Thrombus
  - Pannus
  - Calcification
  - Degeneration
- **Functional Obstruction**
  - Pressure Recovery
  - PPM
- **Significant Regurgitation**
  - Prosthetic
  - Peri-prosthetic
- **Other**
  - High flow
  - Measurement Errors

Zoghbi et al. J Am Soc Echocardiogr, 22:975-1014, 2009.

High Gradients after SAVR

High Gradient after AVR

STEP 1 – Calculate:
Predicted Indexed EOA < 0.85cm²/m²

Yes → **Prosthesis-Patient Mismatch**

Normal reference EOA* and Patient's BSA

STEP 2 - Assess Presence of:
- Abnormal leaflet morphology/ mobility
- EOA < reference EOA* (difference† >0.35 cm²)
- DVI < 0.35
- Gradient increased during FU (Δ > 10 mmHg)
- EOA & DVI decreased during FU
- AT/ET>0.37

Yes → **Prosthetic Valve Stenosis**

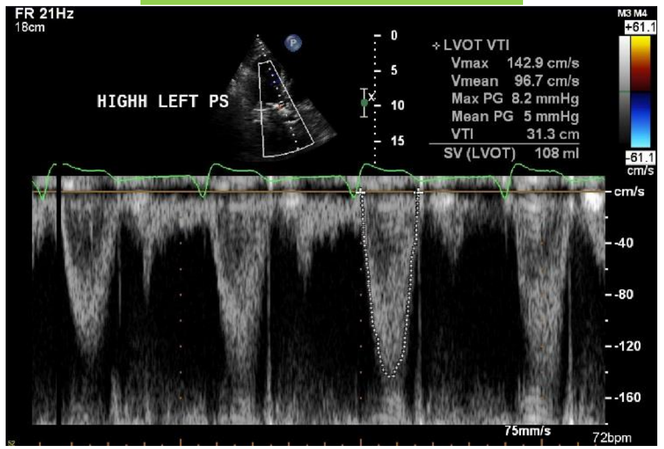
Cine-fluoro MDCT

No ↓

Consider:
- High Flow state / subvalvular obstruction
- Technical error
- Localized high gradient (bileaflet valve)

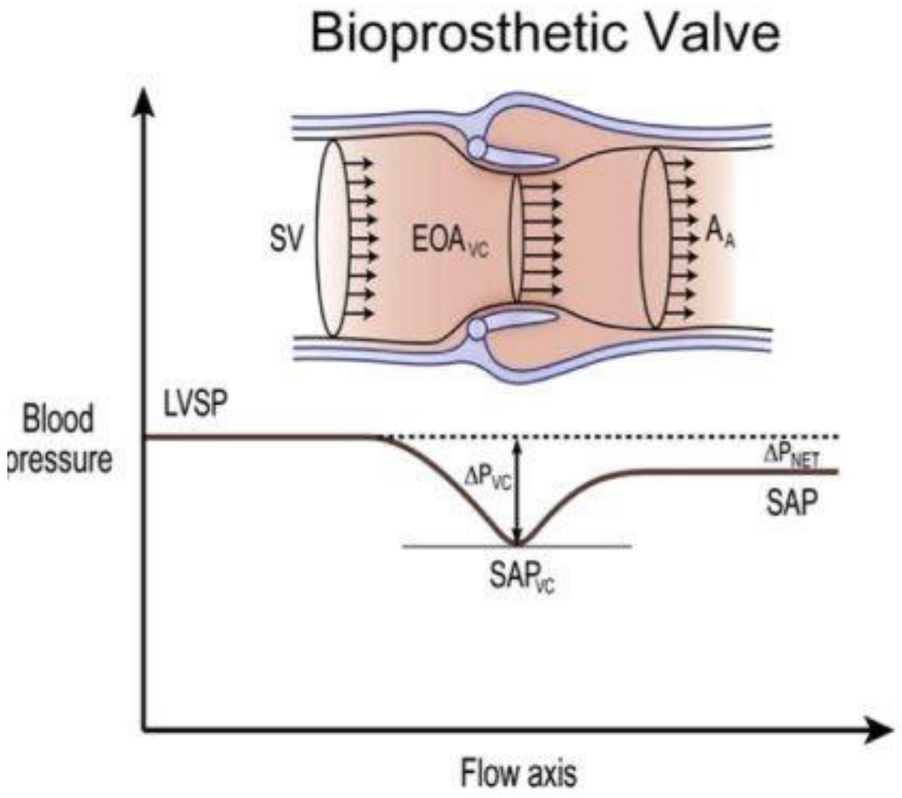
Cave for BMI ≥30 kg/m²
PPM insignificant if EOAi >0.70
Moderate if >0.55 cm²/m² and 0.70 cm²/m²
Severe if <0.55 cm²/m²

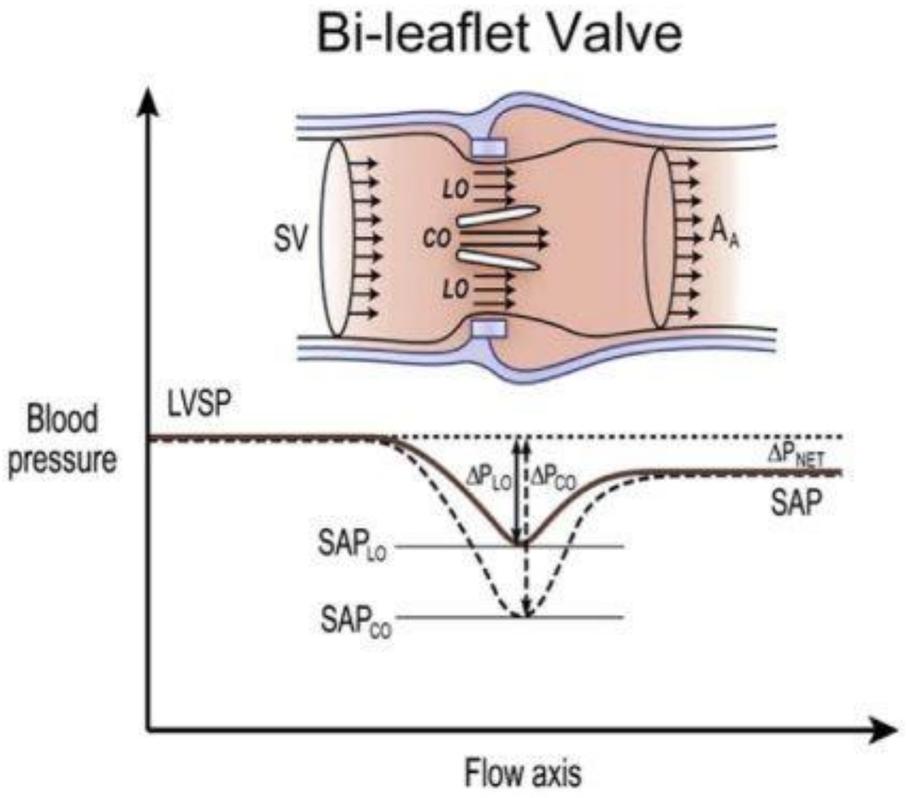
High LVOT VTI



Dahou 2016

Pressure Recovery





Tubular aorta (<3cm)

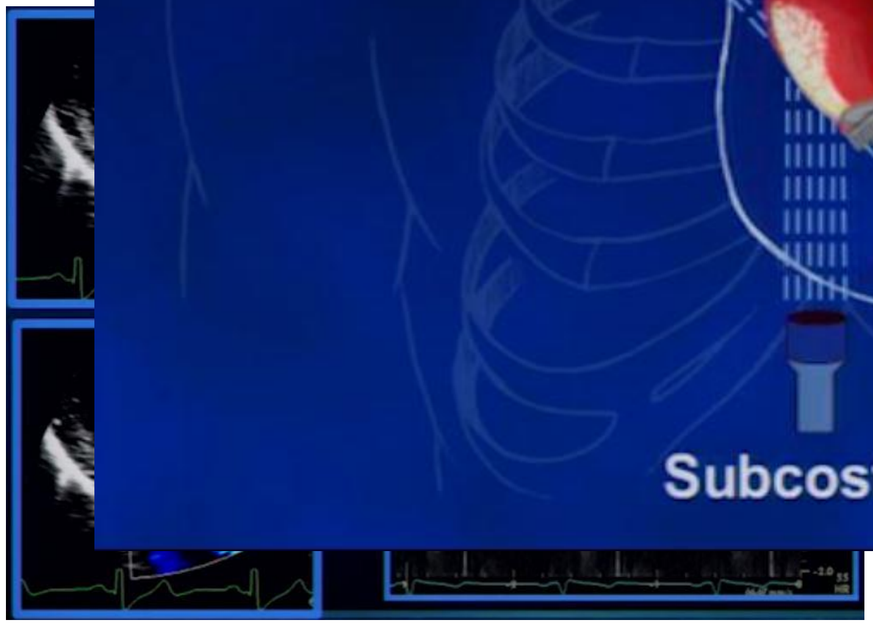
Zoghbi et al. J Am Soc Echocardiogr, 22:975-1014, 2009.

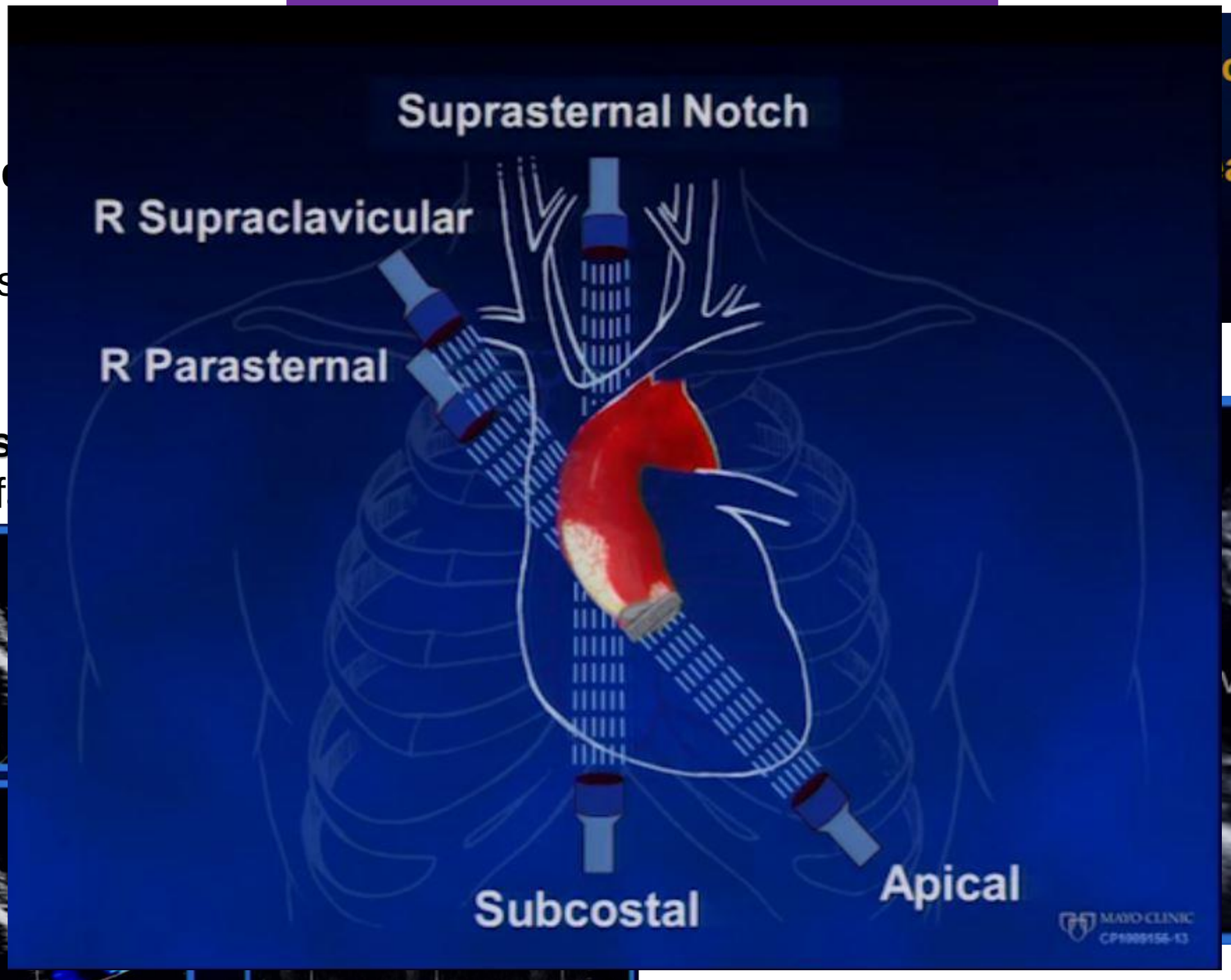
Measurement Errors

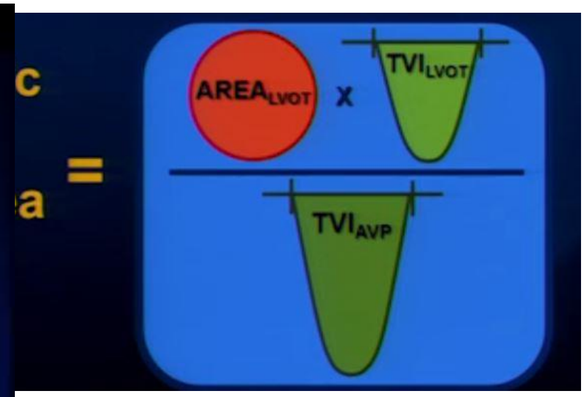
1. Incorrect **LVOT** EOA.

2. LVOT VTI meas EOA.

3. Aortic prosthes only may result in f

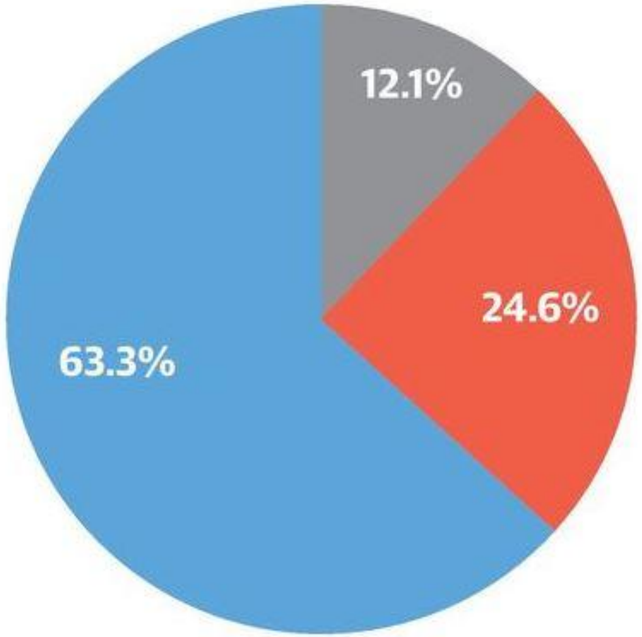




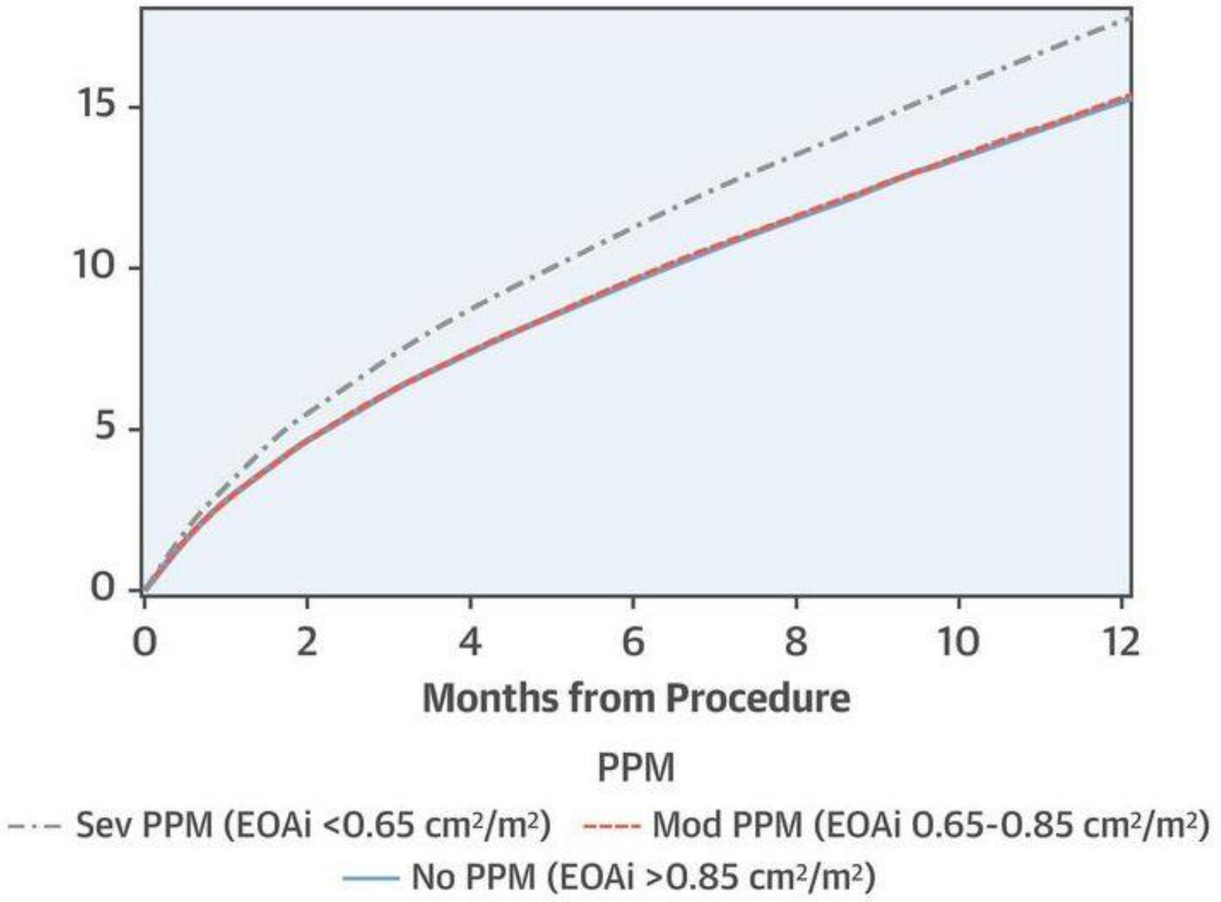


Clinical Impact of PPM after SAVR

Prosthesis-Patient Mismatch (PPM)



Mortality (%)

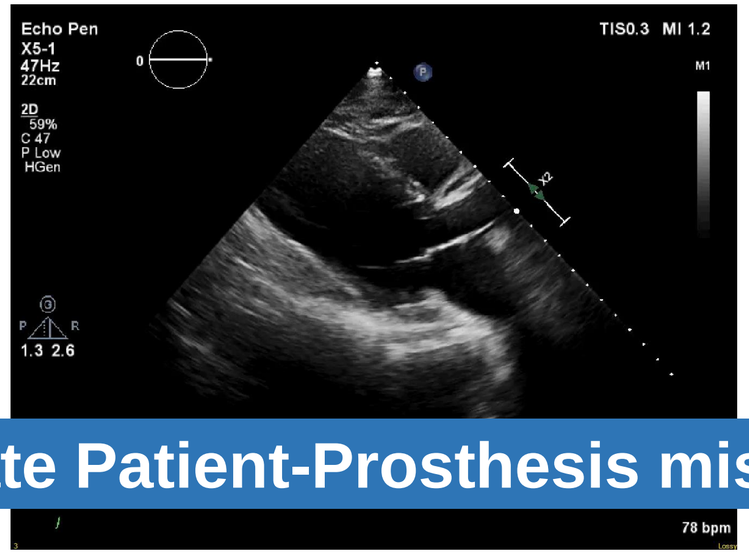


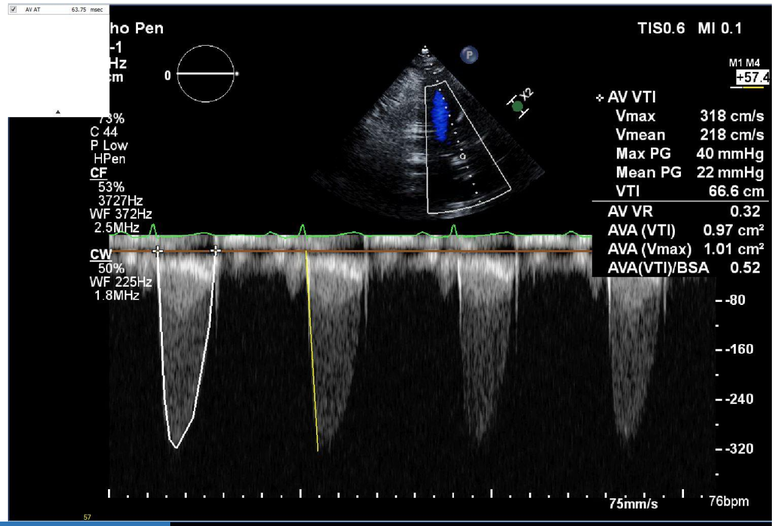
Herrmann, H.C. et al. J Am Coll Cardiol. 2018; 72 (22):2701-11

Case #1: Elevated Gradients Across AV Prosthesis

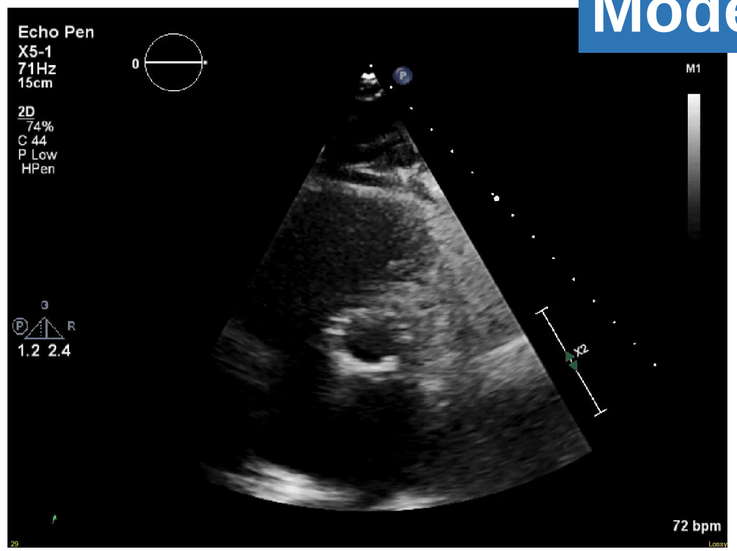
71 years old man
Previous History of CAD
Severe AS treated with Edwards SAPIEN 3 **23 mm** →
EOAp 1.6 ± 0.2 cm²
BSA 1.9 m2 →
iEOAp = 0.84 cm²

30 day FU echo

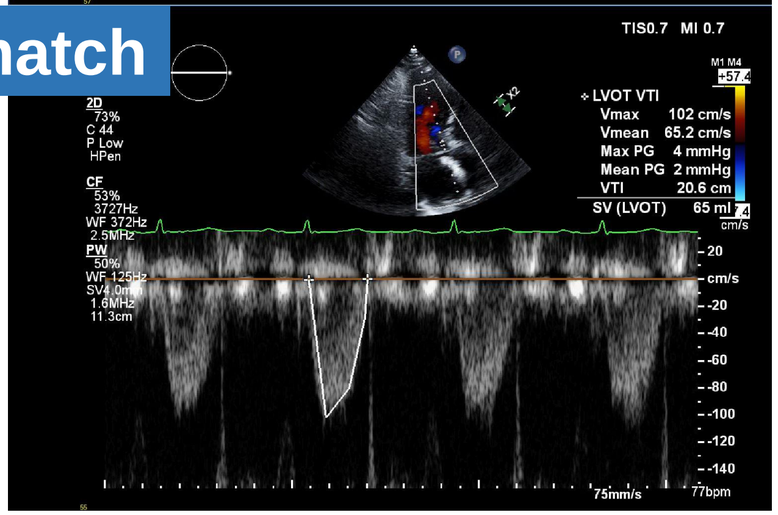




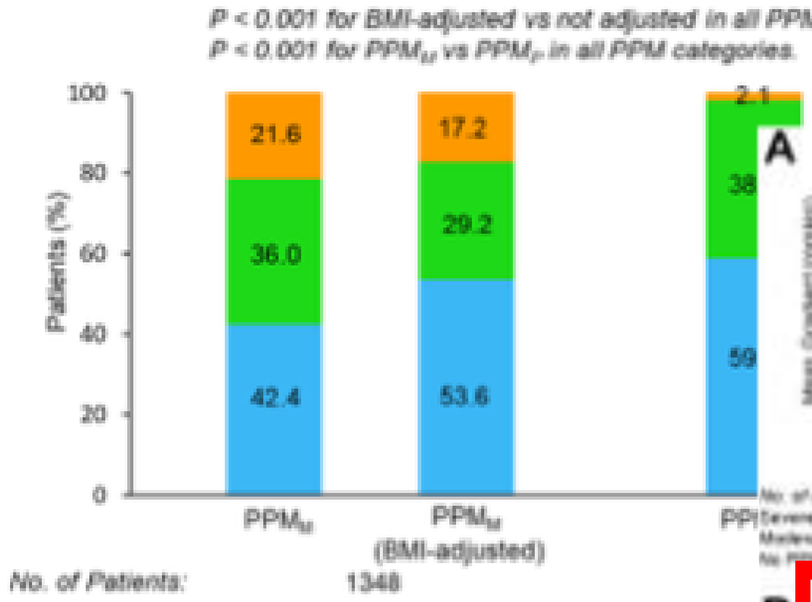
Moderate Patient-Prosthesis mismatch

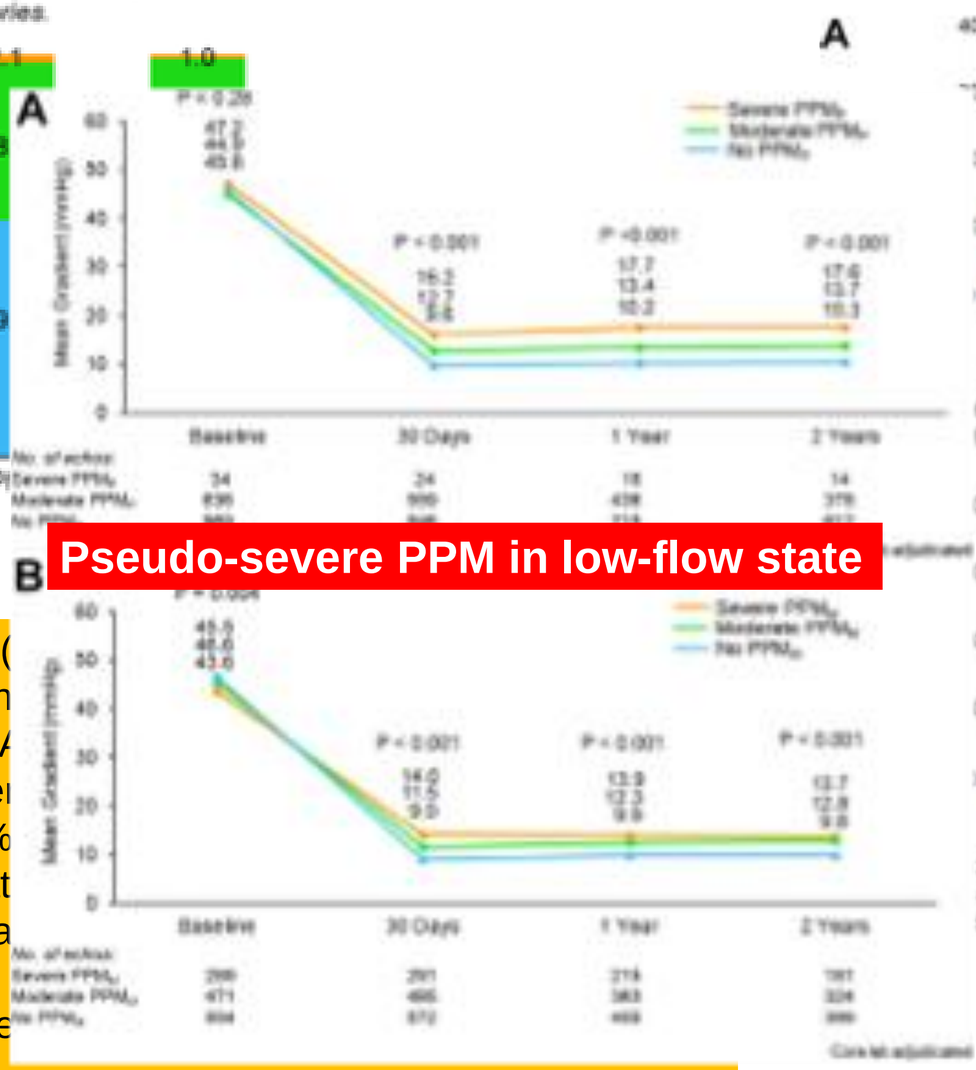


Mean gradient= 22 mmHg
LVOT VTI =20.6
DVI= 0.30
AT= 63 msec
AVAi= 0.52 cm²

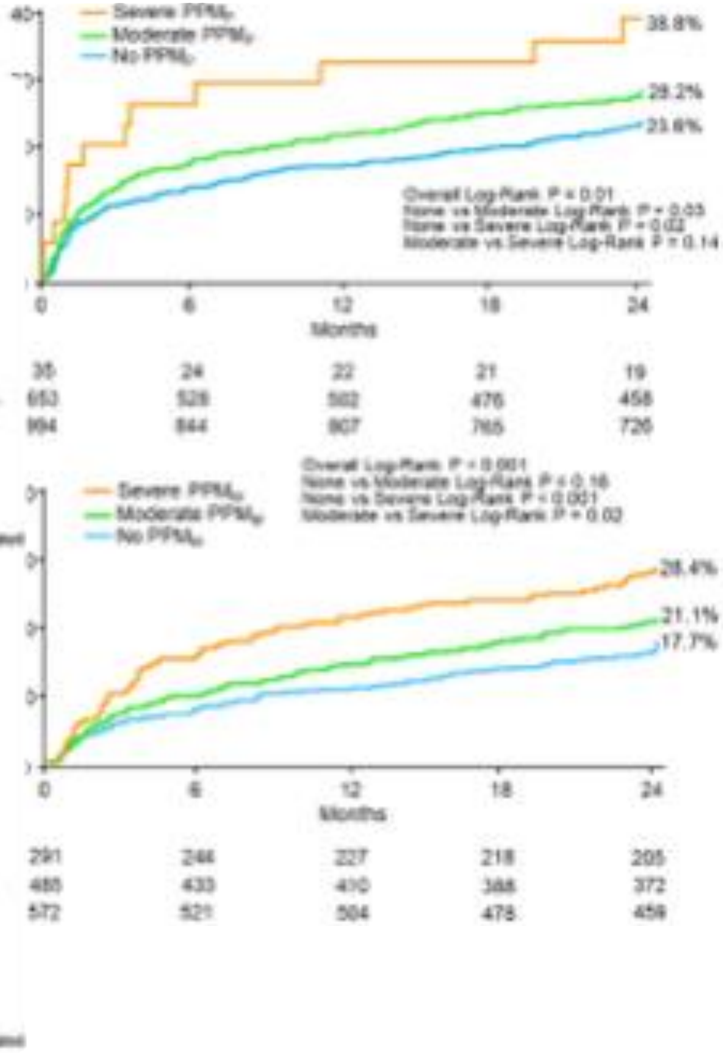


Predicted vs Measured PPM after SAVR





Pseudo-severe PPM in low-flow state

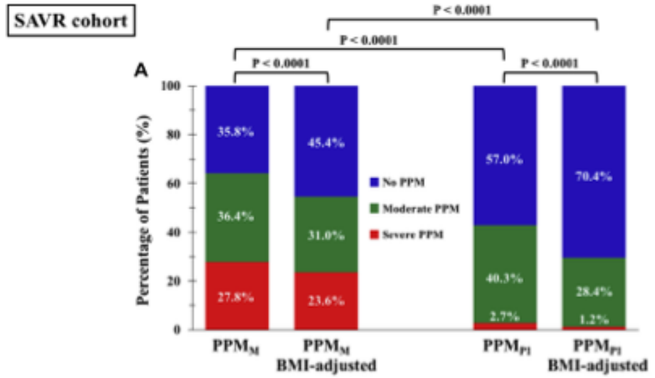


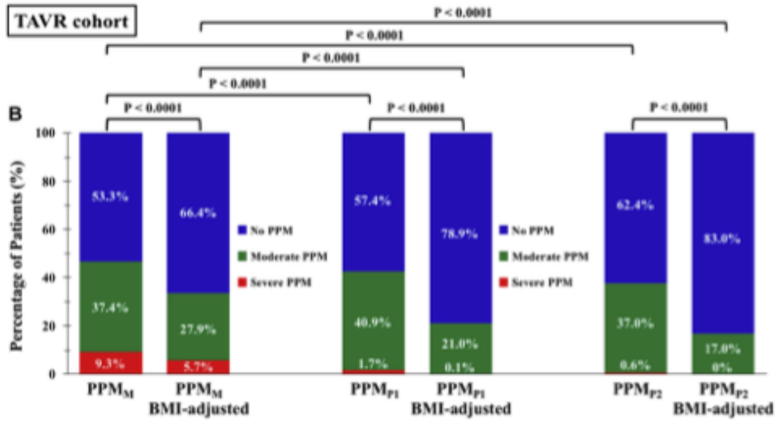
- Measured PPM method overestimates PPM (
- BMI adjustment of EOAi cutpoints in obese in severe PPM for predicted and measured EOA
- Small surgical valves (19 or 21 mm) was over (PPM_P group:75.0% and PPM_M group: 57.0%
- the presence of severe PPM was apparent at maintained through 2 years, with only minima days to 2 years
- Either severe PPM_P and PPM_M are associate
- PPM_p is more specific for true-severe PPM

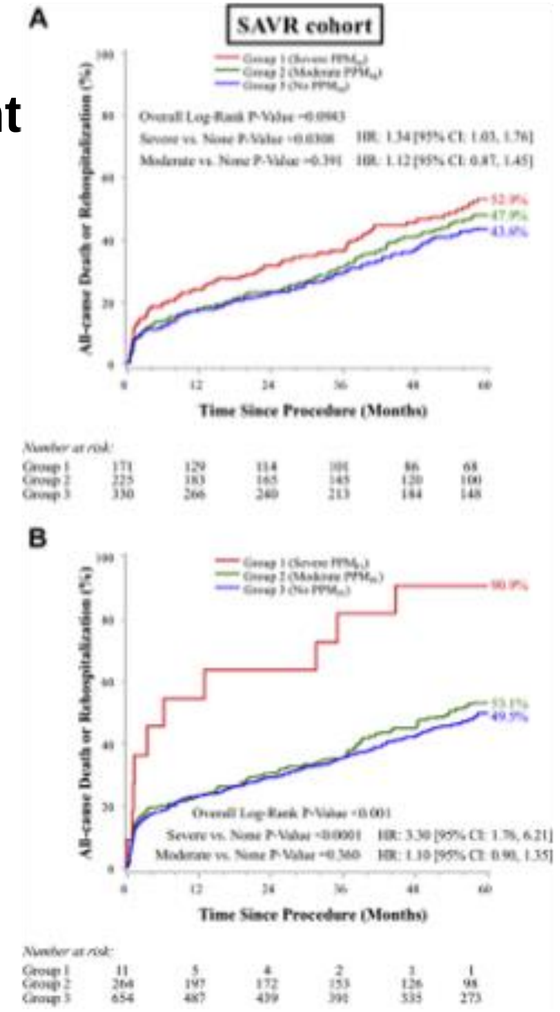
Thourani et al. Ann Thor Surg 2024

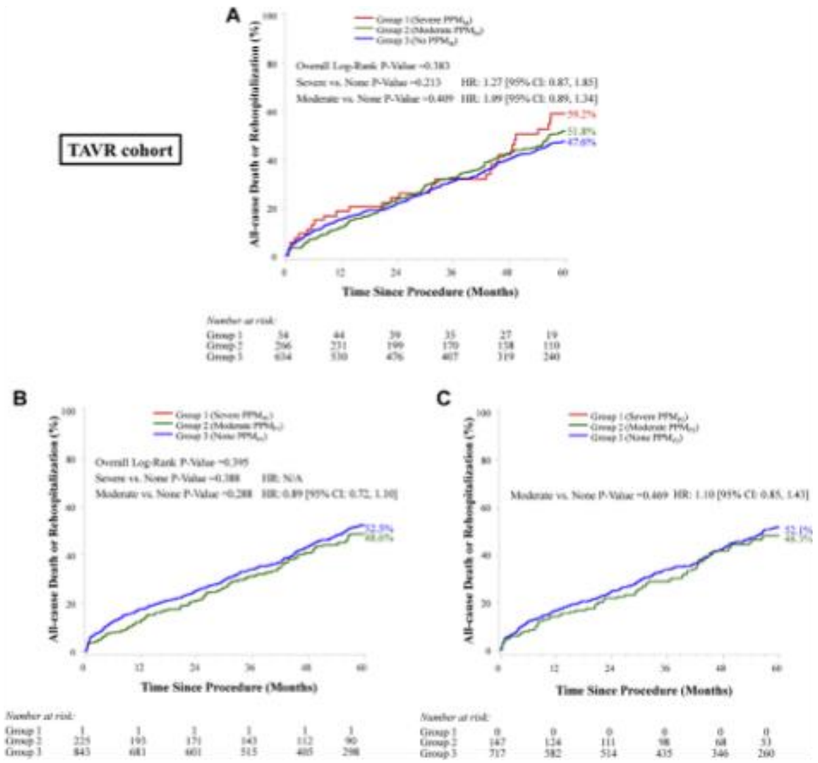
Strategies to Prevent PPM

- TAVR
- Aortic root or annular enlargement
- Sutureless Valves





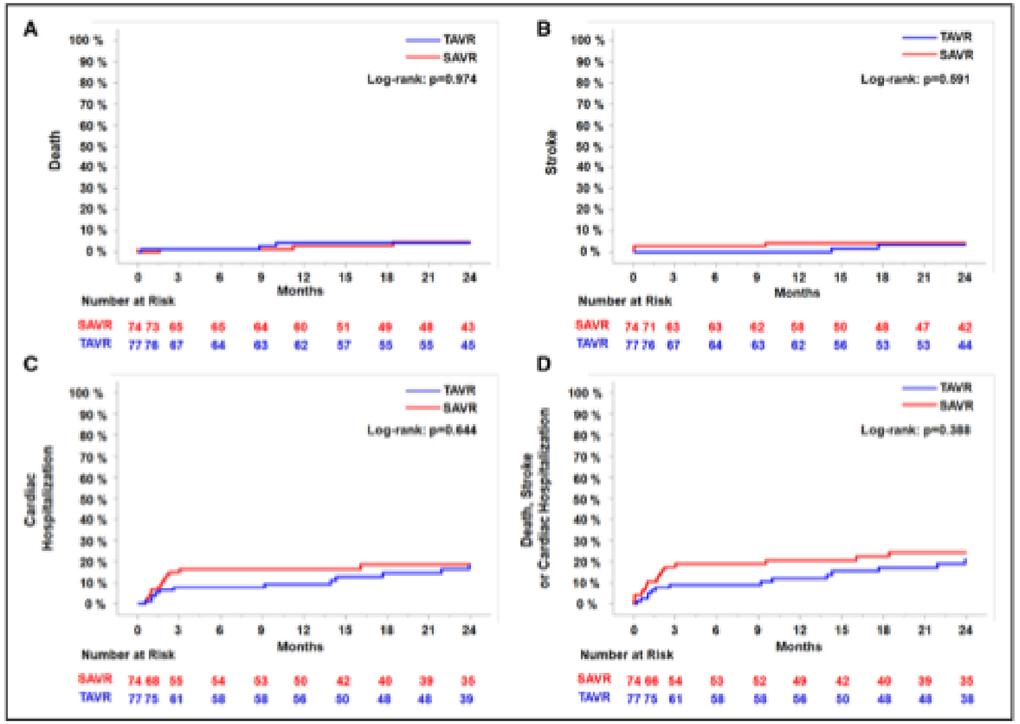


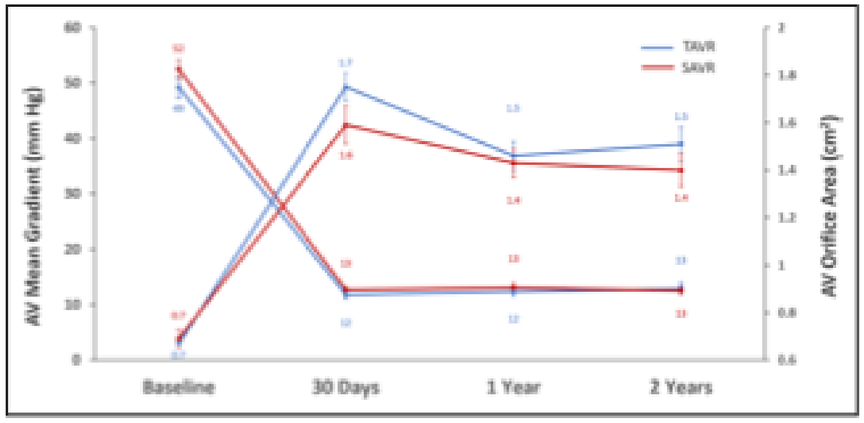


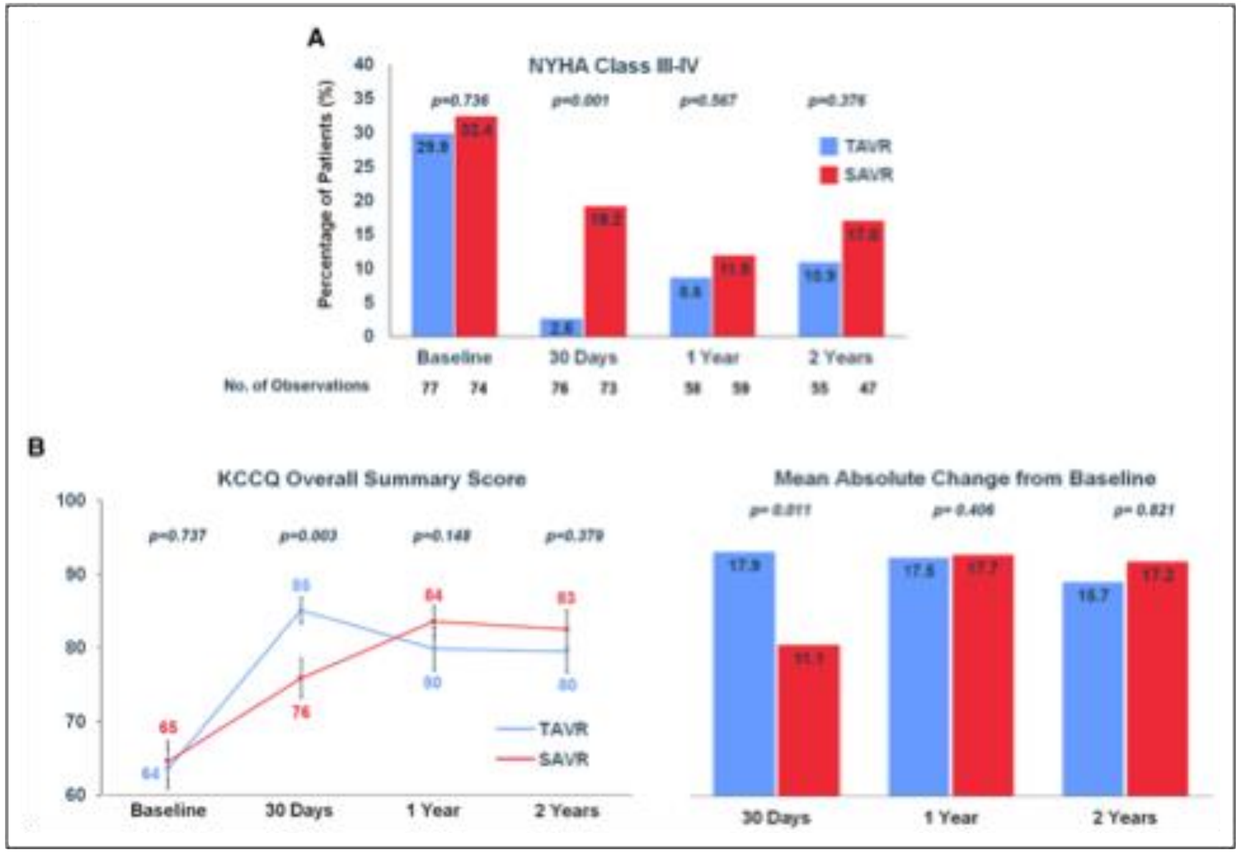
Ternacle J et al. JACC Cardiovasc Interv. 2021

Small Aortic Annulus: the VIVA Trial

- 93% were women, most of them at low surgical risk, and with close to one-third of patients undergoing either aortic root enlargement maneuvers or sutureless valve implantation in the surgical group, and more than half of patients receiving self-expandable supra-annular valves in the TAVR group
- no significant differences between TAVR and SAVR in valve hemodynamic outcomes at 60 days
- TAVR and SAVR exhibited no significant differences in clinical outcomes including mortality, stroke, and cardiac rehospitalization events at 2-year follow-up



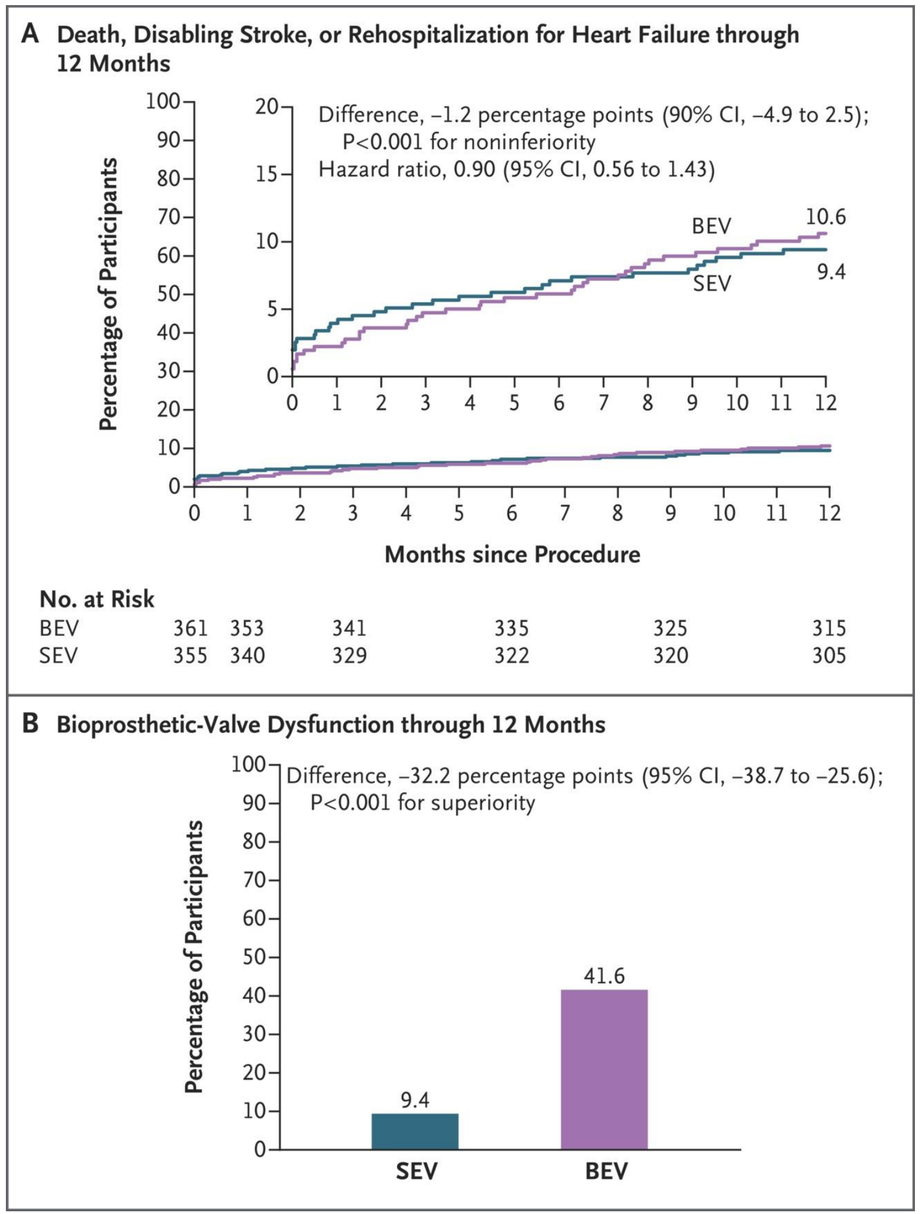


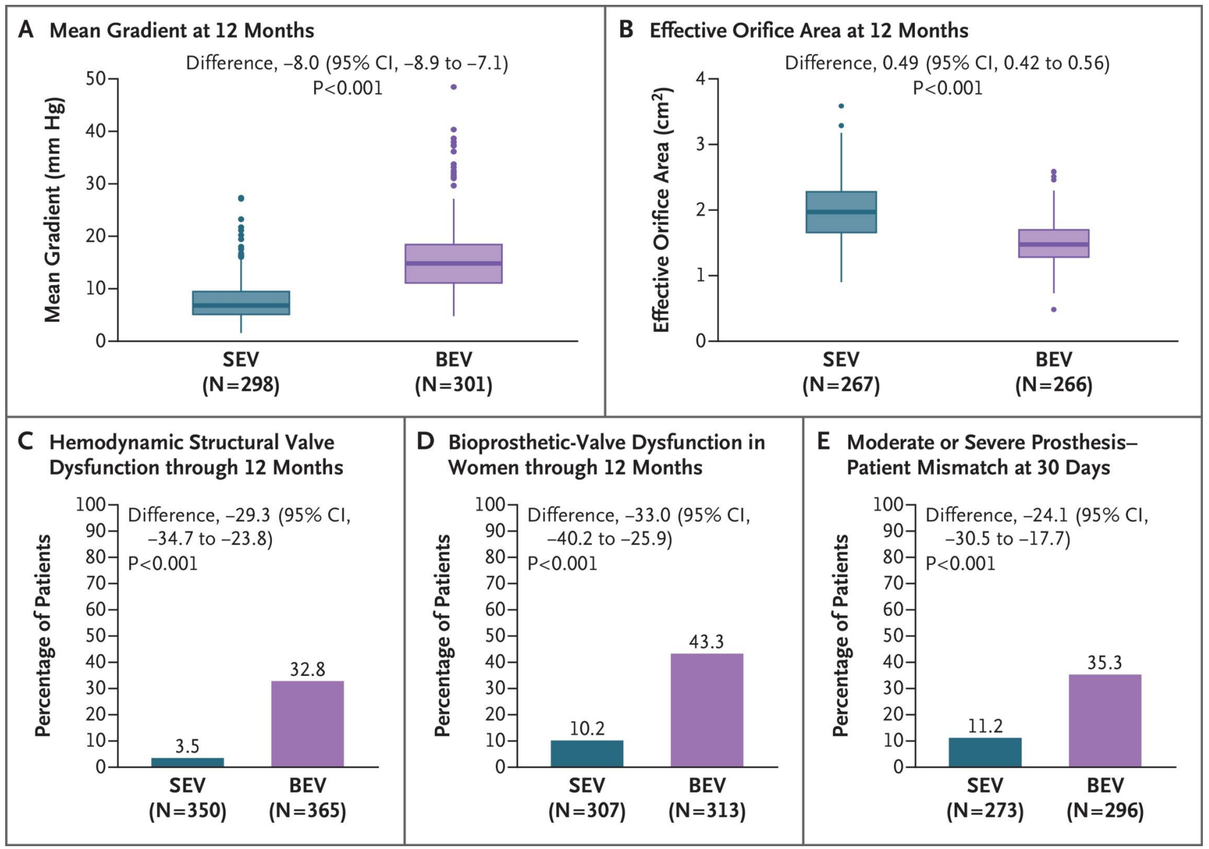


Rodes-Cabau et al. Circulation 2024

Original Article

Self-Expanding or Balloon-Expandable TAVR in Patients with a Small Aortic Annulus





Among patients with severe aortic stenosis and a small aortic annulus who underwent TAVR, a self-expanding supraannular valve was noninferior to a balloon-expandable valve with respect to clinical outcomes and was superior with respect to bioprosthetic-valve dysfunction through 12 months.

Herrmann HC et al. N Engl J Med2024;390:1959-1971

Take Home Messages

- Severe PPM_p is more accurate than PPM_m for valve hemodynamics. Both are associated with higher mortality.
- Valve “size” and model, patient’s prior studies
- **High gradient** does not always mean prosthesis dysfunction
- **TAVR and sutureless valves** have lower incidence of PPM
- **CT assessment** before SAVR is associated with reduced incidence of PPM
- **Aortic root or annular enlargement** is an option by high volume surgeons (critical need for standardization, education, and quality improvement for AE techniques due to high variability in surgeon expertise and increased early mortality)
- Self-expandable supra-annular TAVR might be superior to balloon-expandable in terms of valve dysfunction.