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Redo Aortic Root Surgery for the Small Aortic Annulus

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WHITE PAPER

Aortic Stenosis and Small Aortic Annulus

Clinical Challenges and Current Therapeutic Alternatives

ABSTRACT: The presence of a small aortic annulus poses a considerable challenge in the management of patients with severe aortic stenosis, especially in elderly women, where it is a very frequent finding. The optimal approach for treating these patients remains controversial, and several surgical strategies such as aortic root enlargement, supra-annular stented prosthetic valves, stentless bioprosthesis, and sutureless bioprostheses have been proposed to improve valve hemodynamics and clinical outcomes. More recently, transcatheter aortic valve replacement has emerged as a valid alternative for the treatment of aortic stenosis and excellent valve hemodynamic results have been observed among patients with a small aortic annulus. The purpose of this review is to provide an overview of the current definition, prevalence, and clinical impact of small aortic annulus in patients with aortic stenosis, and evaluate the different therapeutic strategies currently available to improve valve hemodynamics and outcomes in this population.

The presence of a small aortic annulus (SAA) represents a clinical challenge in patients with aortic stenosis (AS). SAA and a small aortic root have been associated with poorer outcomes after aortic valve replacement (AVR), with increased mortality, ischemic cardiovascular events, and stroke.^{1,2} Furthermore, the presence of a SAA may make the assessment of aortic valve disease difficult, complicate the aortic valve intervention, and increase the risk of prosthesis-patient mismatch (PPM), which in turn is associated with an increased risk of perioperative and overall mortality proportionally to its severity, suboptimal valve hemodynamics, and less left ventricular mass regression after AVR.³⁻⁶ Several surgical strategies have been proposed to improve valve hemodynamics and clinical outcomes in these patients, including aortic root enlargement (ARE), the development of stented prostheses implanted in a supra-annular position, stentless bioprosthesis, and, more recently, sutureless bioprostheses. Transcatheter aortic valve replacement (TAVR) has emerged as a therapeutic alternative in patients with symptomatic severe AS and intermediate to high surgical risk.⁷⁻¹⁰ TAVR appears to be particularly beneficial in patients with SAA, with improved valve hemodynamics and outcomes.¹¹ The purpose of this review is to provide an overview of the prevalence and clinical challenges of SAA in patients with AS, and to evaluate the current data on surgical and transcatheter strategies to improve valve hemodynamics and clinical outcomes in these patients.

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Key Words: aortic valve stenosis
heart valve prosthesis • sutureless surgical procedures • transcatheter aortic valve replacement

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- Rough definition:
 - Annulus \leq 23 mm
 - Prosthesis implant \leq 21 mm
- Clinical Implications:
 - Poorer outcomes
 - Increased mortality
 - Suboptimal valve hemodynamics
 - Less LV mass regression
 - *All of which is due to Prosthesis-Patient Mismatch (PPM)*

Definition and Current Stratification of PPM

- PPM occurs when the effective orifice area (EOA) of the implanted prosthetic valve is too small for the patient's body size (BSA)
- Stratification of PPM:
 - No PPM ($>0.85 \text{ cm}^2/\text{m}^2$)
 - Moderate (0.85 to $0.65 \text{ cm}^2/\text{m}^2$)
 - Severe ($\leq 0.65 \text{ cm}^2/\text{m}^2$)

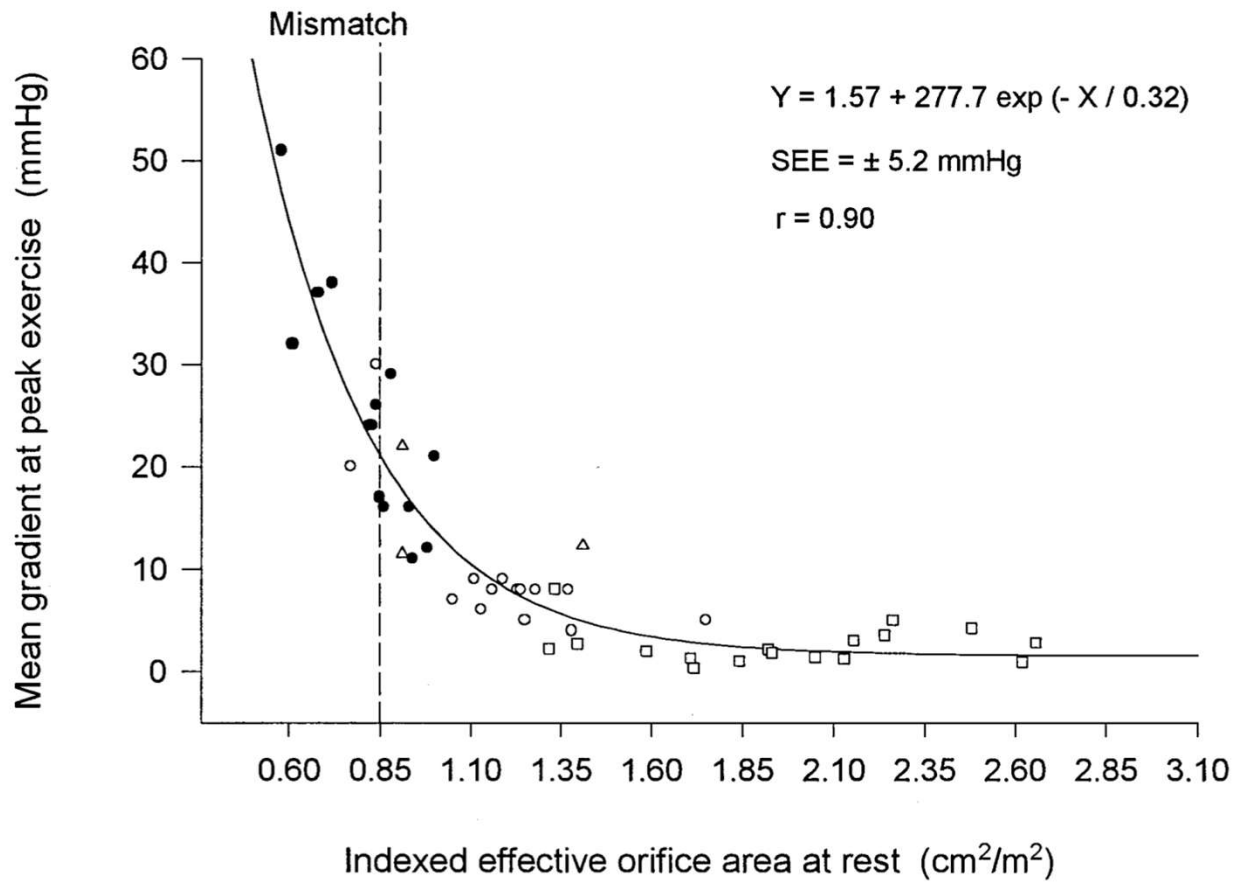
REVIEW ARTICLES

Hemodynamic and Clinical Impact of Aortic Valve Position

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Prosthesis-patient mismatch (PPM) is a condition that occurs in patients with aortic valve prostheses. It is characterized by a high transvalvular gradient at rest and a high gradient at peak exercise. The impact of PPM on the patient's quality of life and survival is still controversial. We propose a simple definition of PPM based on the American Society of Echocardiography (ASE) criteria.

Panel B



impact, and



10.1136/hrt.2005.067363

DEFINE MISMATCH
physiological considerations to characterise PPM is at rest, the EOA of the patient's BSA. The only parameter that consistently correlate with Figure 1 shows that the PG and the indexed EOA gradients increase exponentially. EOA is < 0.8 on basis of this relation, an 5 cm²/m² is generally considered as a mismatch. The relation between 0.65-0.85 cm²/m² moderate PPM and those are PPM.^{2,3,4,5} Such a category because the impact of PPM increases with severity, the reported prevalence varies between 20-70%, PPM is between 2% and

that some authors have used PPM by using the indexed geometric area (IGA) of the prosthesis because IGA is more a static manufacturing parameter than the ex vivo measurement of the prosthesis. The criteria used unfortunately differ from one study to another so that, grossly overestimates the prevalence in the case of a mechanical prosthesis. Hence, the relation EOA varies extensively with the size of prosthesis and that the indexed IGA at postoperative gradients measurement is further corroborated by Koch *et al*¹¹ that, as for aortic valve replacement, pericardial valves indexed IGA but more or less peak and mean gradients also found no relation between IGA and functional aortic valve replacement studies that have used the index to find any significant parameter and adverse

aortic valve replacement; BSA, body surface area; EOA, indexed effective orifice area; IGA, indexed geometric area; LV, left ventricle; PPM, prosthesis-patient mismatch; TPG, transvalvular pressure gradient

Valvular Heat

Selection of the Op

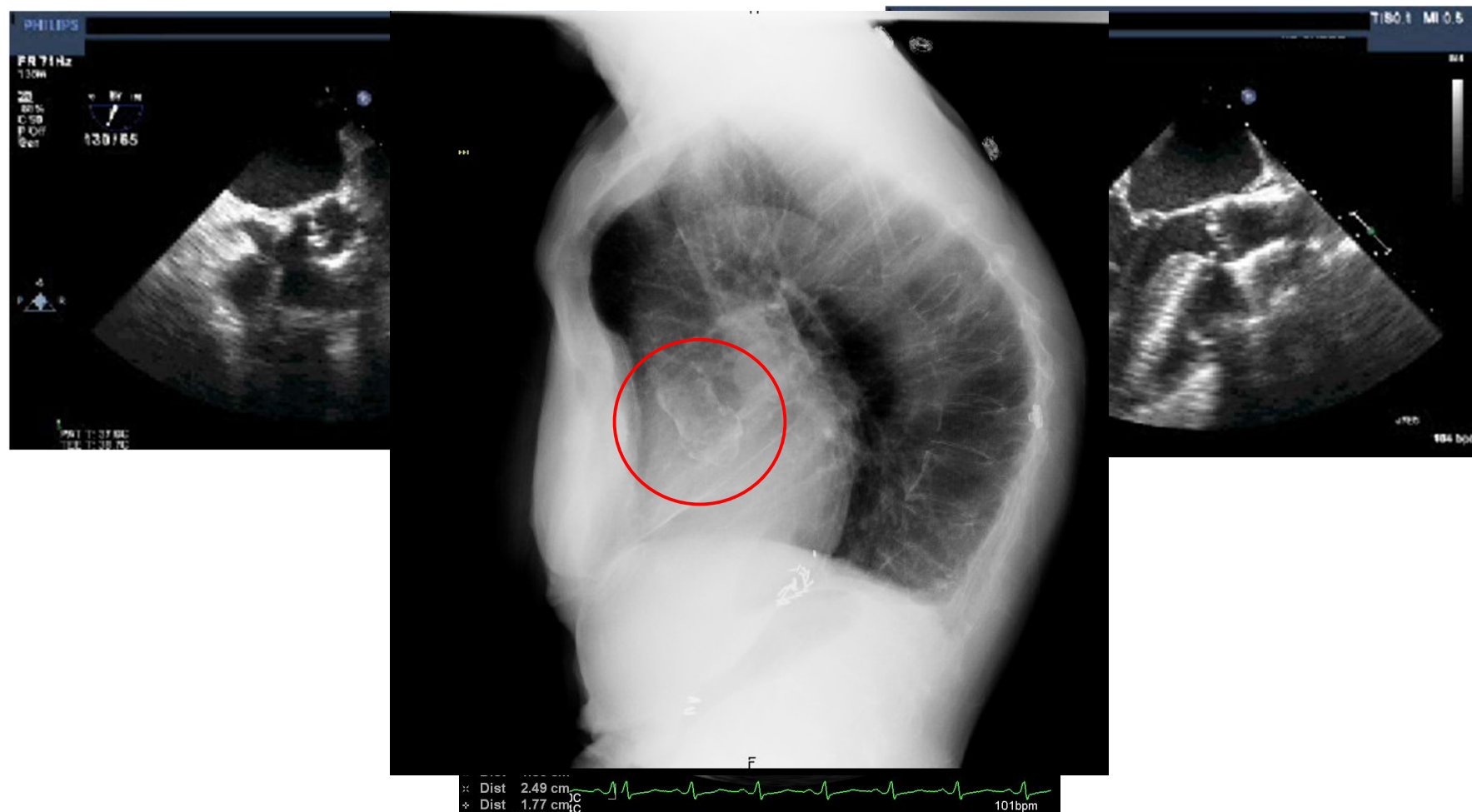
Philippe Pibarot

(Circulation. 2009;119)

Avoiding PPM in a Small Aortic Annulus

- AVR:
 - Sizing technique: supra-annular stented prosthesis
 - Sutureless bioprostheses
 - TAVR
 - Stentless Valves
- Root Enlargement
- Root Replacement-potential wider applicability

Case to illustrate wider applicability:



Stentless Root Replacement Options in the small annulus to avoid PPM



- Less Accessible-potential supply issues
- Superior hemodynamics
- Pliable
- Potential size mismatch @ distal suture line
- Bleeding issues 2° lack of adventitia
- Durability issues
- Primarily used for infection
- Redo explant for SVD complex



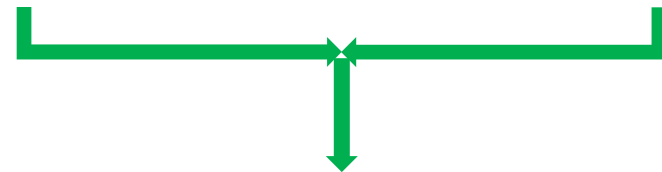
- More Accessible
- Superior Hemodynamics
- Stiff/tear of aortic wall potential issue
- Potential size mismatch @ distal suture line
- Good valve durability
- Structural issues (pseudoaneurysm)
 - *(It's dead pig aorta after all)*
- Redo explant for SVD complex

Option 3: Valsalva+ Freestyle Subcoronary Valve

- Components more accessible
- Superior Hemodynamics
- Pliable/min concern for tearing
- More optimal size match distally
- Good Valve durability
- No known structural issues
- Takes time to build
- Redo for SVD involves isolated AVR



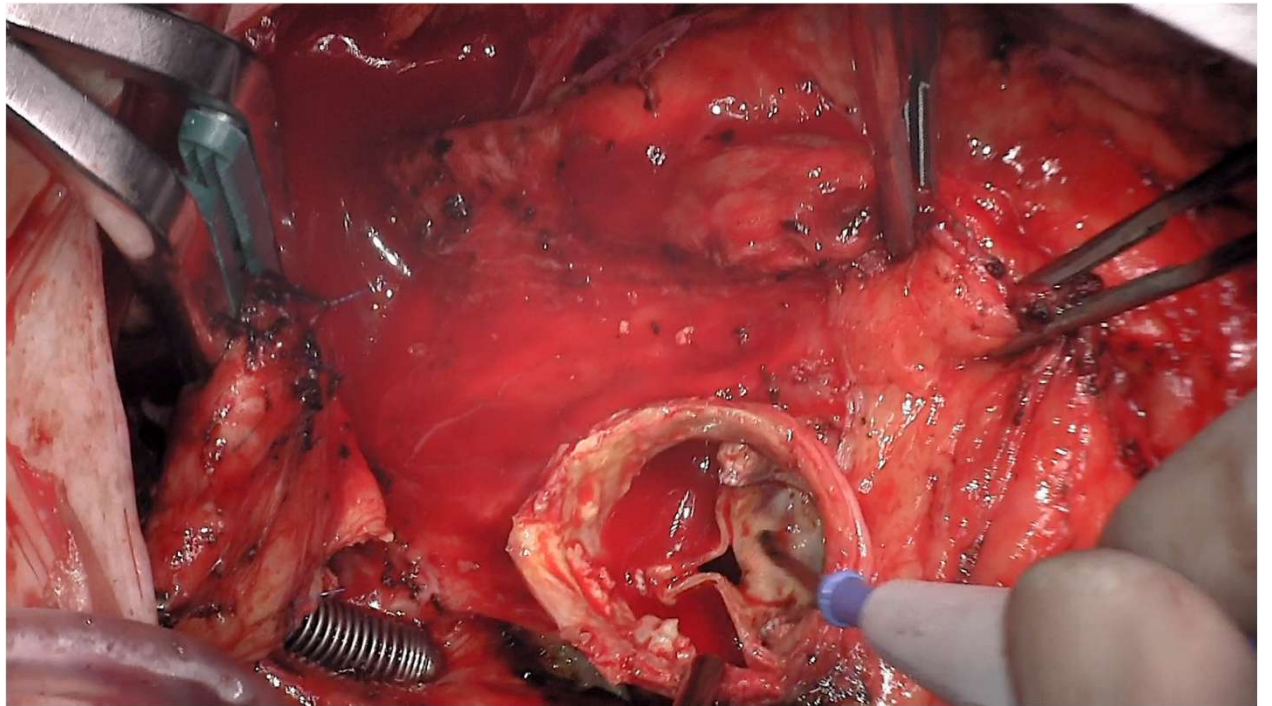
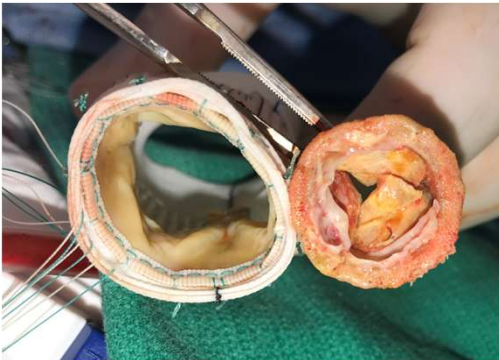
Complete Subcoronary



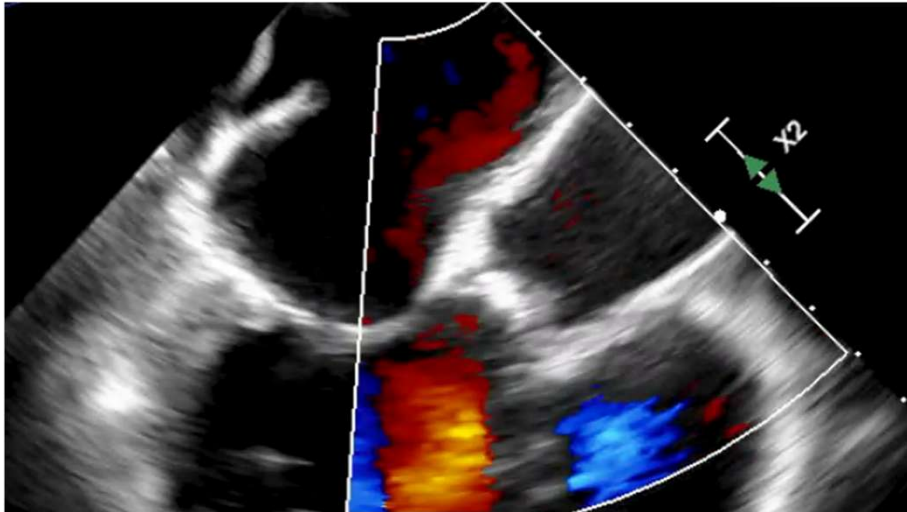
Construction of the Conduit



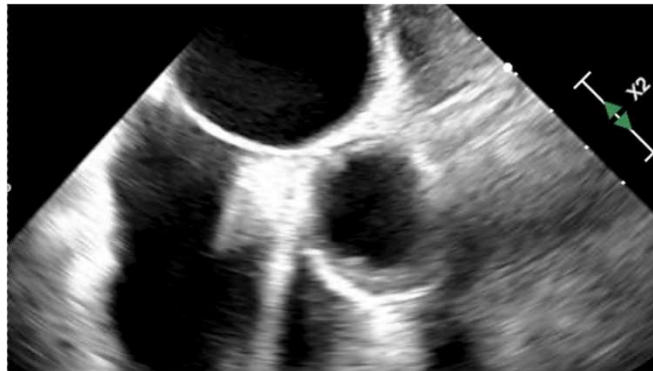
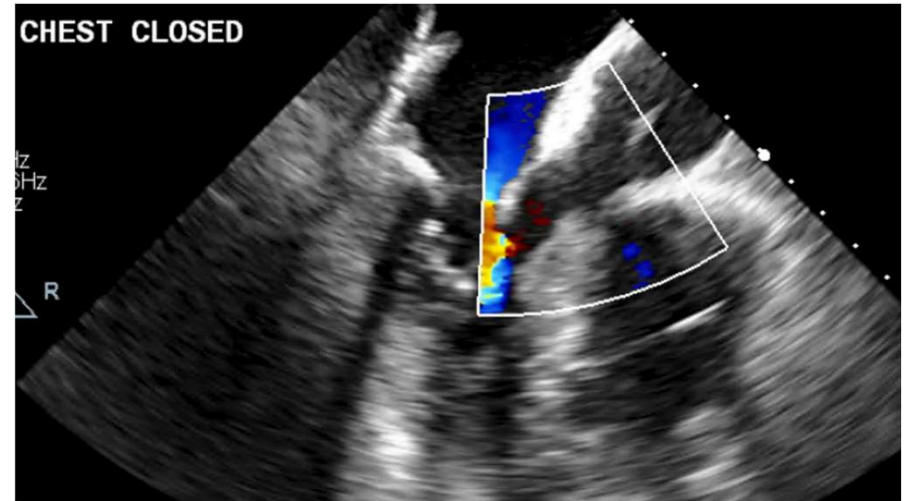
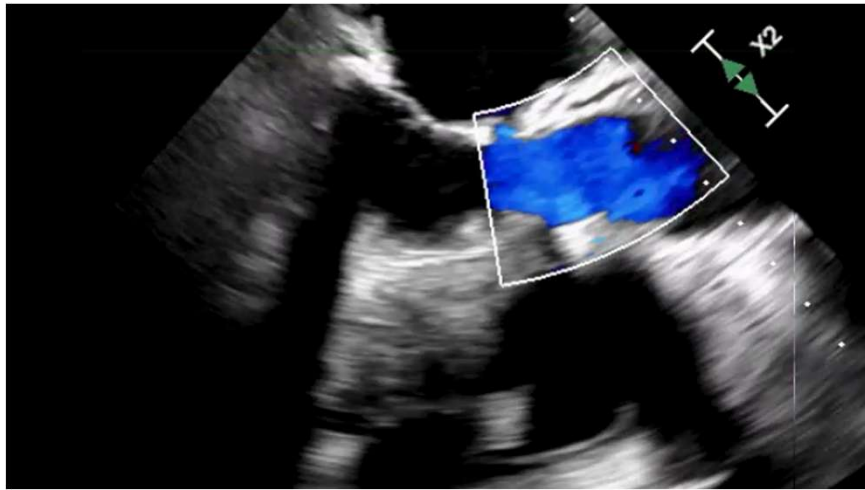
Conduit Implantation: s/p #19 Pericardial AVR



2nd Case Example: 60 yo female BMI 36.63 kg/m²



Post-Stentless Root Replacement





ADULT CARDIAC SURGERY:

The *Annals of Thoracic Surgery* CME Program is located online at <http://www.annalsthoracicsurgery.org/cme/home>. To take the CME activity related to this article, you must have either an STS member or an individual non-member subscription to the journal.

Clinical Outcomes Using Freestyle Valve–Valsalva Graft Composite Conduit for Aortic Root Replacement



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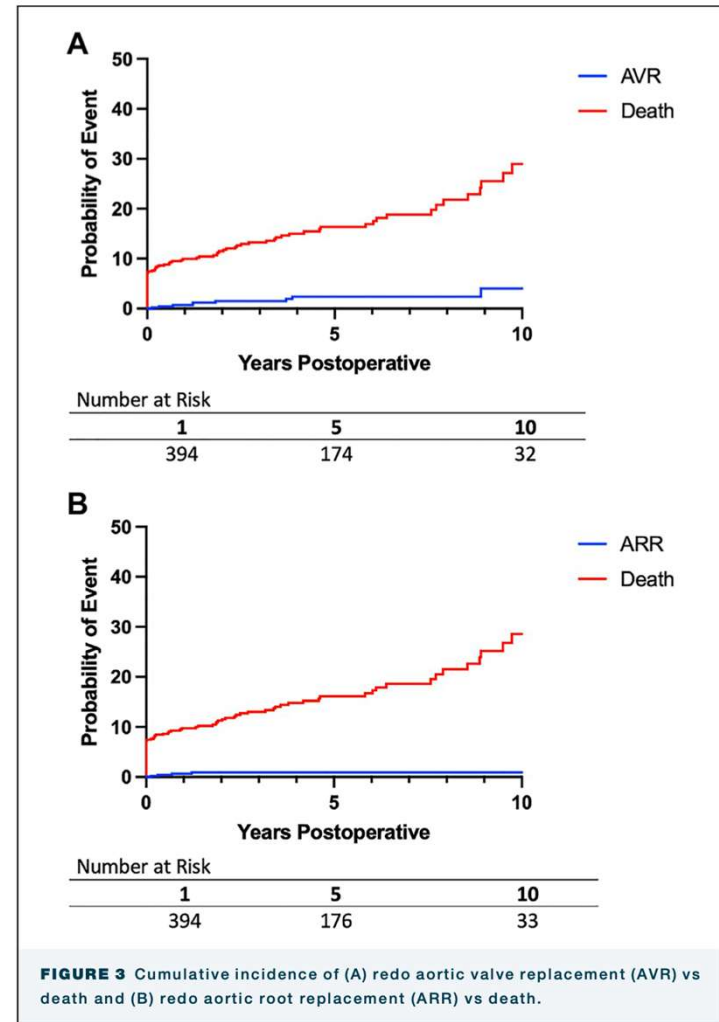
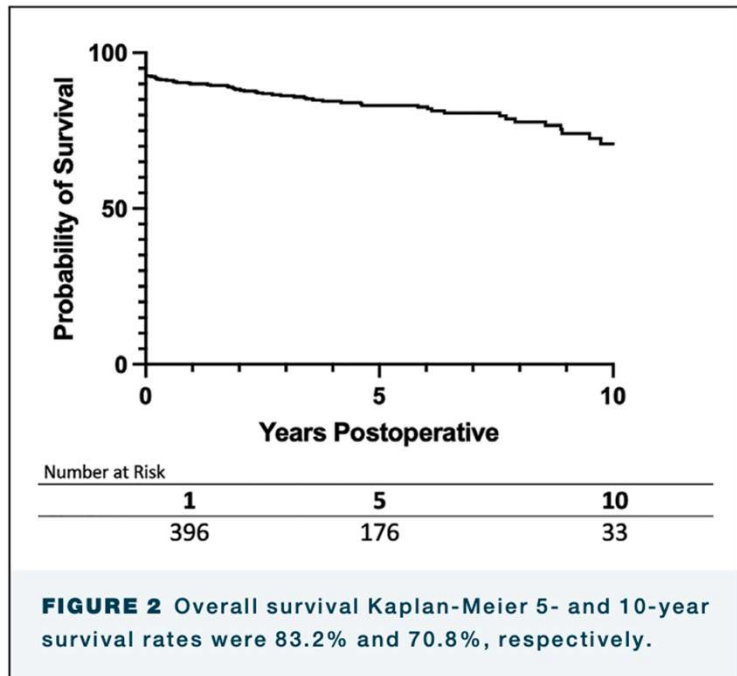
(Ann Thorac Surg 2022;114:643-9)

- 2005-20, 523 pts
- 62 mean age/82%male
- 29.26% Redos
- Hemiarch 44%/Total 8%
- Mitral 4%/CABG 21%
- 30-day Morality 7.7%
- Mean gradient post-op 4.81 mm Hg

TABLE 2 Operative Indications

Operative Indication	Value
Aortic insufficiency	302 (57.74)
Aortic stenosis	129 (24.71)
Acute type A dissection	5 (0.96)
Patient–prosthesis mismatch	31 (5.93)
Aortic root aneurysm	438 (83.75)
Ascending aorta aneurysm	316 (60.42)
Endocarditis	12 (2.29)
Paravalvular leak	3 (0.57)
Structural valve degeneration	1 (0.19)
Prosthetic valve thrombus	4 (0.76)
Other	2 (0.38)

Values are n (%).



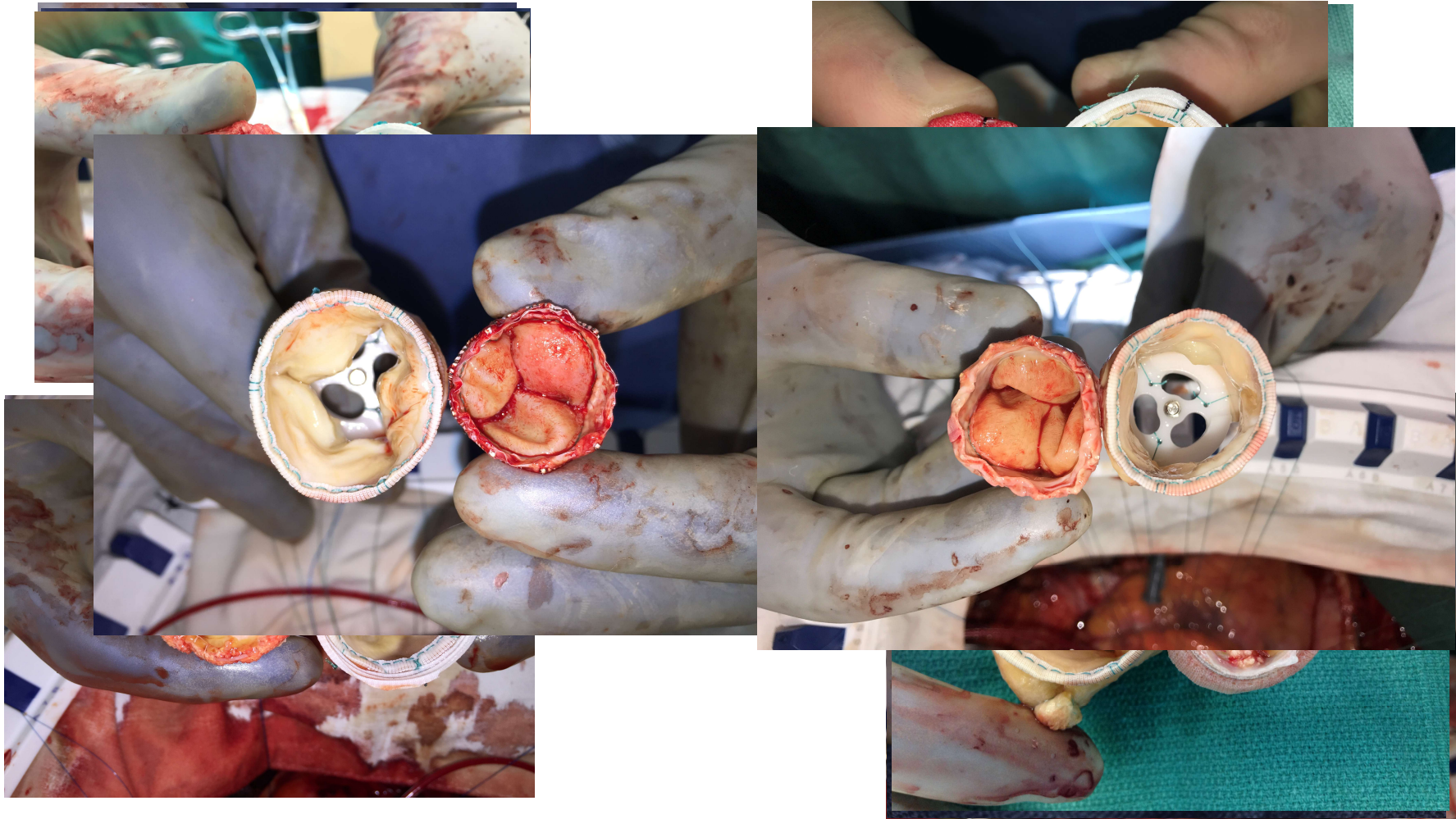
Additional thoughts on the small annulus and avoiding PPM

- Preventing and correcting PPM:
 - Sizing and implantation technique of stented valves matters
 - Intra-annular vs supra-annular
 - Pledgets cause turbulence...turbulence causes pannus formation...pannus causes LVOT narrowing
 - Stentless Valves
 - Isolated AVR
 - Root Replacement

Final thoughts on the small annulus and avoiding PPM

- In most adult patients, PPM in the setting of a small annulus:
 - Occurs when the patients LVOT/annulus is narrowed as part of the surgical AVR/root procedure
 - It is less of a patient anatomy issue than a surgical performance issue

Some examples of upsizing



- Thank you