Lifetime management starts with first valve

Dr Karl Poon, MBBS FRACP

Senior staff interventional cardiologist
The Prince Charles Hospital, Brisbane Australia
St Andrew's War Memorial Hospital, Brisbane, Australia
Senior lecturer, University of Queensland
Edwards Teaching Centre of Excellence

Edwards Lifesciences
Teaching Center of Excellence

The Prince Charles Hospital
Heart and Lung Institute

The University Of Queensland
AUSTRALIA

St Andrew's War Memorial Hospital

CVRF

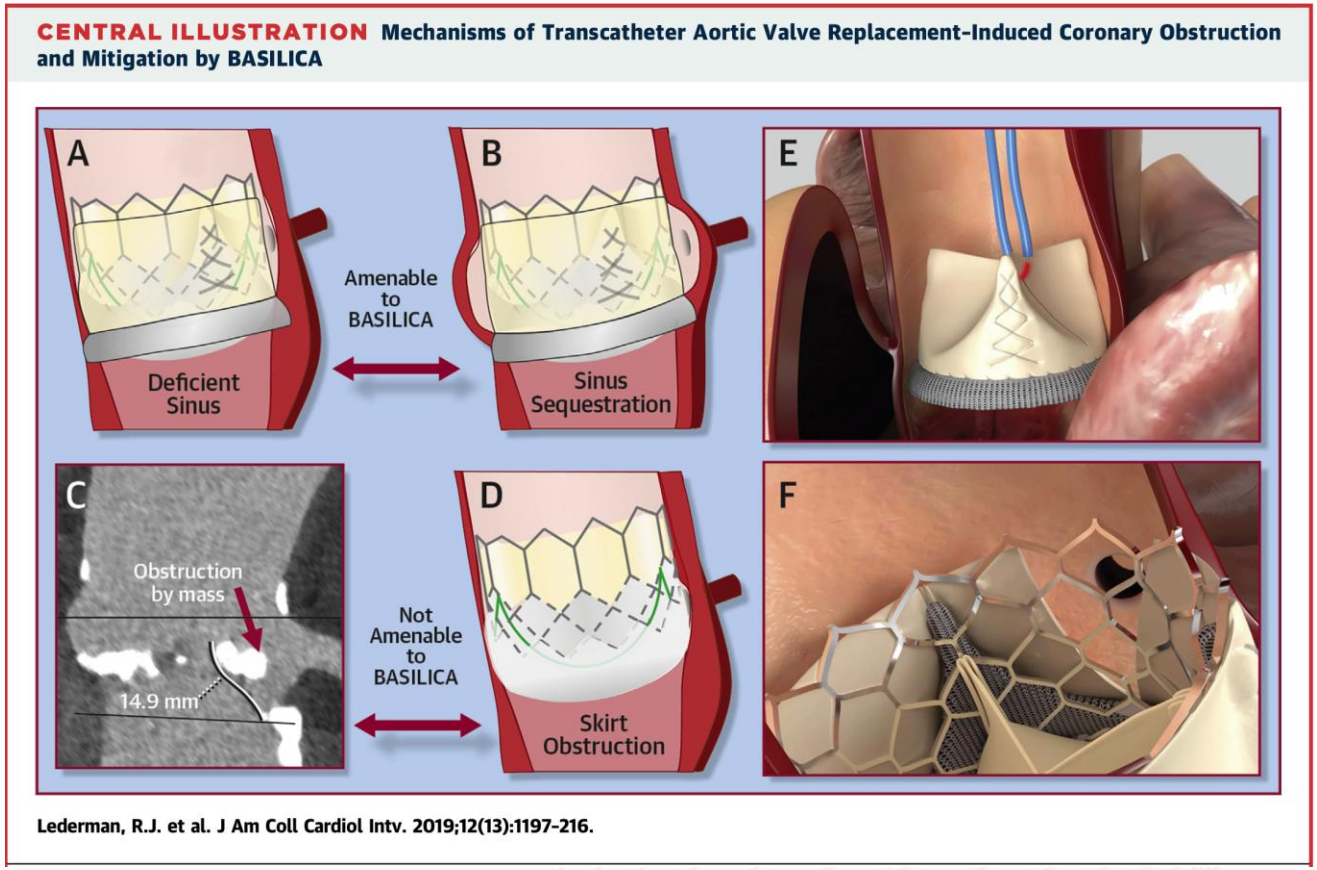
Disclosures

- In the past 12 months, I and/or my spouse, have received the following:

Nature of conflict relevant this presentation	Company
• Consulting fee/Proctoring fee	Edwards LifeSciences, Abbott Vascular
• Unrestricted institutional grant (QHI)	Edwards LifeSciences, Abbott Vascular
• Research role	Edwards Lifesciences, Boston Scientific, Medtronic
• Equity	AnterisTech

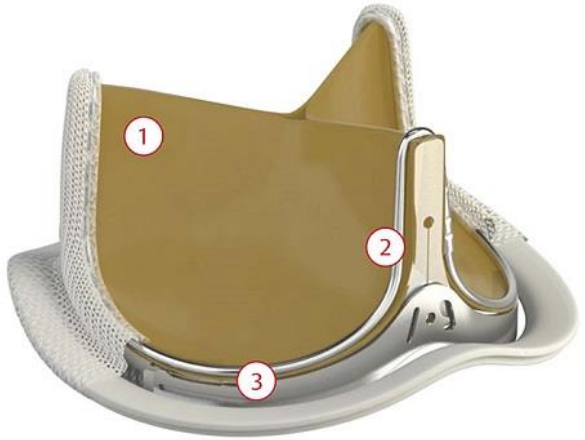
Lifetime management starts with the first SURGICAL valve

- TAVI valve in valve is a well-established treatment option for failed tissue surgical prostheses in *most* cases.
- Coronary obstruction & high residual gradient
- BASILICA – bioprosthetic aortic scallop intentional laceration to prevent iatrogenic coronary artery obstruction

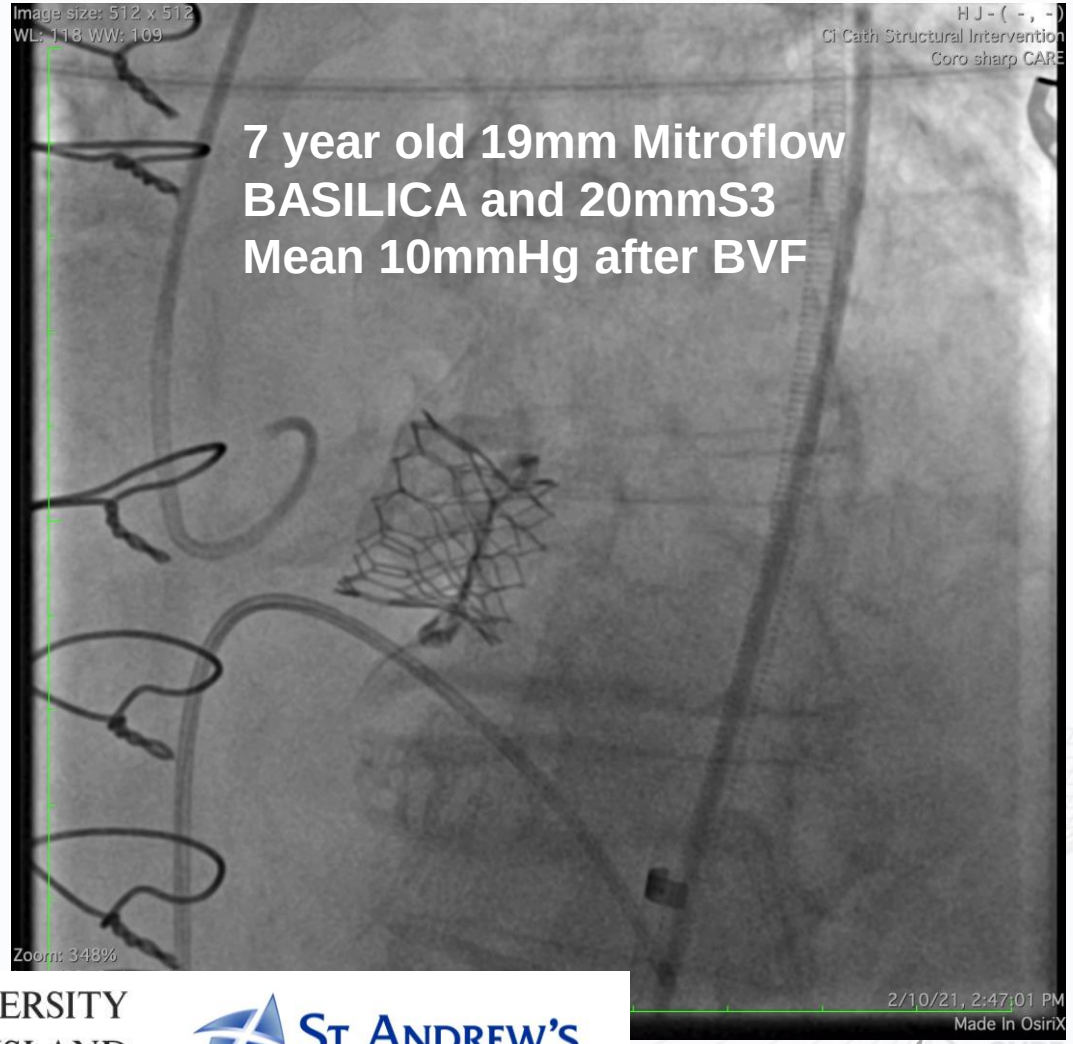


Lifetime management starts from the first SURGICAL valve

- Demand the best from surgery
  - SAVR with durable outcome
  - SAVR +/- root enlargement
  - SAVR to minimize coronary obstruction
  - SAVR with expandable frame – INSPIRIS®



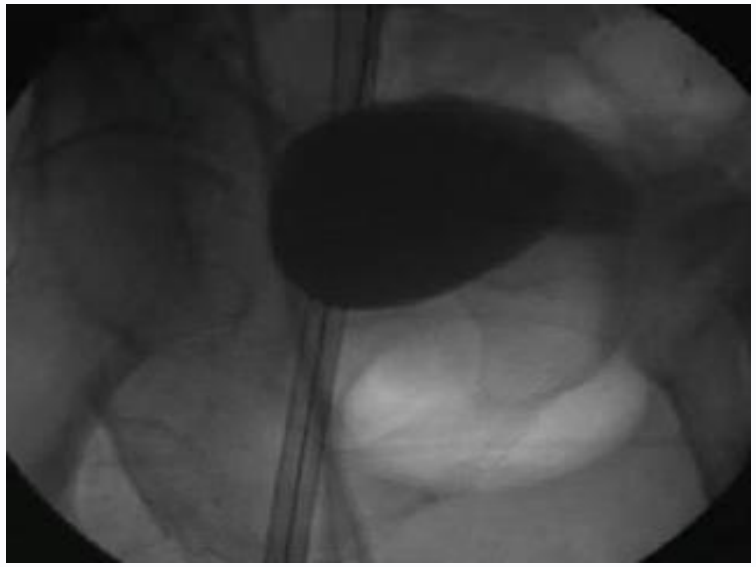
1. RESILIA tissue*6
2. Trusted design and features of the PERIMOUNT platform6
3. VFit technology†6



Lifetime management starts from the first TAVI aortic valve

- First in human *antegrade* TAVI – Prof Alain Cribier – 19th April 2002

April 16, 2002



Percutaneous Transcatheter Implantation of an Aortic Valve Prosthesis for Calcific Aortic Stenosis
First Human Case Description
Alain Cribier, MD; Helene Eltchaninoff, MD; Assaf Bash, PhD; Nicolas Borenstein, MD; Christophe Tron, MD; Fabrice Bauer, MD; Genevieve Derumeaux, MD; Frederic Anselme, MD; François Laborde, MD; Martin B. Leon, MD

- 57 year old male
  - Cardiogenic shock
  - Subacute leg ischemia
  - Failed balloon valvuloplasty
  - Bicuspid severe AS with LV ejection fraction 14% (!)
- TAVI
  - Local anaesthestic
  - 20 sec CPR
- RIP 17 weeks post TAVI
  - Chronic leg infection

Lifetime management starts with the first TAVI

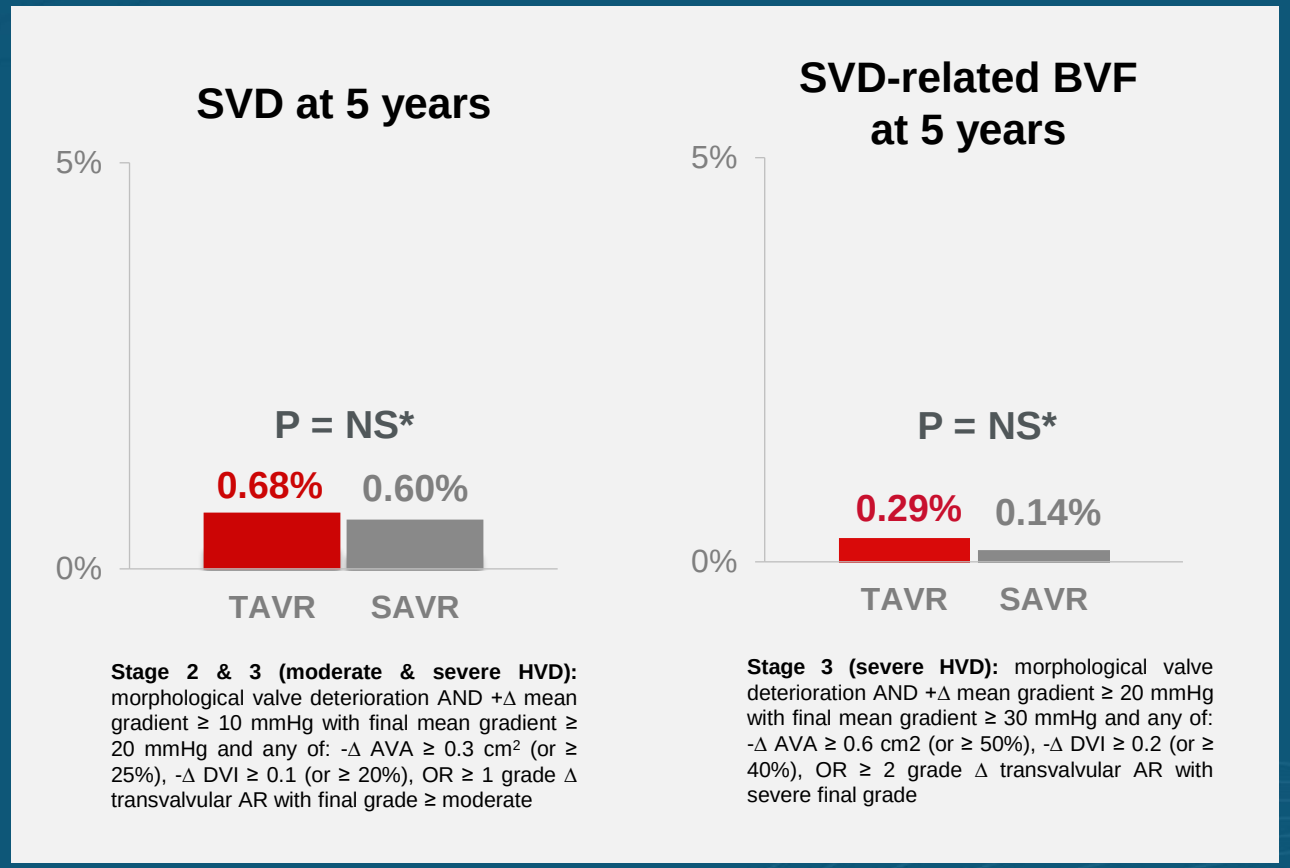
- For *younger* (and *low surgical risk*) patients undergo TAVI, it's vital to consider the future needs of these patients

1. Durability and valve performance
2. Future coronary access
3. Future TAVI in TAVI feasibility

Considering Durability:
Prosthesis Durability

PARTNER II S3i Trial

- Propensity matched cohort between SAVR and SAPIEN 3 TAVR
- **SAPIEN 3 TAVR demonstrated similar rates to SAVR on both SVD and SVD-related BVF out to 5 years**
  - *VARC-3 definition used*
- SAPIEN 3 TAVR also shows similar 5 years rates vs. SAVR on death, disabling stroke, and rehospitalization



Stage 2 & 3 (moderate & severe HVD): morphological valve deterioration AND +Δ mean gradient ≥ 10 mmHg with final mean gradient ≥ 20 mmHg and any of: -Δ AVA ≥ 0.3 cm^2 (or ≥ 25%), -Δ DVI ≥ 0.1 (or ≥ 20%), OR ≥ 1 grade Δ transvalvular AR with final grade ≥ moderate

Stage 3 (severe HVD): morphological valve deterioration AND +Δ mean gradient ≥ 20 mmHg with final mean gradient ≥ 30 mmHg and any of: -Δ AVA ≥ 0.6 cm2 (or ≥ 50%), -Δ DVI ≥ 0.2 (or ≥ 40%), OR ≥ 2 grade Δ transvalvular AR with severe final grade

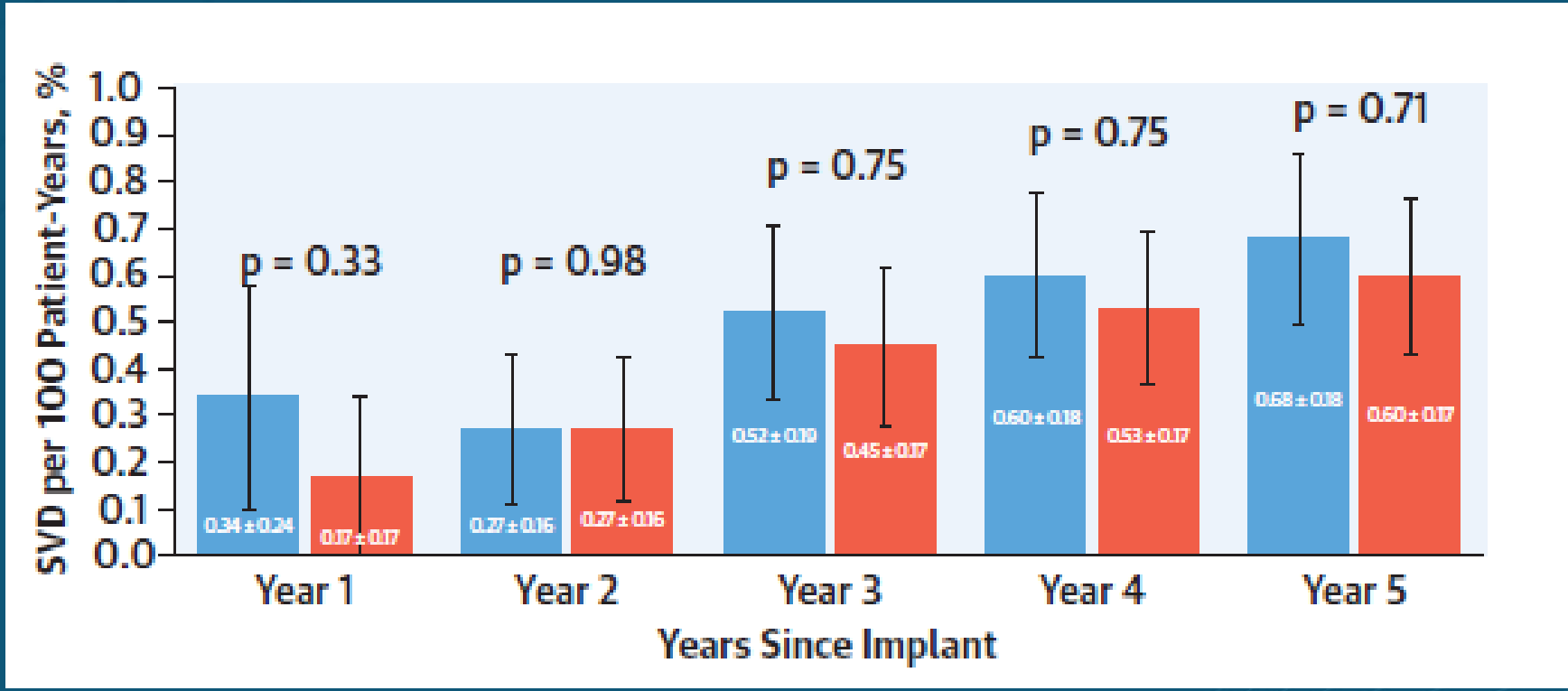
SVD: Structural valve deterioration; BVF: Bioprosthetic valve failure

*There was no statistically significant difference between SAPIEN 3 TAVR for all endpoints except for all-cause (i.e., structural or nonstructural dysfunction) BVF. The majority of cases with all-cause BVF were due to paravalvular regurgitation, a form of nonstructural valve dysfunction

Pibarot P, Ternacle J, Jaber WA, et al. Structural deterioration of transcatheter versus surgical aortic valve bioprostheses in PARTNER-2 trial. *J Am Coll Cardiol.* 2020;76(16):1830-1843.

Considering Durability:
Prosthesis Durability
PARTNER II S3i Trial: 5-year SVD and BVF rates (SAPIEN 3 TAVR & SAVR)

Comparison of the Exposure-Adjusted Incidence Rates of Structural Valve Deterioration and Bioprosthetic Valve Failure in the SAPIEN 3 TAVR Versus SAVR Propensity Score Matched Cohorts



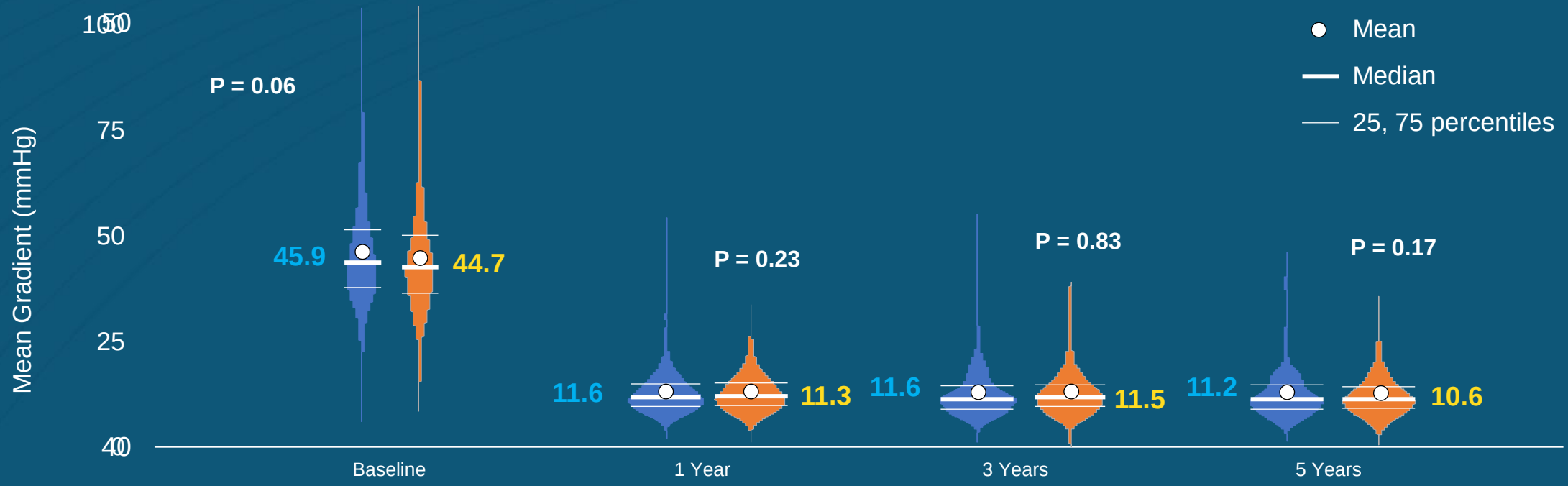
SVD: Structural valve deterioration; BVF: Bioprosthetic valve failure

*There was no statistically significant difference between SAPIEN 3 TAVR for all endpoints except for all-cause (i.e., structural or nonstructural dysfunction) BVF. The majority of cases with all-cause BVF were due to paravalvular regurgitation, a form of nonstructural valve dysfunction

Pibarot P, Ternacle J, Jaber WA, et al. Structural deterioration of transcatheter versus surgical aortic valve bioprostheses in PARTNER-2 trial. *J Am Coll Cardiol.* 2020;76(16):1830-1843.

Considering Durability:
Prosthesis Durability

PARTNER II S3i: 5-year echo-derived gradient measurements



No. of echos:

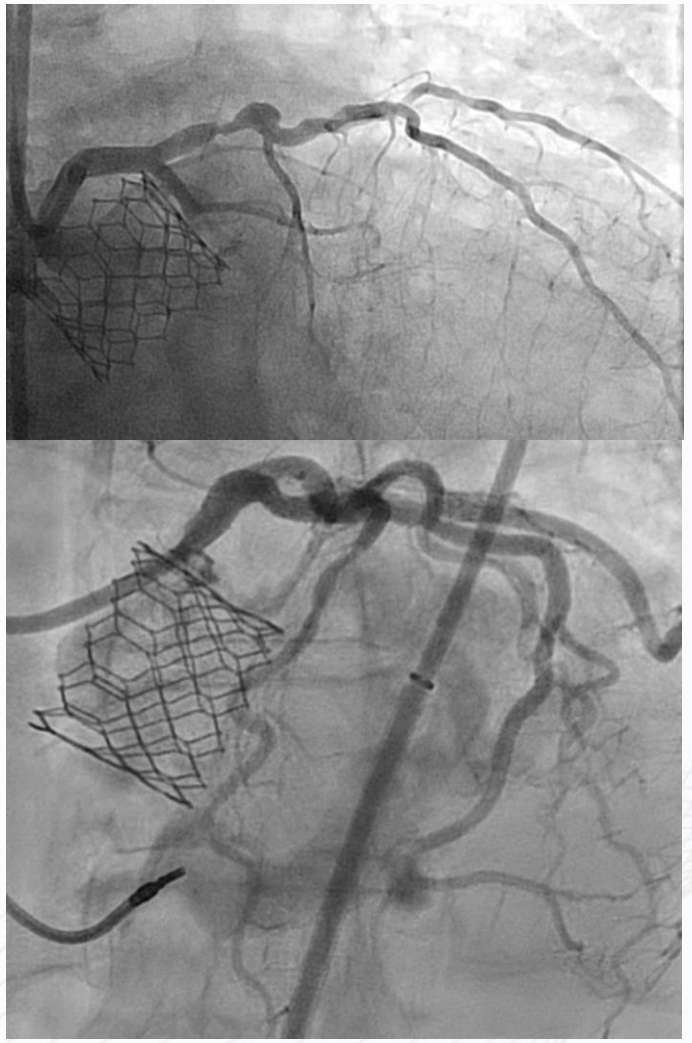
TAVR	769	648	457	277
Surgery	767	535	384	248

Kodali S, et al. SAPIEN 3 transcatheter aortic valve replacement compared with surgery in intermediate-risk patients: a propensity matched analysis of 5-year outcomes. Presented at: TVT Connect 2020; June 21, 2020.
Core lab adjudicated

Mean aortic valve echo-derived gradient (propensity matched)

Lifetime management starts with the first TAVI – coronary access

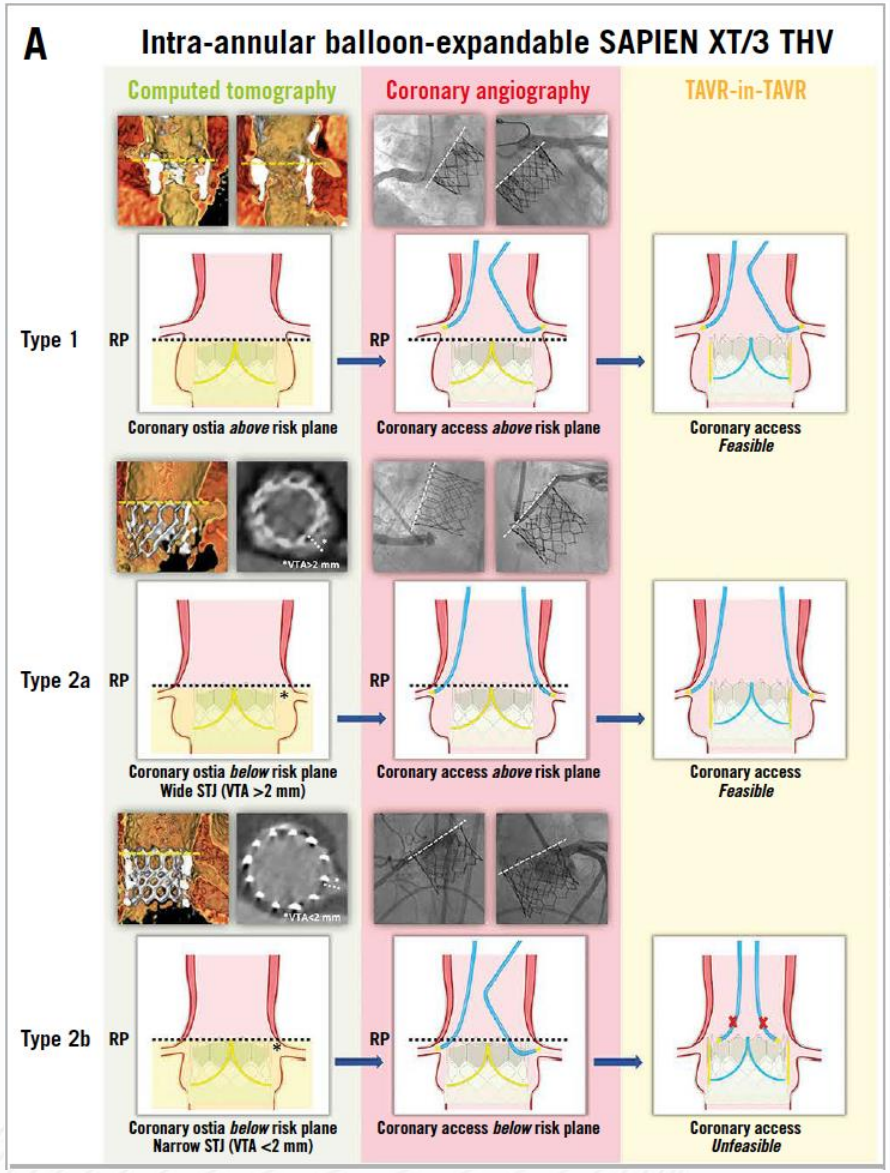
- **Up to 75% of post-TAVR patients will develop CAD**
  - 1 in 3 of these patients will require a future coronary intervention
  - 48% of these patients will not return to the same hospital
  - 2 out of every 3 PCI centers do not have a TAVR program



Hermiller JB, Gunnarsson CL, Ryan MP, Moore KA, Clancy SJ, Irish W. The need for future coronary access following surgical or transcatheter aortic valve replacement. Catheter Cardiovasc Interv. 2021;1-7.
Yudi MB, Sharma SK, Tang GHL, Kini A. Coronary angiography and percutaneous coronary intervention after transcatheter aortic valve replacement. J Am Coll Cardiol. 2018;71(12):1360-1378.

Lifetime management starts with the first TAVI – coronary access

- Unique benefit of a shorter THV frame compared to SEVs
- If S3 placed *below* the coronary ostia, access NO issue
- If S3 placed *above* the coronary ostia, coronary access has to be through larger cell at top row

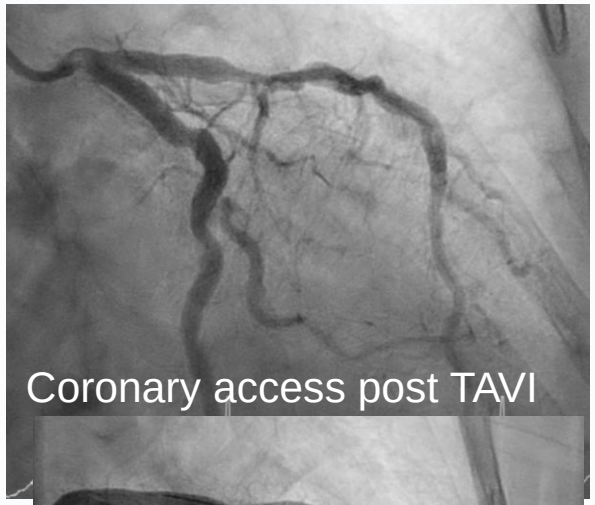


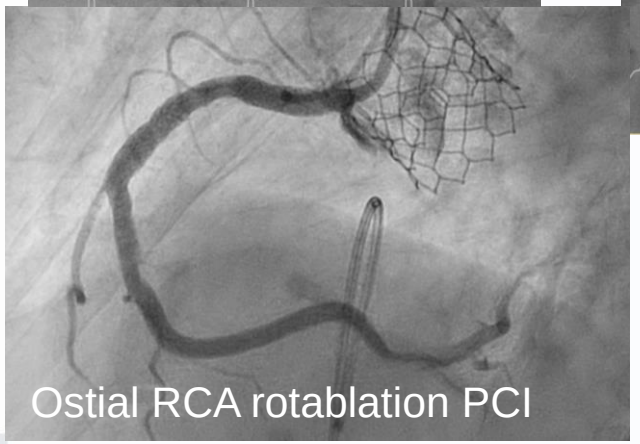
Tarantini, G, et al. Eurointervention 2020

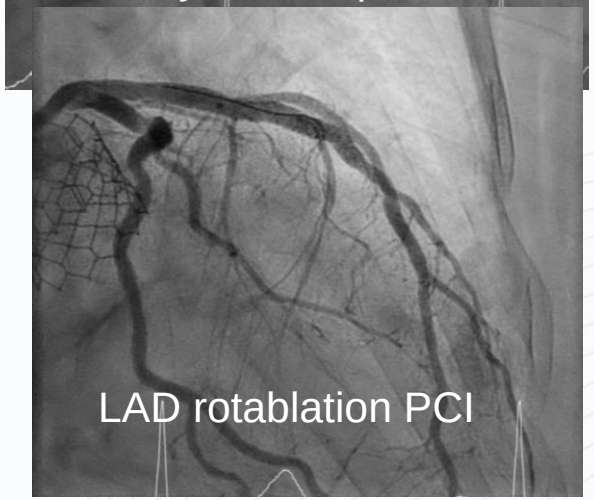
Lifetime management starts with the first TAVI – coronary access

- Coronary access above THV


Ostial severe RCA stenosis

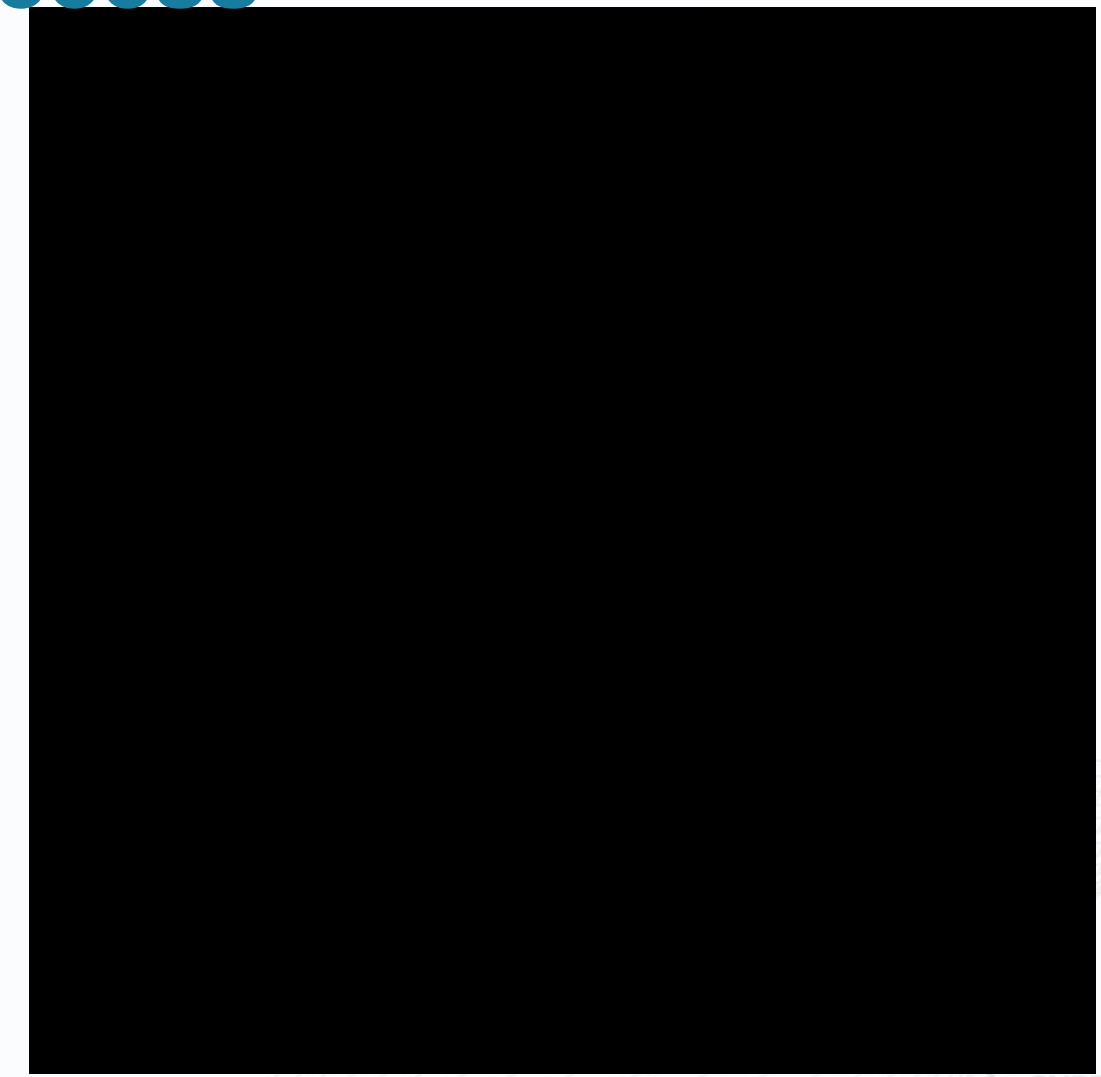

Coronary access post TAVI


Ostial RCA rotablation PCI


LAD rotablation PCI

Lifetime management starts with the first TAVI – coronary access

- Access to coronary ***within*** THV frame

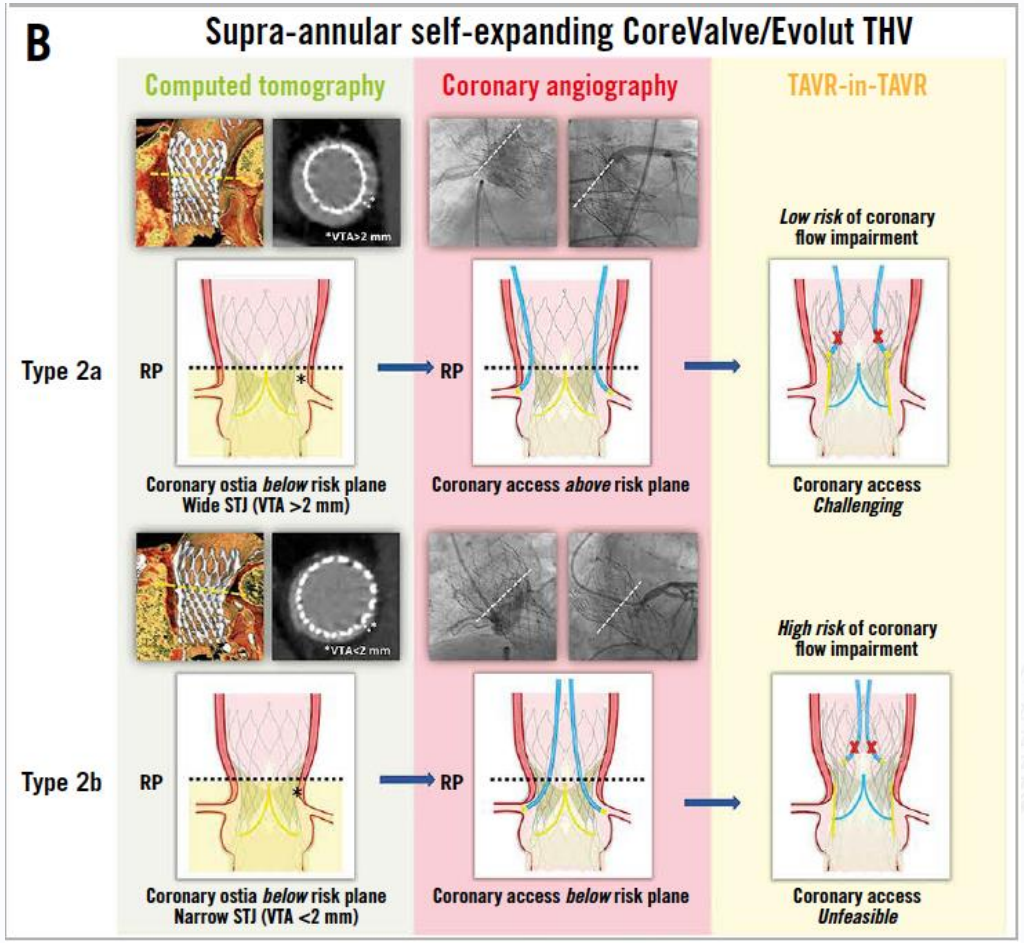


Cannulation for acute PCI procedures should be as quick as possible to maximize patient survival and outcomes, no matter which center or operator is conducting the PCI

Lifetime management starts with the first TAVI – coronary access

Challenges in Self-Expanding THV

- Fundamentally more challenging given taller stent frame
- Coronary engagement must be *through* stent frame
- Significant difference between different THV

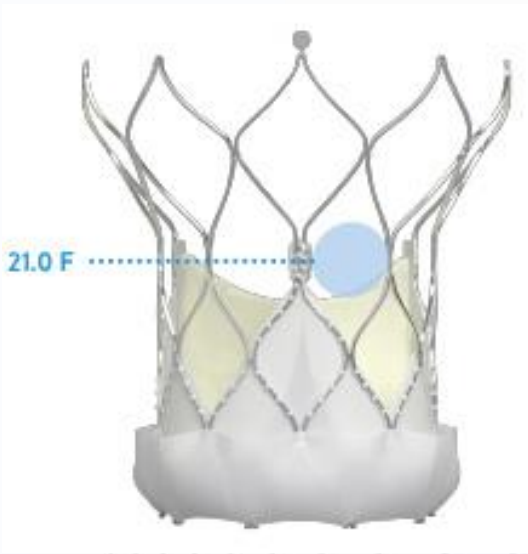


Tarantini, G, et al. Eurointervention 2020

Lifetime management starts with the first TAVI – coronary access

Not all self-expanding THVs are the same

Acurate NEO 2	Evolut PRO	Portico Navitor
Supra-annular	Supra-annular	Intra-annular
Large coronary cell	Small size coronary	Large coronary cell

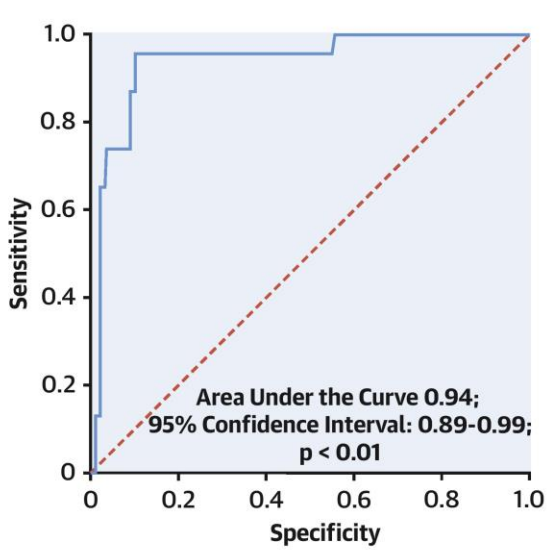


Lifetime management starts with the first TAVI – coronary access

RE-ACCESS in native AS TAVI

- 1st systematic evaluation of pre and post TAVI angiography
- Difficulty in re-accessing coronary ostia almost exclusively a problem with Evolut R THVs
  - 22/23 cases of unsuccessful cannulation
- Not an issue with Portico or Akurate Neo
- Any commissural alignment?

CENTRAL ILLUSTRATION: Predictors of Unsuccessful Coronary Cannulation After Transcatheter Aortic Valve Replacement and Receiver-Operating Characteristic Curve Analysis Applied to Logistic Regression Model



Transcatheter Aortic Valve/ Sinuses of Valsalva Relation
Odds Ratio 1.1;
95% CI: 1.0-1.2; p < 0.01

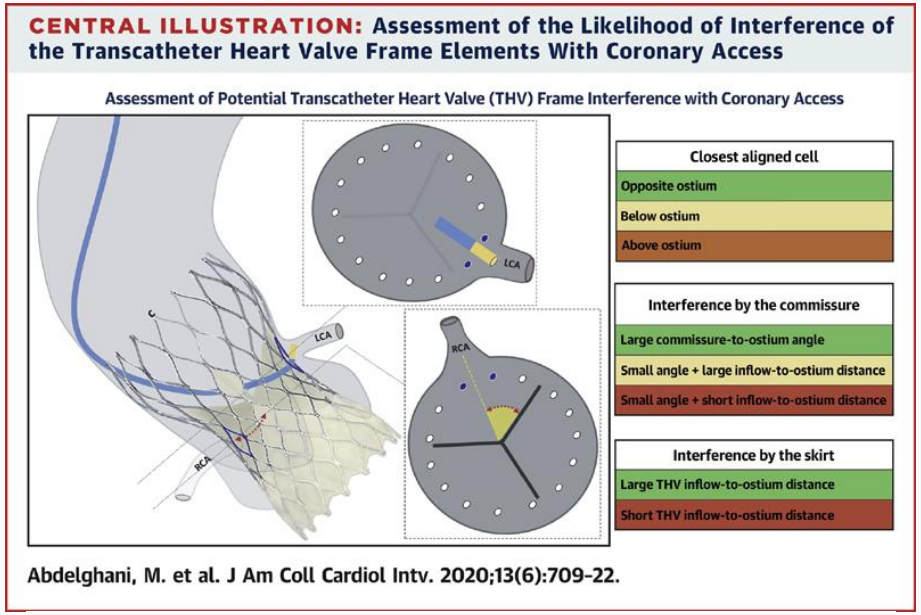
Transcatheter Aortic Valve Implant Depth
Odds Ratio 1.7;
95% CI: 1.3-2.3; p < 0.01

Evolut Transcatheter Aortic Valve
Odds Ratio 29.6;
95% CI: 2.6-335.0; p < 0.01

Barbanti, M. et al. J Am Coll Cardiol Intv. 2020;13(21):2542-55.

The importance of commissural alignment

- Commissural alignment in TAVIs can be random but recent development in self-expanding THVs has shown promise.
- This is particularly pertinent for Evolut and Akurate (supra-annular) TAVIs.
- Each vendor now has specific recommendation and implant technique to achieve this.
- **? Mandatory for SEVs ?**



JACC: CARDIOVASCULAR INTERVENTIONS VOL. 13, NO. 9, 2020

PUBLISHED BY ELSEVIER

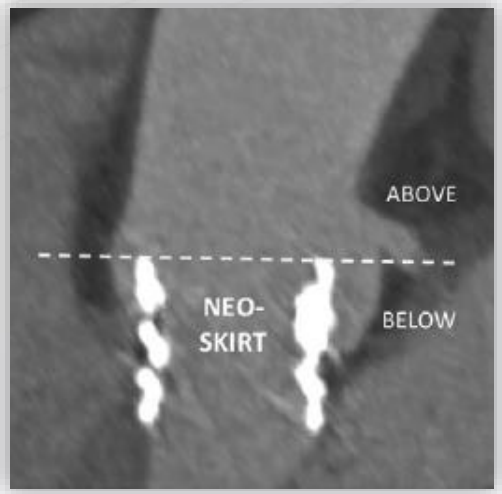
Alignment of Transcatheter Aortic-Valve Neo-Commissures (ALIGN TAVR)

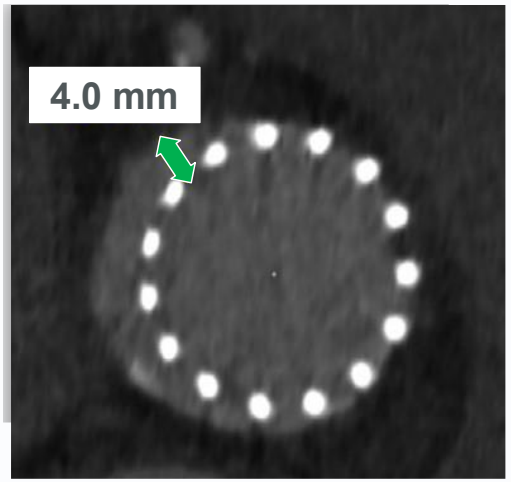
Impact on Final Valve Orientation and Coronary Artery Overlap

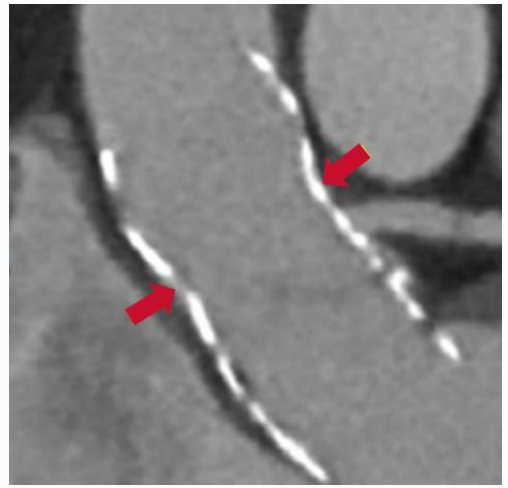
Gilbert H.L. Tang, MD, MSc, MBA,[a] Syed Zaid, MD,[b] Andreas Fuchs, MD, PhD,[c] Tsuyoshi Yamabe, MD,[d] Farhang Yazdchi, MD, MS,[e] Eisha Gupta, MD,[f] Hasan Ahmad, MD,[b] Klaus F. Kofoed, MD,[g] Joshua B. Goldberg, MD,[h] Cenap Undemir, MD,[h] Ryan K. Kaple, MD,[i] Pinak B. Shah, MD,[j] Tsuyoshi Kaneko, MD,[e] Steven L. Lansman, MD, PhD,[h] Sahil Khera, MD,[f] Jason C. Kovacic, MD, PhD,[f] George D. Dangas, MD, PhD,[f] Stamatios Lerakis, MD,[f] Samin K. Sharma, MD,[f] Annapoorna Kini, MD,[f] David H. Adams, MD,[a] Omar K. Khalique, MD,[k] Rebecca T. Hahn, MD,[k] Lars Søndergaard, MD, DMSc,[c] Isaac George, MD,[d] Susheel K. Kodali, MD,[k] Ole De Backer, MD, PhD,[c] Martin B. Leon, MD,[k] Vinayak N. Bapat, MBBS[d]

Lifetime management starts with the first TAVI – coronary access

Prosthesis design should be considered when assessing the patient with the Heart Team







Risk Plane	VTA (Valve-to-Aorta) Distance	Sinus Sequestration
Level under which the stent frame of the index THV would be covered by its leaflets when they are displaced vertically with the implantation of the second THV.	The level at which the prosthesis frame is in closest proximity to the aortic wall and represents the bottleneck where the catheter is not able to further navigate toward the coronary ostium.	The distance is measured from a virtual valve equal to the size of the THV, to the coronary ostia.

Tarantini G, Fabris T, Fovino L. TAVR-in-TAVR and coronary access: importance of preprocedural planning. EuroIntervention, JAA. February 2020; 16:e129-e132.
Yerasi C, Forrestal B, Rogers T. AVR Pitfalls: Addressing Coronary Obstruction Risk. Cardiac Interventions Today. 15(2):45-47. March/April 2021.

Lifetime management – TAVI-in-TAVI – the next frontier

- An emerging challenge – an extension of the concept of coronary access and obstruction.
- Particularly worrying for *supraannular* TAVIs
  - Akurate NEO
  - Medtronic
- With current technology, feasible for TAVI-in-TAVI?

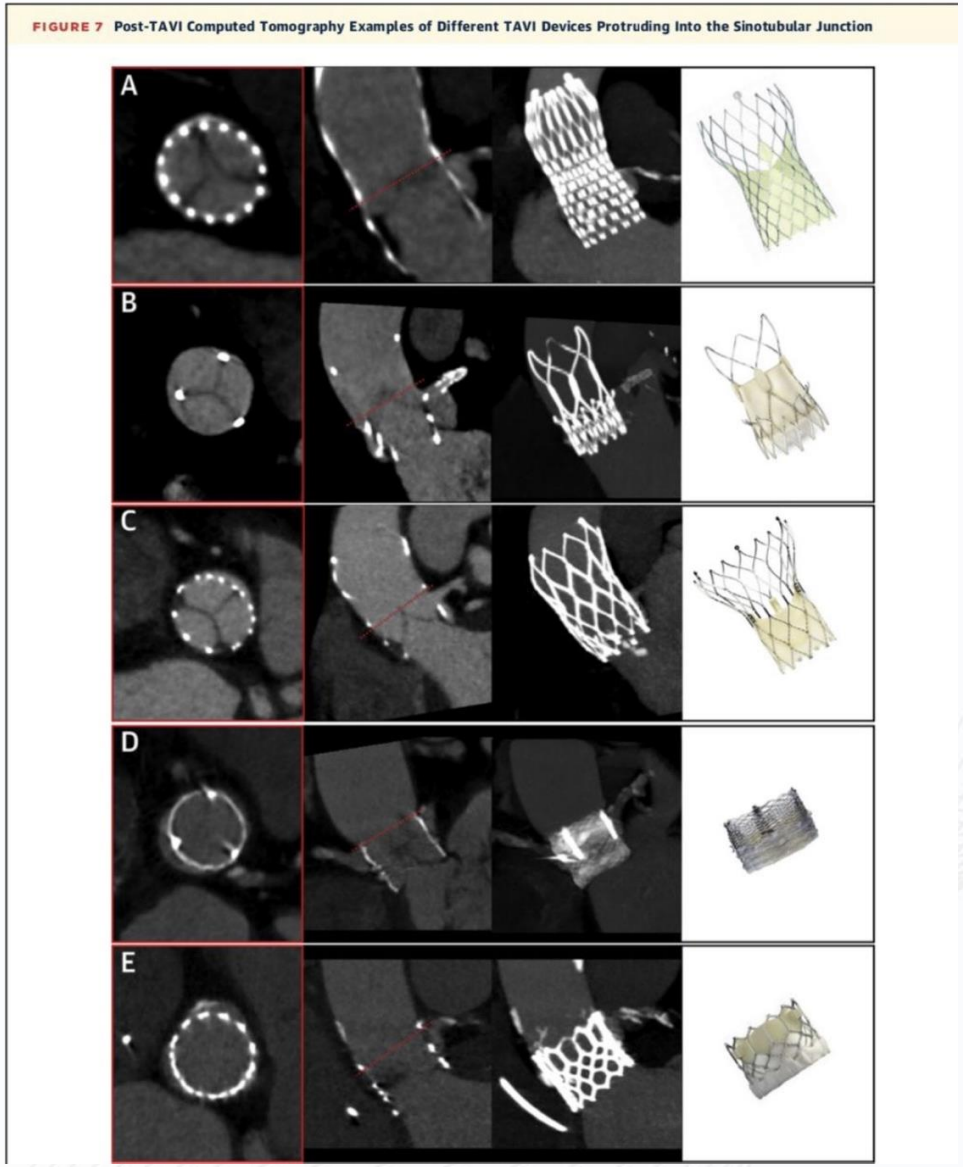
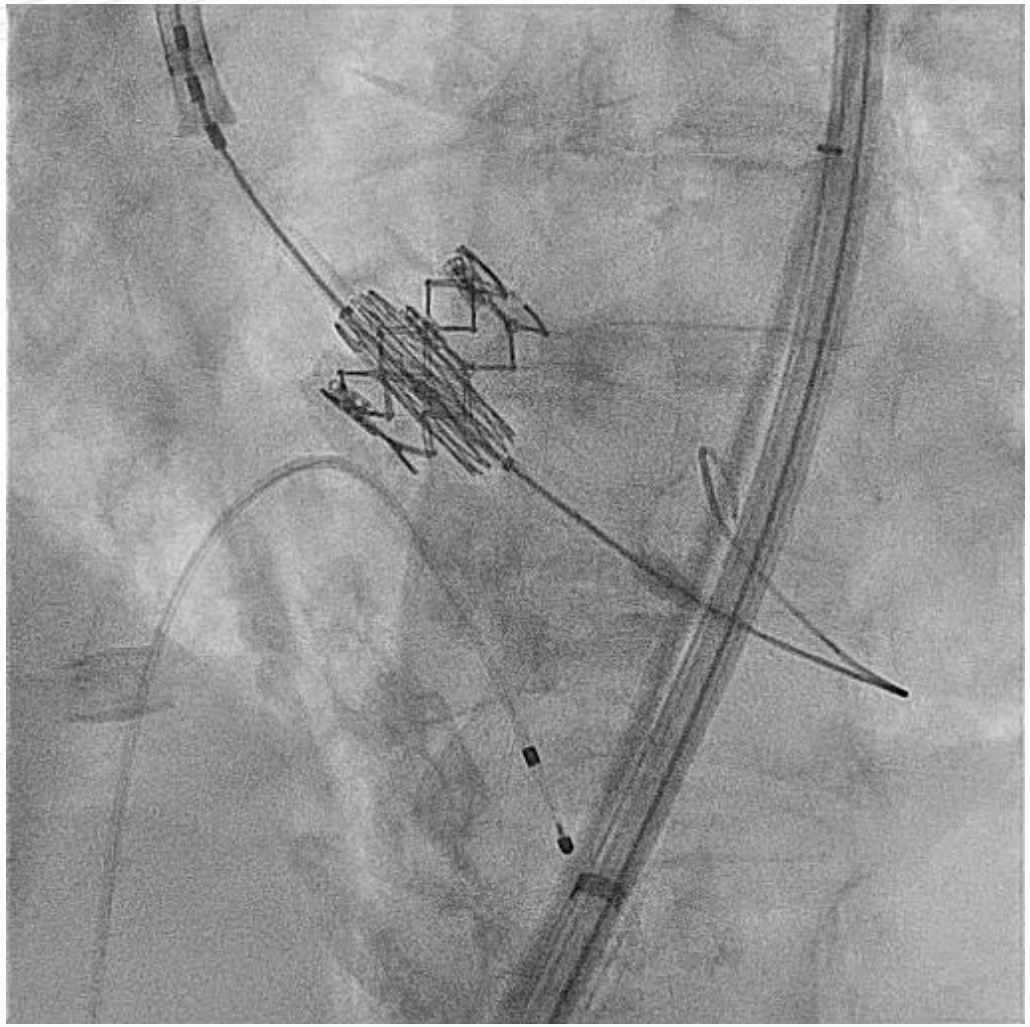


FIGURE 7 Post-TAVI Computed Tomography Examples of Different TAVI Devices Protruding Into the Sinotubular Junction

TAVI-in-TAVI: 6 year old Edwards XT



86 y.o. April 2016

High risk SAVR candidate

Annulus 405mm2

23mm XT nominal filling

92 y.o. July 2022

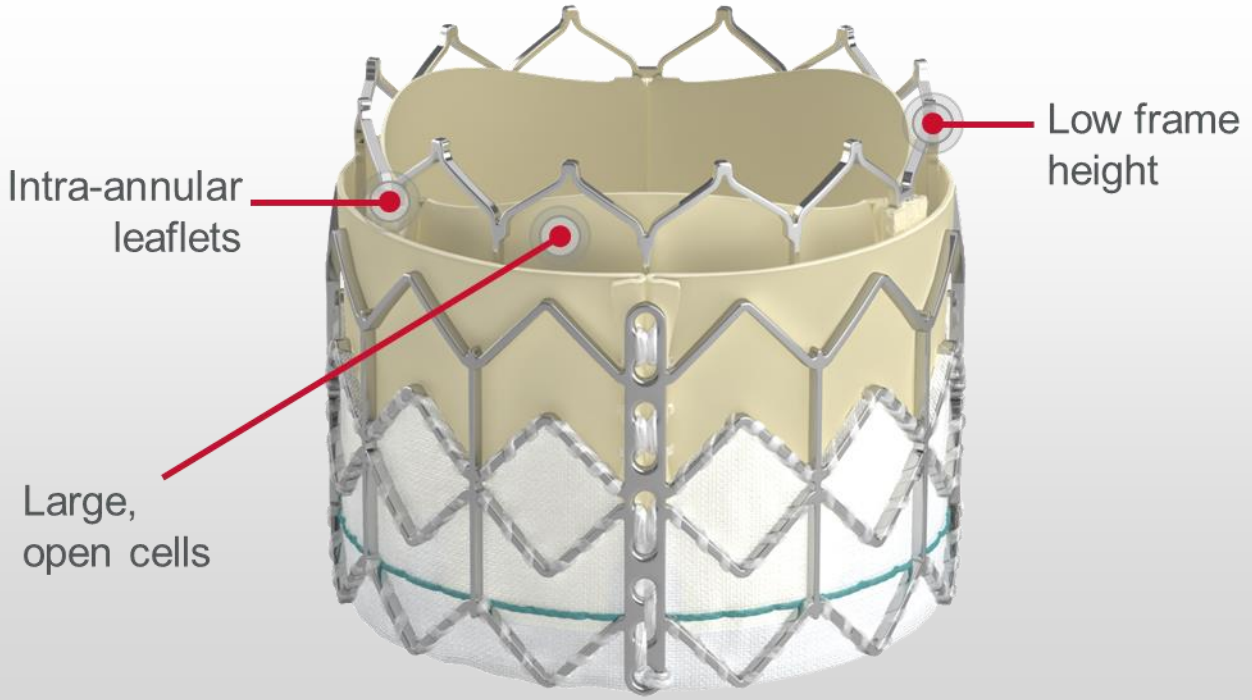
CCF with stenotic failure

23mm S3U +2cc

Supporting Future Interventions:

THV-in-THV Applications

- Only the Edwards SAPIEN 3 THV and the Edwards SAPIEN 3 Ultra THV platforms are currently indicated for THV-in-THV implantation in the United States

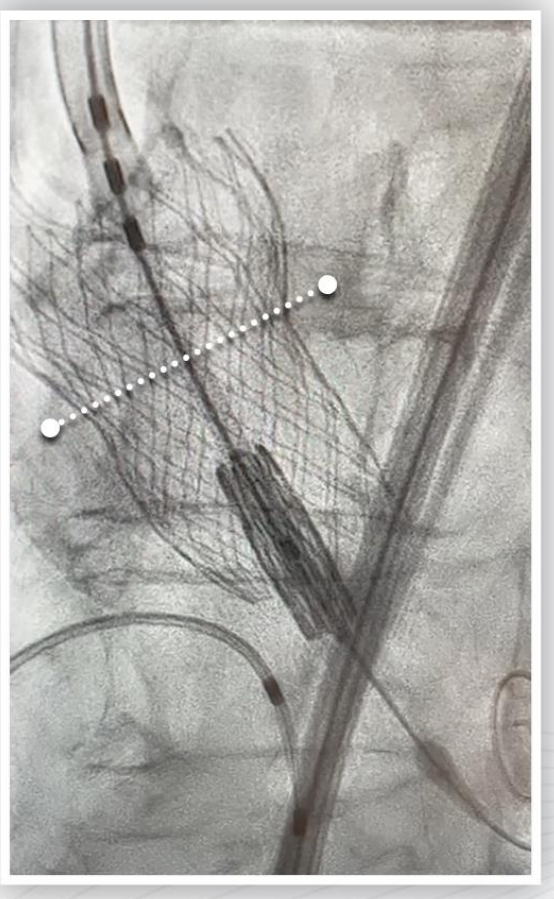


Supporting Future Interventions:

THV-in-THV Applications

- **Leaflet overhang** results when the index THV leaflets "*overhang*" the top of the second THV
  - Includes instances of placing a shorter intra-annular valve inside an index supra-annular valve
  - High index valve implantation height may increase risk of future leaflet overhang

- **Consequences may include:**
  - Suboptimal blood flow
  - Inadequate closing of the leaflets, which may lead to regurgitation
  - Impact to longevity of the second valve



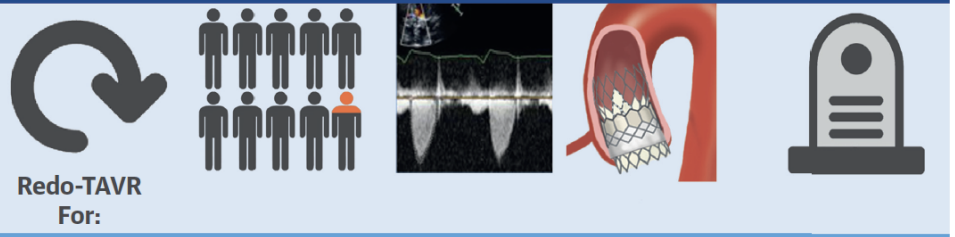
Buzzatti N, et al. Coronary Access After Repeated Transcatheter Aortic Valve Implantation: A Glimpse Into the Future. JACC Cardiovasc Imaging. 2020 Feb;13(2 Pt 1):508-515.

Lifetime management – TAVI-in-TAVI – don't bank on it

Repeat Transcatheter Aortic Valve Replacement for Transcatheter Prosthesis Dysfunction

Uri Landes, MD,[a,b] John G. Webb, MD,[a] Ole De Backer, MD,[c] Lars Sondergaard, MD, MSc,[c]

CENTRAL ILLUSTRATION Repeated Transcatheter Aortic Valve Replacement for Transcatheter Heart Valve Dysfunction



Redo-TAVR For:	Incidence	Residual Gradient	Coronary Flow Obstruction	Mortality at 30 days
Failed TAVR Valve	0.22%	13 mm Hg	0.7%	1.4%
Failed TAVR Procedure	0.11%	11.5 mm Hg	1.3%	5.4%

Landes, U. et al. J Am Coll Cardiol. 2020;75(16):1882-93.

Outcomes stratified for patients presented with probable TAVR failure and those with probable THV failure. TAVR = transcatheter aortic valve replacement; THV = transcatheter heart valve.

Circulation: Cardiovascular Interventions

ORIGINAL ARTICLE

Transcatheter Aortic Valve Replacement for Degenerated Transcatheter Aortic Valves

The TRANSIT International Project

Luca Testa, MD, PhD; Mauro Agnifili, MD; Nicolas M. Van Mieghem, MD, PhD; Didier Tchétché, MD;

- TRANSIT
  - N=172 TAVI in TAVI
  - No coronary obstruction (!!)
- Caution:
  - Selection bias – how many cases rejected?
  - Case series only

Lifetime management – TAVI-in-TAVI – don't bank on it

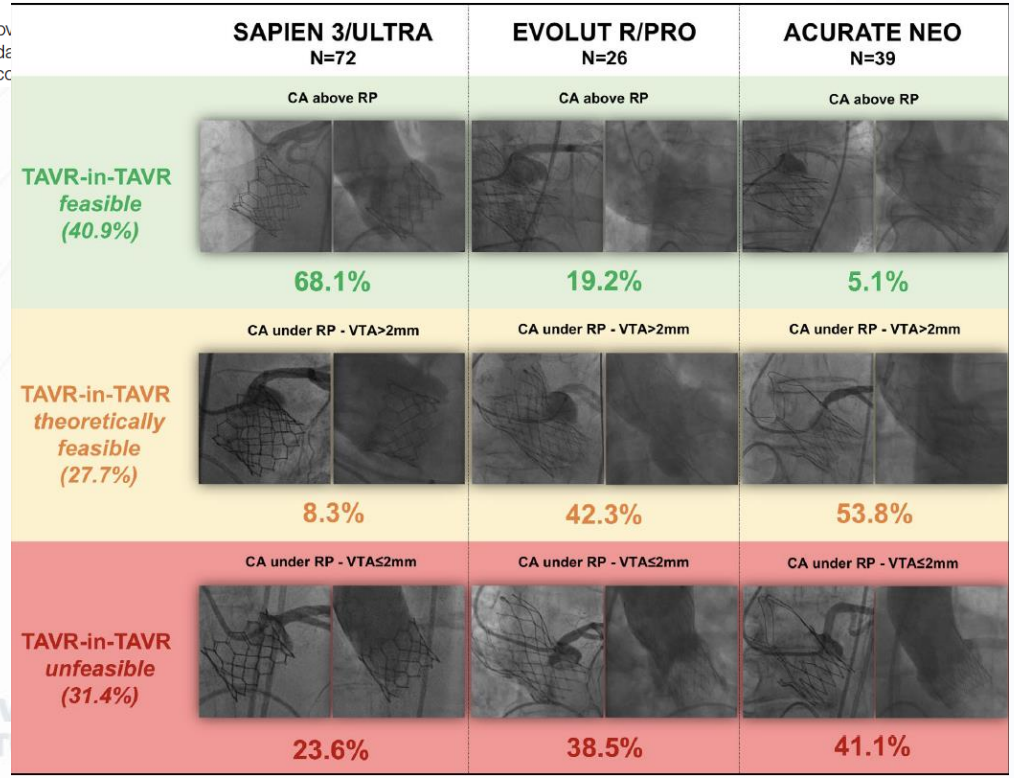
A specially challenging combination of supra-annular THV with narrow sinotubular junction

Journal of the American Heart Association

ORIGINAL RESEARCH

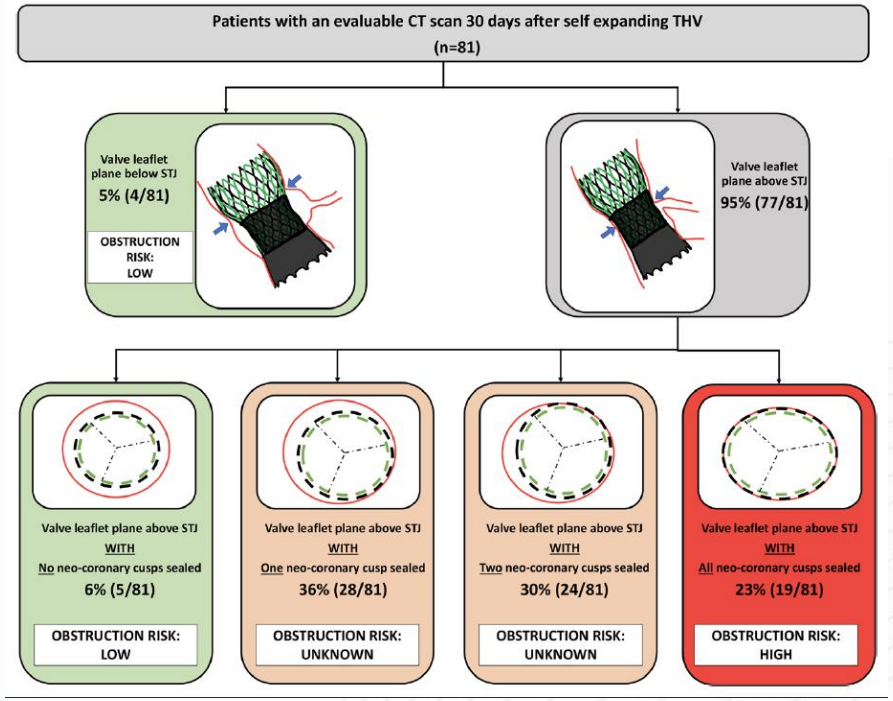
Coronary Angiography After Transcatheter Aortic Valve Replacement (TAVR) to Evaluate the Risk of Coronary Access Impairment After TAVR-in-TAVR

Luca Nai Fov
Yuji Matsuda
Chiara Fracc



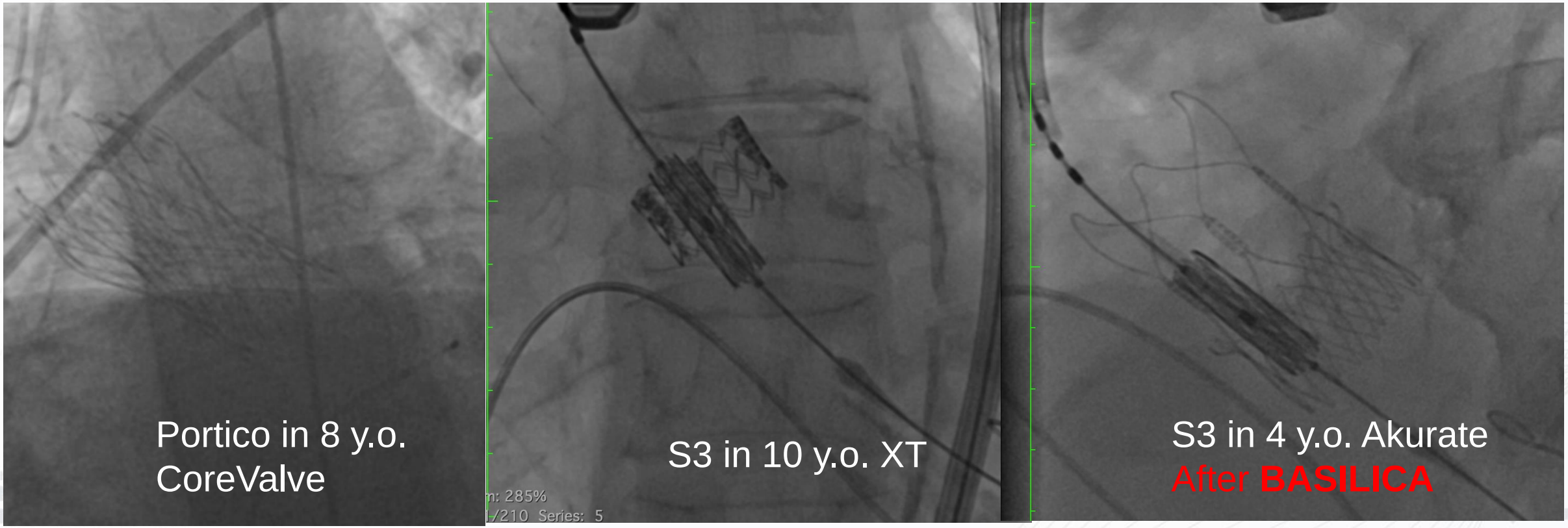
ORIGINAL ARTICLE

Risk of Coronary Obstruction and Feasibility of Coronary Access After Repeat Transcatheter Aortic Valve Replacement With the Self-Expanding Evolut Valve



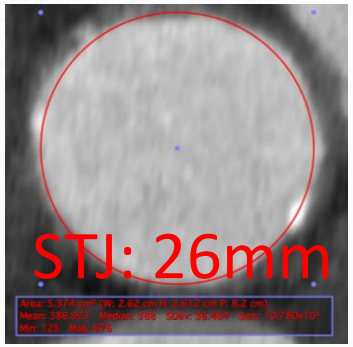
Examples of TAVI-in-TAVI – don’t bank on it

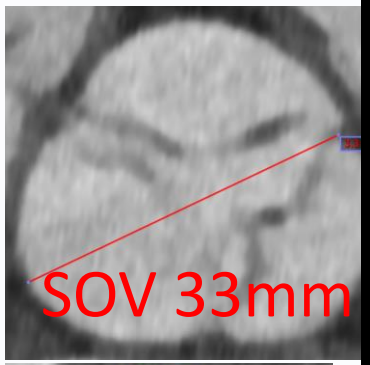
- Feasible if anatomy not challenging
  - May need ancillary technique – i.e. Balloon Assisted-BASILICA

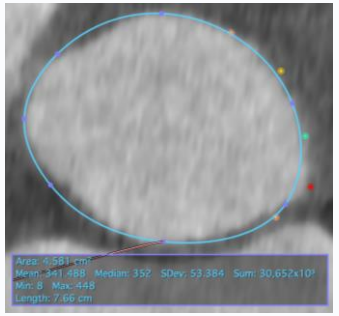


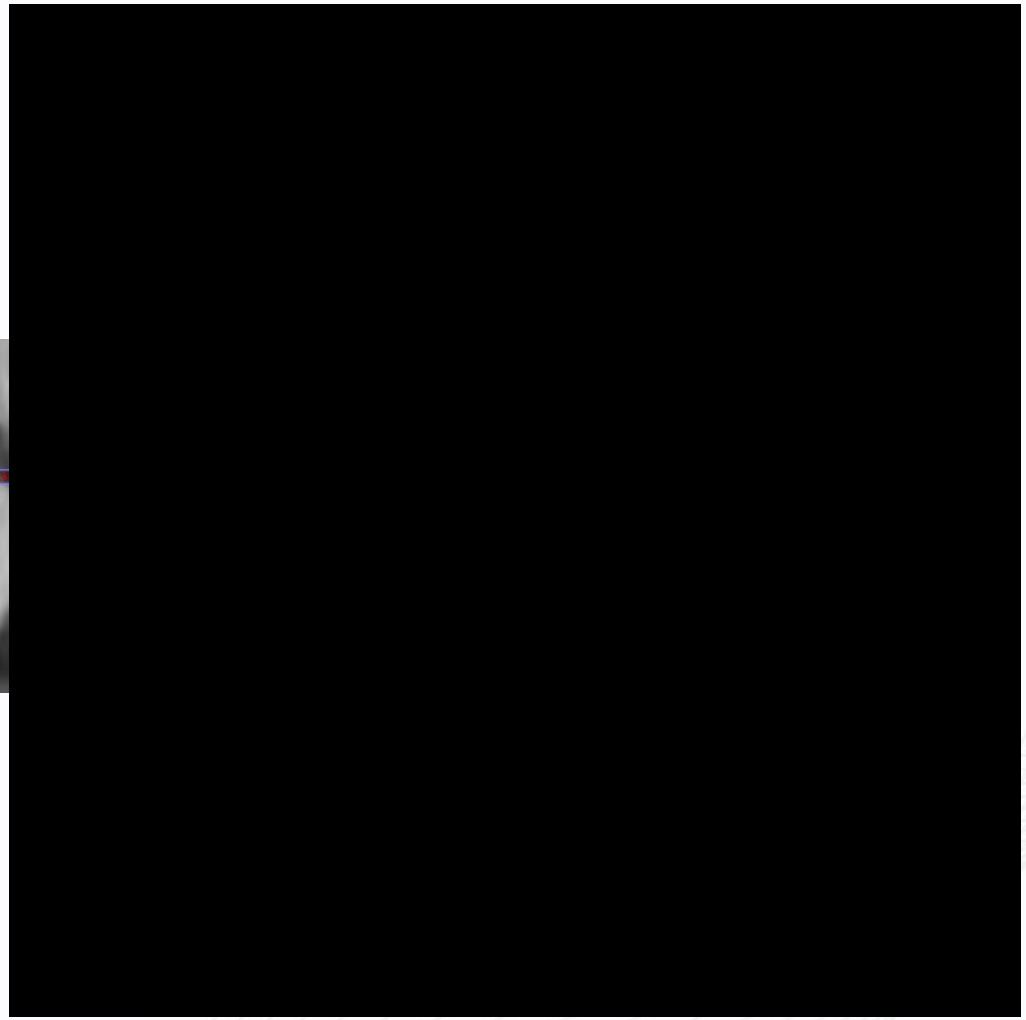
Modifying TAVI implant for the future

- 76 y.o. male recent fall otherwise suitable for SAVR
- Clean annulus, TF case
- 26mmS3 implant lower to avoid the STJ
- Overfill THV by 1cc to modify height of THV
- Anticipate future TAVI-in-TAVI
- Now? 23mm S3ULTRA overfilled







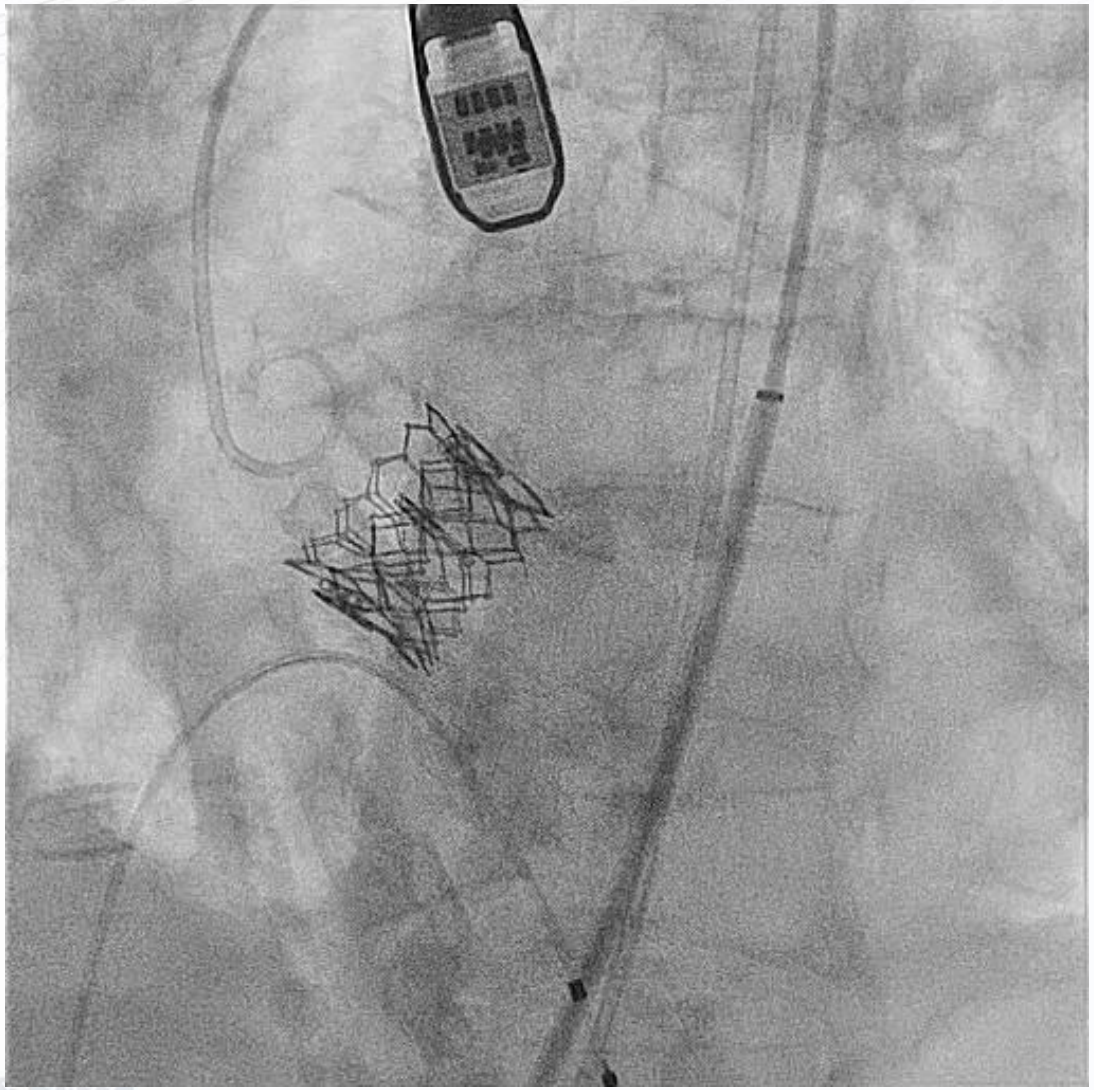


Annulus 450mm2

Controversies in TAVI-in-TAVI

- Optimal 1st THV?
- Re-do THV device?
- Predilate? Predilate with TRUE balloon?
- SEV in BEV; SEV in SEV; BEV in BEV; SEV in BEV???
- Trapped tissue between THV? Nidus for thrombosis?
- Placement of re-do THV?

Here's my wish for the next THV…



Shortest THV possible

Good coronary access

Durable result

Low gradient

Commissural alignment

BRING ON X4!!!

Conclusion

- TAVIs are now performed in patients with longer life expectancies and as such it's vitally important to plan for future interventions such as coronary access and TAVI-in-TAVI.
- The Edwards BEV/ULTRA/S3 platform is the shortest stent frame THV with potentially the best coronary access and future TAVI-in-TAVI feasibility.
- Patient specific anatomical factors – e.g. STJ or SOV dimensions – should form part of the heart team discussion regarding SAVR vs. TAVI and TAVI device choice.
- Given the currently available data, the first valve choice should be a considered choice.

TAV-in-TAV

Dr Karl Poon
MBBS, FRACP
Interventional cardiologist
The Prince Charles Hospital, Brisbane, Australia
St Andrew's War Memorial Hospital
Senior Lecturer, University of Queensland

Disclosure

- In the past 12 months, I and/or my spouse, have received the following:

• Relevant conflict to this presentation	Company
• Consulting fee/Proctoring fee	Edwards LifeSciences, Abbott Vascular
• Unrestricted institutional grant (QHI)	Edwards LifeSciences, Abbott Vascular
• Research role	Edwards Lifesciences, Boston Scientific

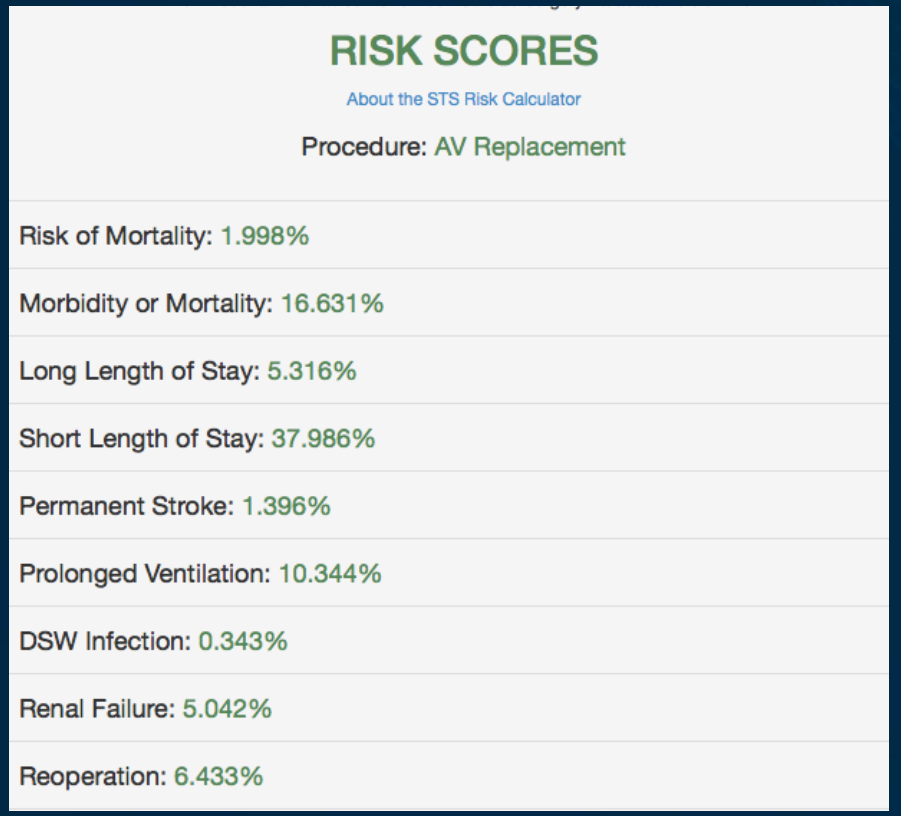
Clinical Background

Original procedure

- 68 year old (2017) male, Jehovah's witness, severe aortic stenosis

- Coronary artery disease
  - CABG – 1996 – LIMA-Diagonal; RA-RCA
  - PCI to LCx 2001
  - PCI to LAD 2003; PCI to RCA 2005
- Normal LV systolic function
- Hypertension, Diabetes, OSA, GORD
- BMI 38

- Cardiac surgeon – TAVI recommended
  - Re-do; Jehovah's witness
  - LIMA adherent to sternum – high risk re-do



RISK SCORES

About the STS Risk Calculator

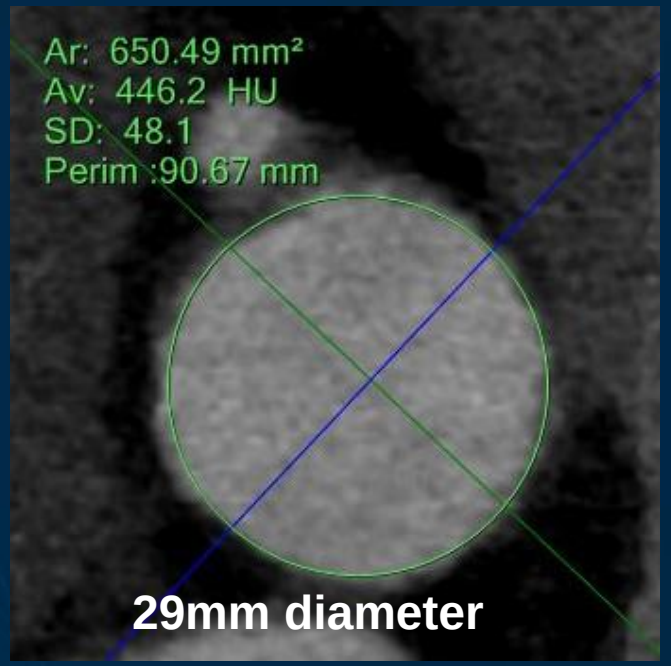
Procedure: AV Replacement

Risk of Mortality:	1.998%
Morbidity or Mortality:	16.631%
Long Length of Stay:	5.316%
Short Length of Stay:	37.986%
Permanent Stroke:	1.396%
Prolonged Ventilation:	10.344%
DSW Infection:	0.343%
Renal Failure:	5.042%
Reoperation:	6.433%

CT analysis

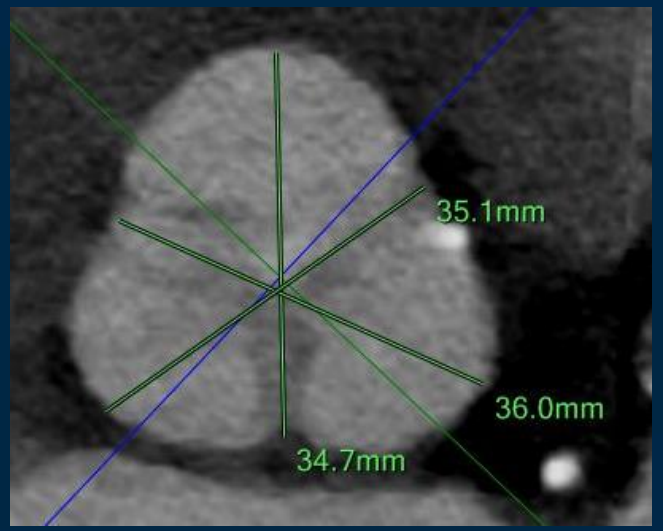
June 2017

Sinotubular junction



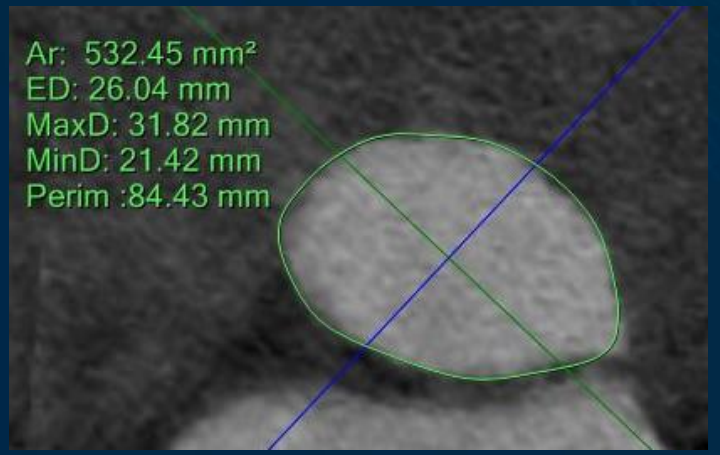
29mm diameter

Sinus of Valsalva



35mm diameter

Aortic annulus



Area 535mm2

Perimeter 84mm

Max diameter 32mm

Min diameter 21mm

- **? Underfilled 29mm S3 (2017)**

Original TAVI procedure – June 2017

Right transfemoral TAVI 29mm S3 -3cc filling

TAVI	Mean	Area	Vmax	PVL
Day 1	8mmHg	2.7 cm2	2.1m/s	0-1

Uncomplicated discharge day 2 POD
Discharged on aspirin as single antithrombotic

TAVI	Mean	Area	Vmax	PVL
Day 180	14mmHg	2.5 cm2	2.7m/s	0-1

Five years post TAVI

- Increasing exertional dyspnoea
- Local cardiologist:
  - Coronary angiography and graft study:
    - Unchanged
    - “Unlikely reason for dyspnoea”
- Year 5…
  - “Request for redo TAVI as soon as possible
- Melanoma – immunotherapy – new

TAVI	Mean	Area	Vmax	PVL
Day 1	8mmHg	2.7 cm2	2.1m/s	0-1

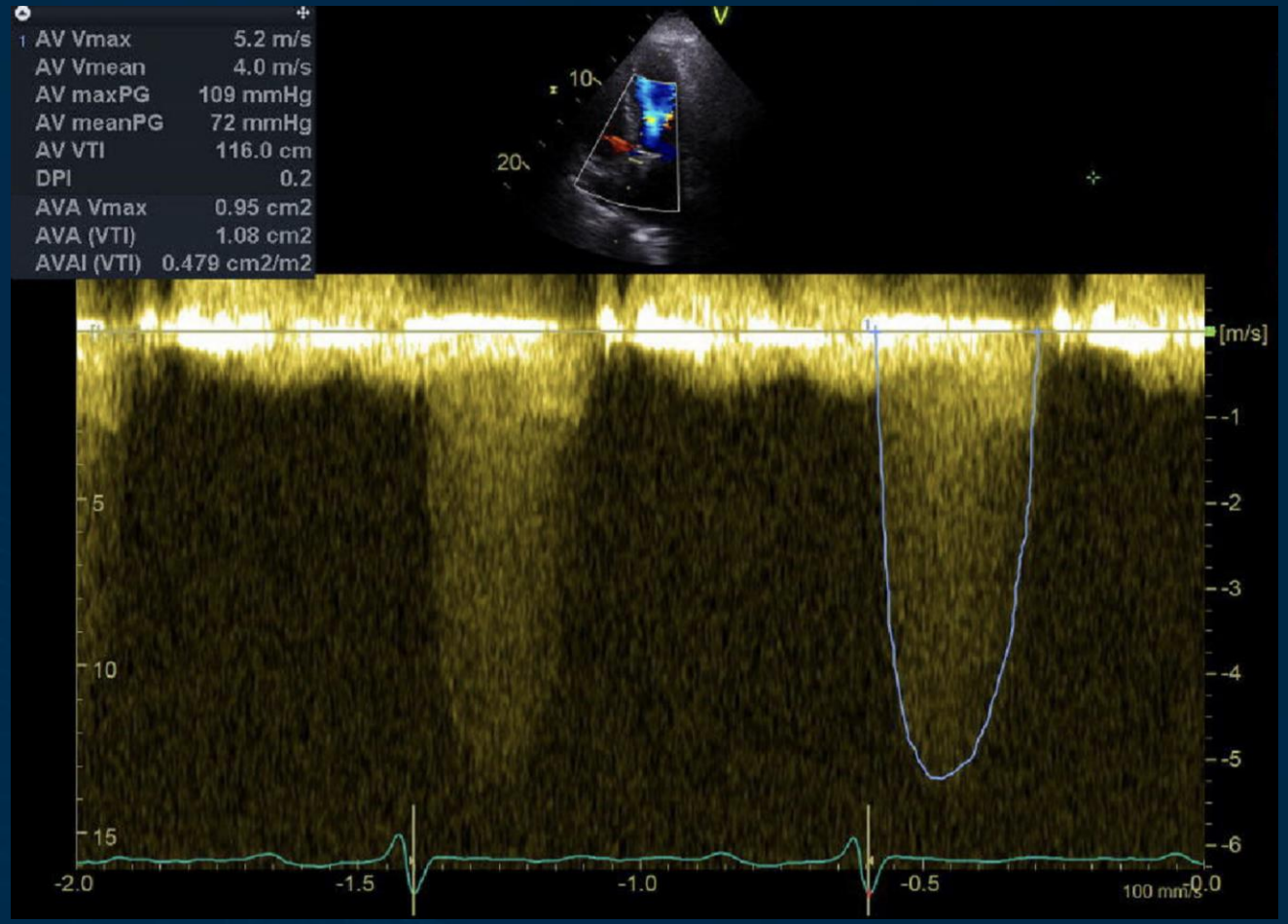
TAVI	Mean	Area	Vmax	PVL
Day 180	14mmHg	2.5 cm2	2.7m/s	0-1

TAVI	Mean	Area	Vmax	PVL
Year 4.5	18mmHg	1.6 cm2	3.0m/s	0-1

TAVI	Mean	Area	Vmax	PVL
Year 5	43mmHg	0.8 cm2	4.0m/s	0-1

TAVI stenosis assessment

TTE and TEE



- TEE comments
  - Heavily restricted THV leaflets
  - Heavily calcified
  - Possible thrombus
- Discharged on DOAC & return for likely TAV-in-TAV

TAV-in-TAV assessment

Step by step approach

- **Confirmation of diagnosis**
  - Stenosis
  - Regurgitation

- **Exclusion of other diagnoses or confounders**
  - Pseudo-stenosis vs. true stenosis
    - LVOT gradient
    - Patient prosthesis mismatch – e.g. high baseline gradient
  - Infective endocarditis
  - Thrombus

TAV-in-TAV assessment

Step by step approach

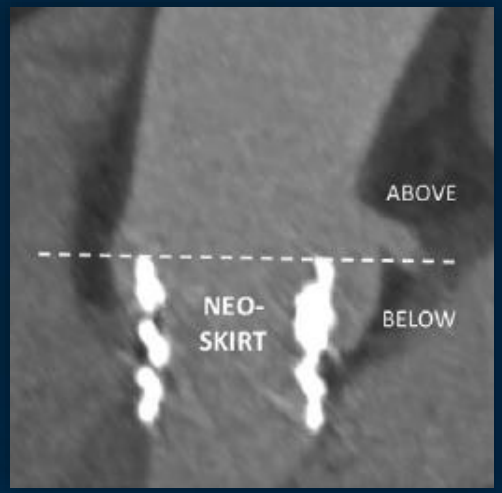
- **ALWAYS OBTAIN ORIGINAL CT IF POSSIBLE**
  - Sizing decision/THV decision
    - Calcium? Hostile anatomy? Hostile root?

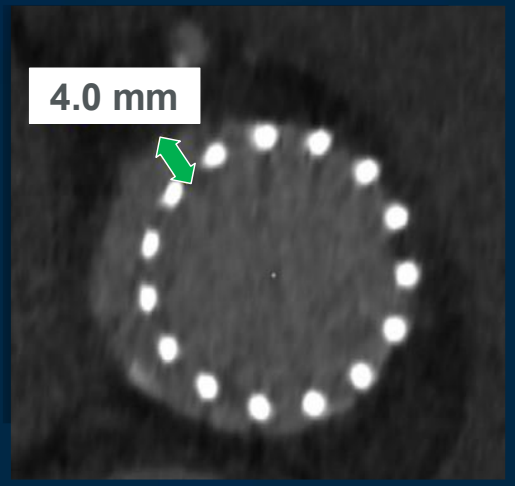
- **OBTAIN ORIGINAL IMPLANT FLUOROSCOPY IF POSSIBLE**
  - Although possible to reimage particular in reference to coronary location and root anatomy

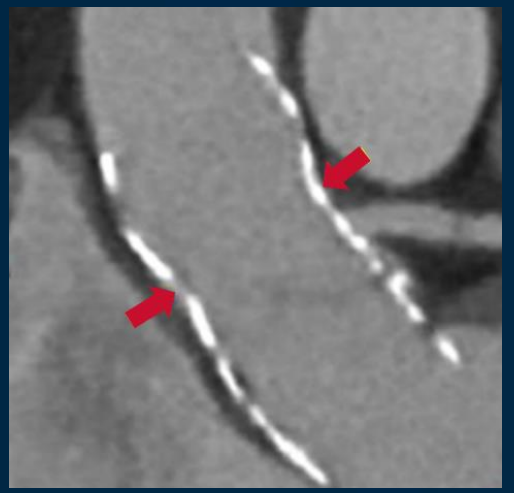
- **ANALYSE CT TAVI**
  - Risk plane; STJ and sinus sequestration risk
  - Neo-skirt
  - Original THV expansion profile

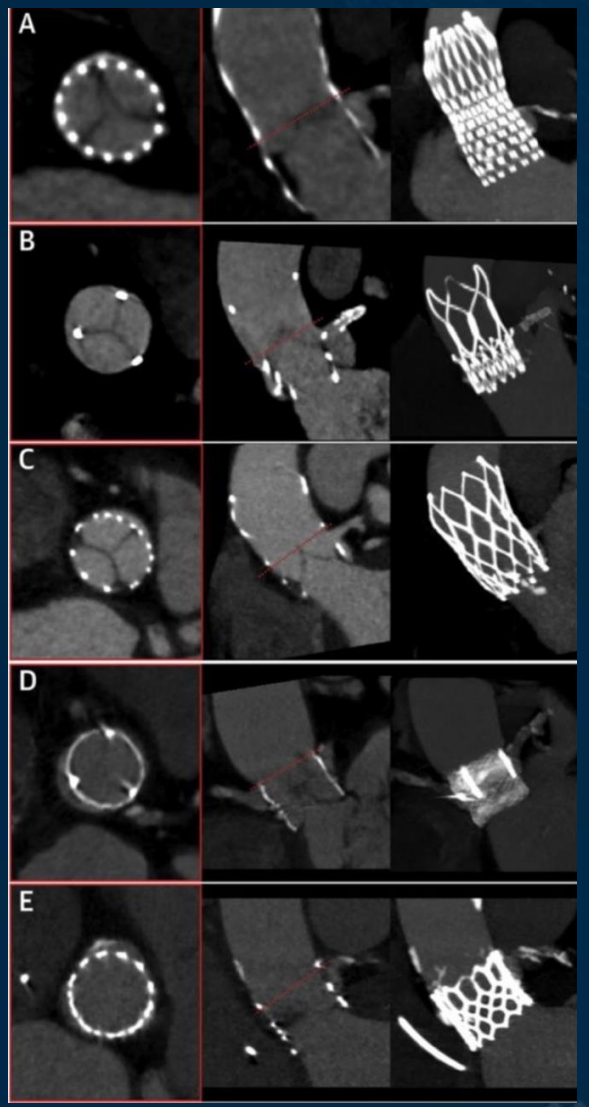
TAV-inTAVI: neoskirt and risk plane

Coronary occlusion risk assessment









Risk Plane	VTA (Valve-to-Aorta) Distance	Sinus Sequestration
Level under which the stent frame of the index THV would be covered by its leaflets when they are displaced vertically with the implantation of the second THV.	The level at which the prosthesis frame is in closest proximity to the aortic wall and represents the bottleneck where the catheter is not able to further navigate toward the coronary ostium.	The distance is measured from a virtual valve equal to the size of the THV, to the coronary ostia.

TAV-in-TAV: current case CT analysis

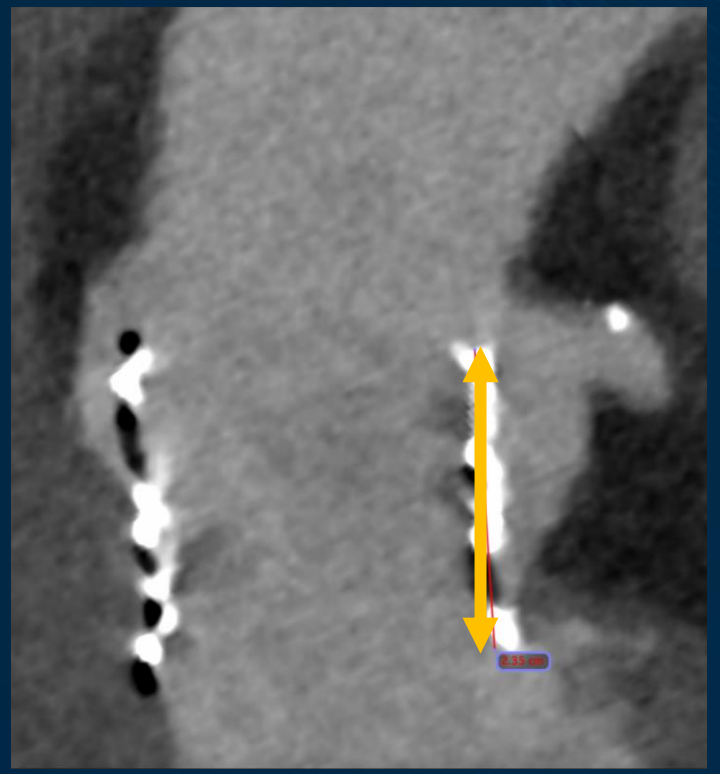
An under-expanded THV

Height
23.9mm

Diameter
26.5mm

Diameter
25.5mm

Diameter
26mm



Height
23.5mm

An underxpanded 29mm S3 with a taller frame and smaller EOA

TAV-in-TAV procedure

Summary of analysis

Diagnosis

- severe/critical stenosis, possible thrombus, no regurgitation, no obvious vegetation

THV characteristics

- An underexpanded (intentionally) 29mm S3 with final expansion profile 26mm or less
- Taller stent frame

Coronary occlusion risk

- Nil (also protected/partially grafted vasculature)

TAV-in-TAV procedure plan

Plan and Rationale

- **Right** transfemoral TAV-in-TAVI with **left** transfemoral “BVF”
- Sentinel cerebral embolic protection
- TRUE balloon 26mm PRE dilatation
- 26mm S3U + 2cc
- TRUE Balloon post dilatation

➢ **Contralateral access to BVF so ipsilateral THV ready to deploy if AR**

➢ **Concern re embolic risk due to multiple inflation planned**

➢ **Address under-expansion prior to new THV**

➢ **Achieve high pressure expansion**

➢ **Prevent underexpansion of TWO stent frames**

TAV-in-TAV Procedure

TRUE 26mm balloon inflation

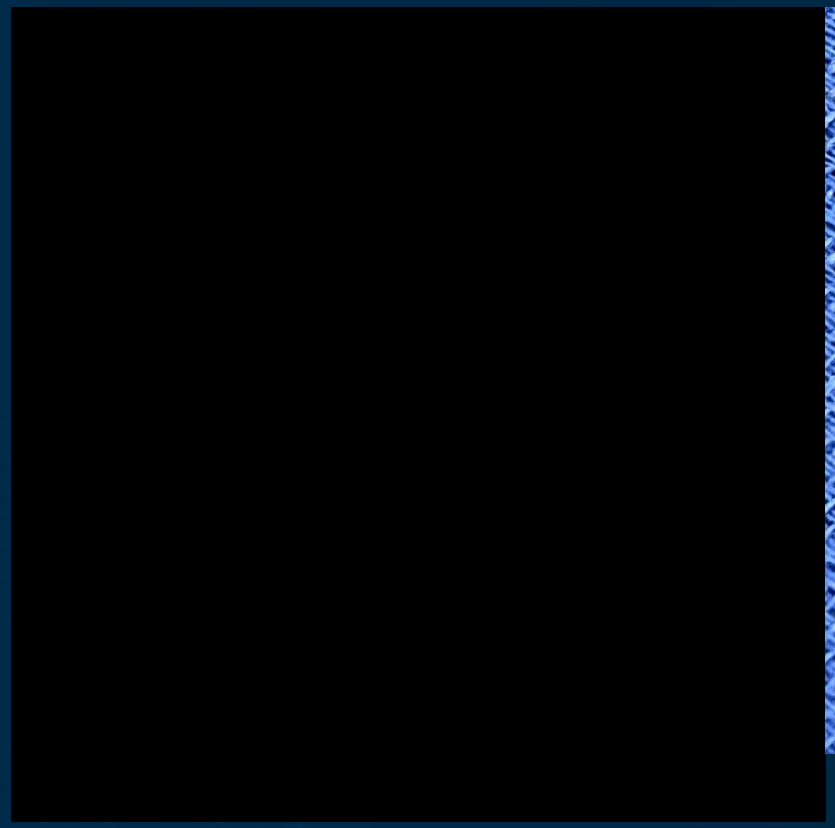
S3 26mm in waiting

S3 26mm +2cc inflation @ 9ATM

Top of new THV as per previous

TAV-in-TAV

Procedural outcome



TRUE 26mm balloon inflation

Coaptation length on TEE from 9mm to 4mm

Procedure outcome

- Large (6mm) debris in CEP basket
- No CVA/PPM/vascular complications
- Discharged day 2
- Discharged on **warfarin**

Echocardiographic outcome Day 1

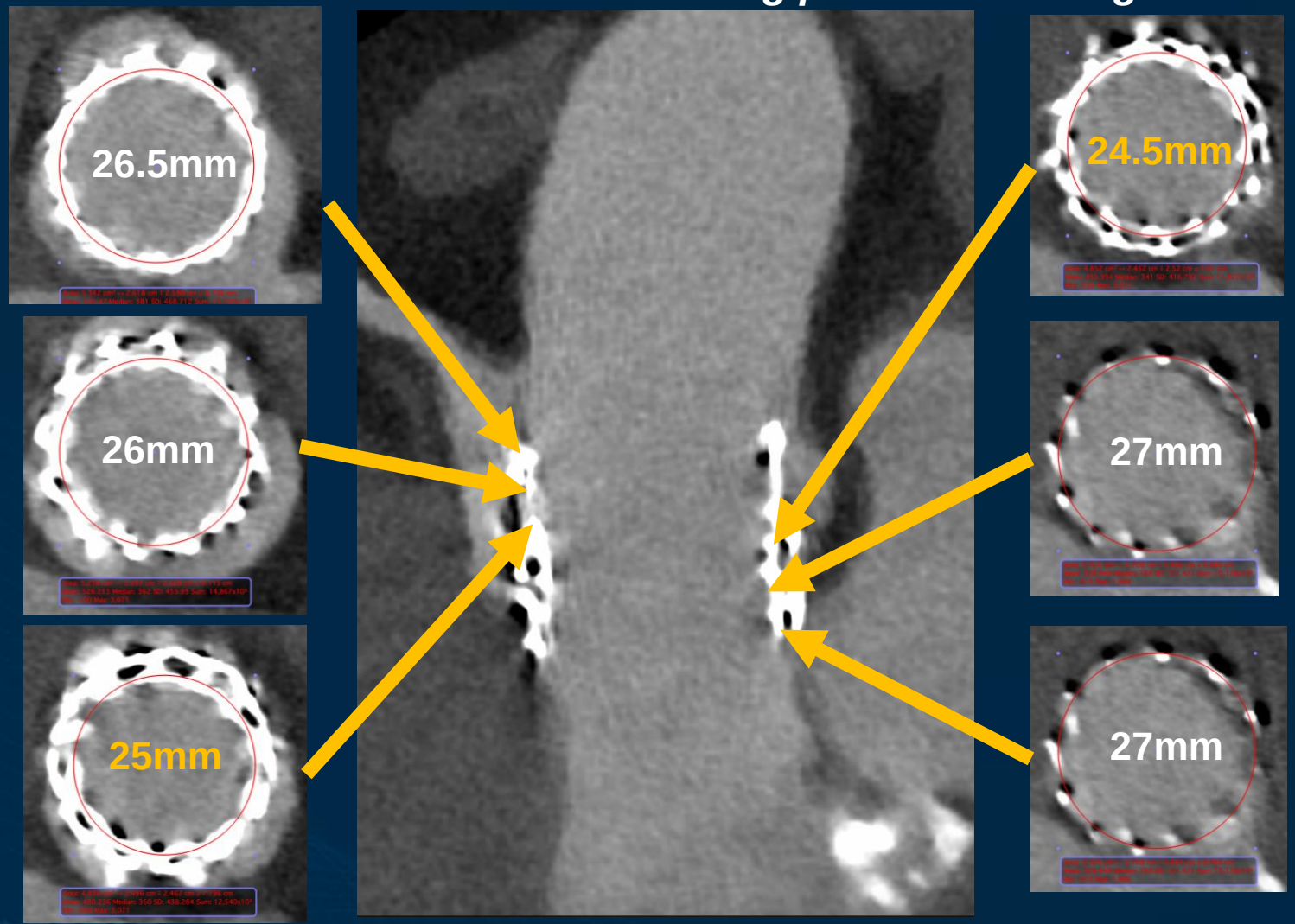
- Mean gradient:12mmHg
- Peak: 21mmHg
- EOA: 2.6cm2

Echocardiographic outcome Day 60

- Mean gradient:12mmHg
- Peak: 27mmHg
- EOA: 2.6cm2

TAV-in-TAVI postscript – CT TAVI

Learning points – challenges for TAV-in-TAV

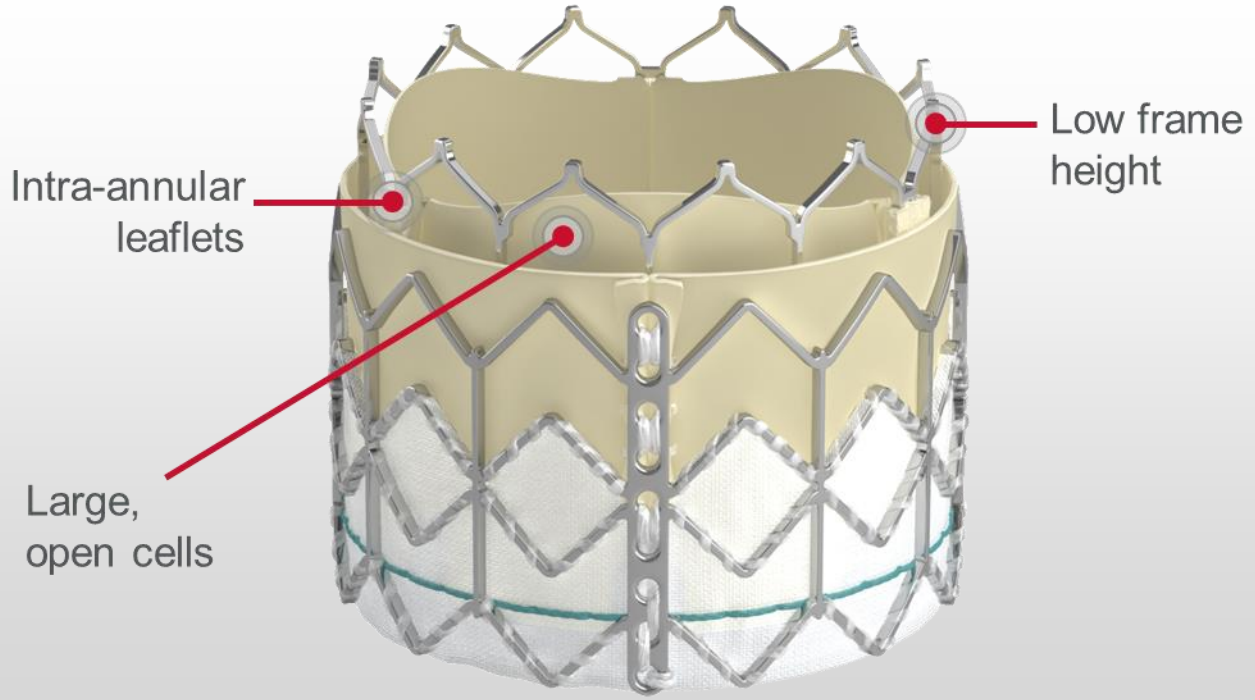


- **Overall improved expansion of THV particular the first THV, particular inflow/outflow**
- **Despite predilatation significant “sandwiched” tissue from 1st THV**
- **Despite postdilatation mid body remains waisted**

Supporting Future Interventions:

THV-in-THV Applications

- Only the Edwards SAPIEN 3 THV and the Edwards SAPIEN 3 Ultra THV platforms are currently indicated for THV-in-THV implantation in the United States

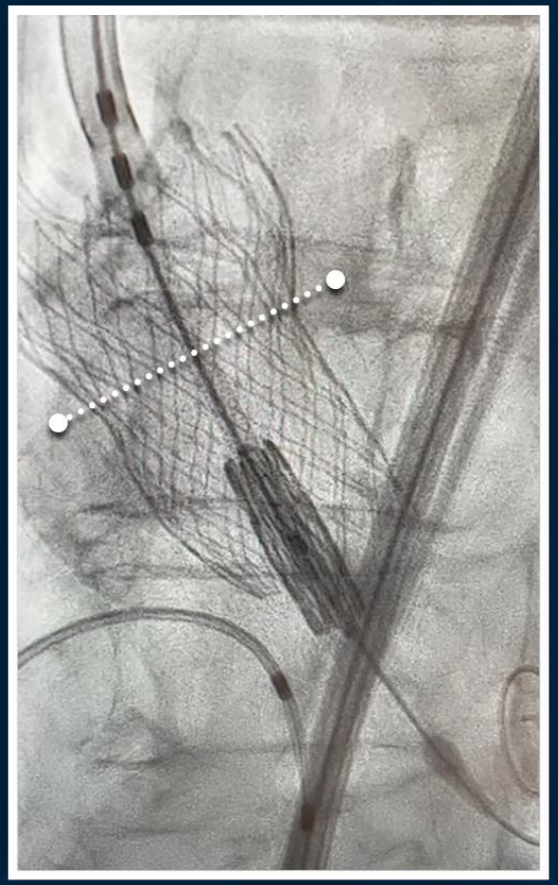


Supporting Future Interventions:

THV-in-THV Applications

- **Leaflet overhang** results when the index THV leaflets "*overhang*" the top of the second THV
  - Includes instances of placing a shorter intra-annular valve inside an index supra-annular valve
  - High index valve implantation height may increase risk of future leaflet overhang

- **Consequences may include:**
  - Suboptimal blood flow
  - Inadequate closing of the leaflets, which may lead to regurgitation
  - Impact to longevity of the second valve

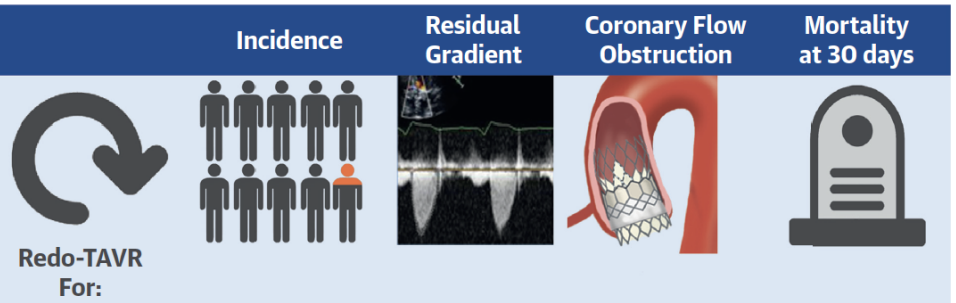


Buzzatti N, et al. Coronary Access After Repeated Transcatheter Aortic Valve Implantation: A Glimpse Into the Future. JACC Cardiovasc Imaging. 2020 Feb;13(2 Pt 1):508-515.

Lifetime management – TAV-in-TAV – don't bank on it

Repeat Transcatheter Aortic Valve Replacement for Transcatheter Prosthesis Dysfunction

Uri Landes, MD,[a,b] John G. Webb, MD,[a] Ole De Backer, MD,[c] Lars Sondergaard, MD, MSc,[c]



Redo-TAVR For:	Incidence	Residual Gradient	Coronary Flow Obstruction	Mortality at 30 days
Failed TAVR Valve	0.22%	13 mm Hg	0.7%	1.4%
Failed TAVR Procedure	0.11%	11.5 mm Hg	1.3%	5.4%

Landes, U. et al. J Am Coll Cardiol. 2020;75(16):1882-93.

Outcomes stratified for patients presented with probable TAVR failure and those with probable THV failure. TAVR = transcatheter aortic valve replacement; THV = transcatheter heart valve.

Circulation: Cardiovascular Interventions

ORIGINAL ARTICLE

Transcatheter Aortic Valve Replacement for Degenerated Transcatheter Aortic Valves

The TRANSIT International Project

Luca Testa, MD, PhD; Mauro Agnifili, MD; Nicolas M. Van Mieghem, MD, PhD; Didier Tchétché, MD;

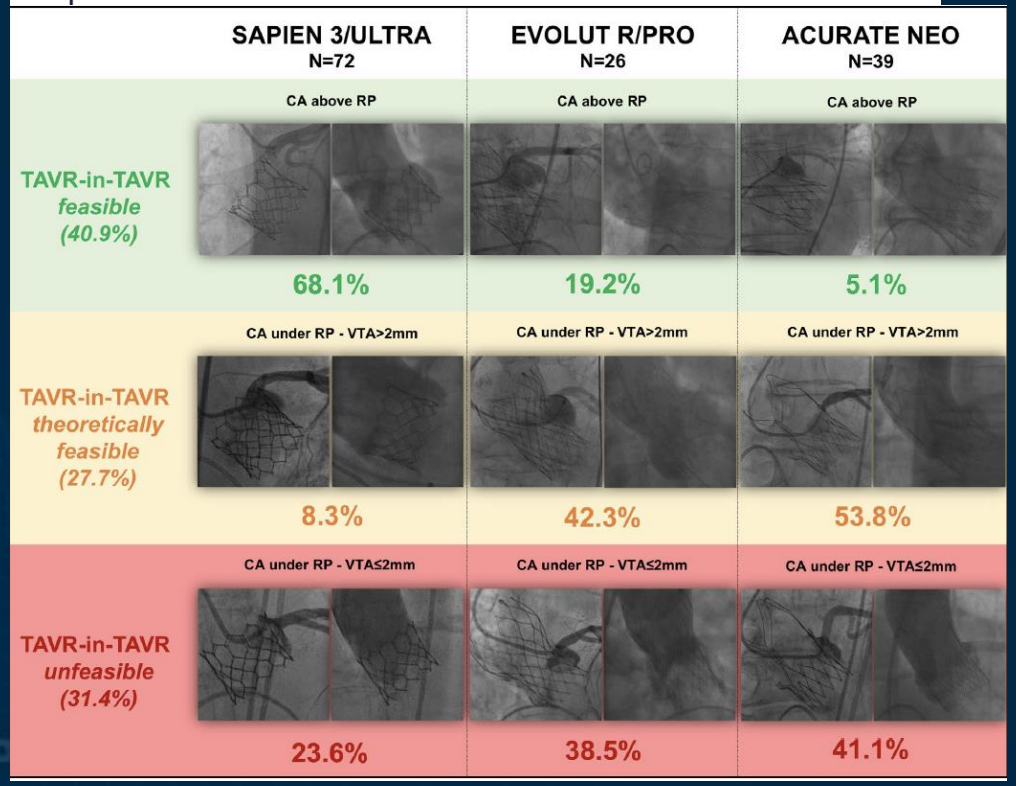
- TRANSIT
  - N=172 TAVI in TAVI
  - No coronary obstruction (!!)
- Caution:
  - Selection bias – how many cases rejected?
  - Case series only

Lifetime management – TAV-in-TAV – don't bank on it

Journal of the American Heart Association

ORIGINAL RESEARCH

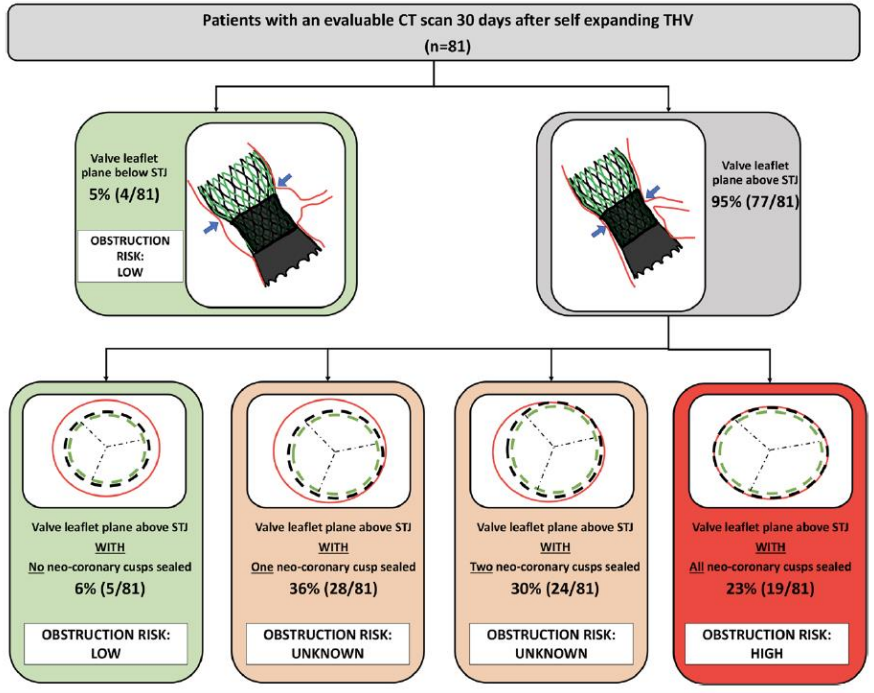
Coronary Angiography After Transcatheter Aortic Valve Replacement (TAVR) to Evaluate the Risk of Coronary Access Impairment After TAVR-in-TAVR



Circulation: Cardiovascular Interventions

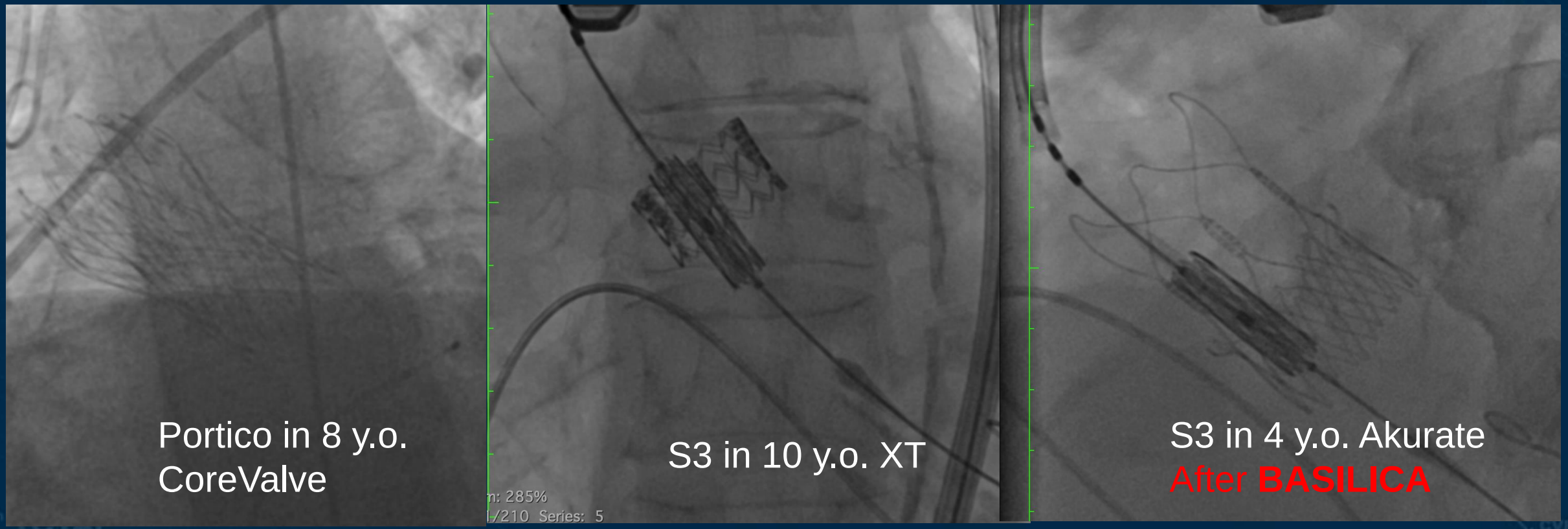
A specially challenging combination of supra-annular THV with narrow sinotubular junction

Risk of Coronary Obstruction and Feasibility of Coronary Access After Repeat Transcatheter Aortic Valve Replacement With the Self-Expanding Evolut Valve



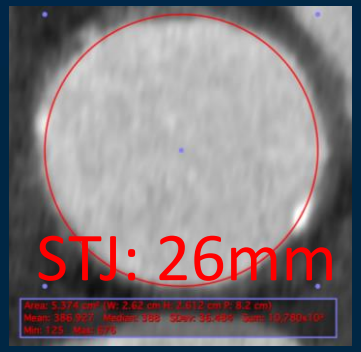
Examples of TAVI-in-TAVI – don't bank on it

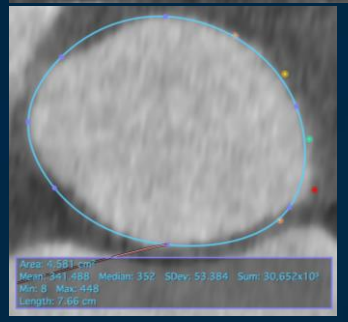
- Feasible if anatomy not challenging – feasible, but long term outcomes?
  - May need ancillary technique – i.e. Balloon Assisted-BASILICA

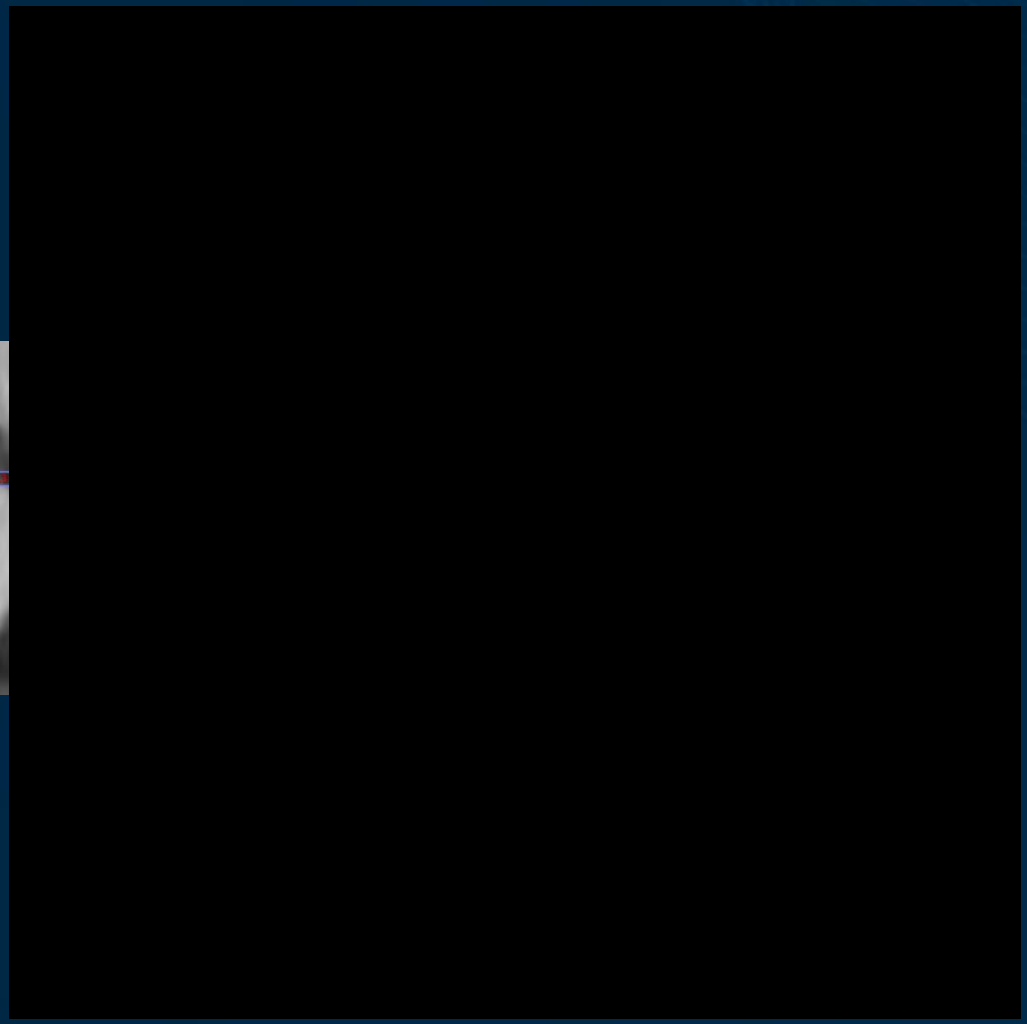


Modifying TAVI implant for the future

- 76 y.o. male recent fall otherwise suitable for SAVR
- Clean annulus, TF case
- 23mmS3 implant lower to avoid the STJ
- Overfill THV by 2cc to modify height of THV
- Anticipate future TAVI-in-TAVI
- 23mm S3ULTRA overfilled





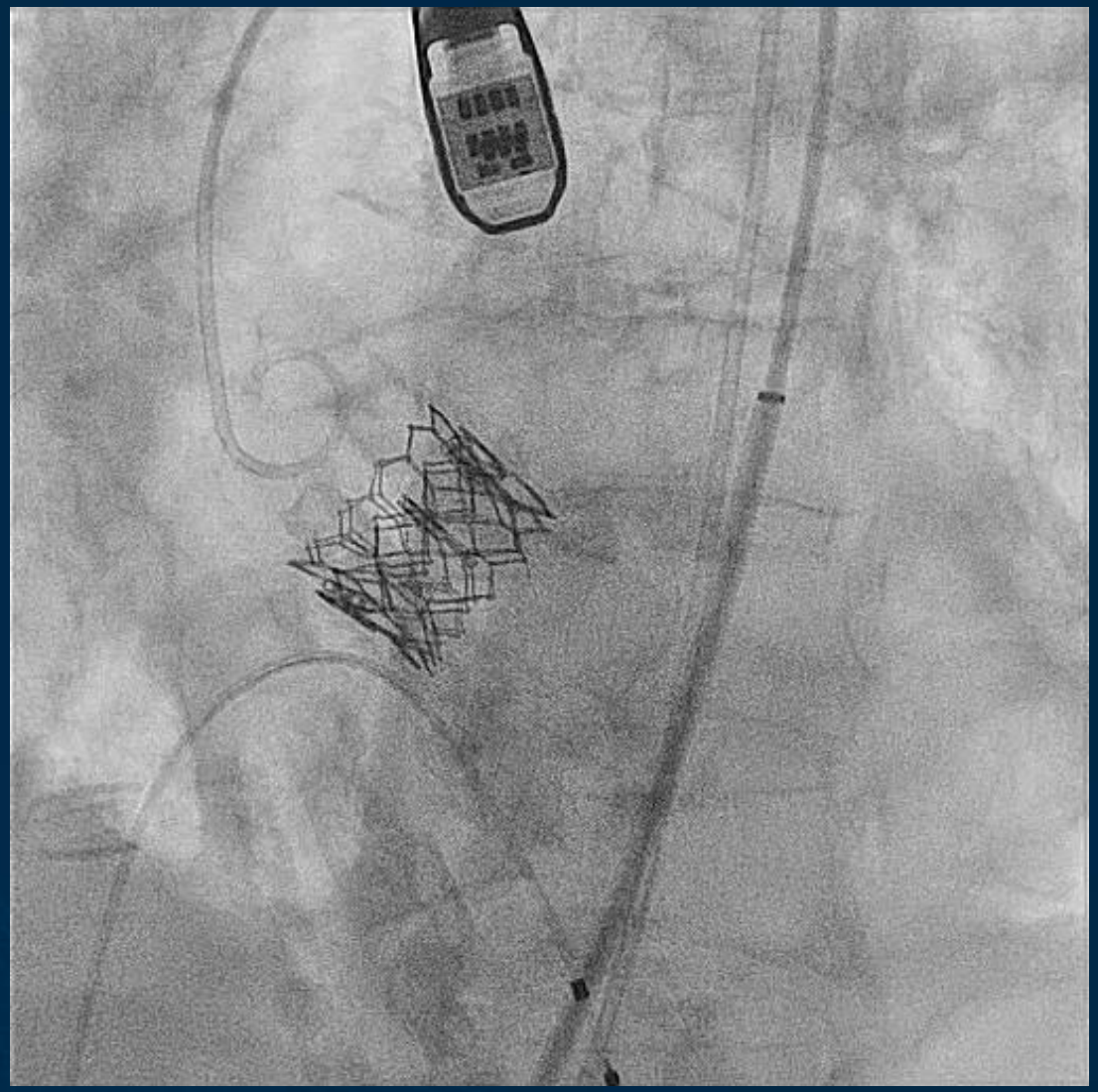


Annulus 450mm2

Controversies in TAVI-in-TAVI

- Optimal 1st THV?
- Re-do THV device?
- Predilate? Predilate with TRUE balloon?
- SEV in BEV; SEV in SEV; BEV in BEV; SEV in BEV???
- Trapped tissue between THV? Nidus for thrombosis?
- Placement of re-do THV?

Here's my wish for the next THV…



- Shortest THV possible
- Good coronary access
- Durable result
- Low gradient
- Commissural alignment

BRING ON X4!!!

TAV-in-TAV: a new disease

- There are some case series on TAV-in-TAV focusing on **feasibility** and **survival** in TAV-in-TAV.
- No literature of failed TAVI not suitable for TAV-in-TAV – EXPLANT vs. TAV-in-TAVI. Poor results from some EXPLANT studies.
- Even if TAV-in-TAV may be feasible, **significant knowledge gap**:
  - Technical considerations
  - Durability?
  - Hemodynamics?
- With this knowledge gap, more important than ever to plan the first TAVI (or consider surgery) in **younger patients** for the future.

TAV-in-TAV: key concepts

1. **Index procedure –obtain original CT data & implant images if possible**
   - Understand sizing strategy and original anatomy
   - Understand the implication of THV placement and suprannular vs. intrannular

2. **Pre procedural planning – CT TAVI**
   - Comprehensive understanding of THV placement, leaflet, STJ, coronary etc

3. **Procedural plan**
   - Anticipate the need to predilate – perhaps more for BEV?
   - Sentinel? BASILICA? Short-cut?

4. **Post procedural plan**
   - ? Anticoagulate?

Current status and future perspectives on TSMVIV

Dr Karl Poon
Interventional cardiologist
St Andrew's War Memorial Hospital
Senior Lecturer, University of Queensland

Edwards Lifesciences
Teaching Center of Excellence

The University Of Queensland
AUSTRALIA

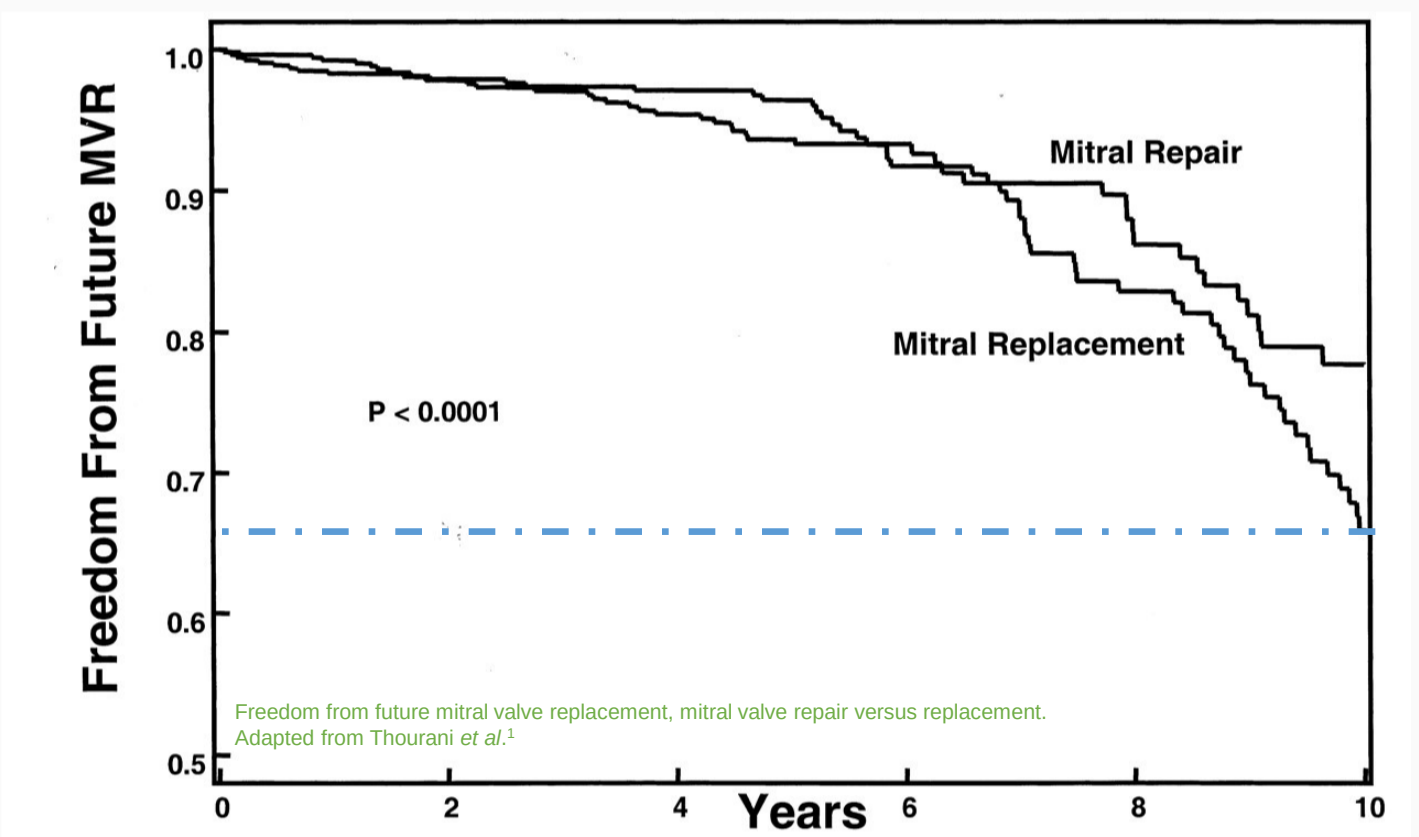
St Andrew's War Memorial Hospital

Disclosure

- In the past 12 months, I and/or my spouse, have received the following:

• Relevant conflict to this presentation	Company
• Consulting fee/Proctoring fee	Edwards LifeSciences, Abbott Vascular
• Unrestricted institutional grant (QHI)	Edwards LifeSciences, Abbott Vascular
• Research role	Edwards Lifesciences, Boston Scientific

Mitral valve disease – need for reinterventions/re-do MVR



Freedom from future mitral valve replacement, mitral valve repair versus replacement.
Adapted from Thourani *et al*.[1]

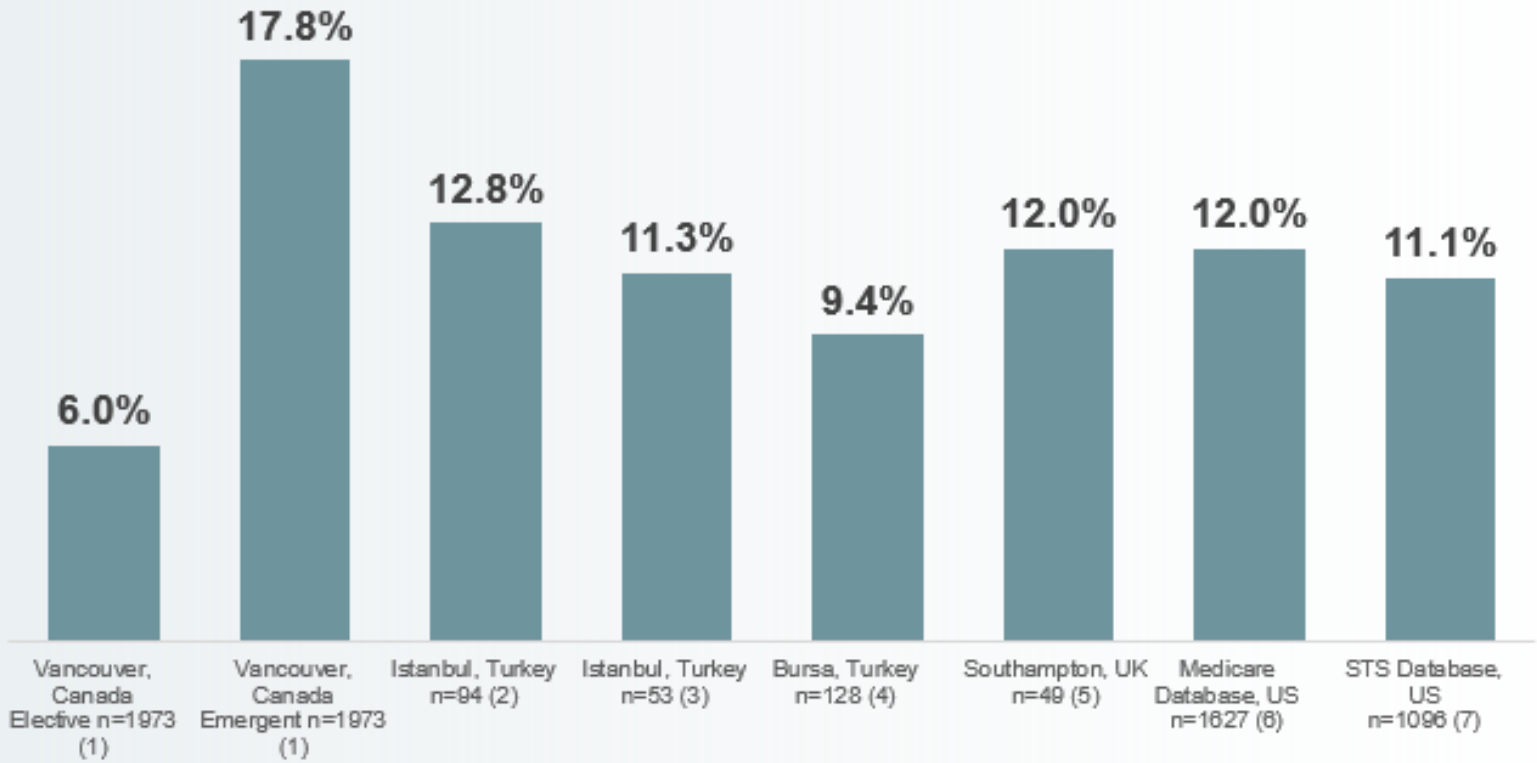
Repair FF MVR	1	0.98	0.98	0.97	0.95	0.94	0.93	0.91	0.86	0.8	0.78
At Risk	537	491	387	363	336	298	140	124	96	73	56
Replace FF MVR	1	0.99	0.98	0.97	0.97	0.96	0.92	0.87	0.83	0.76	0.66
At Risk	537	505	402	357	318	281	179	141	113	88	65

30-35% of the patients may need repeat MVR within 10 years

1. Thourani, VH. *et al*.. Outcomes and Long-Term Survival for Patients Undergoing Mitral Valve Repair Versus Replacement. *Circulation* 2003; 108: 298–304

Re-do MVR is high risk – alternatives needed

The operative **mortality for repeat mitral surgery** is between **6,0 and 17,8%**



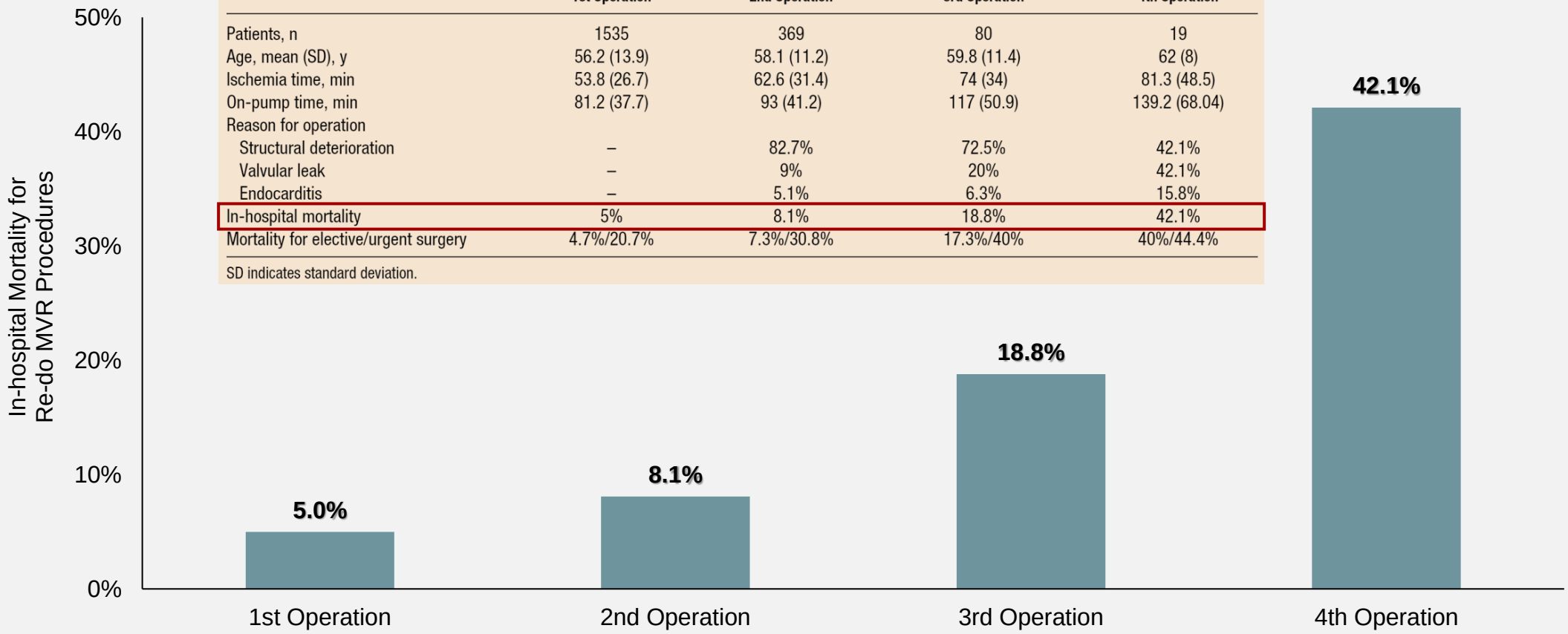
1. Jamieson et al., Circulation 2003:108[suppl II]:II-98-II-102, 2Albeyoglu, et al., Thorac Cardiovasc Surg 2006:54(4):244-249, 3Toker et al., Tex Heart Inst J 2009:26(6):557-562, 4Ozyaziciogiu et al., Turkish J Thorac Cardiovasc Surg 2012:12(3):497-502, 5Vohra et al., Interact Cardiovasc Thorac Surg 2012 May:14(5):575-579, 6Kwedar et al., Ann Thorac Surg 2017:104:1516-1521, 7Mehaffey et al., Heart 2018:104:652-656

Redo MVR – *In-hospital* mortality risk increases with every redo

Clinical Characteristics of the Various Repeat Operations

	1st Operation	2nd Operation	3rd Operation	4th Operation
Patients, n	1535	369	80	19
Age, mean (SD), y	56.2 (13.9)	58.1 (11.2)	59.8 (11.4)	62 (8)
Ischemia time, min	53.8 (26.7)	62.6 (31.4)	74 (34)	81.3 (48.5)
On-pump time, min	81.2 (37.7)	93 (41.2)	117 (50.9)	139.2 (68.04)
Reason for operation				
Structural deterioration	–	82.7%	72.5%	42.1%
Valvular leak	–	9%	20%	42.1%
Endocarditis	–	5.1%	6.3%	15.8%
In-hospital mortality	5%	8.1%	18.8%	42.1%
Mortality for elective/urgent surgery	4.7%/20.7%	7.3%/30.8%	17.3%/40%	40%/44.4%

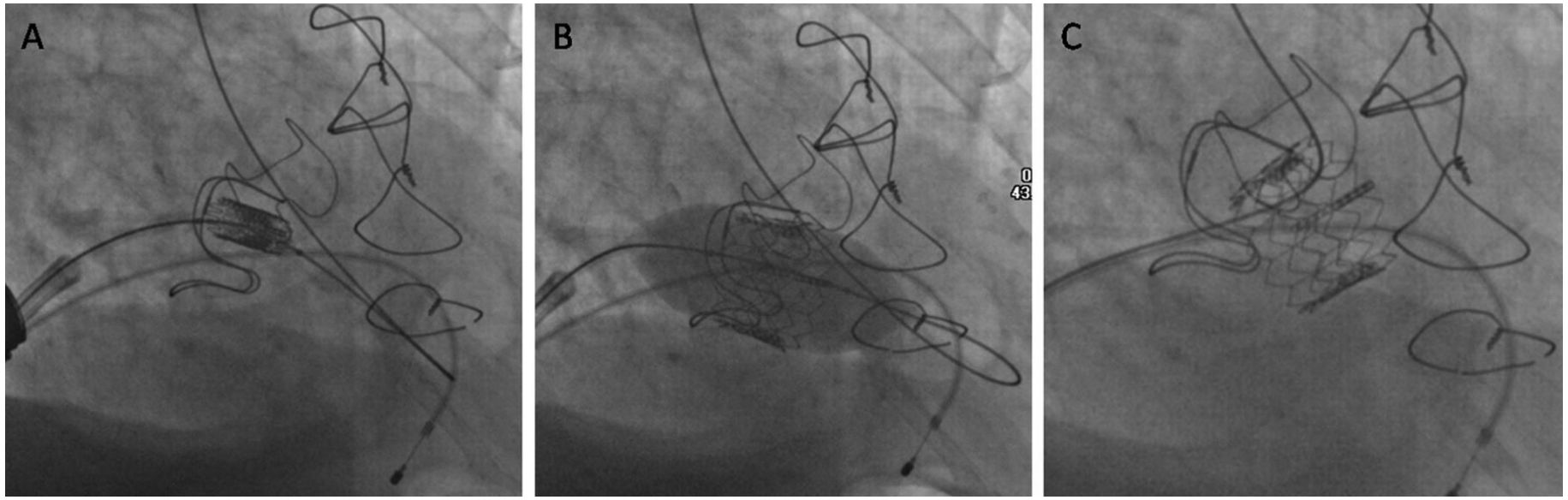
SD indicates standard deviation.



1. Expósito *et al.* Repeat Mitral Valve Replacement: 30-Years' Experience. *Revista Española De Cardiología* (English Edition) 2009; 62(8): 929-932.

Transcatheter solution to re-do MVR

- **Transeptal** Mitral Valve-in-Valve – 1st approach in 2009
  - Prof John Webb
  - Edwards SAPIEN 1st Generation THV
  - Short frame
  - THV embolized

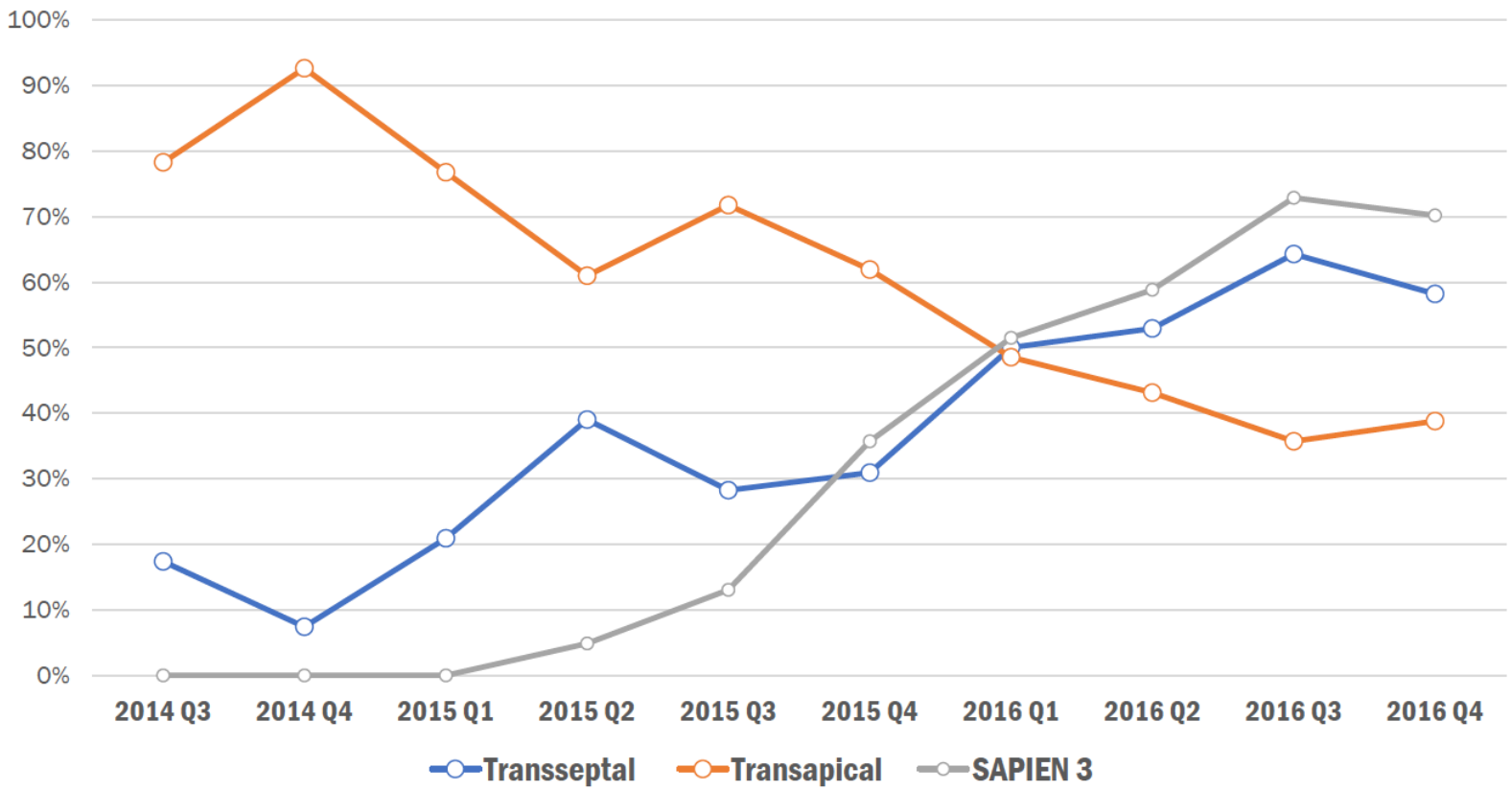


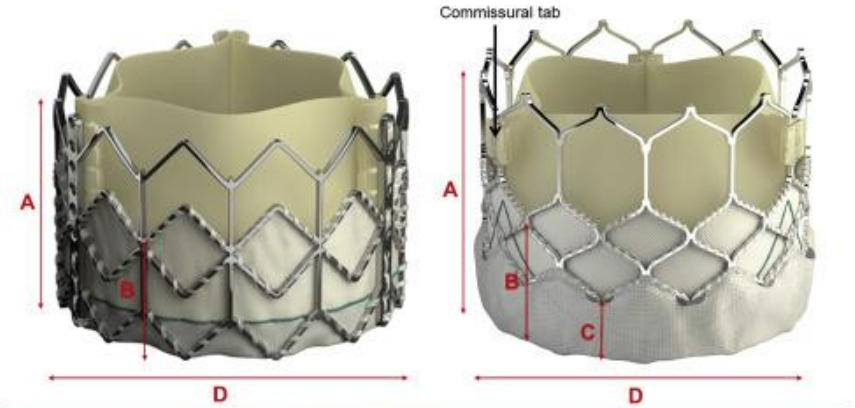
Webb, J, Circulation 2010

- Transapical – initial case series

A relentless march towards *transeptal* MVinV

- With Sapien 3 THV, lower profile, longer THV frame, better steerable deliver y catheter





	23 mm Sapien XT	26 mm Sapien XT	29 mm Sapien XT	20 mm Sapien 3	23 mm Sapien 3	26 mm Sapien 3	29 mm Sapien 3
A. Frame Height	14 mm	17 mm	19 mm	15.5 mm	18 mm	20 mm	22.5 mm

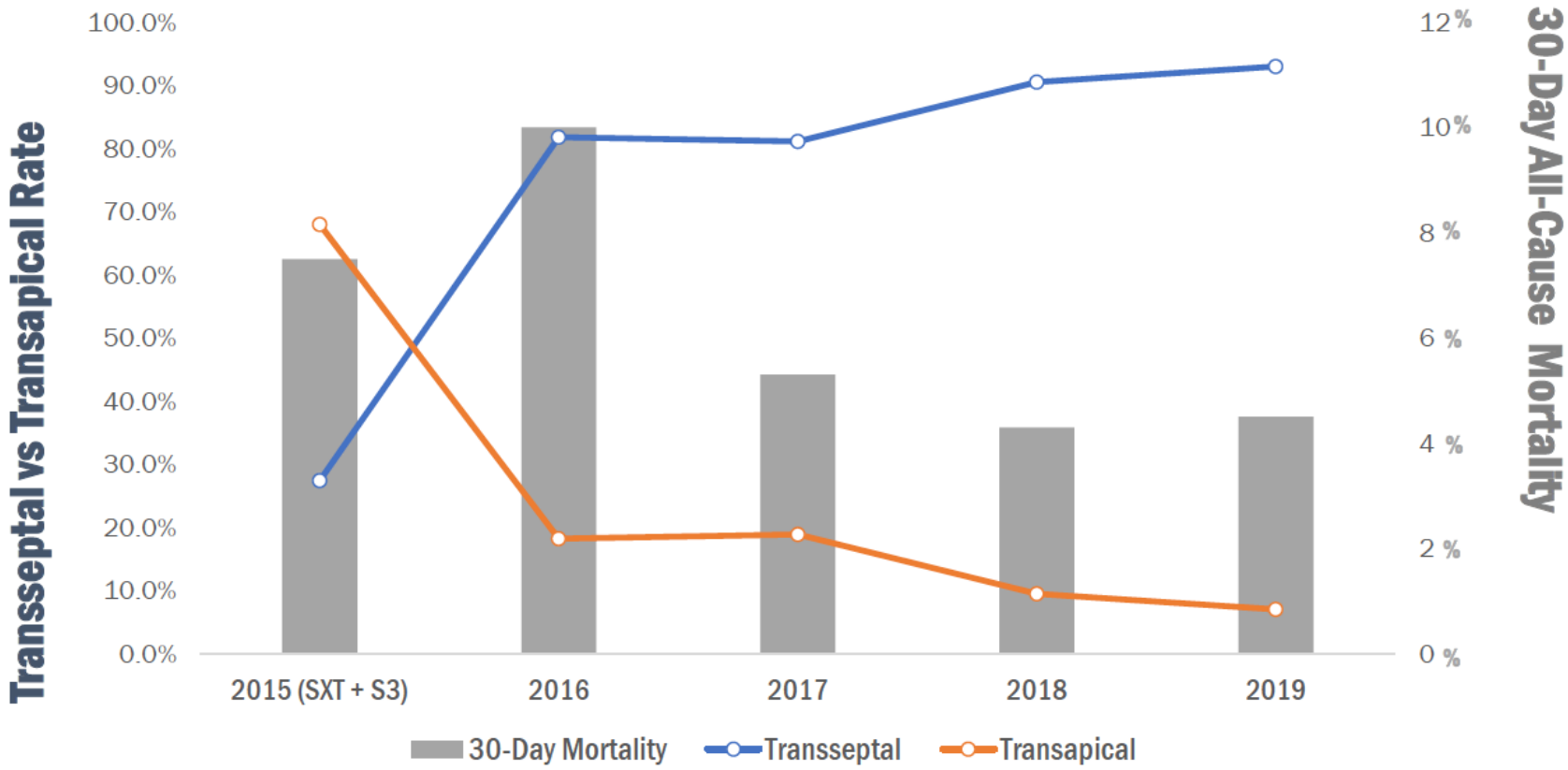
Edwards Lifesciences
Teaching Center of Excellence

The University Of Queensland
AUSTRALIA

St Andrew's
War Memorial Hospital

Transeptal vs transapical MVinV – TVT registry

Increase in Transseptal Access and Decrease in 30-Day Mortality



Guerrero, M. TCT 2019

Edwards Lifesciences
Teaching Center of Excellence

The University Of Queensland
AUSTRALIA

St Andrew's
War Memorial Hospital

Transeptal vs transapical MVinV – TVT registry

30-Day and 1-Year Outcomes

% or mean (±SD)	30-DAY TRANSSEPTAL n=1,326	30-DAY TRANSAPICAL n=203	*p* value	1-YEAR* TRANSSEPTAL n=865	1-YEAR* TRANSAPICAL n=171	*p* value
All-Cause Mortality	5%	8.1%	0.07	15.8%	21.7%	0.03
Cardiovascular death	2.1%	5.1%	0.01	3.7%	5.7%	0.07
Stroke	1.1%	1%	0.91	3.3%	3.5%	0.95
Mitral Valve Reintervention	0.4%	0.5%	0.82	0.8%	0.5%	0.78
New dialysis requirement	1.5%	3.1%	0.1	1.6%	3.1%	0.13
New Pacemaker	1.4%	2%	0.44	2%	2.8%	0.44
Device thrombosis	0.2%	0.5%	0.49	0.3%	1.2%	0.17
LV Ejection fraction	54.2 (± 11.73)	52.7 (± 12.55)	0.17	53.3 (± 11.52)	52.8 (± 13.11)	0.77
Mean MVG (mmHg)	7.4 (± 2.75)	7.2 (± 2.69)	0.5	7.0 (± 2.94)	7.0 (± 2.61)	0.99

Guerrero, M. TCT 2019

Limited data of TSMVIV vs. Redo MVR

What about the patient's profiles? Converging evidence

Baseline characteristics from Simonetto *et al*[1]

	SMVR (n= 29)	Valve-in-Valve (n = 27)	P Value
Mean Surgical risk score (STS)	3.6 ± 2.6%	8.5 ± 7.2%	p < 0.001
Mean Age	67.7 ± 9.3 years	77.8 ± 12 years	p < 0.001
Comorbidities	eGFR (mL/min/1.73 m²) 67.9 ± 21.9	eGFR (mL/min/1.73 m²) 49.2 ± 21.6	p = 0.003
	CABG 7.1%	CABG 37.0%	p = 0.017
	NYHA class I 3.6% NYHA class II 39.3%	NYHA class I 0.0% NYHA class II 11.1%	p = 0.017

Baseline characteristics from Murzi *et al*[3]

	SMVR (n= 40)	Valve-in-Valve (n = 21)	P Value
Mean Surgical risk Euroscore	23 ± 10%	39 ± 19	p = 0.005
Mean Age	67 ± 6 years	77 ± 9 years	p = 0.001
Comorbidities	Chronic kidney failure 12.2%	Chronic kidney failure 19%	p = 0.03
	Severe pulmonary hypertension 34.1%	Severe pulmonary hypertension 90.4%	p = 0.001
	Atrial Fibrillation 9.8%	Atrial Fibrillation 42.8%	p = 0.006

Baseline characteristics from Kamioka *et al*[2]

	SMVR (n = 59)	Valve-in-Valve (n = 62)	P Value
Mean Surgical risk score (STS)	8.7 ± 10.1%	12.7 ± 8.0%	p < 0.001
Mean Age	63.7 ± 14.9 years	74.9 ± 9.4 years	p < 0.001
Comorbidities	Lung disease 13.6%	Lung disease 33.9%	p = 0.01
	CAD 30.5% CABG 25.4%	CAD 53.2% CABG 46.8%	p = 0.01 p = 0.02
	Atrial Fibrillation 27.1%	Atrial Fibrillation 75.8%	p < 0.001

1. Simonetto *et al.* Surgical redo versus transseptal or transapical transcatheter mitral valve-in-valve implantation for failed mitral valve bioprosthesis. *Cath. and Cardiovasc. Interv.*, 2020
2. Kamioka *et al.* Comparison of Clinical and Echocardiographic Outcomes After Surgical Redo Mitral Valve Replacement and Transcatheter Mitral Valve-in-Valve Therapy. *JACC. Cardiovasc. Interv*. 2018; 11(12): 1131–1138
3. Murzi *et al.* Transapical transcatheter mitral valve-in-valve implantation versus minimally invasive surgery for failed mitral bioprosthesis. *Interactive CardioVascular and Thoracic Surgery*. 2017; 25(1): 57–61

Limited data of TSMVIV vs. Redo MVR

What about the patient's profiles? Converging evidence

Patients mortality at 1-year follow-up			
	SMVR	Valve-in-Valve	P Value
Simonetto *et al*[1]	17.2%	14.8%	p = 1.00
Kamioka *et al*[2]	11.9%	11.3%	p = 0.92
Murzi *et al*[3]	13 ± 1% at 2-year	14 ± 1% at 2-year	log-rank p = 0.148

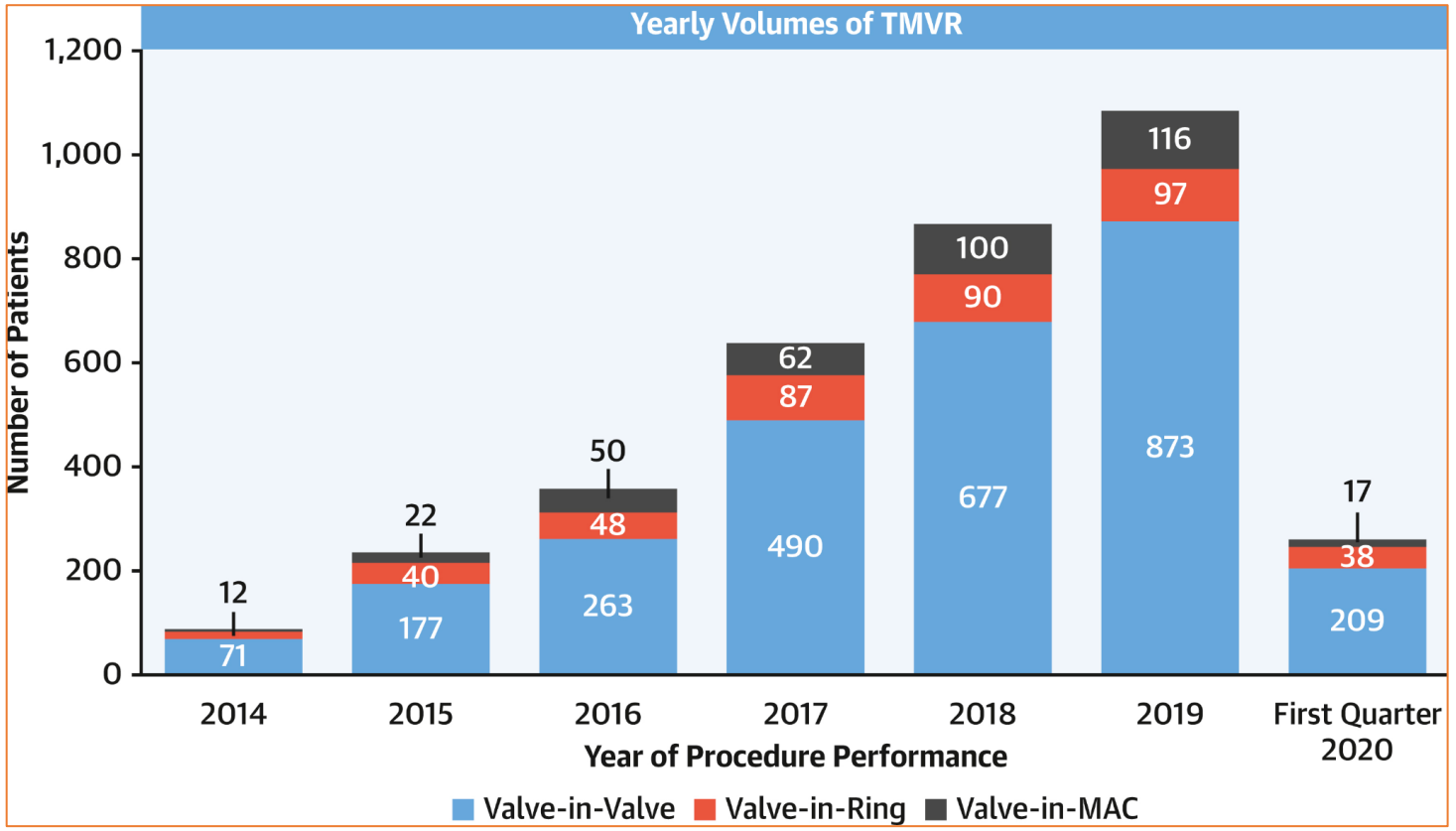
- In these 3 studies[1-3]: procedure time, ICU time, and LoS were significantly reduced in patients undergoing mitral ViV
- Although ViV patients were systematically older, at higher risk, and having more comorbidities, 1-year or 2-year mortality was similar to surgical patients.

> "High EuroSCORE II and STS scores, advanced age at surgery, LVEF <30%, previous CABG, severe pulmonary hypertension or preoperative dialysis might represent in the future preferred indications for [transcatheter Mitral valve-in-valve] in the redo-mitral surgery scenario."
>
> **Onorati *et al*[4]**

1. Simonetto *et al.* Surgical redo versus transseptal or transapical transcatheter mitral valve-in-valve implantation for failed mitral valve bioprosthesis. *Cath. and Cardiovasc. Interv.*, 2020
2. Kamioka *et al.* Comparison of Clinical and Echocardiographic Outcomes After Surgical Redo Mitral Valve Replacement and Transcatheter Mitral Valve-in-Valve Therapy. *JACC. Cardiovasc. Interv.* 2018; 11(12): 1131–1138
3. Murzi *et al.* Transapical transcatheter mitral valve-in-valve implantation versus minimally invasive surgery for failed mitral bioprosthesis. *Interactive CardioVascular and Thoracic Surgery*, 2017; 25(1): 57–61
4. Onorati *et al.* Hospital Outcome and Risk Indices of Mortality after redo-mitral valve surgery in Potential Candidates for Transcatheter Procedures: Results From a European Registry. *J. Cardioth. Vasc. Anesth.* 2018; 32: 646-653

Transcatheter Mitral Valve therapy (VIV, VIR, VinMAC)

TMVR US volumes 2014-2019



Median age: 75 years, consistent over time; 60% female patients. Annual volumes of TAVI have increased over the same time period, from 16,312 to 72,991, while the prevalence of MR is greater than that of aortic stenosis, especially for those aged >60 years. Adapted from Mack, M. *et al.*[1]

Caution: Mitral Valve-in-Valve is approved in high surgical risk patients. Valve-in-Ring and valve-in-MAC are off-label procedures in Europe.

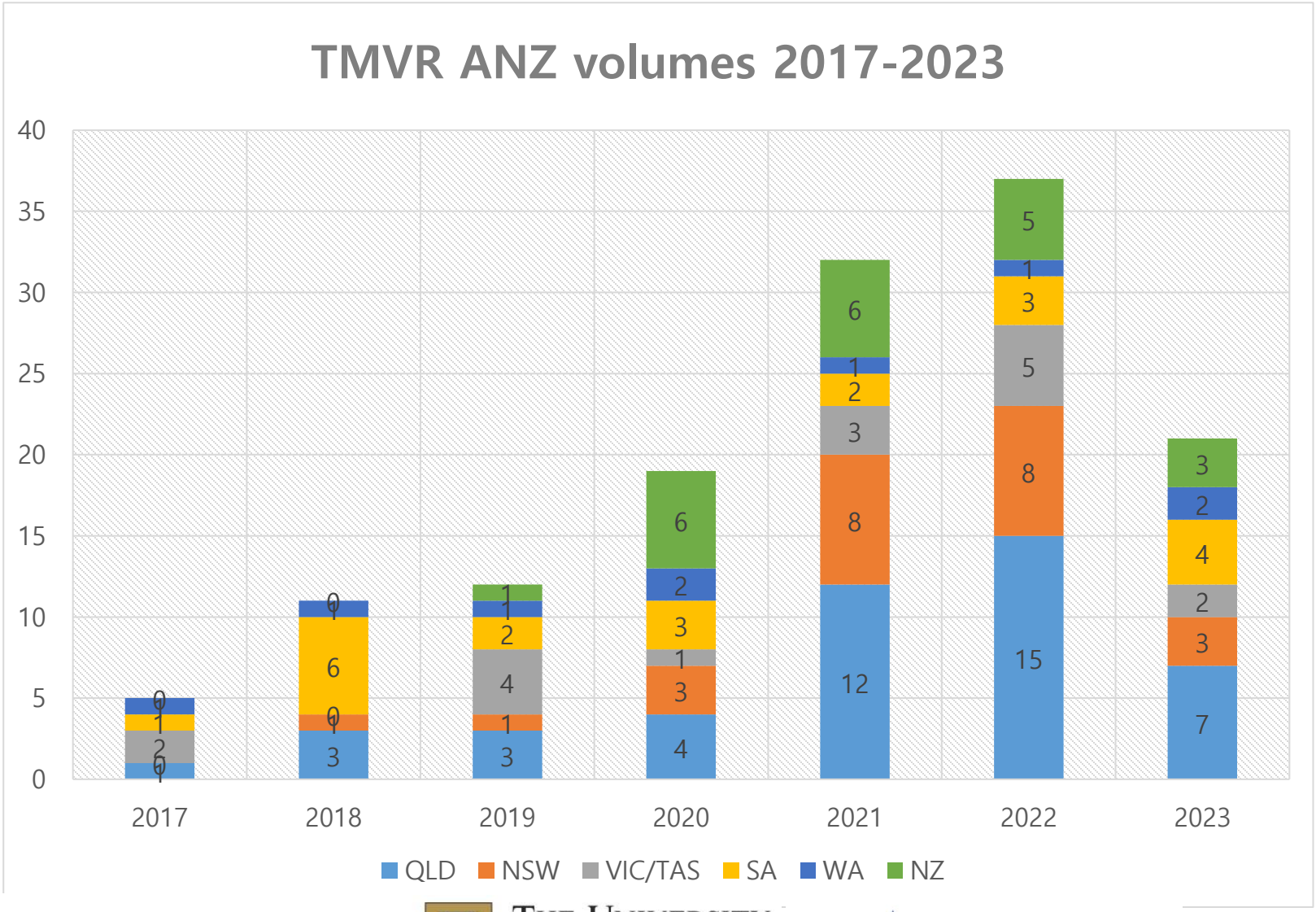
- MViV case volumes are increasing worldwide[1,2]
- Failure modes of surgical bioprostheses: regurgitation, stenosis or mixed disease

MViV specific considerations[3]

- Accurate evaluation of the dimensions of the mitral annulus/bioprosthesis crucial for THV sizing and confirming the eligibility for TMVR
- Access type (TA/TSS)
- Periprocedural complications incl. LVOT obstruction

1. Mack, M. *et al.* Transcatheter Mitral Valve Therapy in the United States: A Report From the STS-ACC TVT Registry. *JACC* 2021; 78(23): 2326–2353
2. Petronio, AS., *et al.* Current status of transcatheter mitral valve therapy in Europe: results from an EAPCI survey (Part II). *Eurointervention* 2017; 12: 1934-1939
3. Urena, M., *et al.* Current Indications for Transcatheter Mitral Valve Replacement Using Transcatheter Aortic Valves. *Circulation*. 2021; 143: 178–196

Transcatheter Mitral Valve therapy in Australia/New Zealand



- **Slower increase in ANZ region**
  - Approved for MVinV
  - No specific risk categorization unlike in the USA
  - No private reimbursement
- **Overall very small numbers except QLD ☺**

Edwards Lifesciences
Teaching Center of Excellence

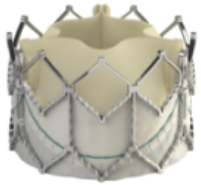
The University Of Queensland
AUSTRALIA

St Andrew's War Memorial Hospital

MITRAL

Mayra Guerrero et al

What did we study? MITRAL Trial



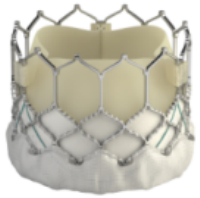
SAPIEN XT

Mitral **I**mplantation of **TRA**nscatheter va**L**ves

91 patients extremely high surgical risk (STS PROM >15% or M&M >50%)

Inclusion Criteria

NYHA II or greater



SAPIEN 3

Valve-in-Valve n=30	Valve-in-Ring n=30	Native MV (MAC) n=31*
Severe MS (MVA ≤1.5 cm2)	Severe MS (MVA ≤1.5 cm2)	Severe MS (MVA ≤1.5 cm2)
At least Moderate-Severe MR	At least Moderate-Severe MR	Severe MR + Moderate MS
100% Transseptal	**100% Transseptal**	**48.4% Transseptal** **48.4% Transatrial** **3.2% Transapical**

First 2 patients in MAC arm were treated with SAPIEN XT, al subsequent patients were treated with SAPIEN 3 valves

* 1 withdrew consent 3 weeks post TMVR

What are the essential results?

Baseline Characteristics

Characteristics	ViV n=30 n(%), or mean (±SD)	ViR n=30 n(%), or mean (±SD)	ViMAC n=31* n(%), or mean (±SD)
Age	76.4 (±9.6)	71.7 (±8.9)	74.9 (±7.7)
Female	19 (63.3%)	11 (36.7%)	22 (71%)
NYHA			
II	6 (20%)	7 (23.33%)	4 (12.9%)
III	20 (66.7%)	20 (66.67%)	22 (71%)
IV	4 (13.3%)	3 (10%)	5 (16.1%)
Diabetes	6 (20%)	9 (30%)	12 (38.7%)
Atrial Fibrillation	18 (60%)	21 (70%)	13 (41.9%)
Renal Failure	6 (20%)	10 (33.33%)	9 (29%)
Prior CABG	11 (36.67%)	19 (63.3%)	12 (38.7%)
Prior AVR	6 (20%)	4 (13.33%)	16 (51.6%)
STS score	10.2 (±6.5)	8.7 (±4.7)	8.6 (±8.2)

Transcatheter mitral valve replacement – MITRAL Trial

1- and 4-year outcomes

Patient Flow[1]

38 patients presented in case review call*

8 patients excluded:
3= Right Ventricular Dysfunction
2= Became unstable requiring pressors
1= No central MR, mostly PVL.
1= LV EF barely 20%, considered cohort "C"
1= Risk of LVOTO

↓

30 patients enrolled

↓

1 Non-Cardiovascular Death on day 29

↓

30-Day follow-up in 29 (100%)

↓

No deaths after 30 days

↓

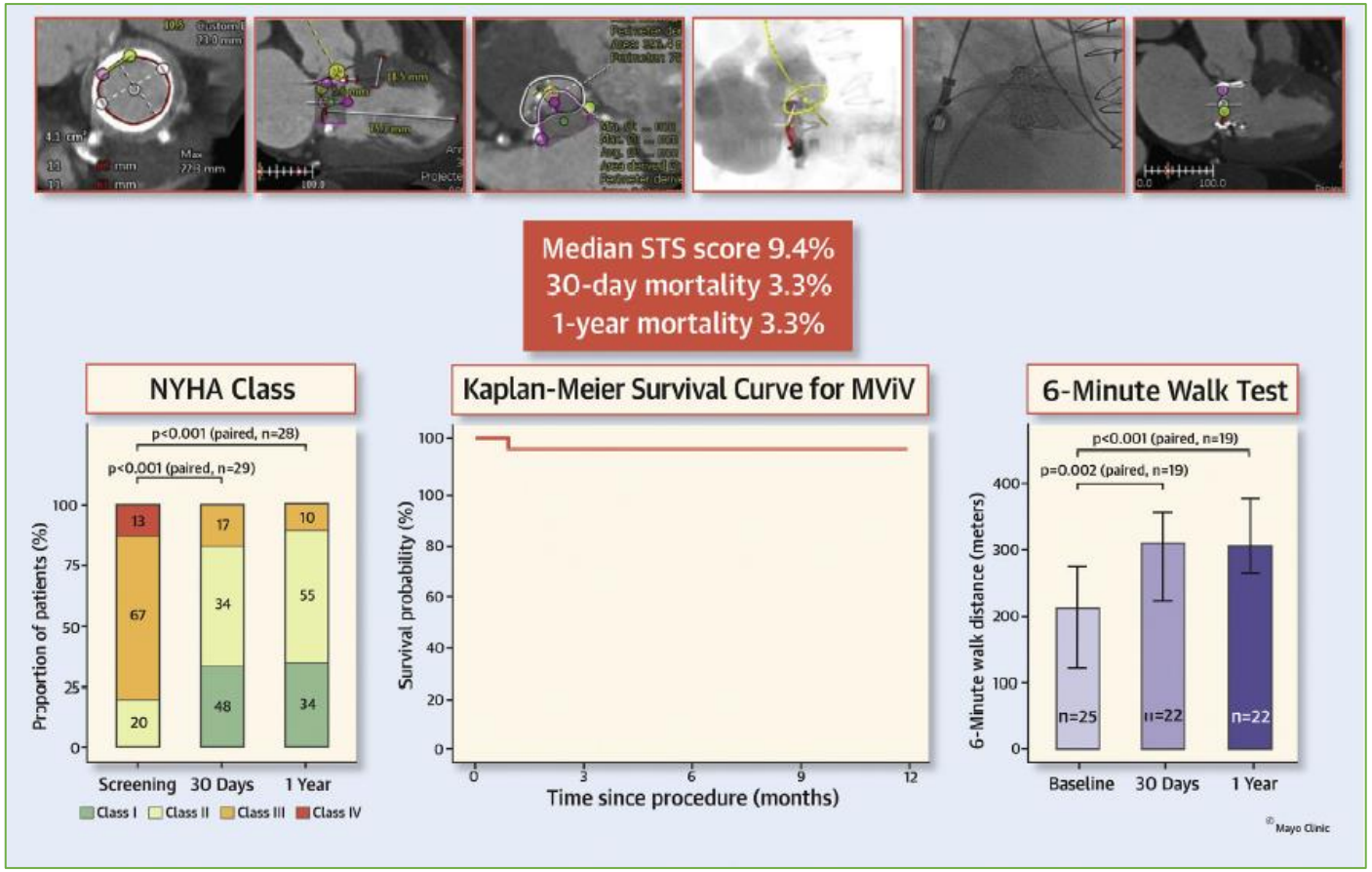
1 year follow-up in 29/29 (100%)

Valve Type	n
Edwards perimount Family (perimount Magna Ease, Baxter)	16
Medtronic Mosaic	6
St. Jude Biocor/Epic	5
Edwards CE Standard	3

Failure mode	n(%)
Regurgitation	18 (60%)
Stenosis	8 (26.7%)
Both	4 (13.3%)

*All patients presented at case review call. All CT scans reviewed by Cire Lab before presentation. CT: computed tomographic; EF: ejection fraction; LV: left ventricular; LVOTO: left ventricular outflow tract obstruction; MR: mitral regurgitation; PVL: paravalvular leak. Adapted from Guerrero, M.[1]

30-day and 1-year outcomes[1]



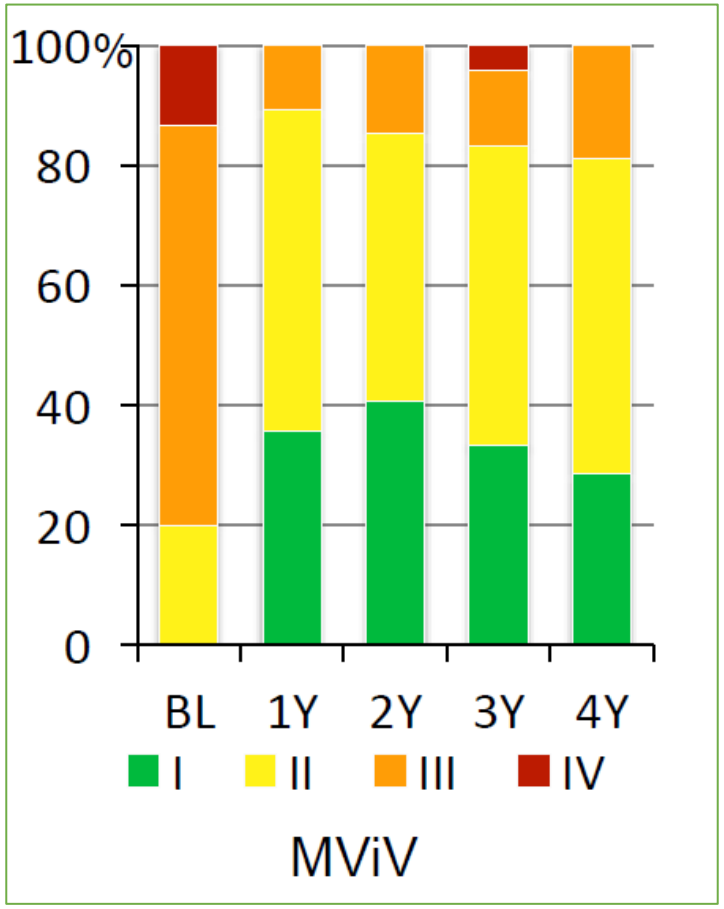
Early and late outcomes for functional capacity (NYHA functional class; left) and 6-min walk distance (right; median and interquartile range). Both measures were significantly improved compared with baseline and remained stable. The early mortality (KM survival; center) was better than expected on the basis of the STS score. Adapted from Guerrero, M.[1]

1. Guerrero, M., *et al.* Prospective Evaluation of Transseptal TMVR for Failed Surgical Bioprostheses. MITRAL Trial Valve-in-Valve Arm 1-Year Outcomes. *JACC Cardiovasc. Interv.* 2021; 14(8): 859-872

Transcatheter mitral valve replacement – MITRAL Trial

1- and 4-year outcomes

NYHA Classes[1]



CEC Adjudicated

4-Year Clinical Events

	MViV n=29 (%)	MViR n=27 (%)	MAC n=27 (%)
All-cause Death	**3 (10.3%)**	**17 (63%)**	**18 (66.7%)**
Cardiovascular	1 (3.4%)	9 (33.3%)	8 (29.6%)
Non-Cardiovascular	2 (6.9%)	8 (29.6%)	10/27 (37%)
Stroke	4 (13.8%)	1 (3.7%)	4 (14.8%)
Ischemic	2 (6.9%)	0	4 (14.8%)
Mitral Valve Reintervention *One PVL closure attempt followed by surgical MVR. One Transseptal MViV and PVL closure. ** One transseptal MVIV and 1 Transatrial TMVR.	1 (3.4%)	3 (11.1%)*	5 (18.5%)**
Septostomy closed (in transseptal cases)	0	7 (25.9%)	5/14 (35.7%)
Hemolytic Anemia (* 1 prior to discharge treated with PVL closure attempt followed by surgical MVR. One after 30 days treated conservatively. **3 at 30 days, one required MViV and 2 spontaneously resolved. Two more at 1-year, one required PVL closure, one treated conservatively)	0	2 (7.4%)*	5 (18.5%)** Only 2 required MV intervention
Device migration or embolization after index procedure	0	1 (3.7%)	0
Acute Kidney Injury requiring new onset hemodialysis	1 (3.4%)	5 (18.5%)	5 (18.5%)
Hospitalization for heart failure	7 (24.1%)	9 (33.3%)	11 (40.7%)

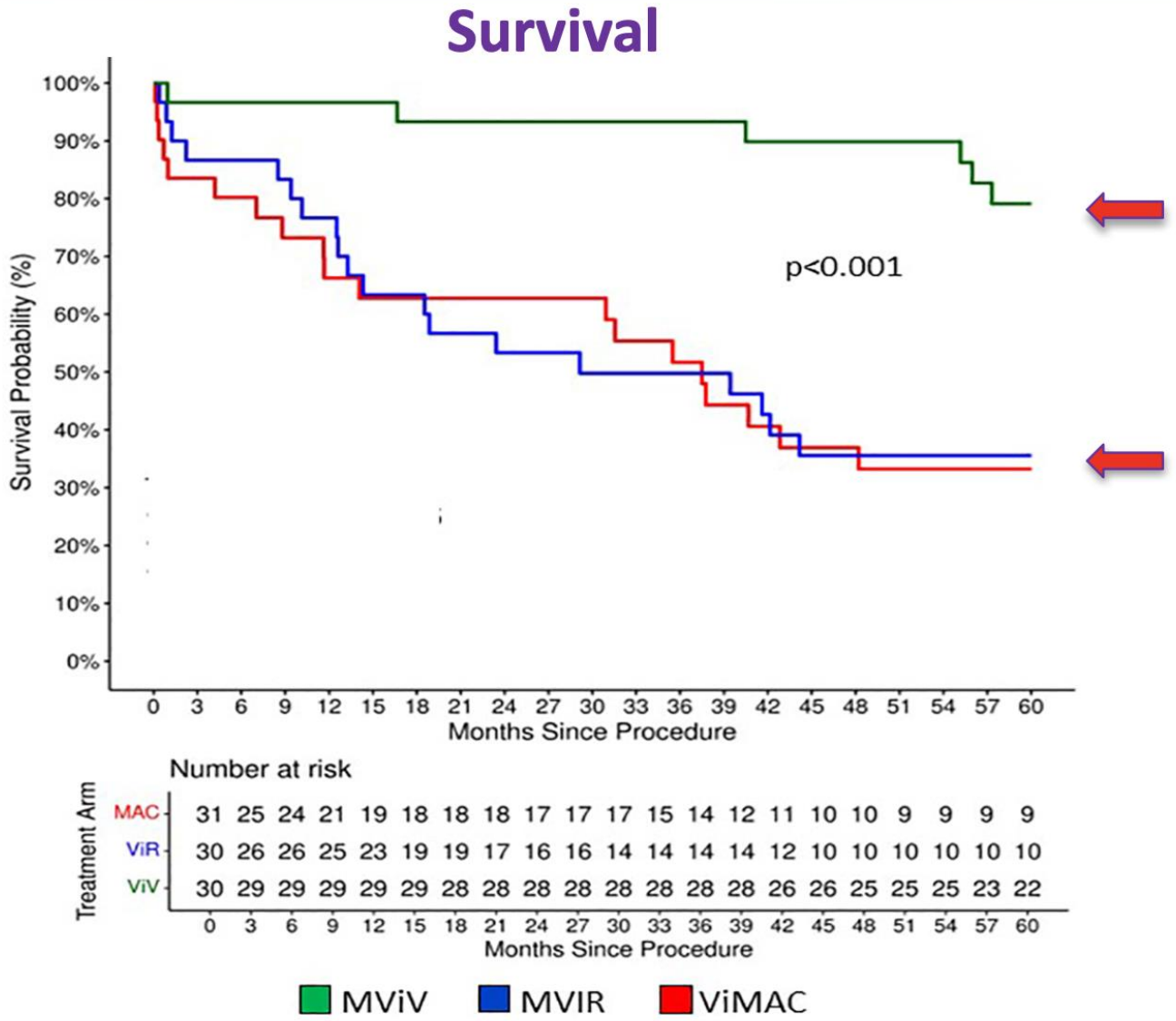
1. Guerrero, M., *et al.* 4-year outcomes in a Prospective Evaluation of Transcatheter Mitral Valve-in-Valve, Valve-in-Ring and Valve-in-MAC: MITRAL Trial Results. *Presented at the ESC Congress 2022*. Barcelona 2022.

5-Year Clinical Outcomes

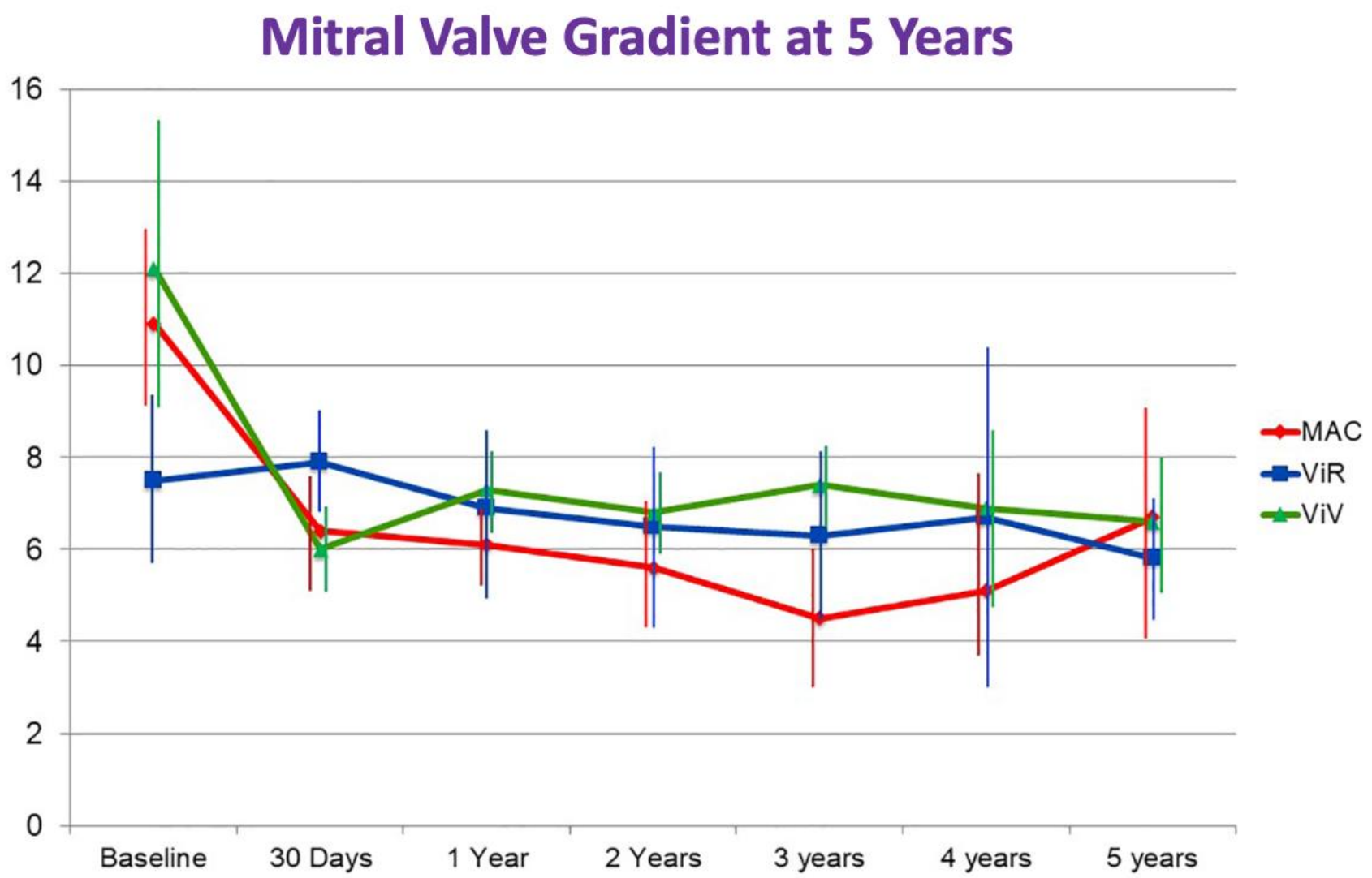
	MViV n=28 (%)[a]	MViR n=29 (%)[b]	MAC n=28 (%)[c]
All-cause Death	**6 (21.4%)**	**19 (65.5%)**	**19 (67.9%)**
Cardiovascular	3 (10.7%)	10 (34.5%)	8 (28.6%)
Non-Cardiovascular	3(10.7%)	9 (31.0%)	11 (39.3%)
Stroke	4 (14.3%)	2 (6.9%)	5 (17.9%)
Ischemic	2 (7.14%)	1 (3.4%)	5 (17.9%)
Mitral Valve Reintervention *1 PVL closure attempt followed by surgical MVR. 1 TS MViV and PVL closure, 1 PVL closure. ** 1 TS MVIV, 1 Transatrial TMVR, 2 PVL closures.	1 (3.6%)	3 (10.3%)*	5 (17.9%)**
Septostomy closed (in transseptal cases)	3 (10.7%)	7 (24.1%)	5/13 (38.5%)
Hemolytic Anemia (* 1 prior to discharge treated with PVL closure attempt followed by surgical MVR. 1 after 30 days treated conservatively. **3 at 30 days, 1 required MViV and 2 spontaneously resolved. 2 more at 1-year, 1 required PVL closure, 1 treated conservatively).	0	2 (6.9%)*	5 (17.9%)** Only 2 required MV intervention
Device migration or embolization after index procedure	0	1 (3.4%)	0
Acute Kidney Injury requiring new onset hemodialysis	1 (3.6%)	5 (17.2%)	5 (17.9%)
Hospitalization for heart failure	8 (28.6%)	11 (34.5%)	12 (42.9%)
Transcatheter valve thrombosis	1 (3.6%)	0	2 (7.1%)
Valve endocarditis	0	0	2 (7.1%)

[a] 1 lost follow-up after 1194 days and 1 withdrew consent after 1,381 days.
[b] 1 withdrew consent at 860 days.
[c] 3 withdrew consent at 8, 187 and 651 days.

What are the essential results?



What are the essential results?



TSMVIV – what about intermediate risk patients?

- Whilst TSMVIV approved in the USA since 2017 for high risk surgical candidates, little data for intermediate risk candidates
- 50 patients multicentre prospective study, core lab adjudicated, intermediate risk patients TSMVIV
- 2018 to 2021
- Embargo results: but 30D and 1Y mortality… ☺
- 10 year follow up

Title: One-year Outcomes of Transseptal Transcatheter Mitral Valve Replacement for Bioprosthetic Valve Failure in Intermediate-Risk Patients

Brief Title: Mitral Valve-in-Valve in Intermediate-risk Patients

Authors and Affiliations:

S. Chris Malaisrie, MD[a] and Mayra Guerrero, MD[b]; Charles Davidson, MD[a]; Mathew Williams, MD[c]; Fabio Sândoli de Brito Jr, MD, PhD[d]; Alexandre Abizaid, MD, PhD[d]; Pinak Shah, MD[e]; Tsuyoshi Kaneko, MD[e]; Karl Poon, MD[f]; Justin Levisay, MD[g]; Xiao Yu, PhD[h]; Philippe Pibarot, DVM, PhD[i]; Rebecca Hahn, MD[j,k]; Philipp Blanke, MD[l]; Martin B. Leon, MD[j,k]; Michael J. Mack, MD[m]; Alan Zajarias, MD[e] on behalf of the PARTNER 3 Mitral Valve-in-Valve Study Investigators

[a]Northwestern University, Chicago, IL, USA
[b]Mayo Clinic, Rochester, MN, USA
[c]NYU Langone Medical Center, New York, NY, USA
[d]Instituto do Coração da Universidade de São Paulo, São Paulo, Brazil
[e]Washington University, Barnes-Jewish Hospital, St. Louis, MO, USA
[f]Prince Charles Hospital, Brisbane, Australia
[g]NorthShore Univ Health System, Evanston, IL, USA

Late-Breaking Clinical Science III: Early Human Experiences – Mitral Valve Replacement Innovation

Room: Innovation & Clinical Science, Room 106, 100 Level, Phoenix Convention Center – West Building

11:00 AM	**Late-Breaking Clinical Science III: Early Human Experiences – Mitral Valve Replacement Innovation**
11:30 AM	Bioprosthetic Surgical Valves in Intermediate-risk Patients: 1-Year Outcomes of the PARTNER 3 Mitral Valve-in-Valve Study

Edwards Lifesciences
Teaching Center of Excellence

The University Of Queensland
AUSTRALIA

St Andrew's War Memorial Hospital

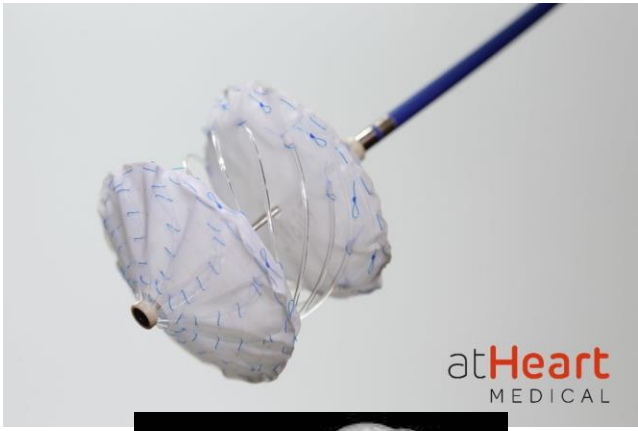
Future perspectives

TSMVIV – interatrial septal devices

- With the advent of multiple transcatheter/transeptal devices coming, ASD/PFO closure may carry significant long term implications not currently an issue

- Traditional devices - Amplatzer septal occluder/Occlutech – are all **nitinol lace** with significant metal making repuncture challenging

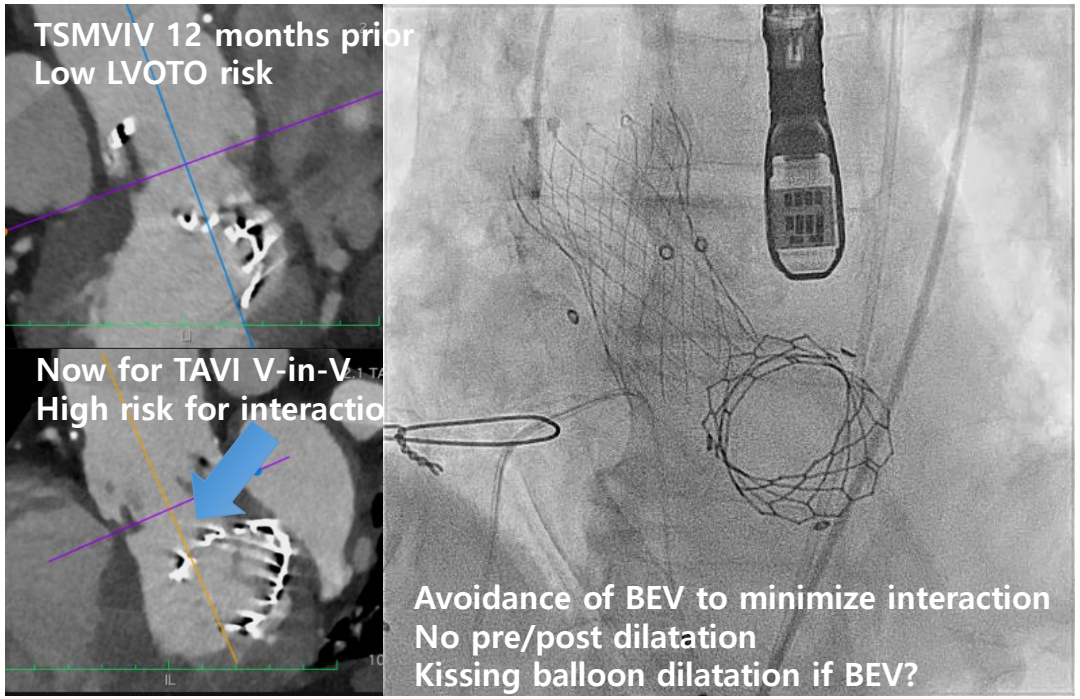
- More **fabric based devices**, e.g. Gore Cardioform or Ascent (both not approved FDA approved) for future transeptal access may be preferred



- Particularly in TMVR (”virgin chest”)

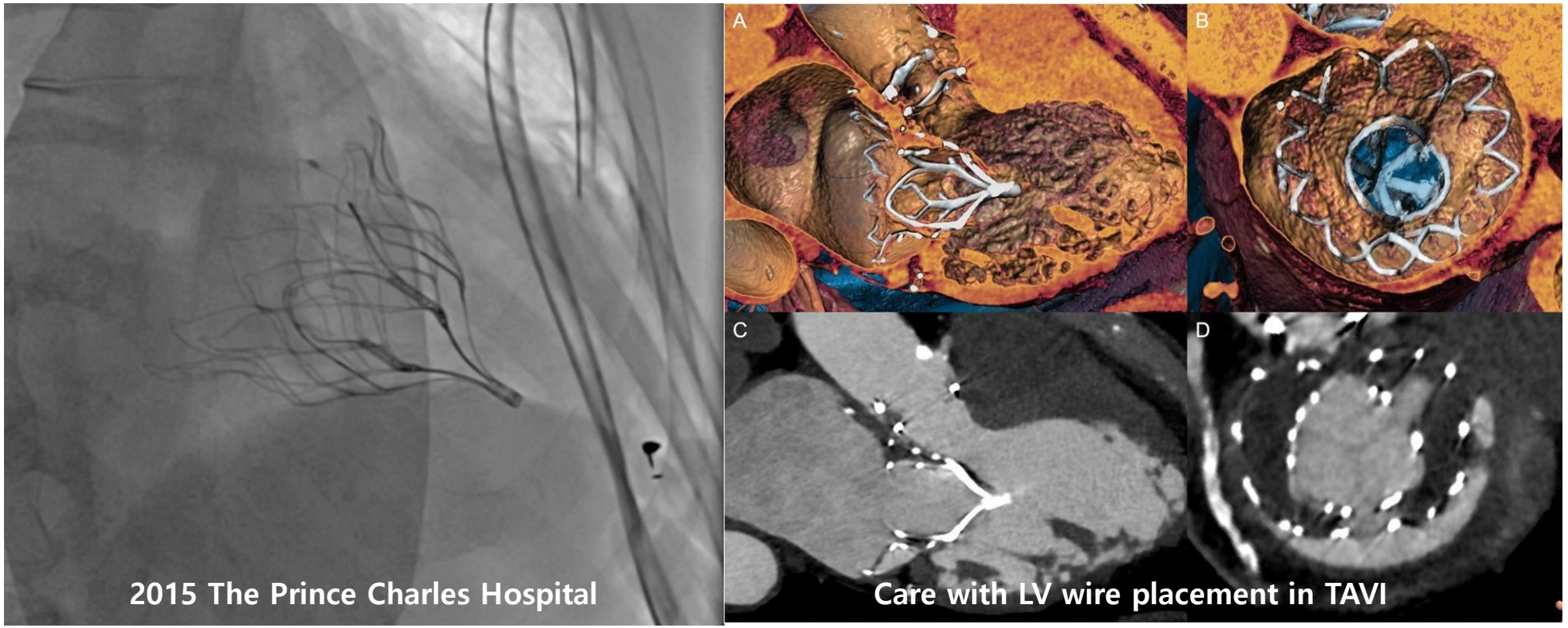
TSMVIV/TMVR vs. Aortic interventions

- Traditionally, if simultaneous TAVI and TSMVIV/TMVR, always perform TAVI first
- If TSMVIV first, may impact on choice of TAVI e.g. self-expanding vs. BEV



TSMVIV/TMVR vs. Aortic interventions

- In the future, perhaps when transcatheter heart valves are the dominant treatment option, staging and strategic forward planning is important due to limited LVOT space…
- TMVR in place…

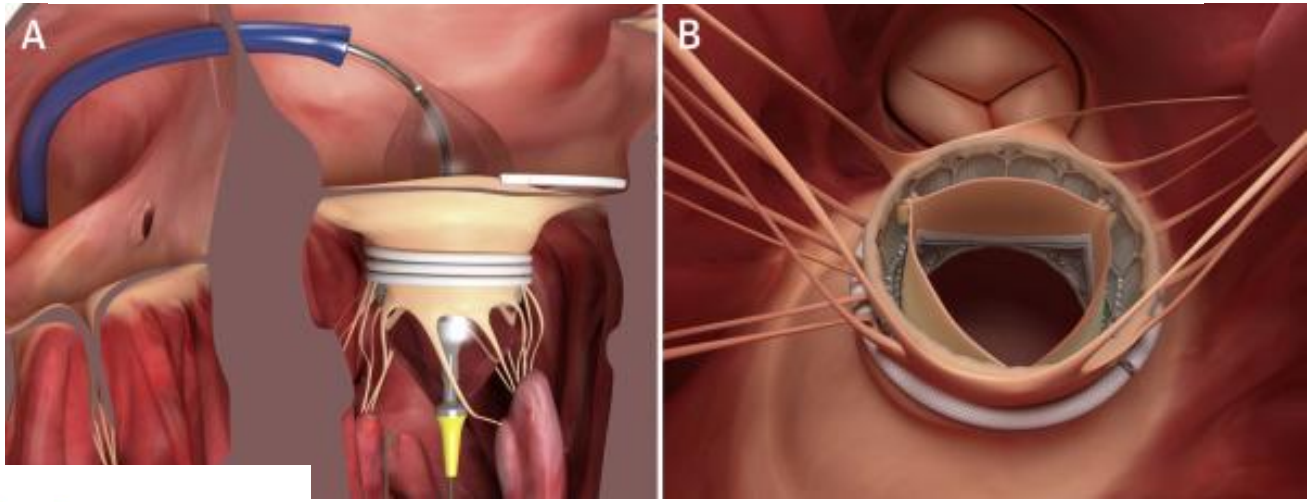


Dedicated TSMVIV devices?

- ? Unlikely given the niche area for development

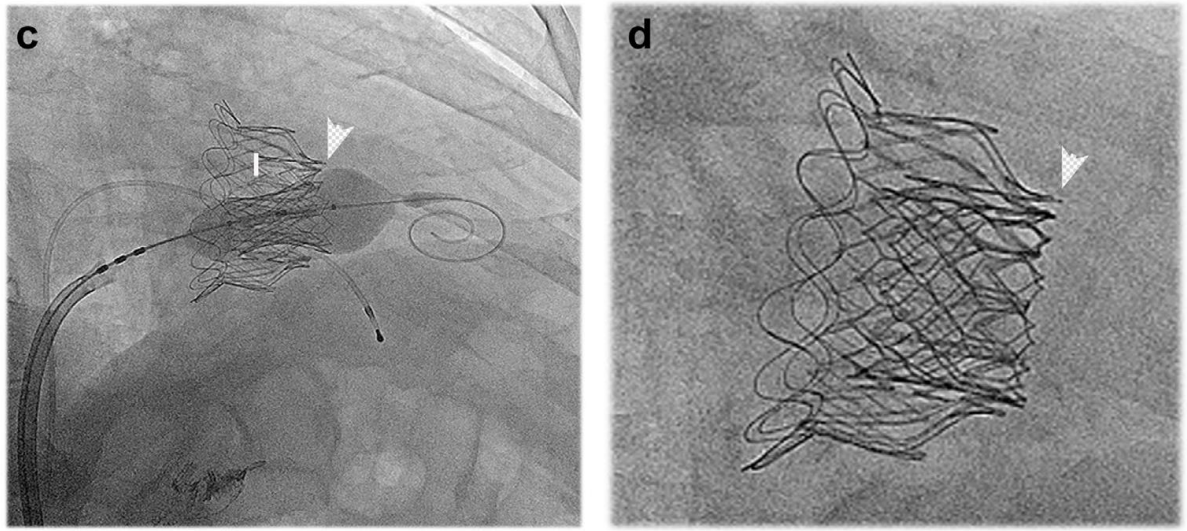
- ? More importantly currently well covered by balloon expandable devices in the commercial and research space

- Perhaps a steerable delivery sheath would be useful although once again with experience the need for this is very rare



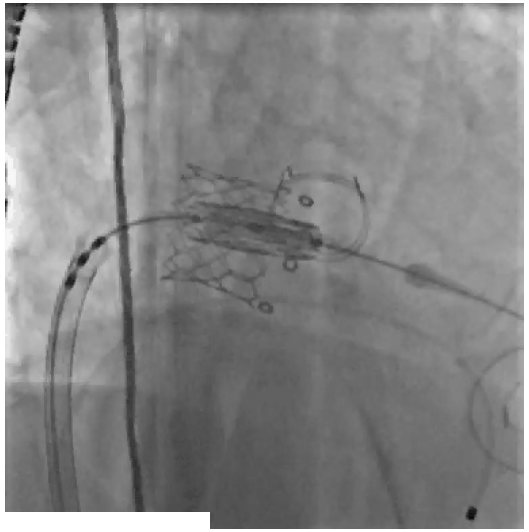
TSMVIV – what happens when TSMVIV fails - TSMVIVinV

- TSMVinV within a 5.5 year old Intrepid MDT TMVR



Sorraja, P. Structural Heart 2023

- TSMVinVinV – 12 month old 23mm S3



Halim, M, Poon et al under review

Conclusion

- Redo MVR is inherently high risk an operation in many patients.
- TSMVIV is increasingly practiced worldwide as an alternative to redo MVR.
- TSMVIV has an excellent safety profile, much improved over transapical access, and in small case series has shown to have excellent long term results.
- In intermediate re-do MVR candidates data will be eagerly awaited.
- Anatomical contraindications remain challenging.
- Future research will need to focus on durability, need for BVF, optimal antithrombotic, gradient, etc…

Complex scenarios during TSMVIV and TSMVinR

Dr Karl Poon
Interventional cardiologist
St Andrew's War Memorial Hospital
Senior Lecturer, University of Queensland

Edwards Lifesciences
Teaching Center of Excellence

The University Of Queensland
AUSTRALIA

St Andrew's War Memorial Hospital

Case One

- 80 year old female; BSA 1.58m2, Ht 163cm Wt 55kg

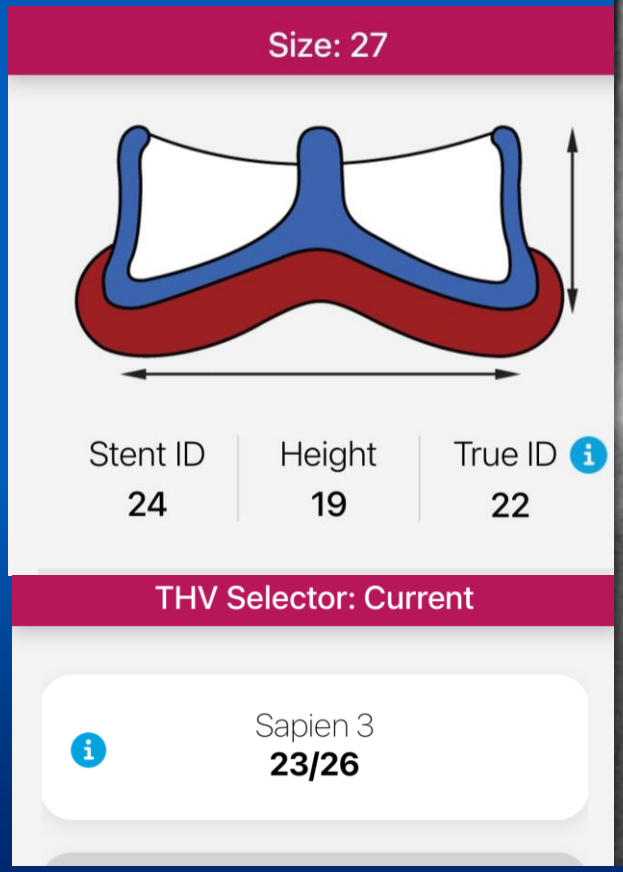
- AVR 2015; AVR/MVR 2021
- Acute MVR 27mm Mosaic regurgitation

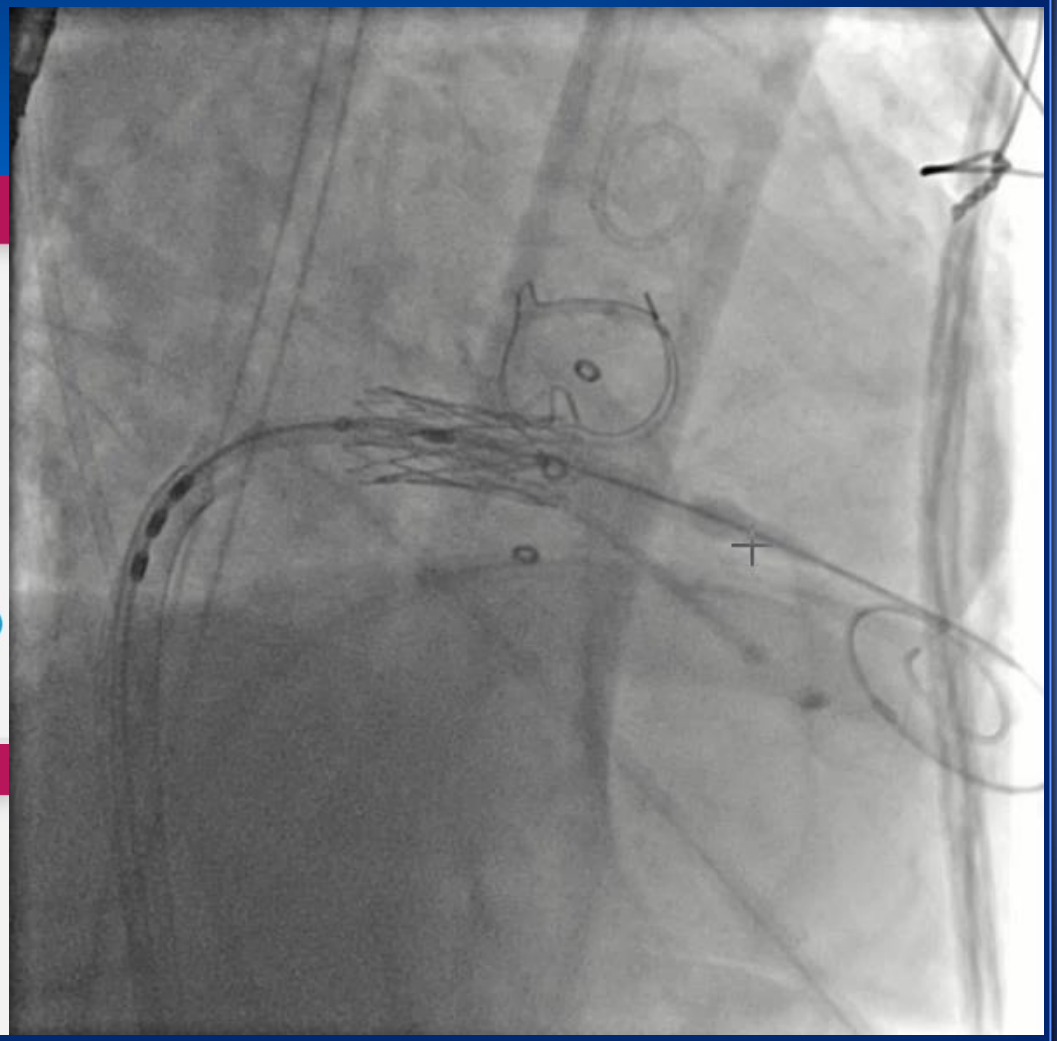
- Not for third redo sternotomy
- STS 21%

- TSMVIV

Case One

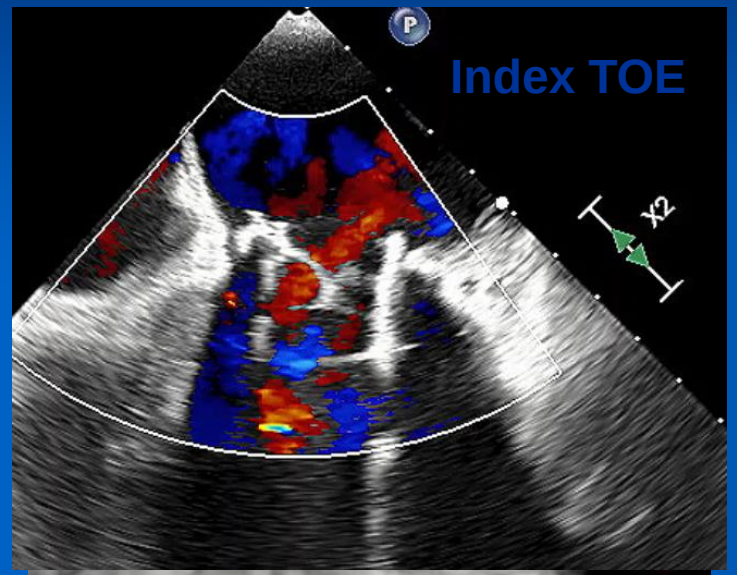
- Valve sizing dilemma
- Some LVOTO risk concern
- Overfill 23mm +2cc
- No significant gradient invasively

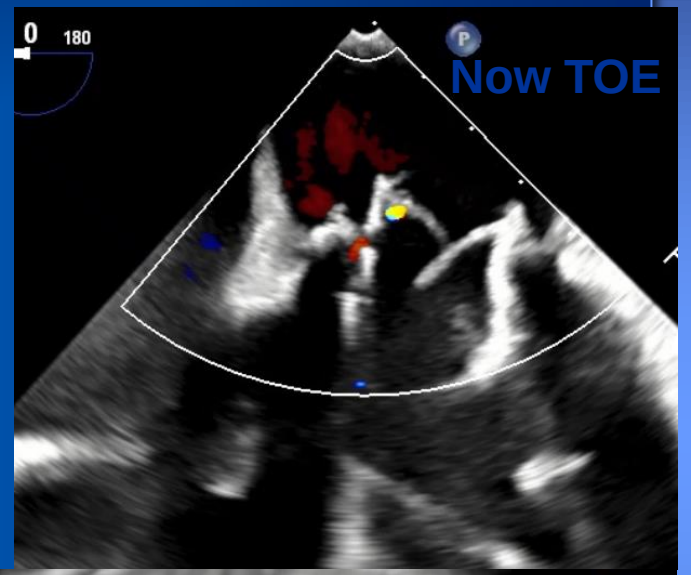


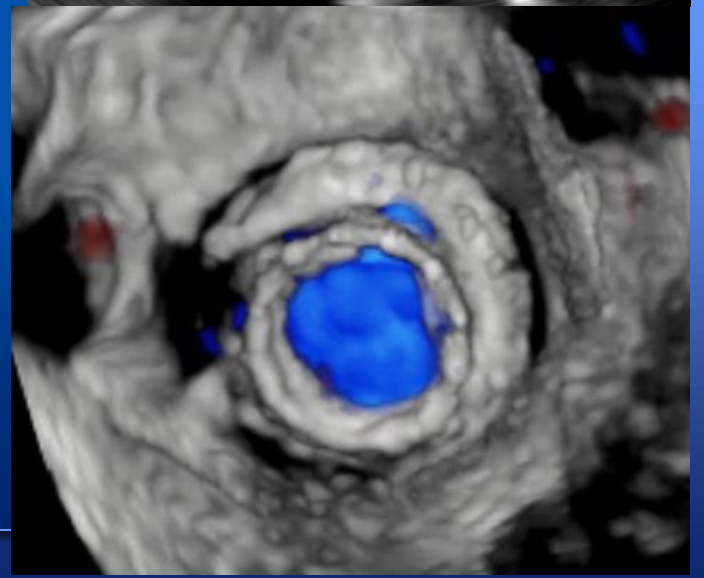


Case One

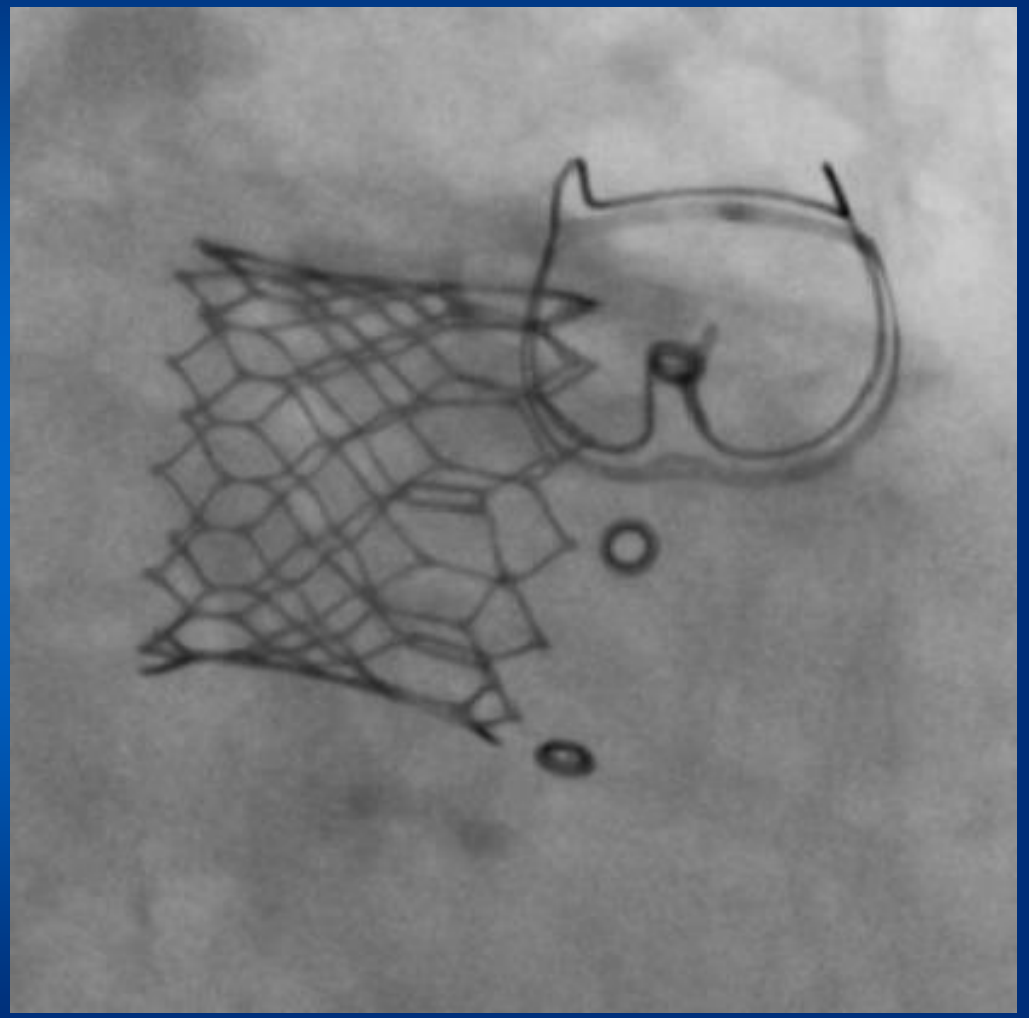
- Heart failure resolved
- 1 month and 6 month TTE satisfactory
- 12 months – hemolysis



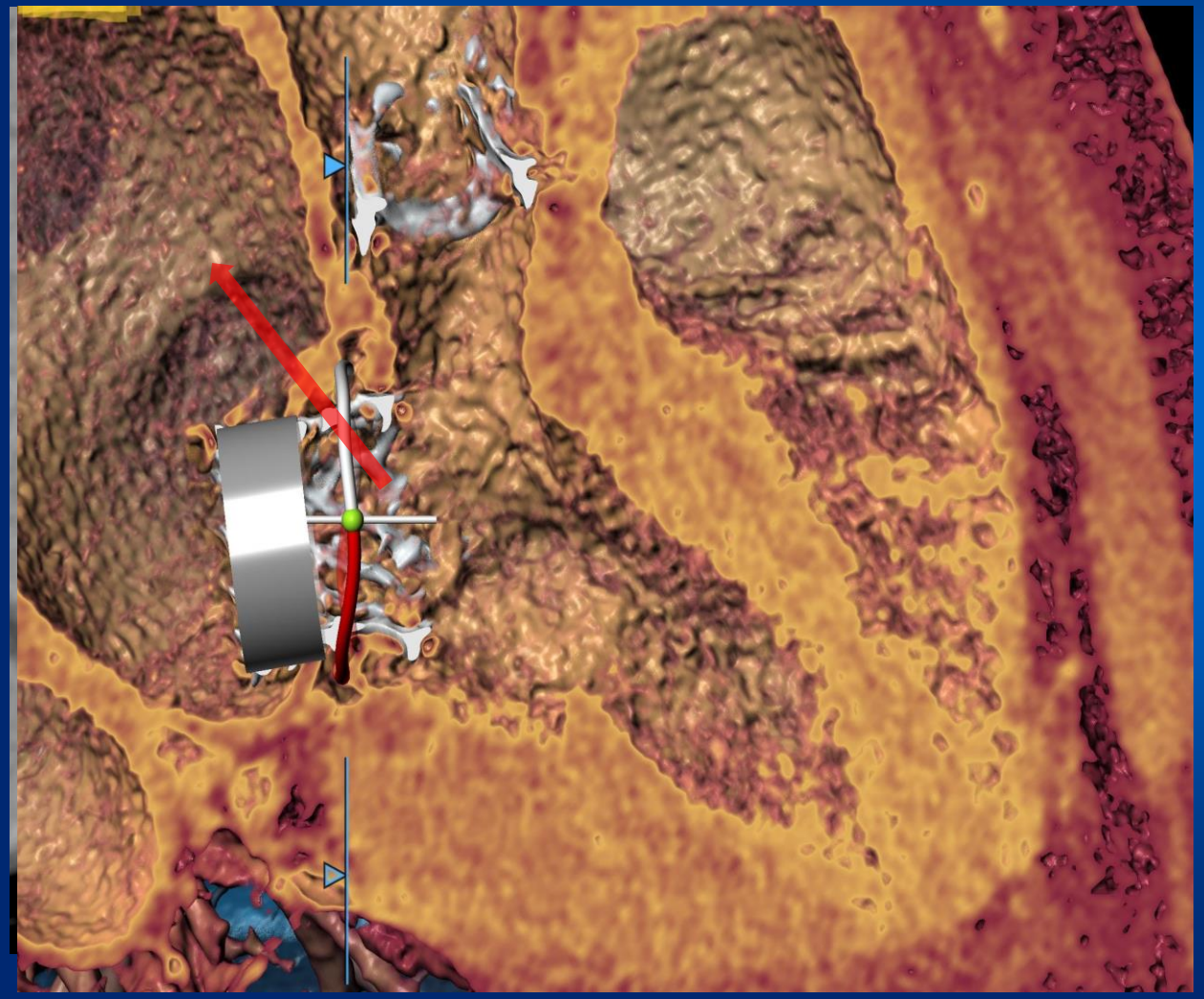


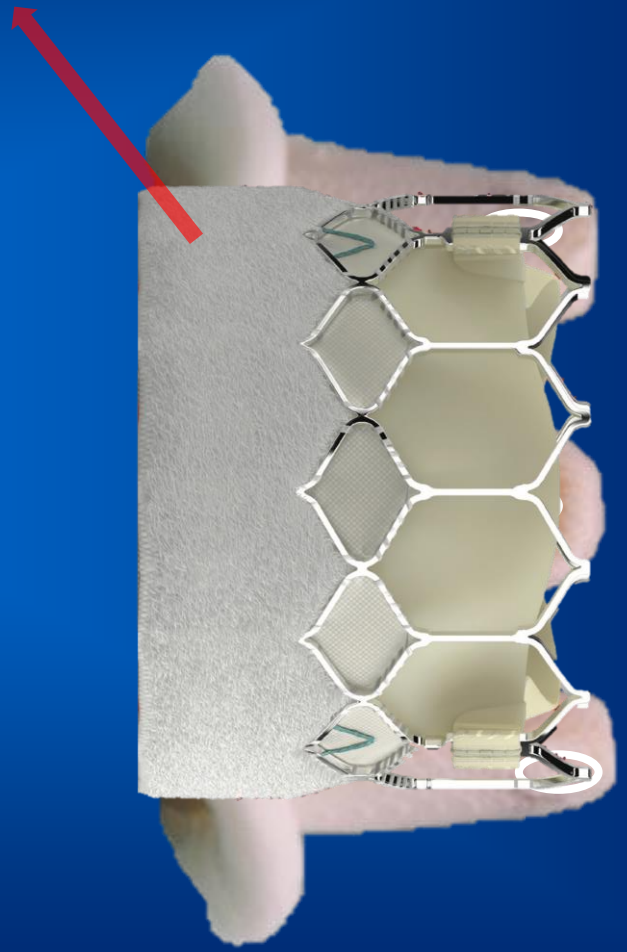


Case One



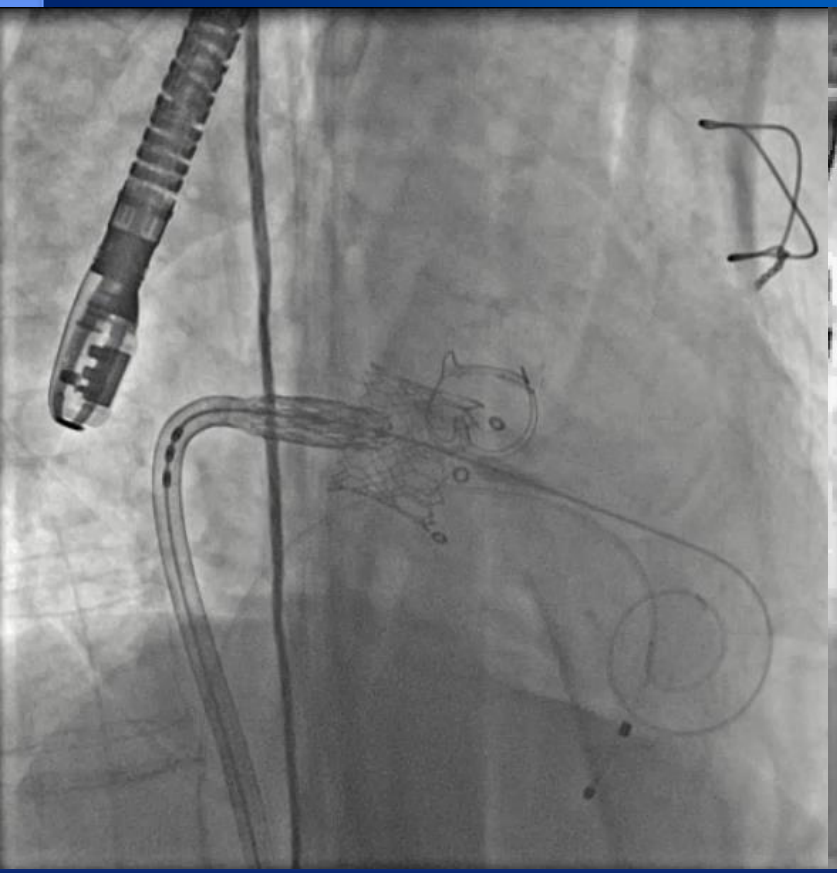
Case One – *delayed* embolization

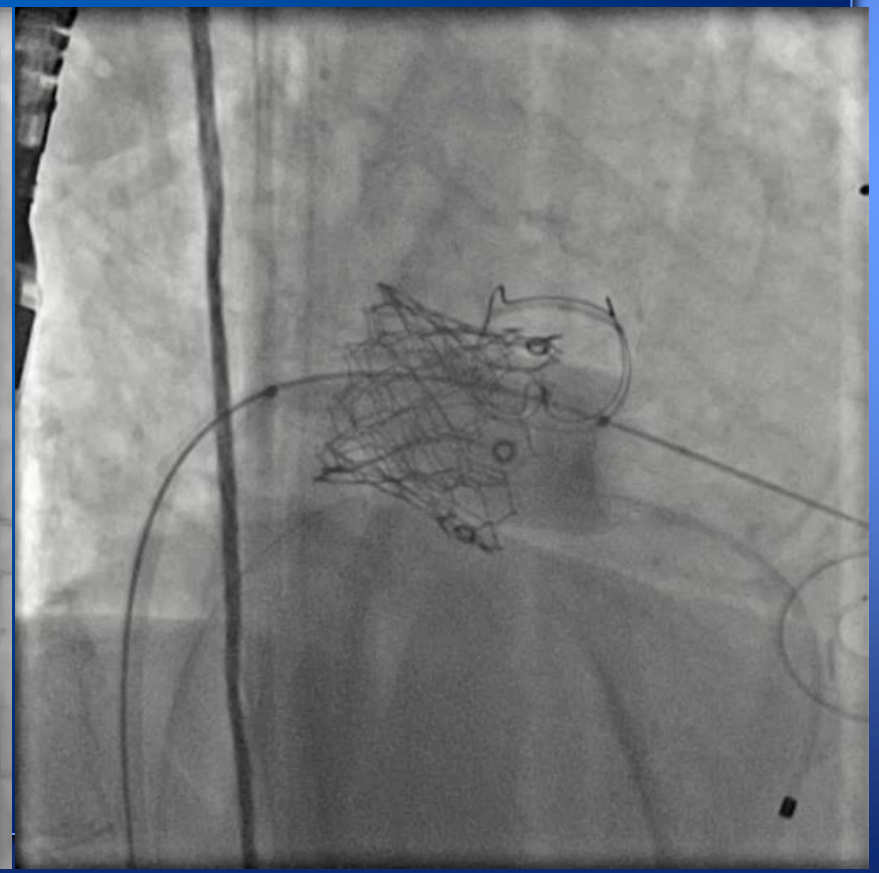




Case One – treatment

- 26mm Edwards S3 (+ 2mL) in 23mm S3 at rapid pacing of 180bpm
- Post-dilatation
  - 26mm X 45mm True BARD balloon





Case two

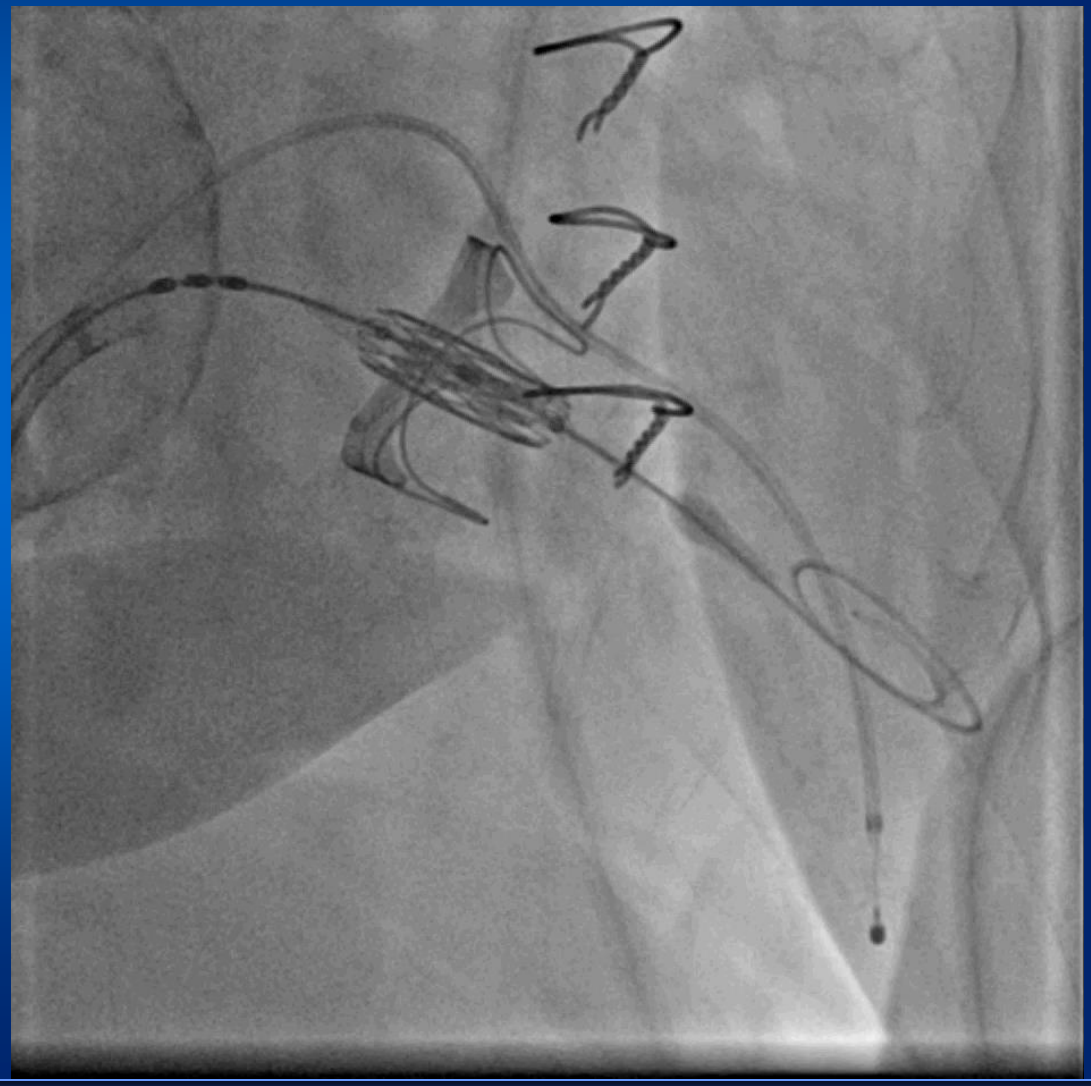
iASD

Case Two

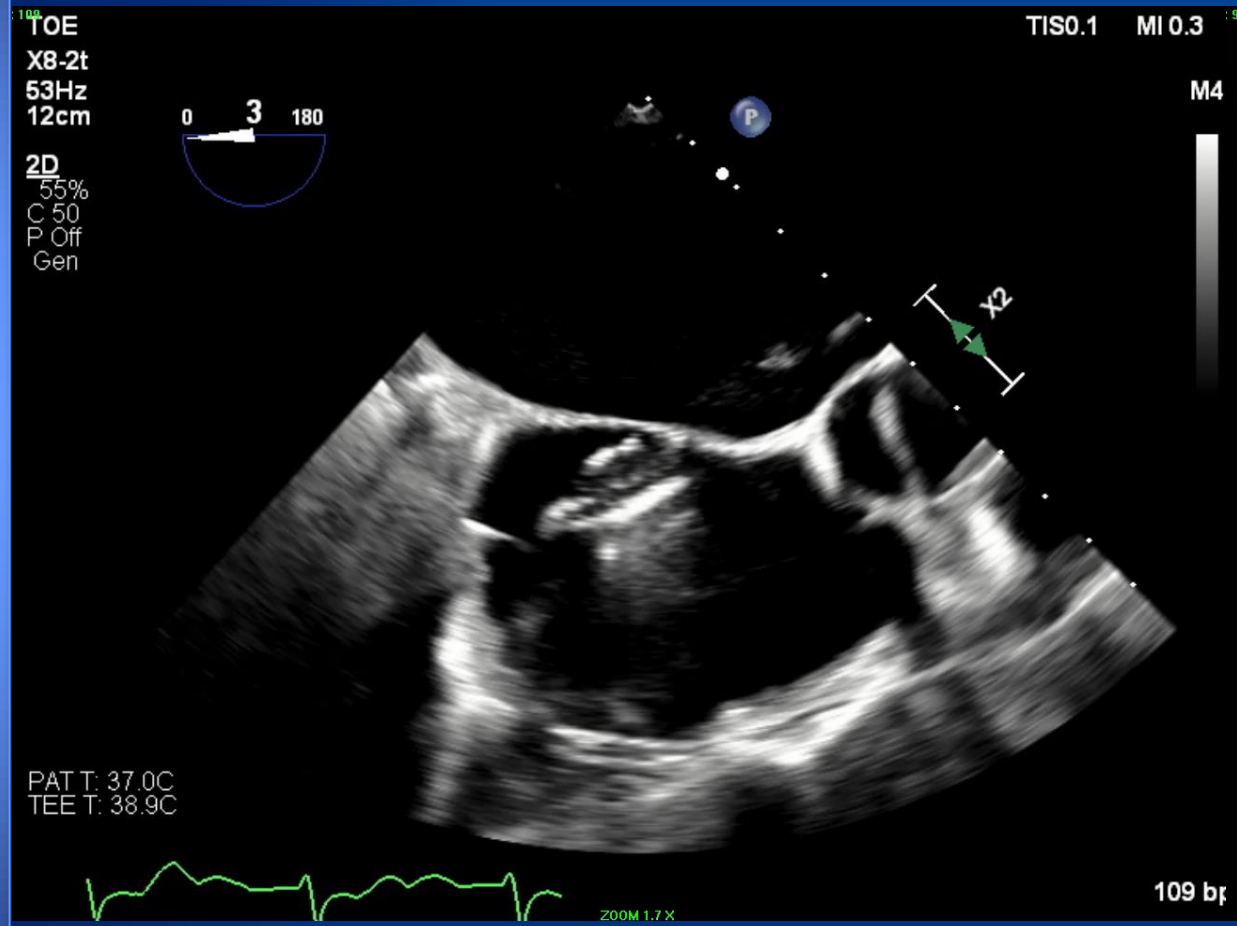
- 75 year old female; BSA 1.94m2, Wt 80kg, Ht 170cm
- 14 year old 27mm Perimount MVR
- Mixed stenosis/regurgitation
- STS redo 11%
- For TSMVIV

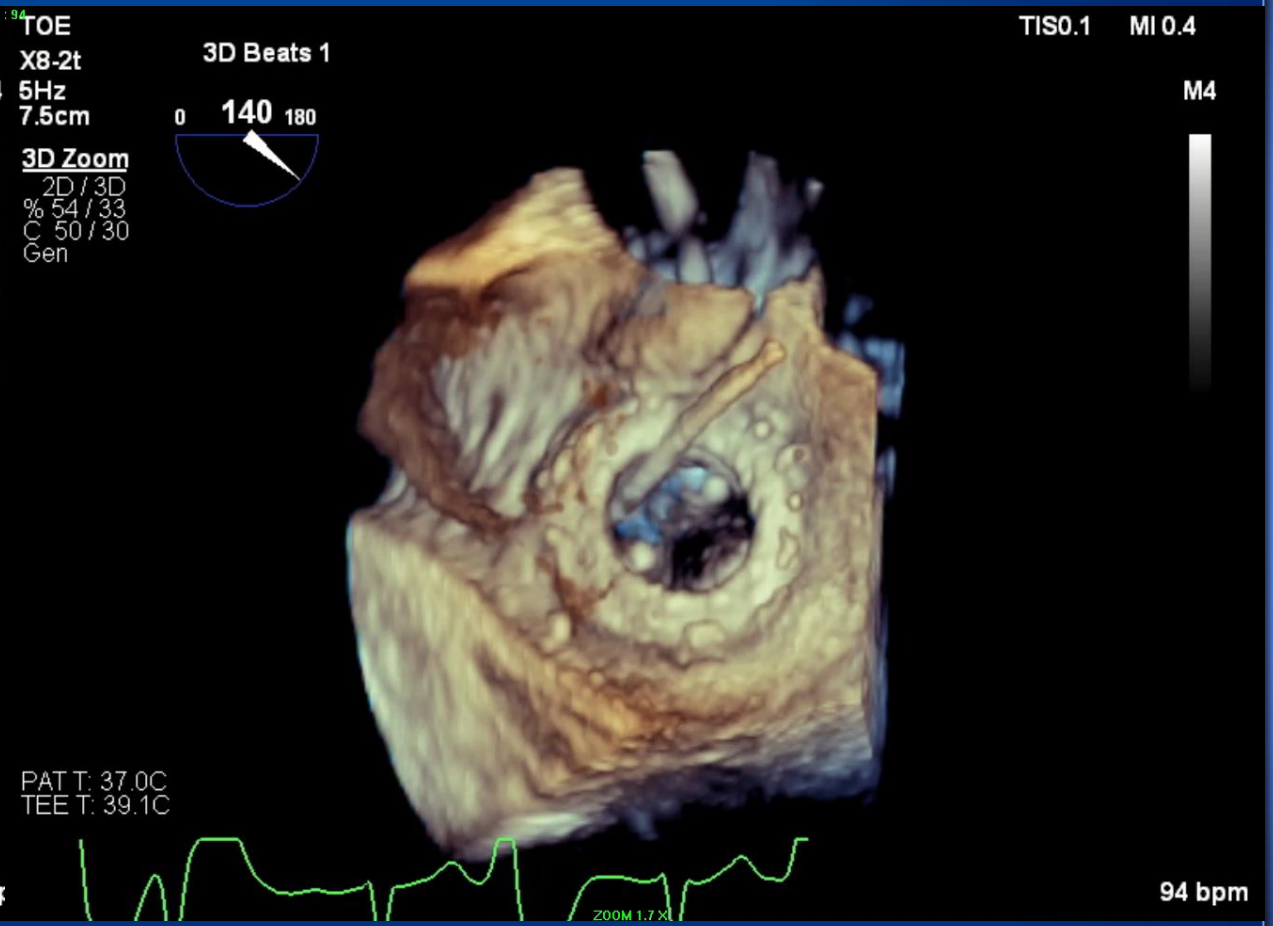
Case Two

- 26mm S3U nominal filling within 27mm Perimount MVR
- Routine procedure routine septostomy with 14mm balloon
- The ”Simon Redwood” curve

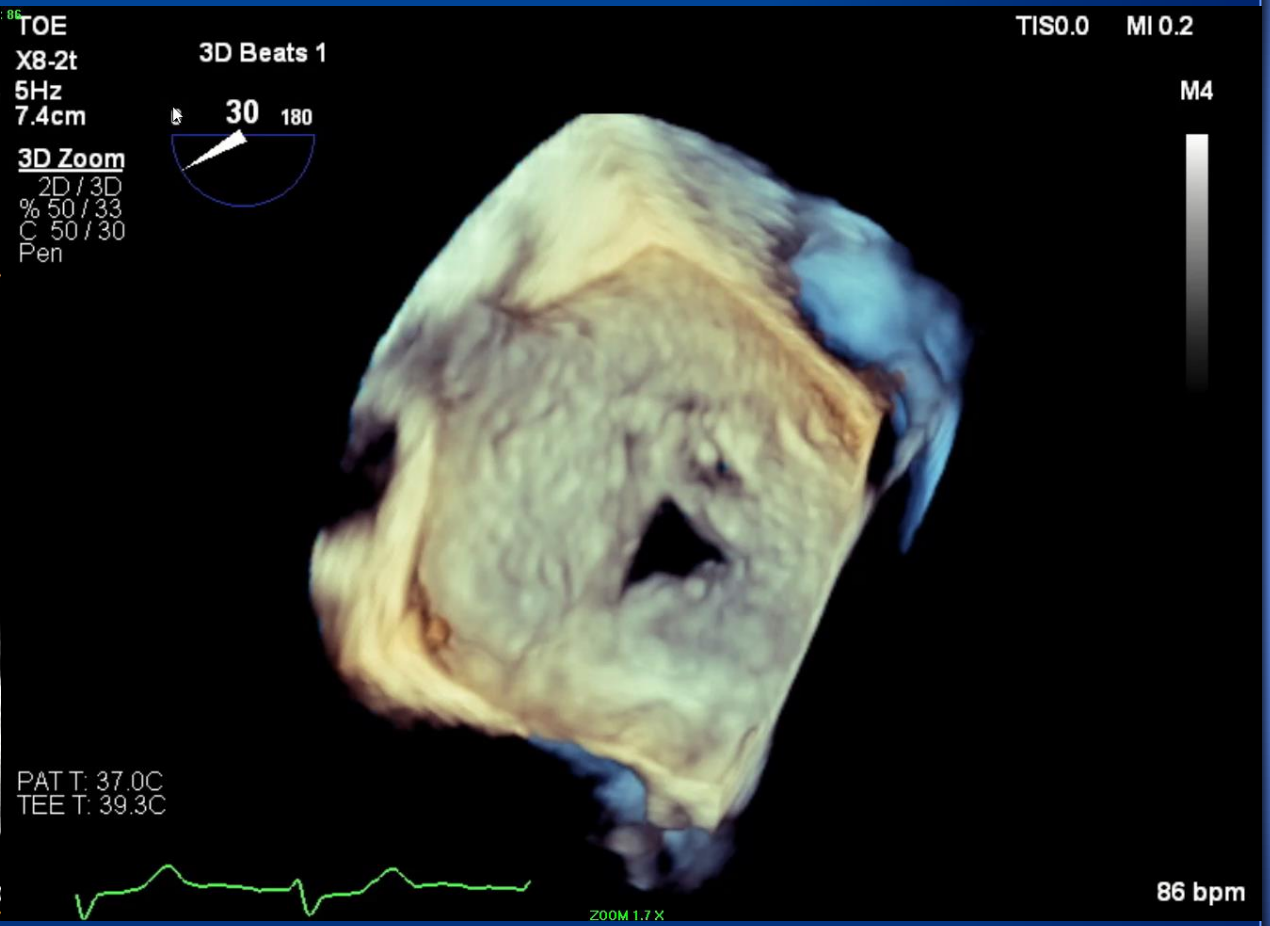


Case Two TEE images



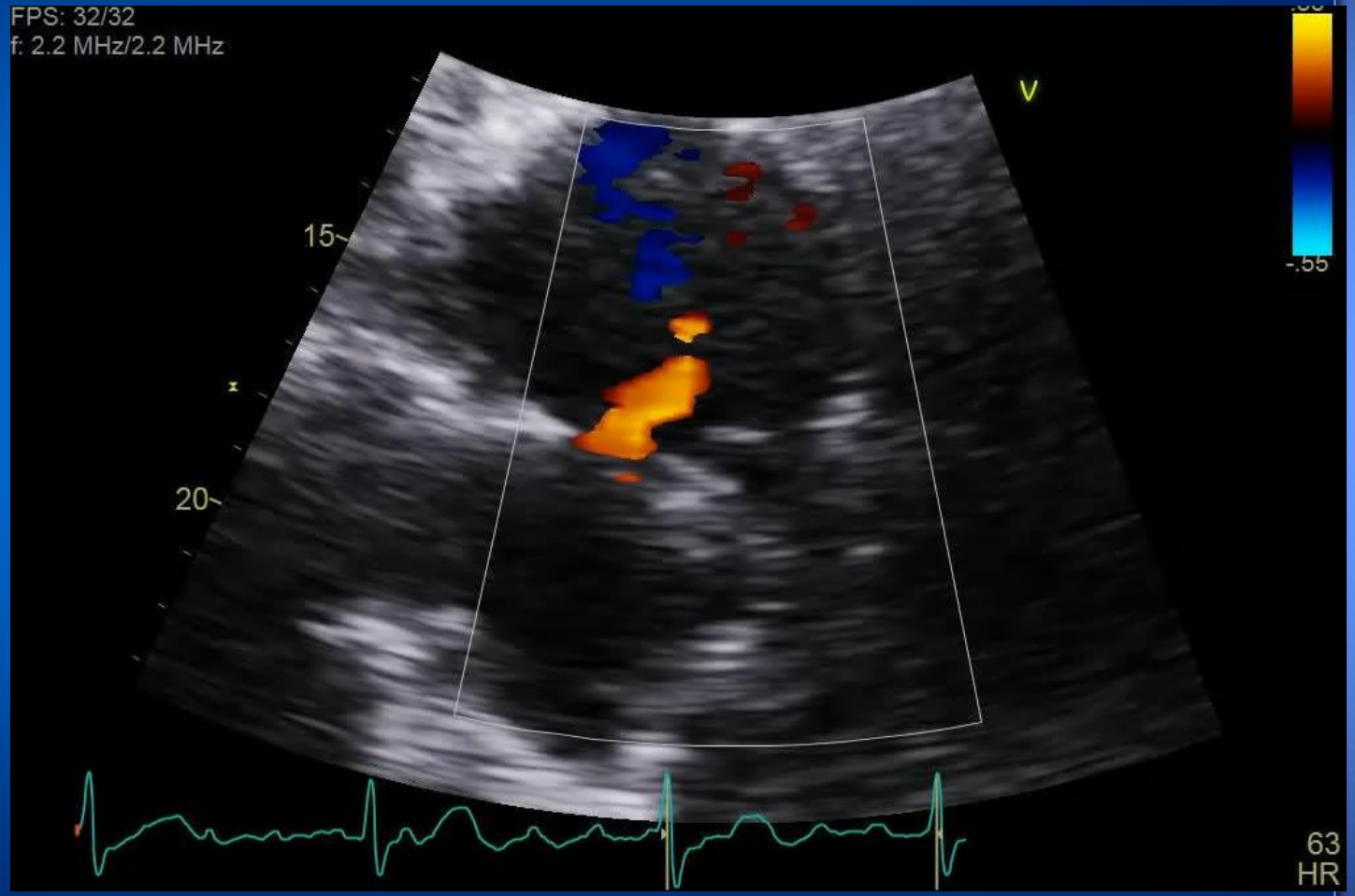


Case Two TEE iASD



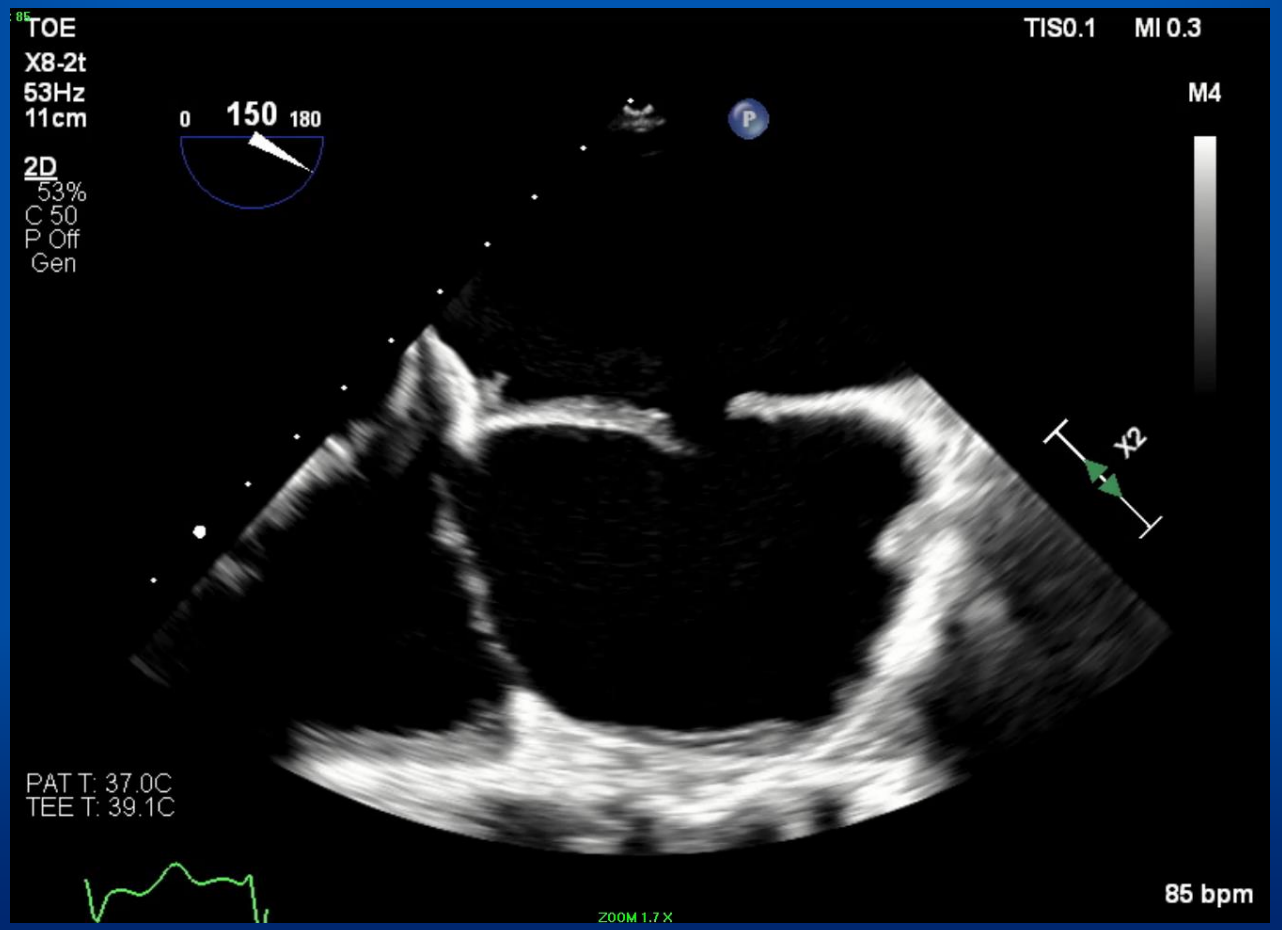
Case Two

- **9 months later**
  - Severe RHF refractory SOA
  - ? Referred for TriClip assessment
- **TTE**
  - severe RV dilatation (new)
  - Severe 4/4 TR
  - **Bidirectional** shunt across iASD



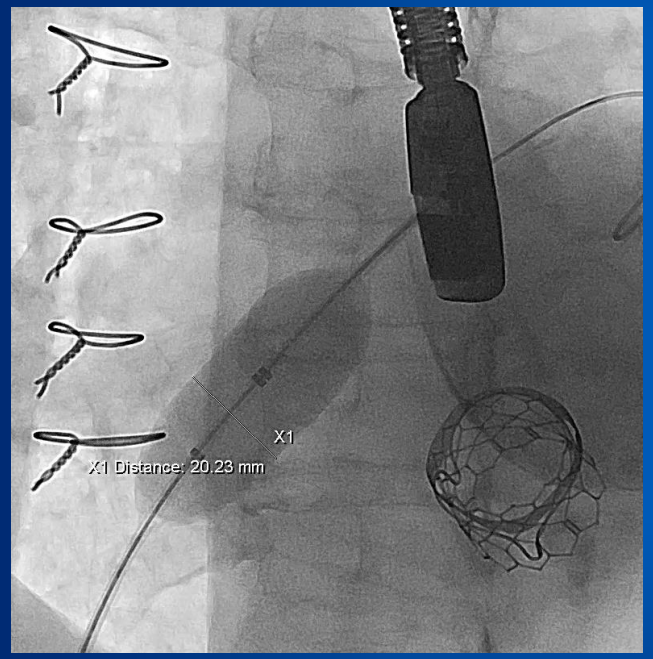
Case Two – in retrospect…

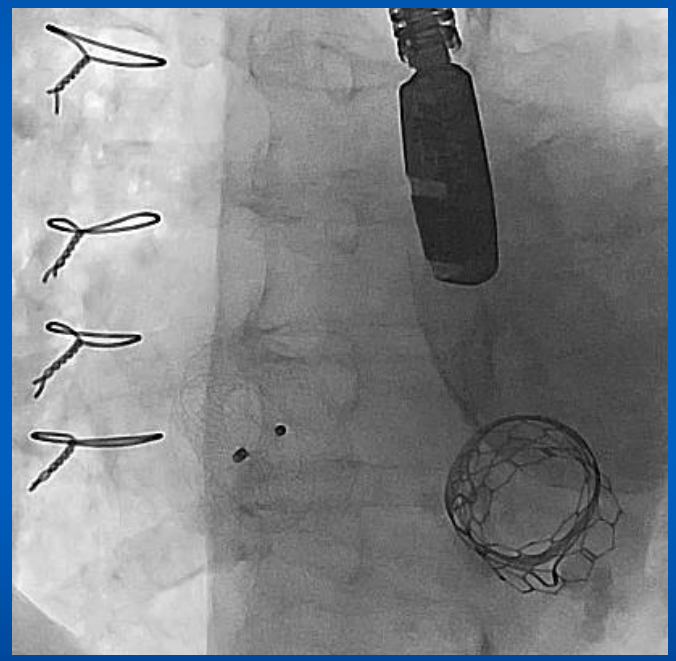
- Unusual septostomy appearance

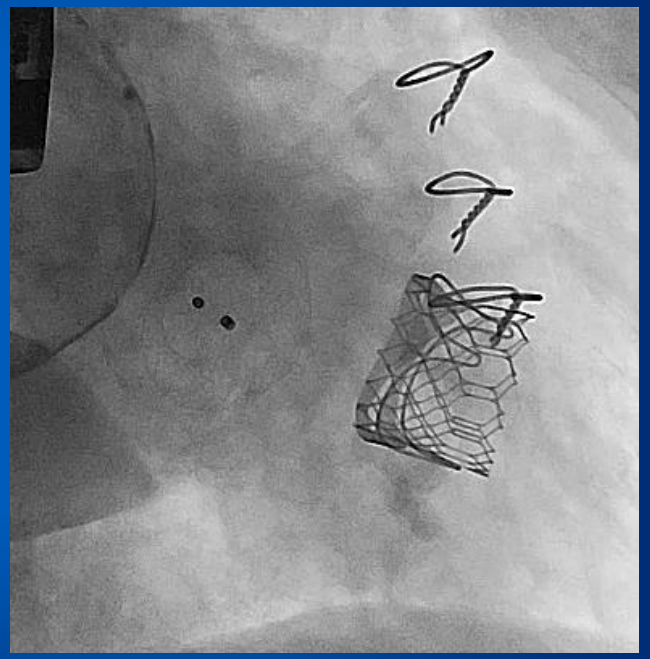


Case Two

- **ASD closure with 20mm ASO device**



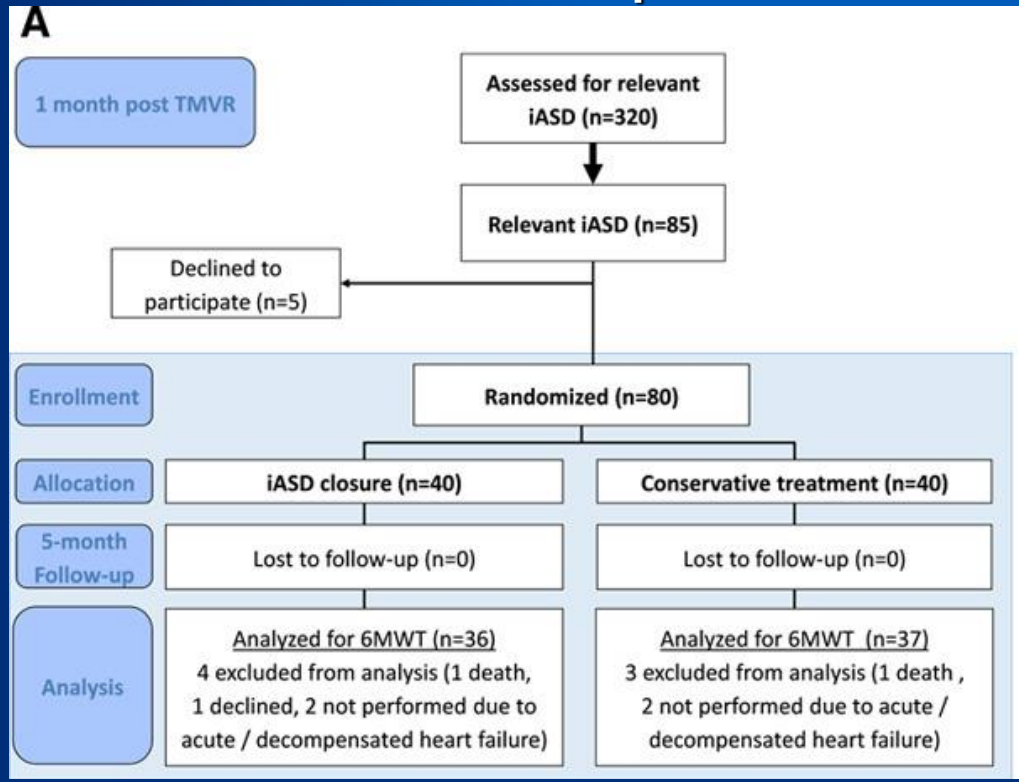


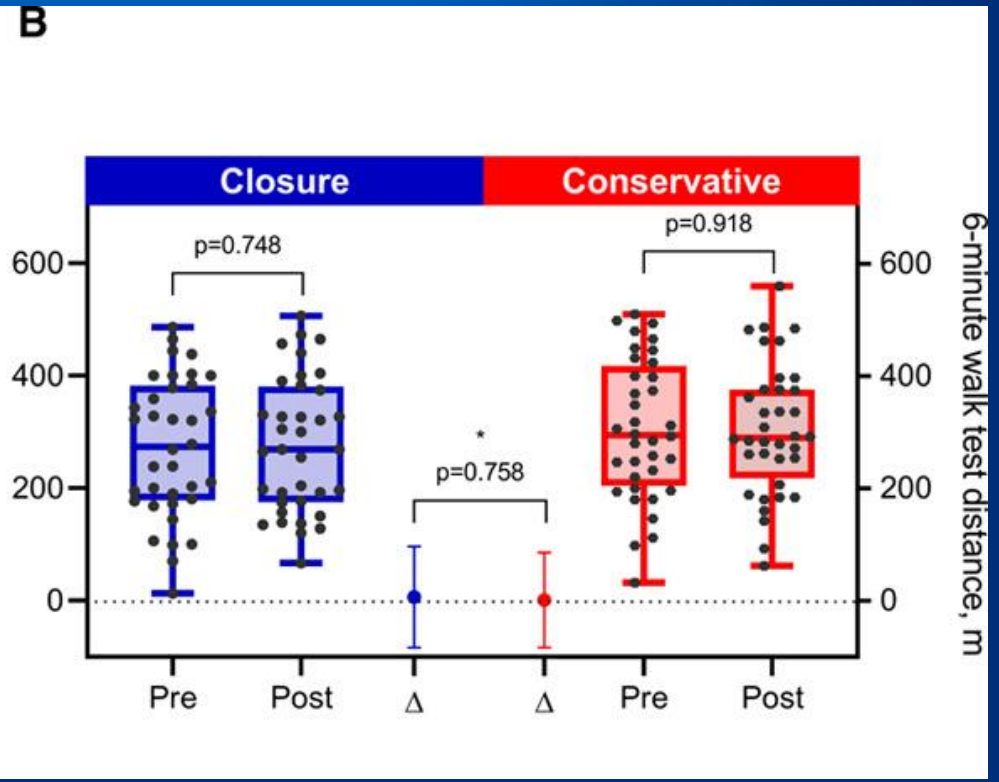


- **Importance on ongoing surveillance TTE**
  - Referring cardiologist to be aware of ***expected iASD size***

iASD closure – MITHRAS

- **Following TEER (mitraclip) – no septostomy**
  - **Randomized after one month post TEER**





  - **Caveat: bidirectional shunt or mainly right to left shunt**
  - **Most shunts close – if not then close?**

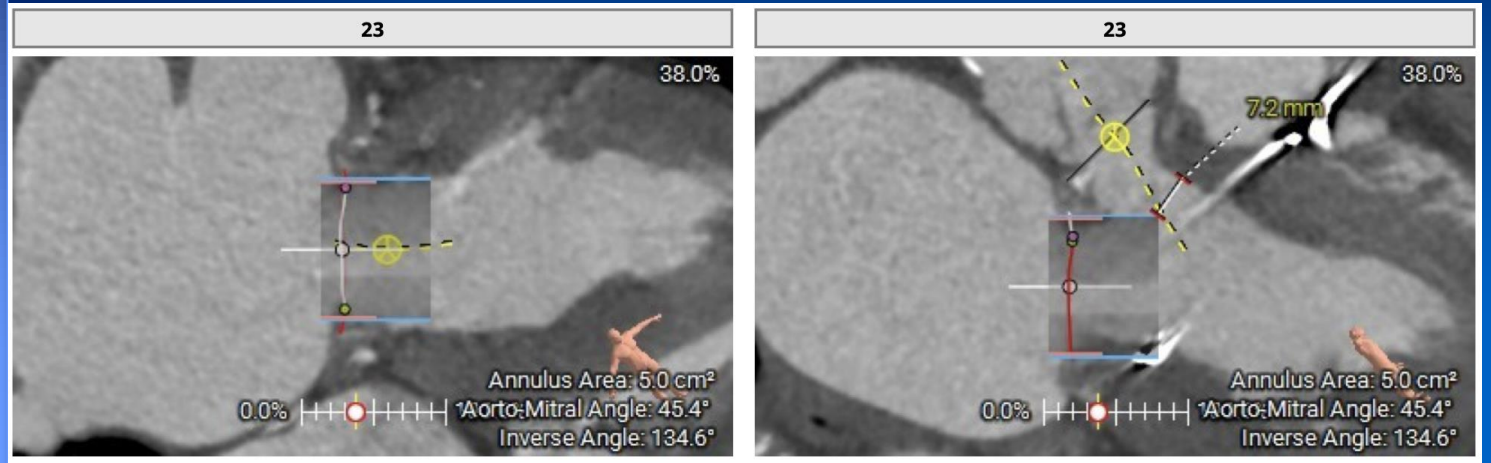
Case Three

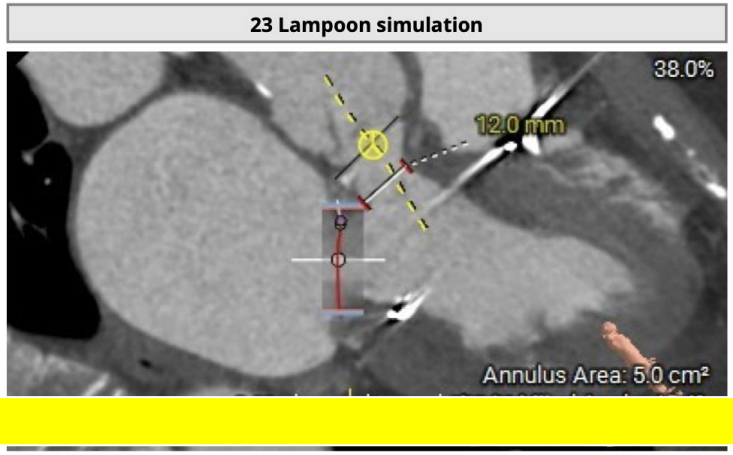
Dealing with the LVOT

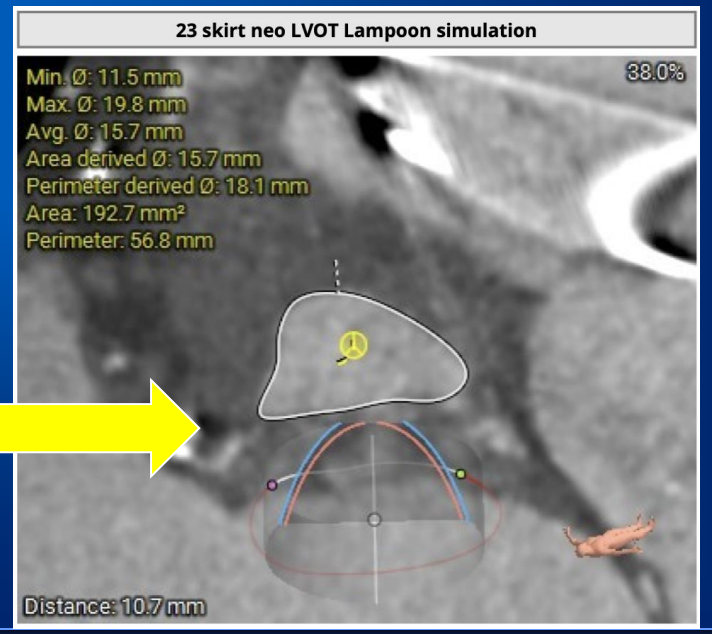
Case Three

- 79-year-old female; BSA 1.57m2, Ht 156cm; Wt 58kg
- 27mm Mosaic MVR (8 year old)
- Regurgitant failure
  - 4/4 no vegetation
- STS 8.5%
- Not for re-do MVR

Case Three

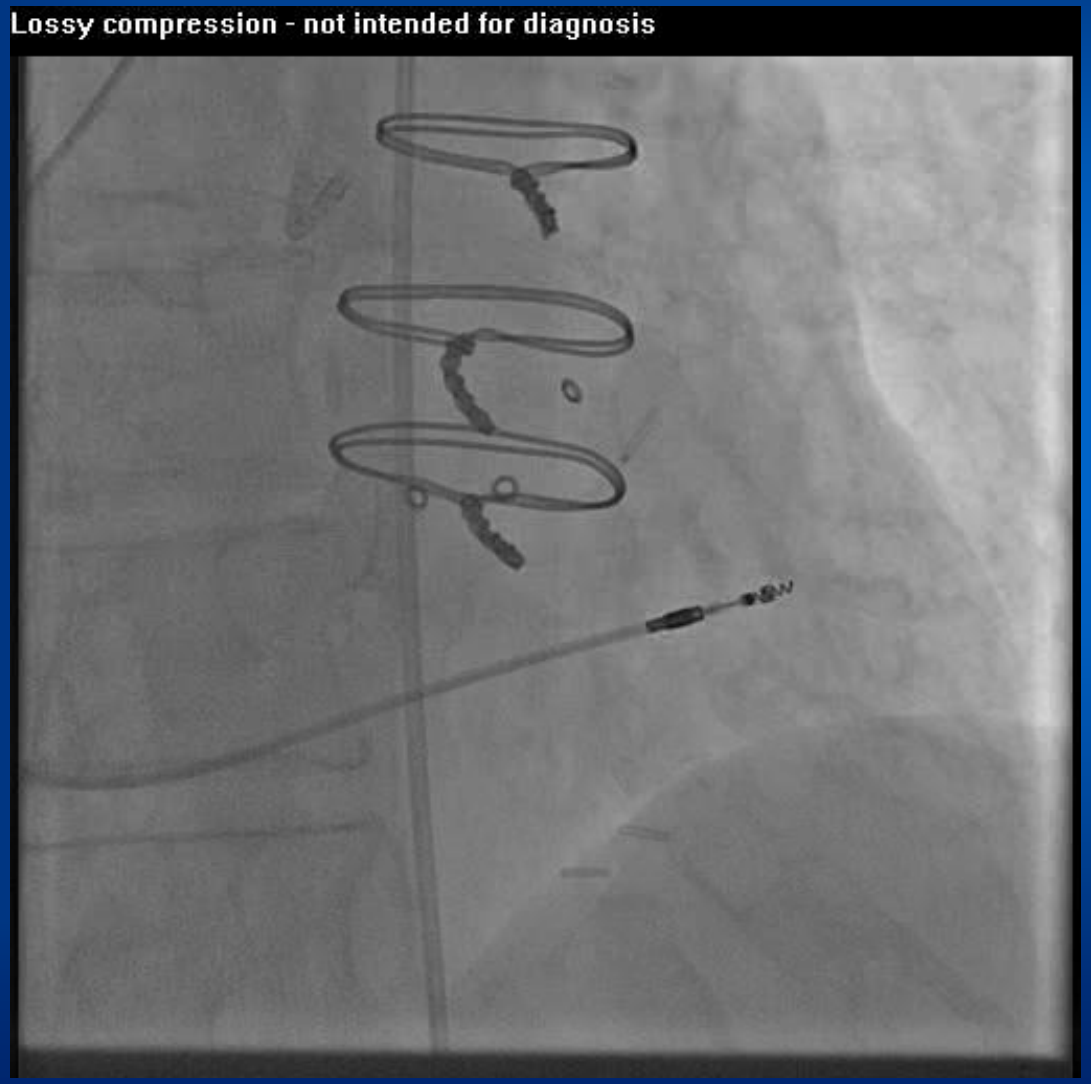






- CT reconstruction of LVOTO risk
- NeoLVOT 112mm2
- LAMPOON 190mm2

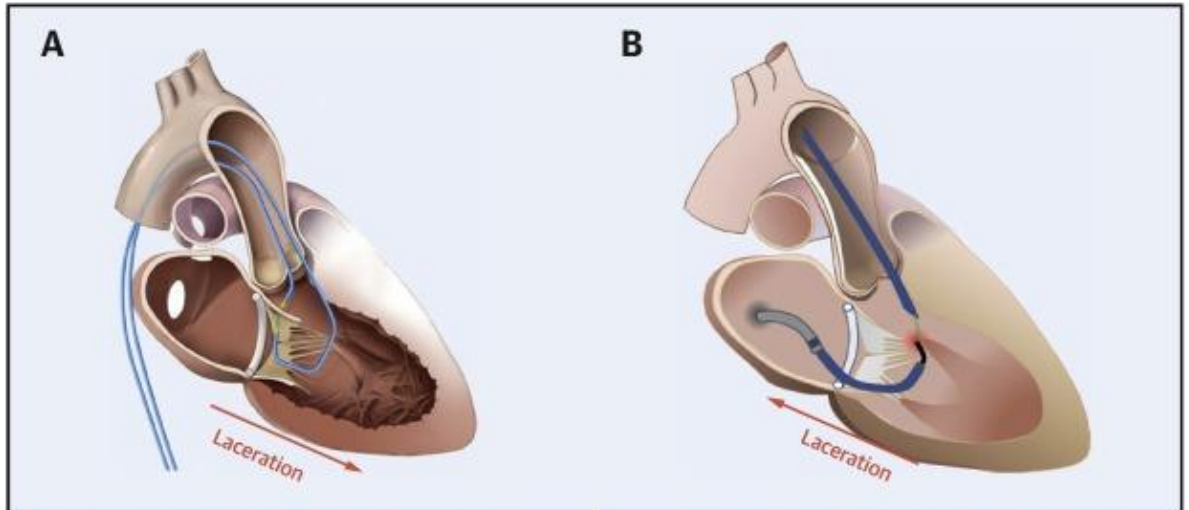
Case Three – preparatory TASH



- 0.6mL alcohol injected
- No resting LVOT gradient pre
- No resting LVOT gradient post
- No MRI done

Case Three – tip to base LAMPOON

CENTRAL ILLUSTRATION: Tip-to-Base LAMPOON Is a Simplified Approach to Lacerate the Anterior Mitral Leaflet

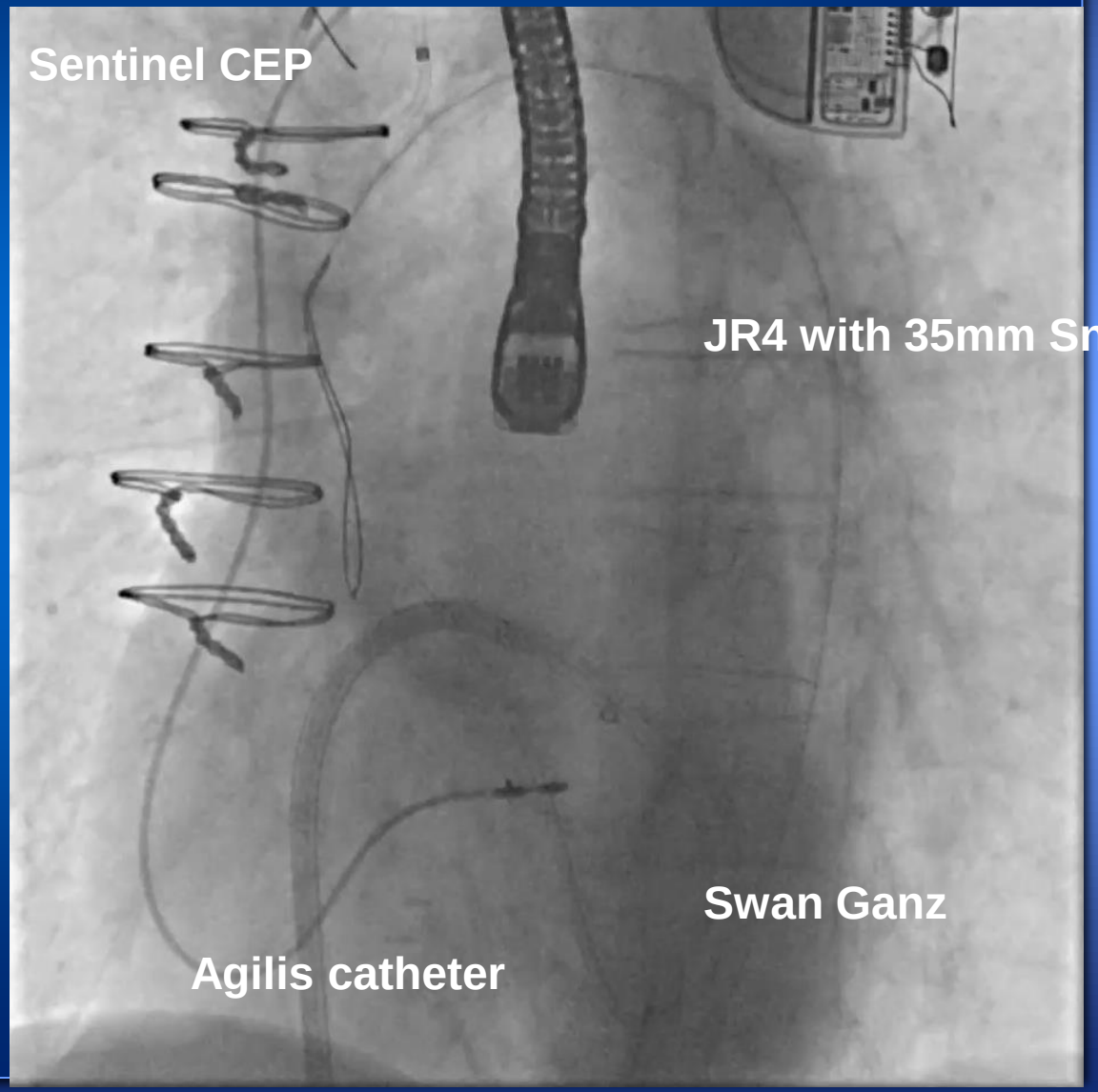


Retrograde (Base-to-Tip) intentional laceration of the anterior mitral leaflet to prevent left ventricular outflow tract obstruction	Tip-to-Base intentional laceration of the anterior mitral leaflet to prevent left ventricular outflow tract obstruction
Requires technically challenging leaflet traversal	Allows for leaflet laceration without traversal
Solely preventive strategy	Preventive or rescue strategy
Applicable to patients with mitral annular calcification, surgical mitral valve replacement, or mitral ring	Applicable to patients with surgical mitral valve replacement or mitral ring

Lisko, J.C. et al. J Am Coll Cardiol Intv. 2021;14(5):541-50.

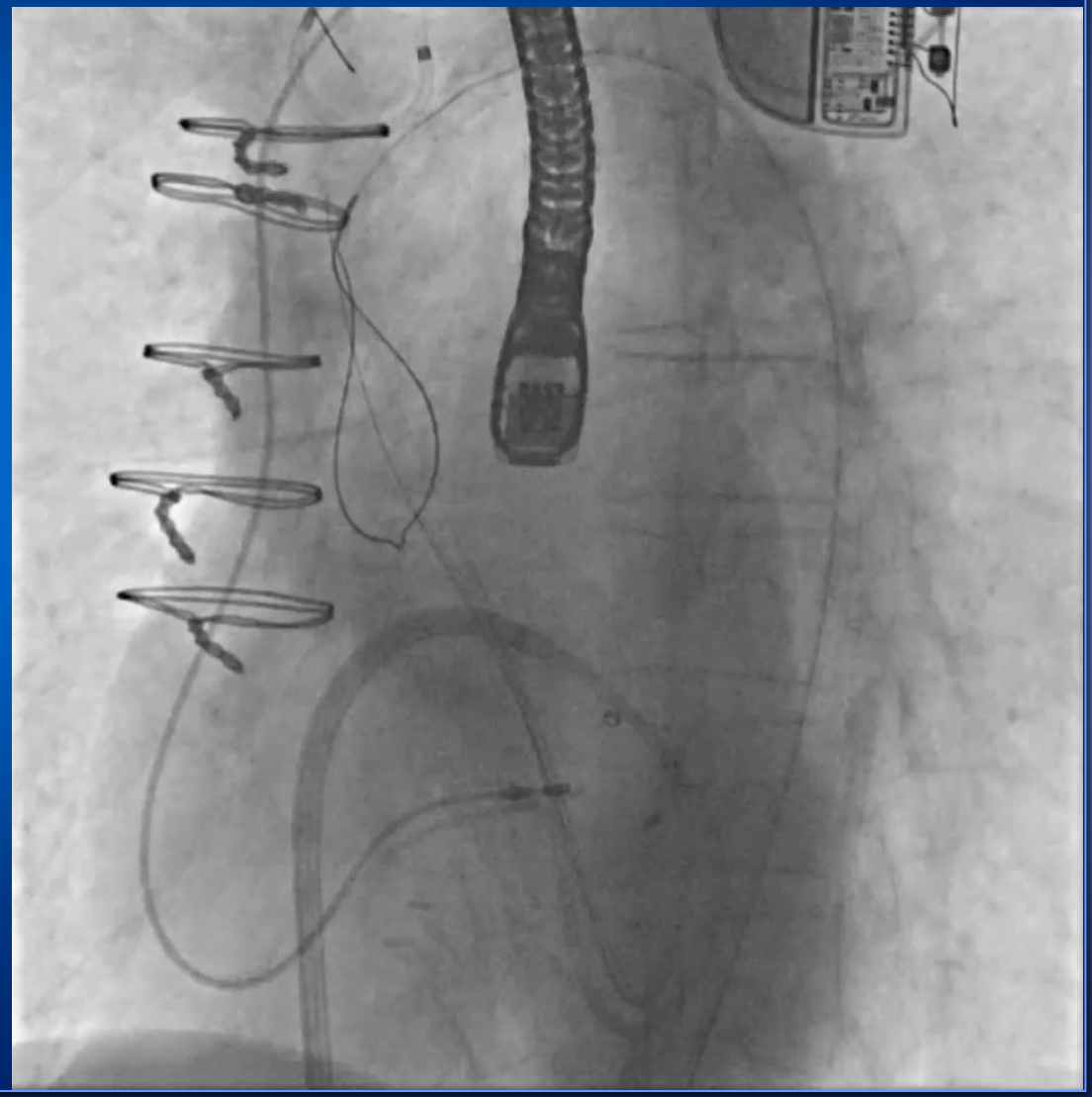
Case Three – LAMPOON

- **Procedural plan**
  - RRA – Sentinel CEP
  - RFV – primary access – 24Fr large sheath
  - LFA – contralateral arterial (snare)
  - LFV – (pacing) – optional
- **Step One**
  - Swan Ganz across aortic valve into the ascending aorta for snaring
  - Avoid mitral chordae



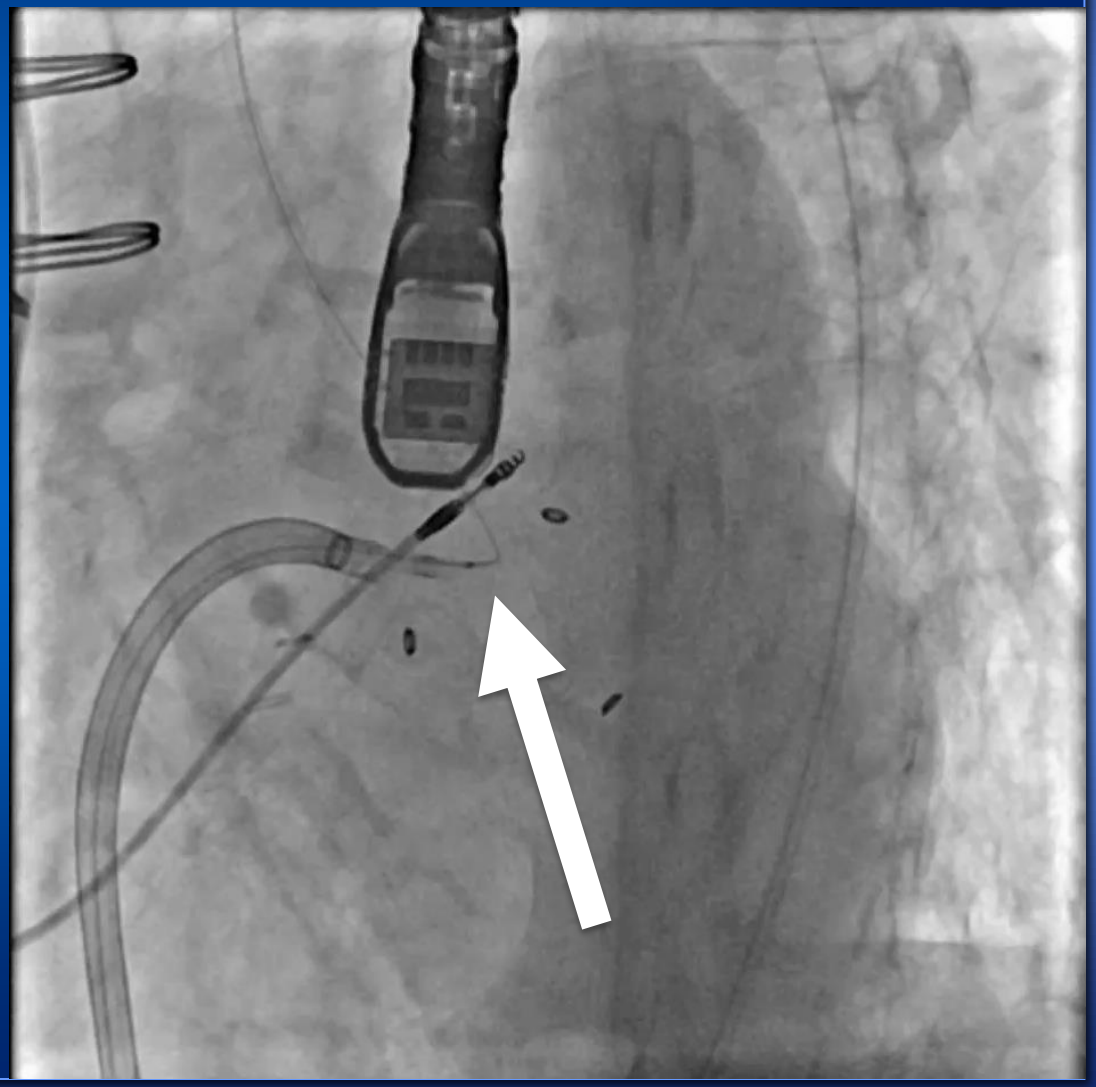
Case Three – LAMPOON – tip to base

- **Step Two**
  - 300cm ASTATO wire into Swan Ganz
  - 35mm Snare in ascending aorta within 6Fr JR4
- **Step Three**
  - Remove Swan Ganz
  - Exchange for an MPA catheter over Astato wire

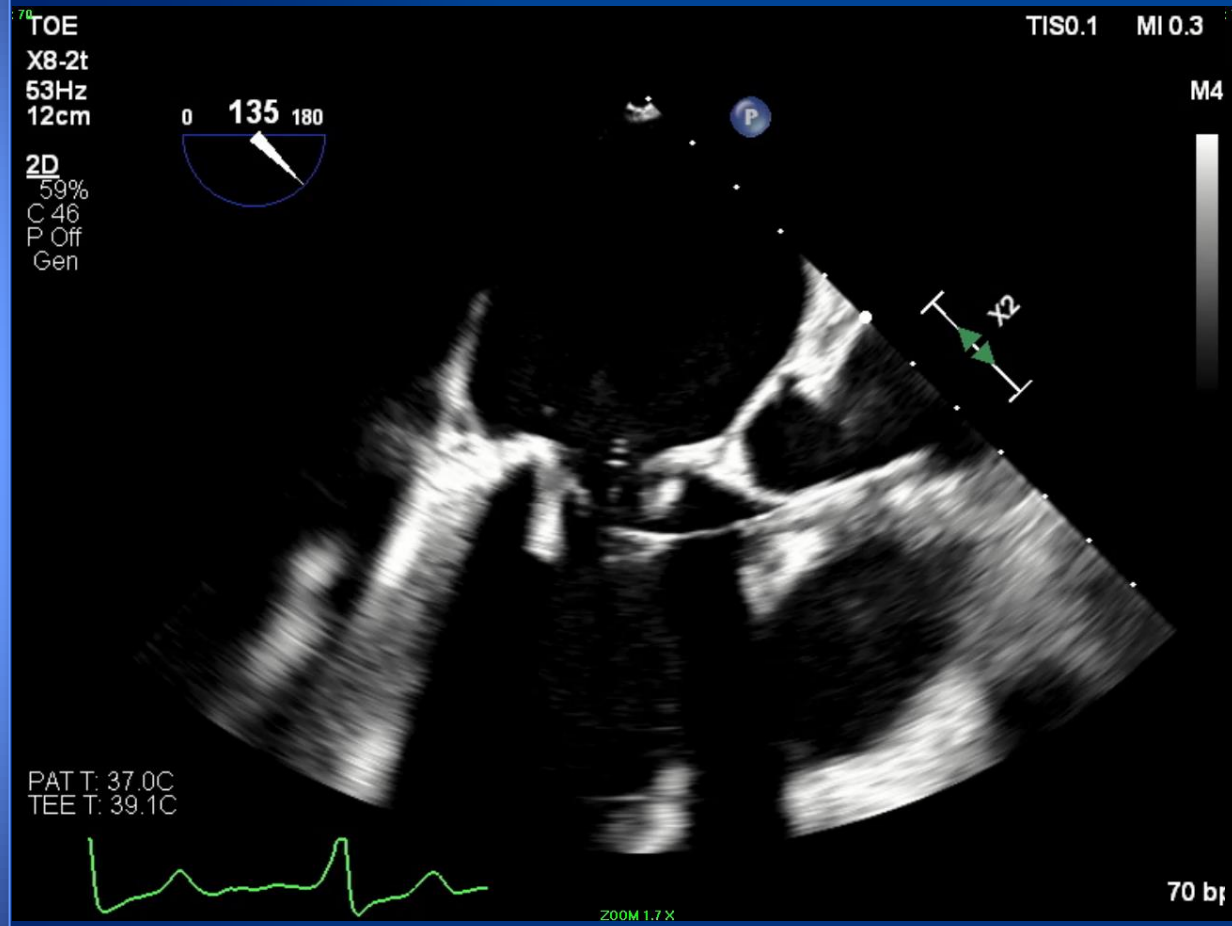


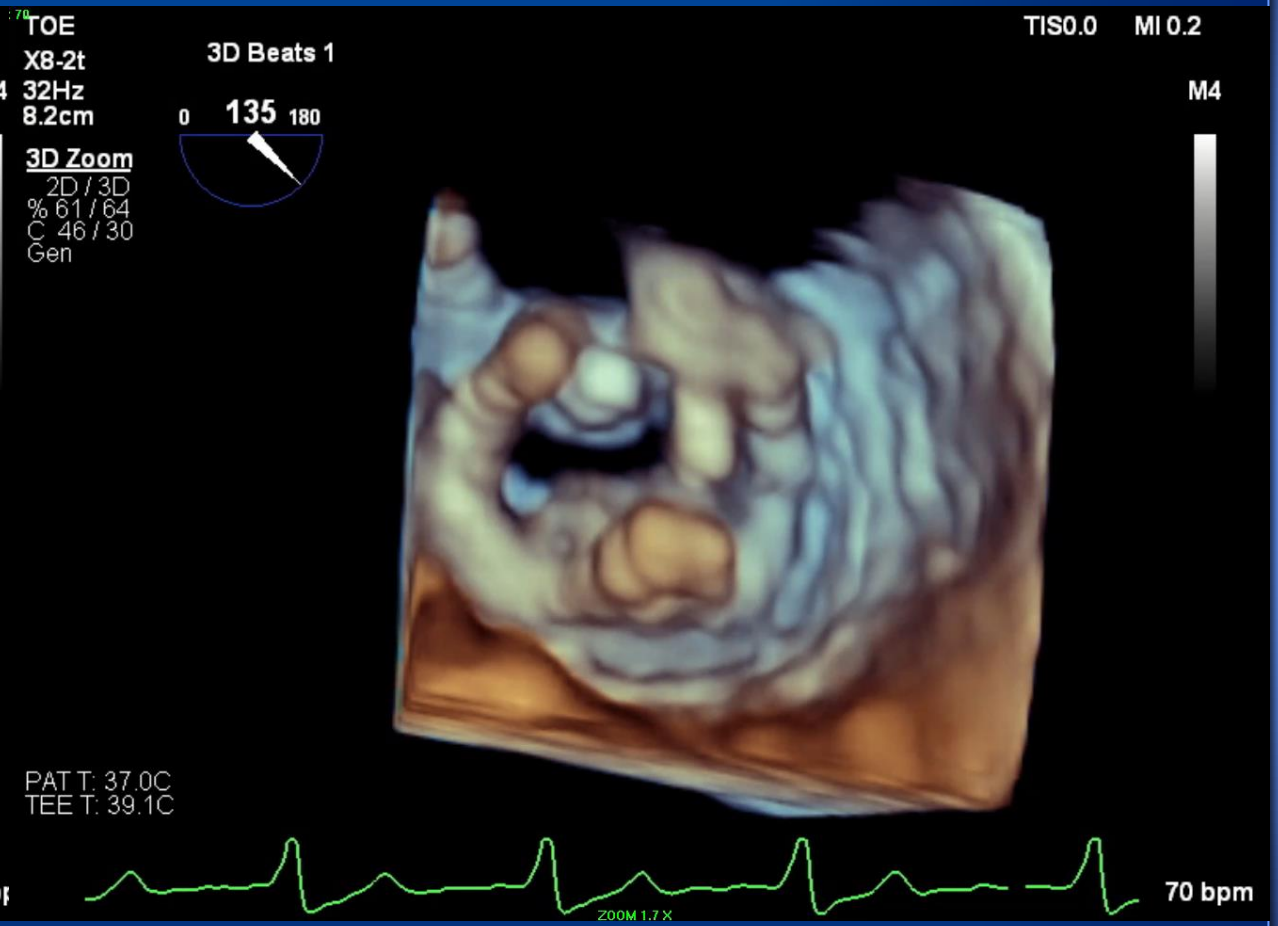
Case Three – LAMPOON – tip to base

- **Step Four**
  - Piggyback or similar microcatheter into ipsilateral Astato wire (RFV)
  - Create flying V for laceration
- **Step Five**
  - Exteriorize 300cm Astato wire from MPA (vein) to JR4 (LFA)
  - Position MPA/piggyback in the middle of two posts of MVR – TEE guidance



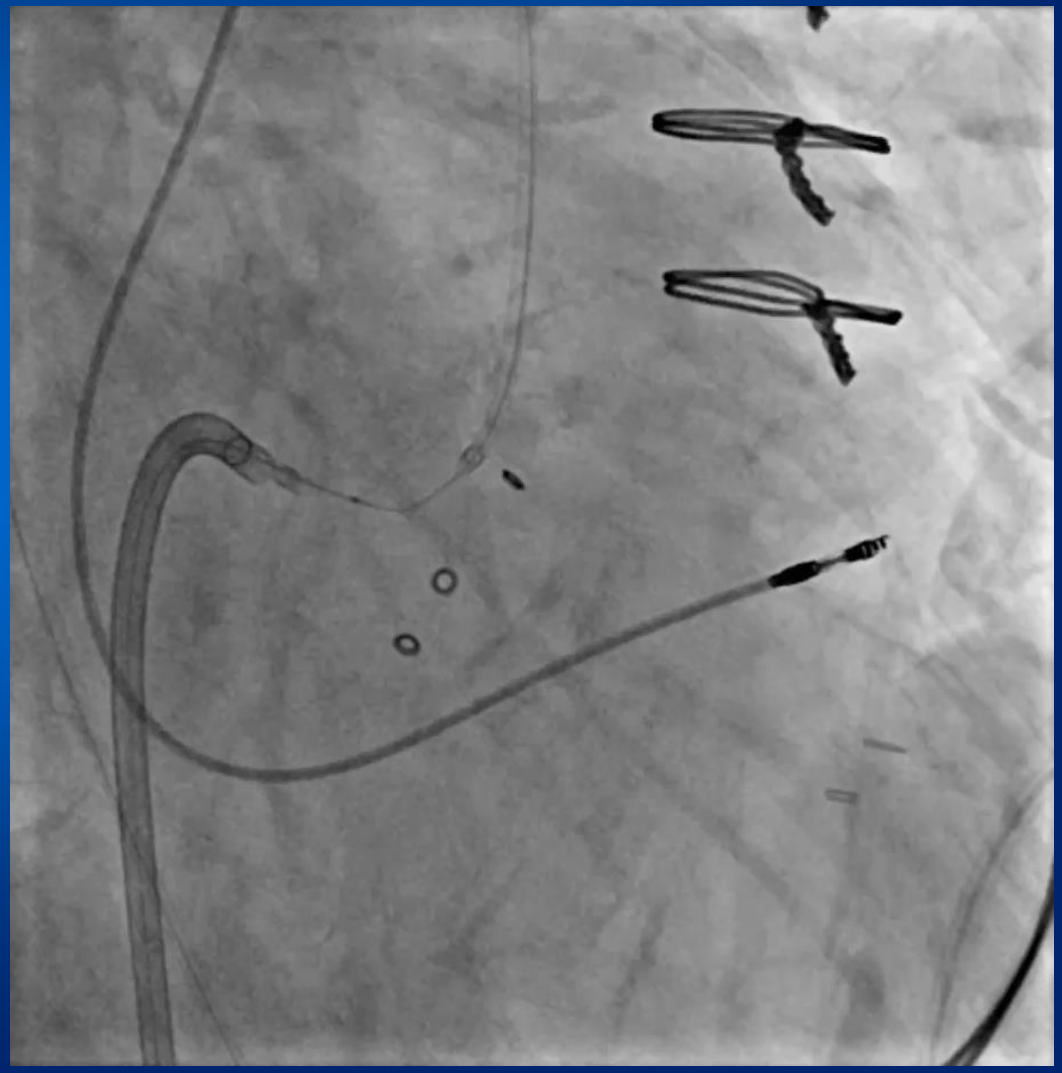
Case Three – LAMPOON – TEE 3D





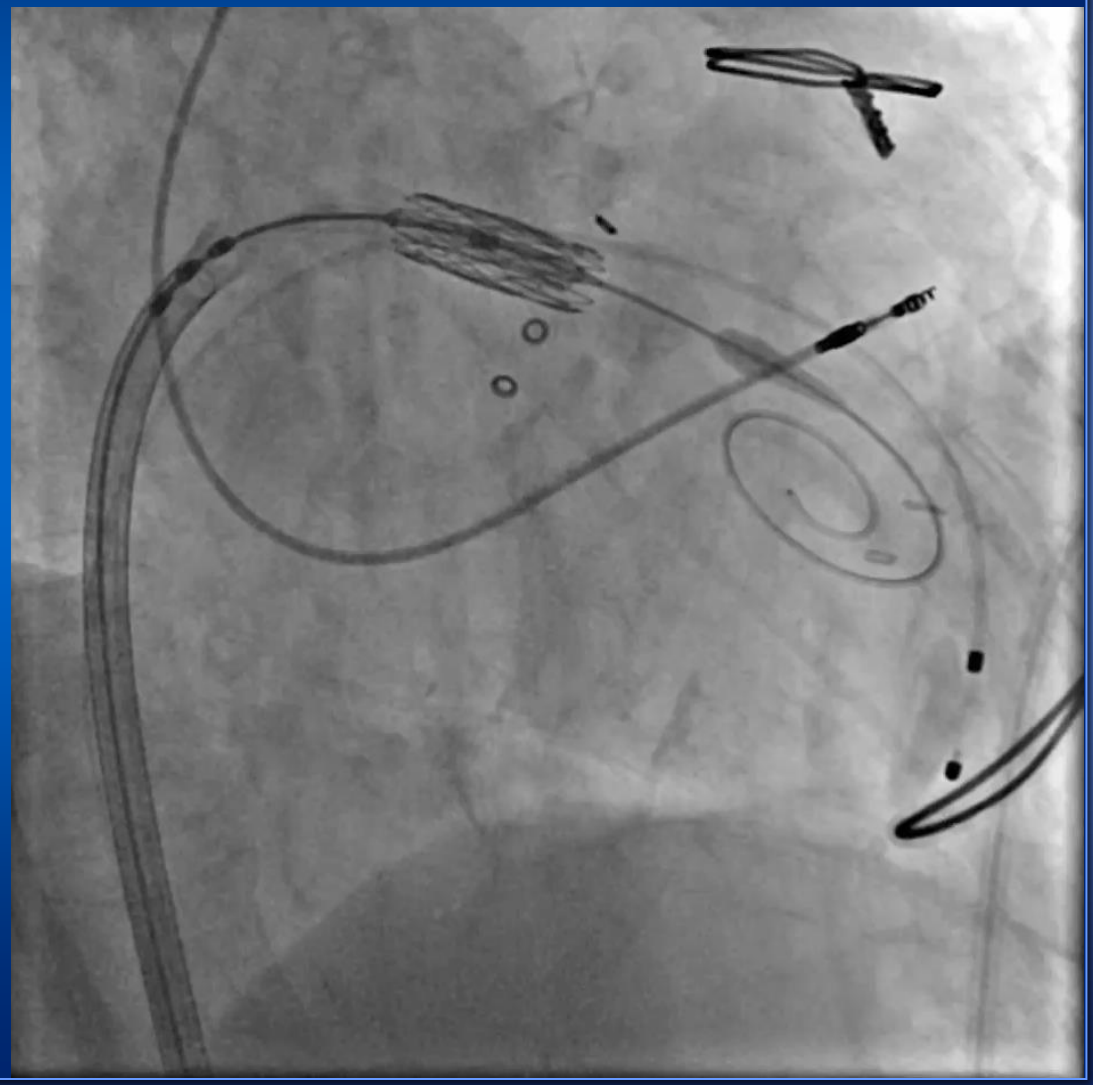
Case Three– LAMPOON – tip to base

- **Step Six**
  - ADVANCE JR4 ACROSS AORTIC VALVE
  - Avoid laceration of aortic valve
  - Laceration with 70W cutting with 5% dextrose infusion
- **Step Seven**
  - Remove Agilis
  - Exchange for Safari ES wire in LV
  - Balloon septostomy 14mm



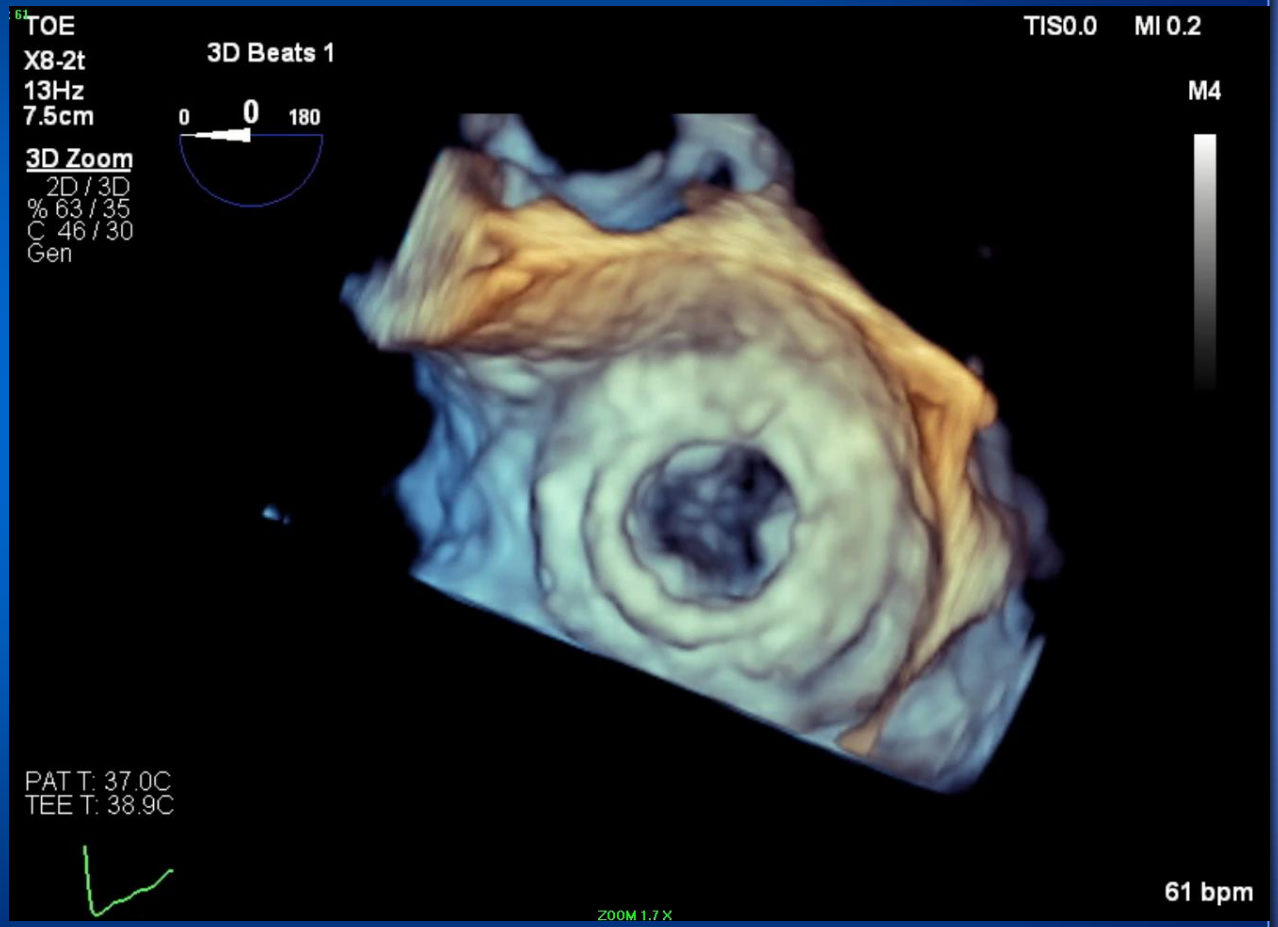
Case Three – TSMVIV

- **TSMVIV**
  - 23mm S3 THV +3cc
  - Inflated at 10 ATM



Case Three – TSMVIV final results

- **TTE day one**
  - Mean TSMVIV gradient: 8mmHg
  - EOA 1.5cm2
  - No PVL
  - No LVOT gradient but turbulent flow through LVOT



Case Four

Valve sizing dilemma

Case Four

- 79-year-old male; BSA 1.8m2, Wt 73kg, Ht 165cm

- 20 year prior MV repair
- 13-year-old Mosaic MVR
- Stenotic failure

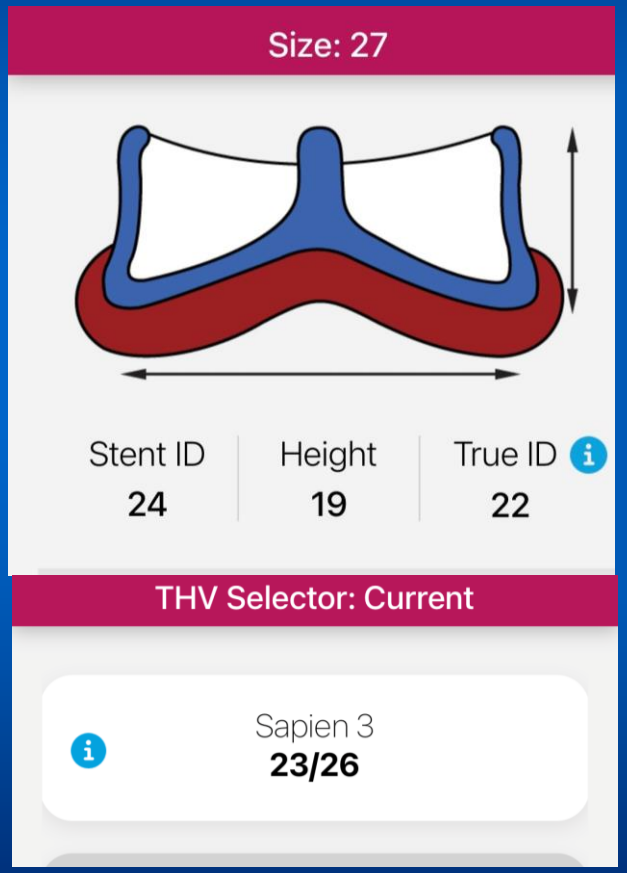
- STS redo redo 15.2%

- For TSMVIV if feasible

- 26mmS3 vs 23mmS3???

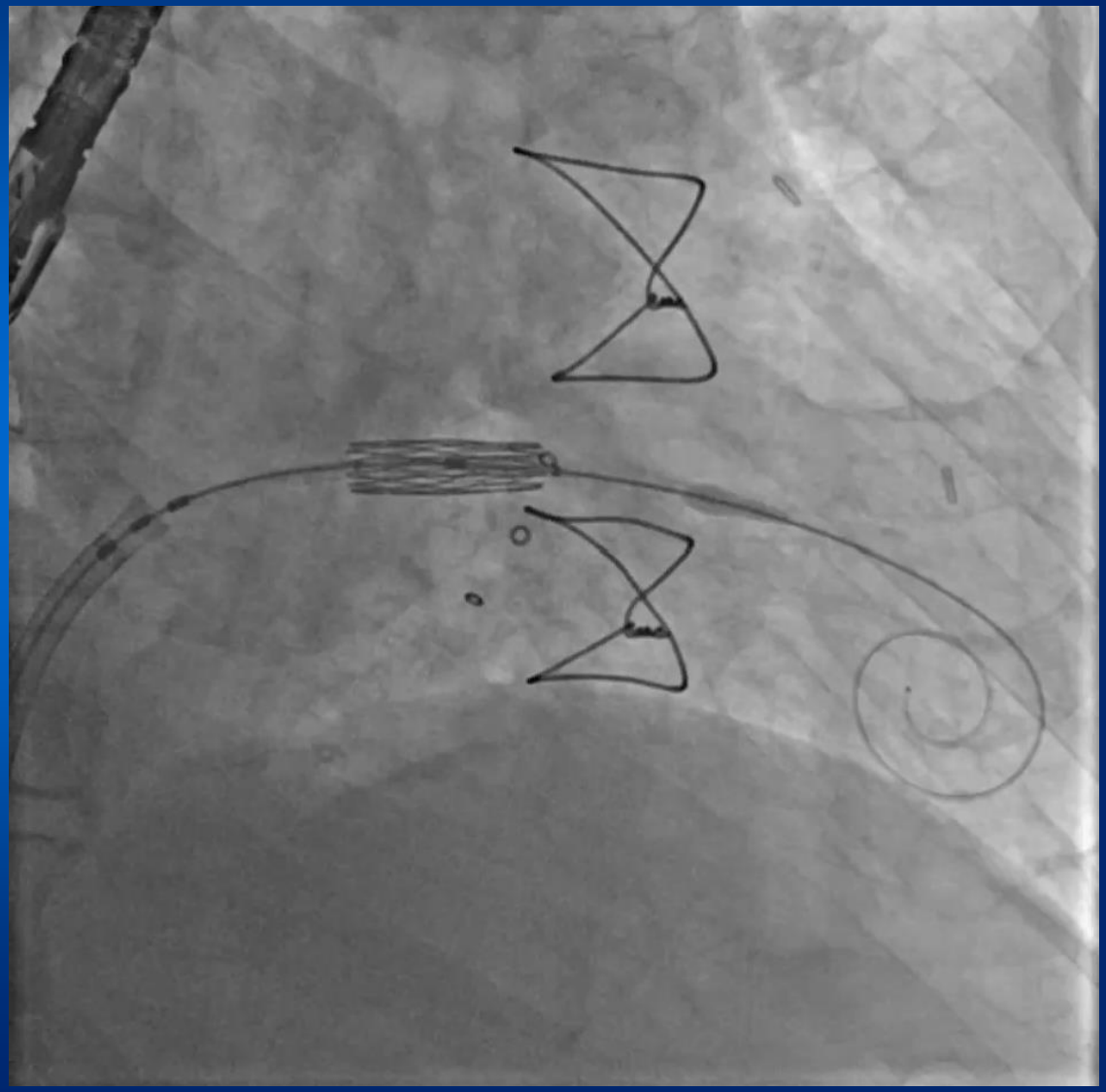
Case Four

- Valve choice dilemma – 27mm Mosaic MVR
- 23mm vs. 26mm
- Given no risk for LVOTO and body habitus
- 26mmS3 with BVF



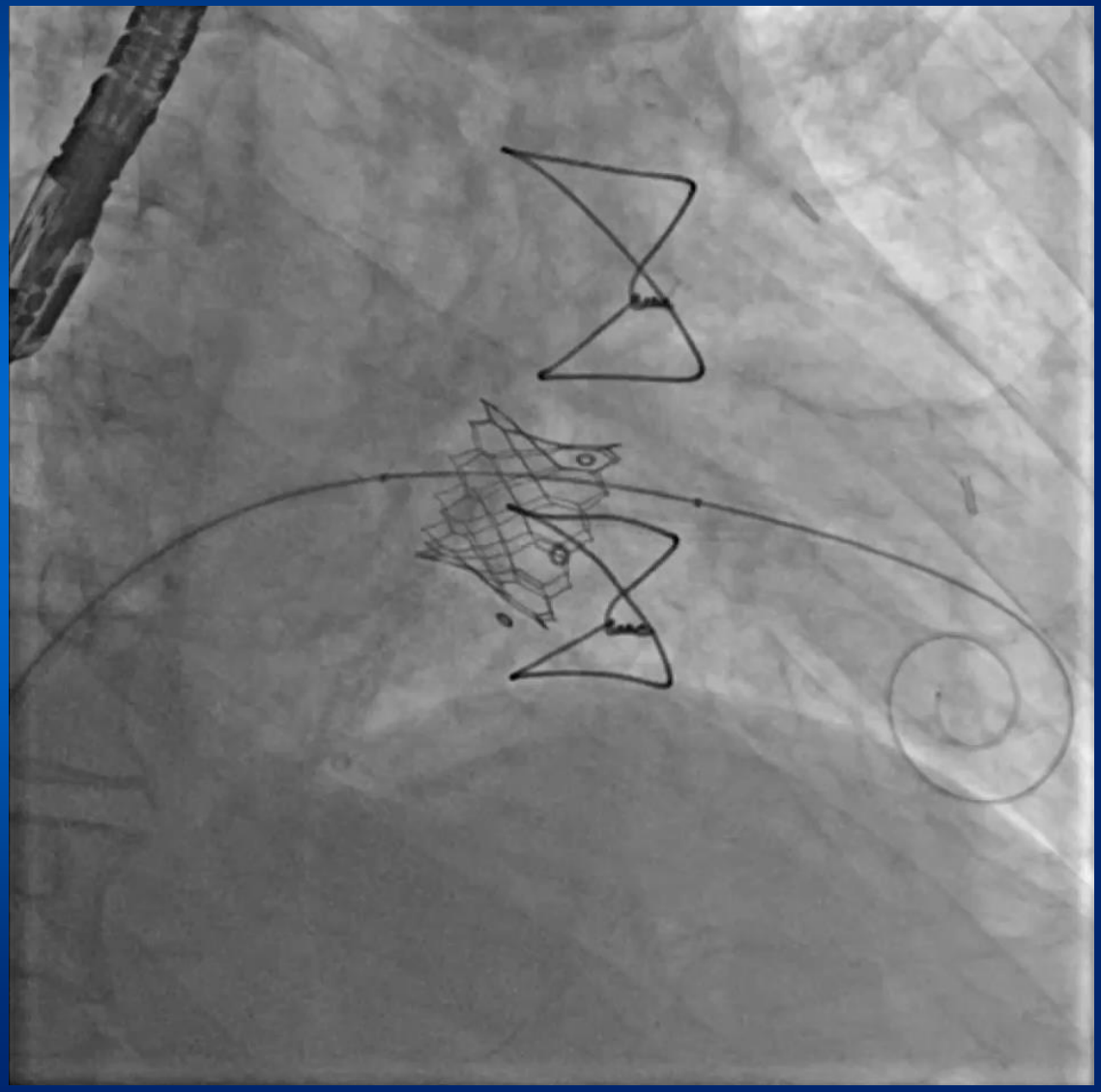
Case Four

- TSMVinV with 26mmS3U THV
- Deployed at 8atm
- Full volume inflation



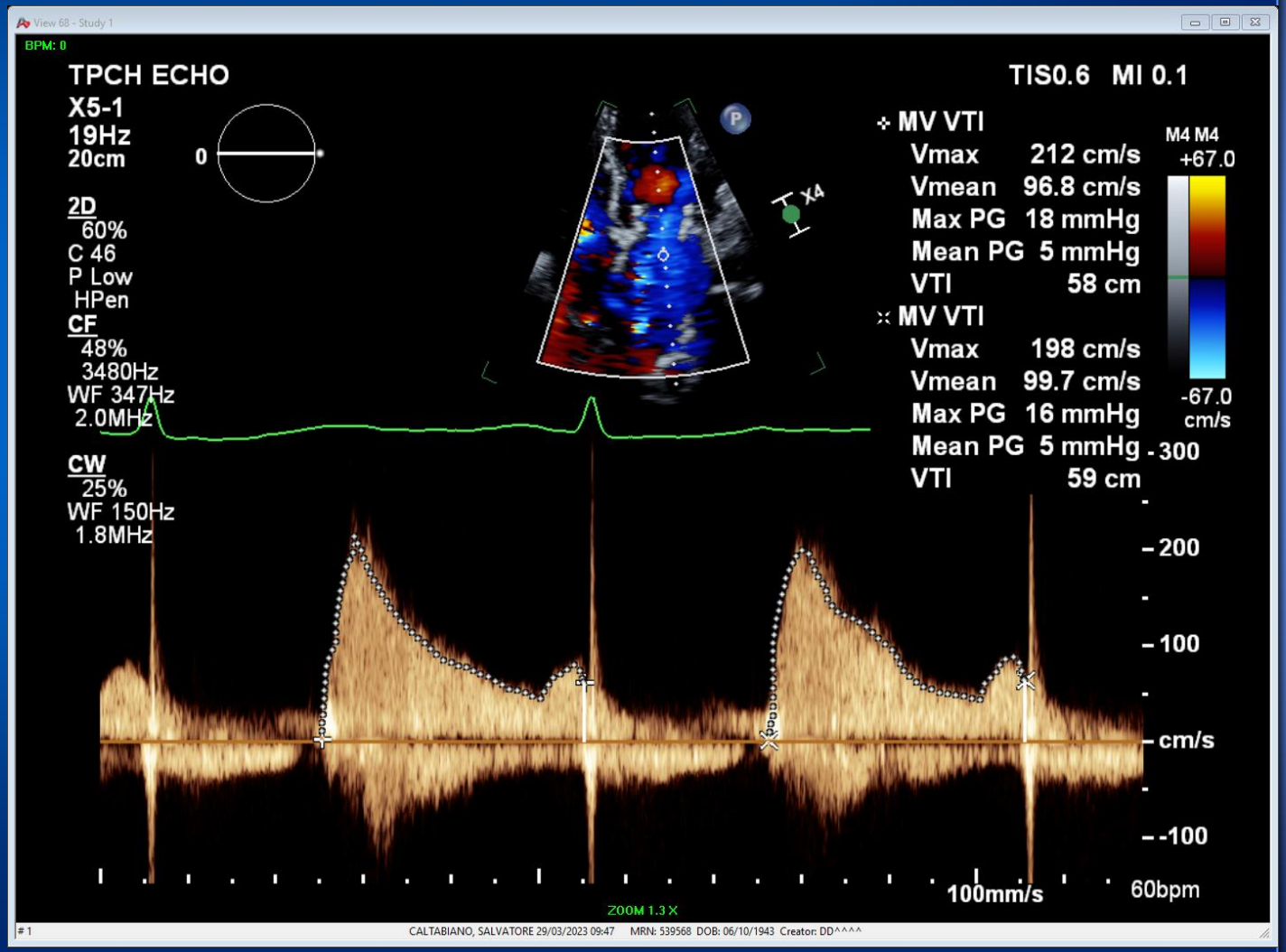
Case Four

- Significant waist on sewing ring for 26mm S3U
- BVF as planned – 26mm TRUE balloon at 16 atm



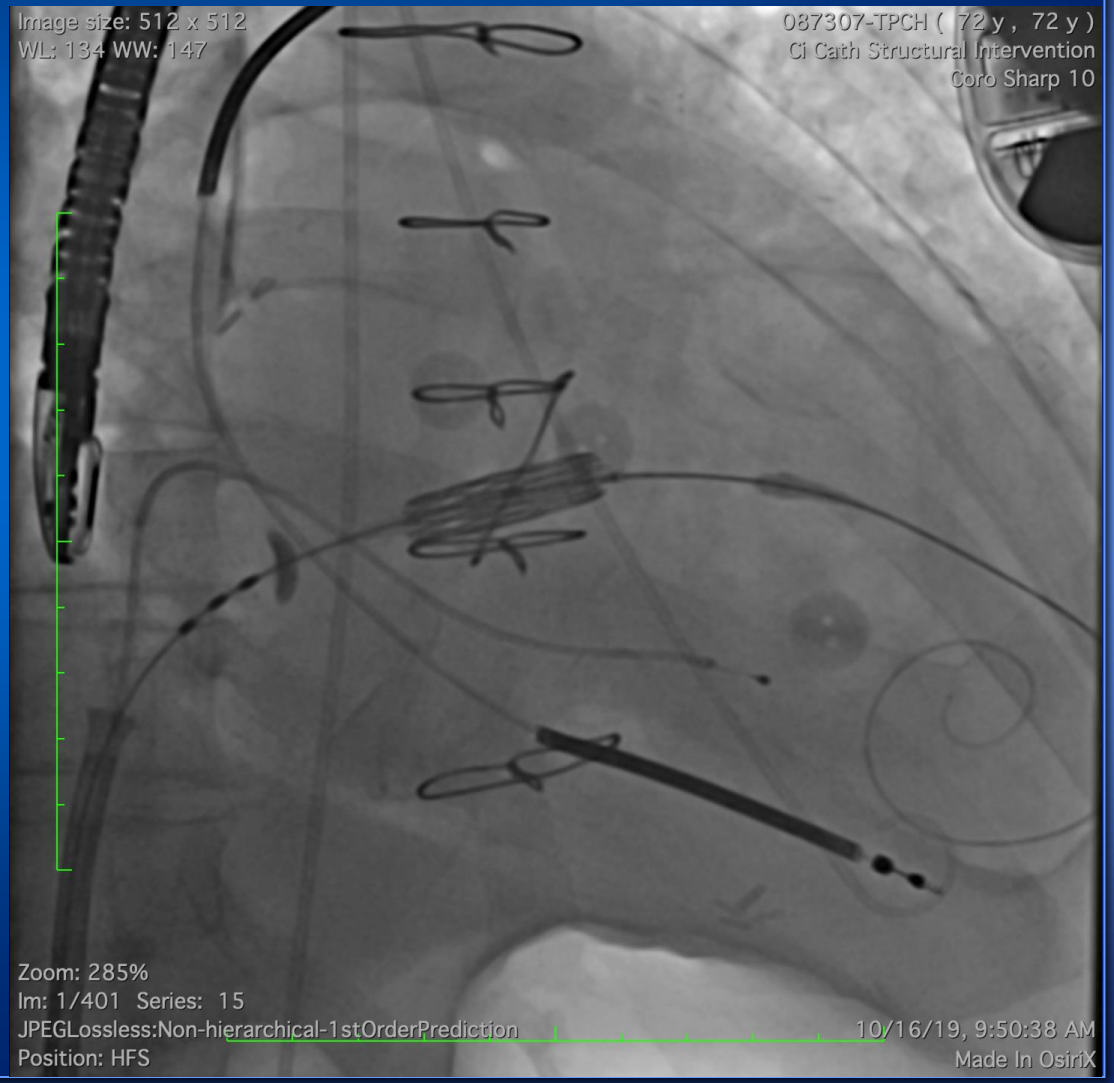
Case Four – results

- One-month TTE
  - Mean gradient 5mmHg
- In general avoid 23mm S3



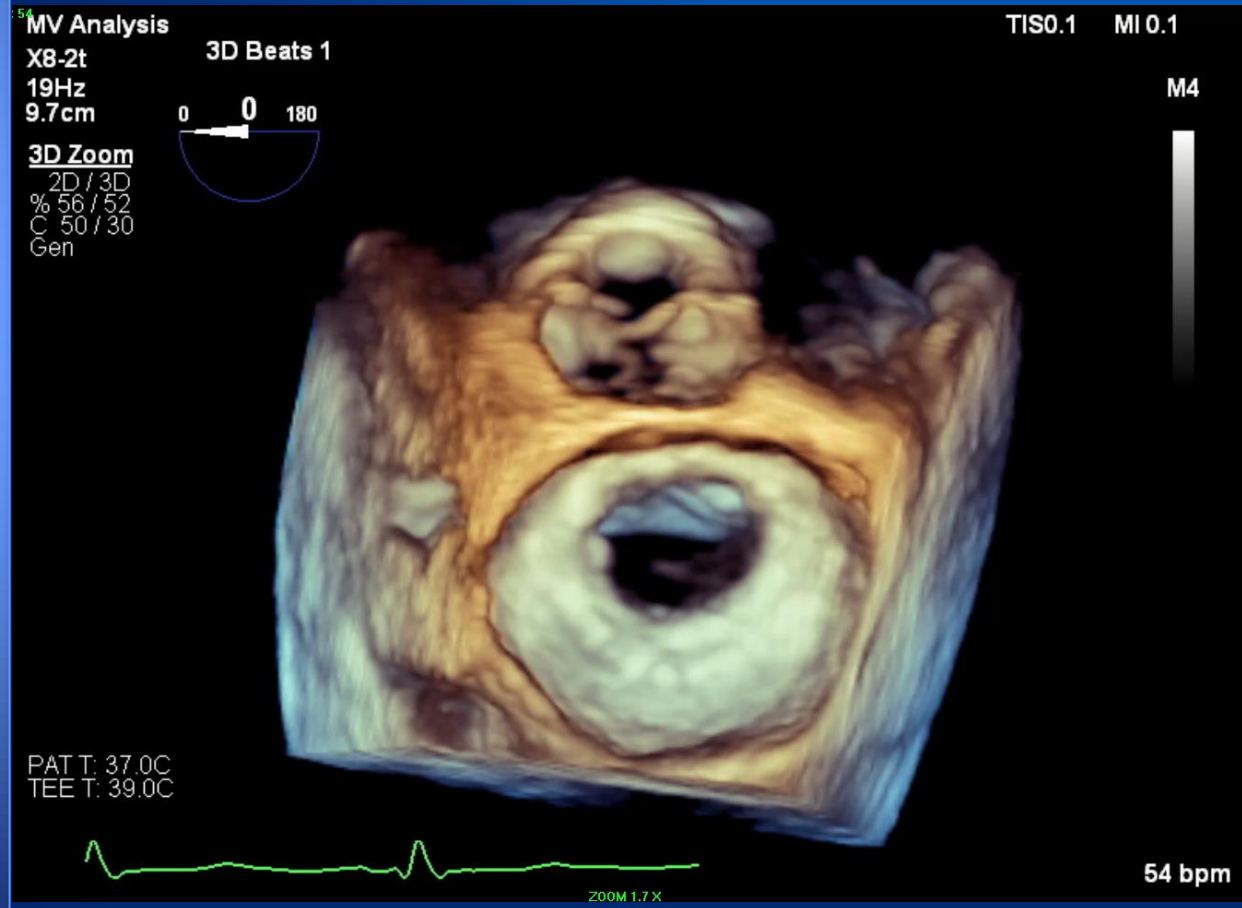
Case Five - TSMVinRing

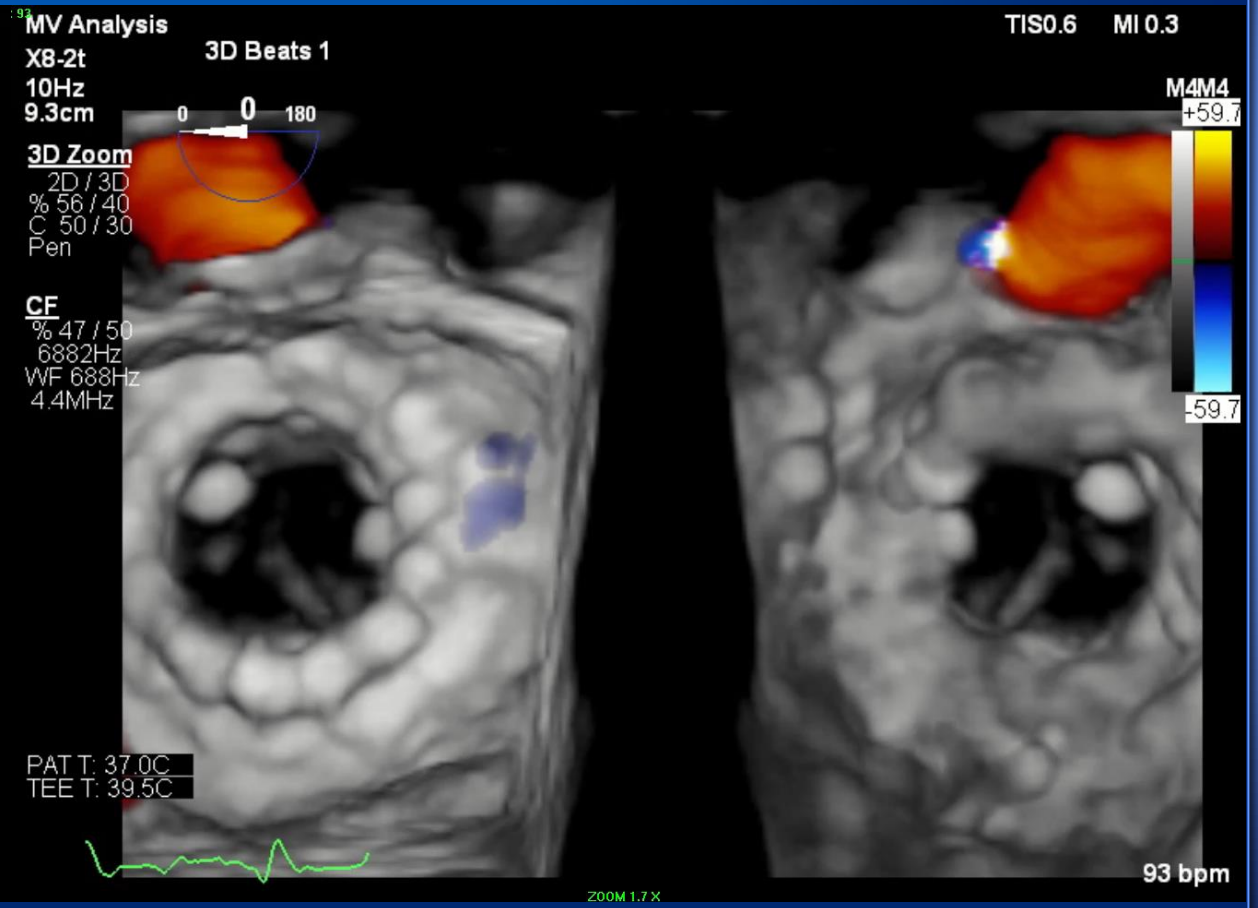
- 72-year-old male; BSA
- 7-year-old Duran 29mm Ancore complete ring
- Regurgitant failure (dominant)
- STS 8.9% (LVEF 16%!!!)



Case Five – TSMVinR – why so difficult?

- Free moving thin leaflets
- Good final results no regurg





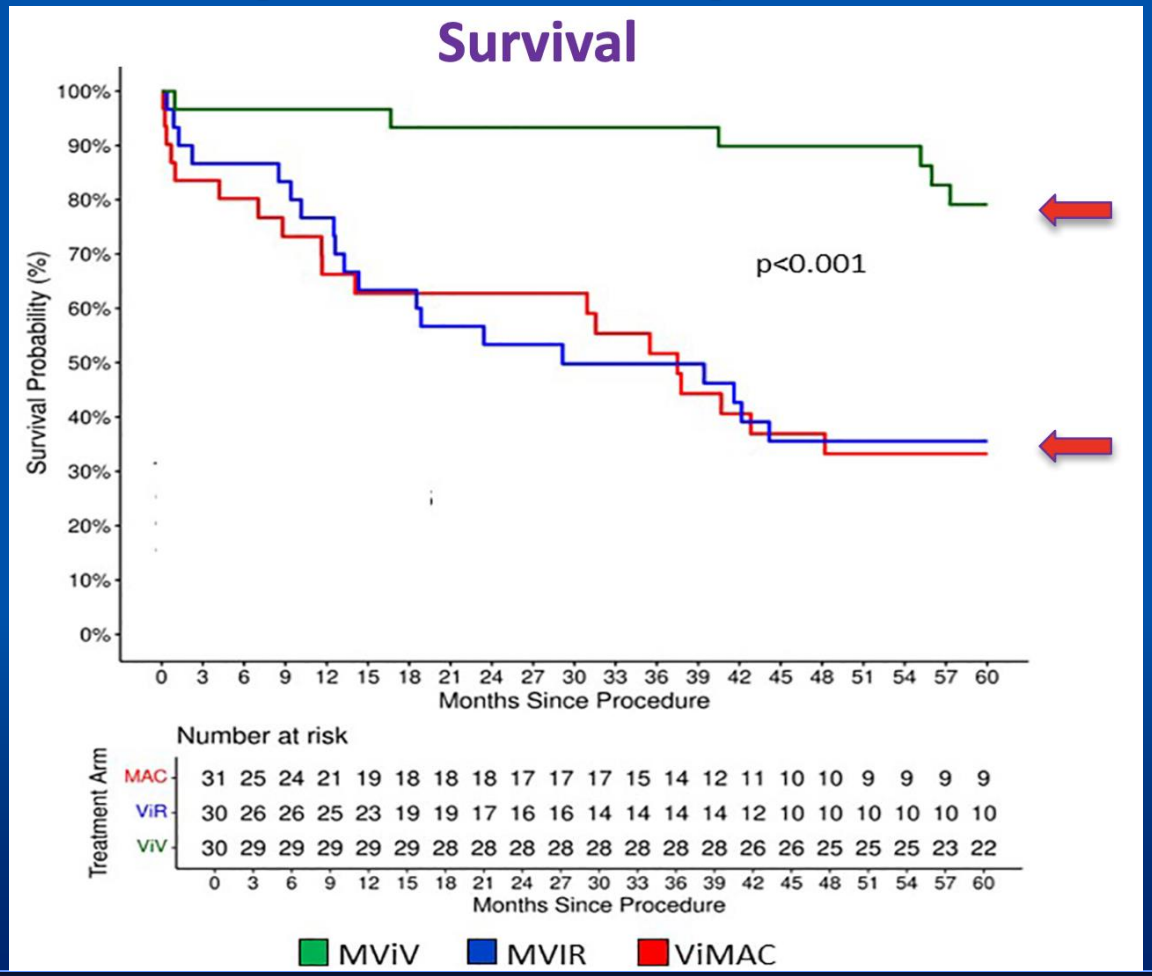
5-Year Clinical Outcomes

	MViV n=28 (%)[a]	MViR n=29 (%)[b]	MAC n=28 (%)[c]
All-cause Death	**6 (21.4%)**	**19 (65.5%)**	**19 (67.9%)**
Cardiovascular	3 (10.7%)	10 (34.5%)	8 (28.6%)
Non-Cardiovascular	3(10.7%)	9 (31.0%)	11 (39.3%)
Stroke	4 (14.3%)	2 (6.9%)	5 (17.9%)
Ischemic	2 (7.14%)	1 (3.4%)	5 (17.9%)
Mitral Valve Reintervention *1 PVL closure attempt followed by surgical MVR. 1 TS MViV and PVL closure, 1 PVL closure. ** 1 TS MVIV, 1 Transatrial TMVR, 2 PVL closures.	1 (3.6%)	3 (10.3%)*	5 (17.9%)**
Septostomy closed (in transseptal cases)	3 (10.7%)	7 (24.1%)	5/13 (38.5%)
Hemolytic Anemia (* 1 prior to discharge treated with PVL closure attempt followed by surgical MVR. 1 after 30 days treated conservatively. **3 at 30 days, 1 required MViV and 2 spontaneously resolved. 2 more at 1-year, 1 required PVL closure, 1 treated conservatively).	0	2 (6.9%)*	5 (17.9%)** Only 2 required MV intervention
Device migration or embolization after index procedure	0	1 (3.4%)	0
Acute Kidney Injury requiring new onset hemodialysis	1 (3.6%)	5 (17.2%)	5 (17.9%)
Hospitalization for heart failure	8 (28.6%)	11 (34.5%)	12 (42.9%)
Transcatheter valve thrombosis	1 (3.6%)	0	2 (7.1%)
Valve endocarditis	0	0	2 (7.1%)

[a] 1 lost follow-up after 1194 days and 1 withdrew consent after 1,381 days.
[b] 1 withdrew consent at 860 days.
[c] 3 withdrew consent at 8, 187 and 651 days.

Case Five – TSMVinRing

- Why are the results so poor and on par with TSMVinMAC?



Case Six – MAC

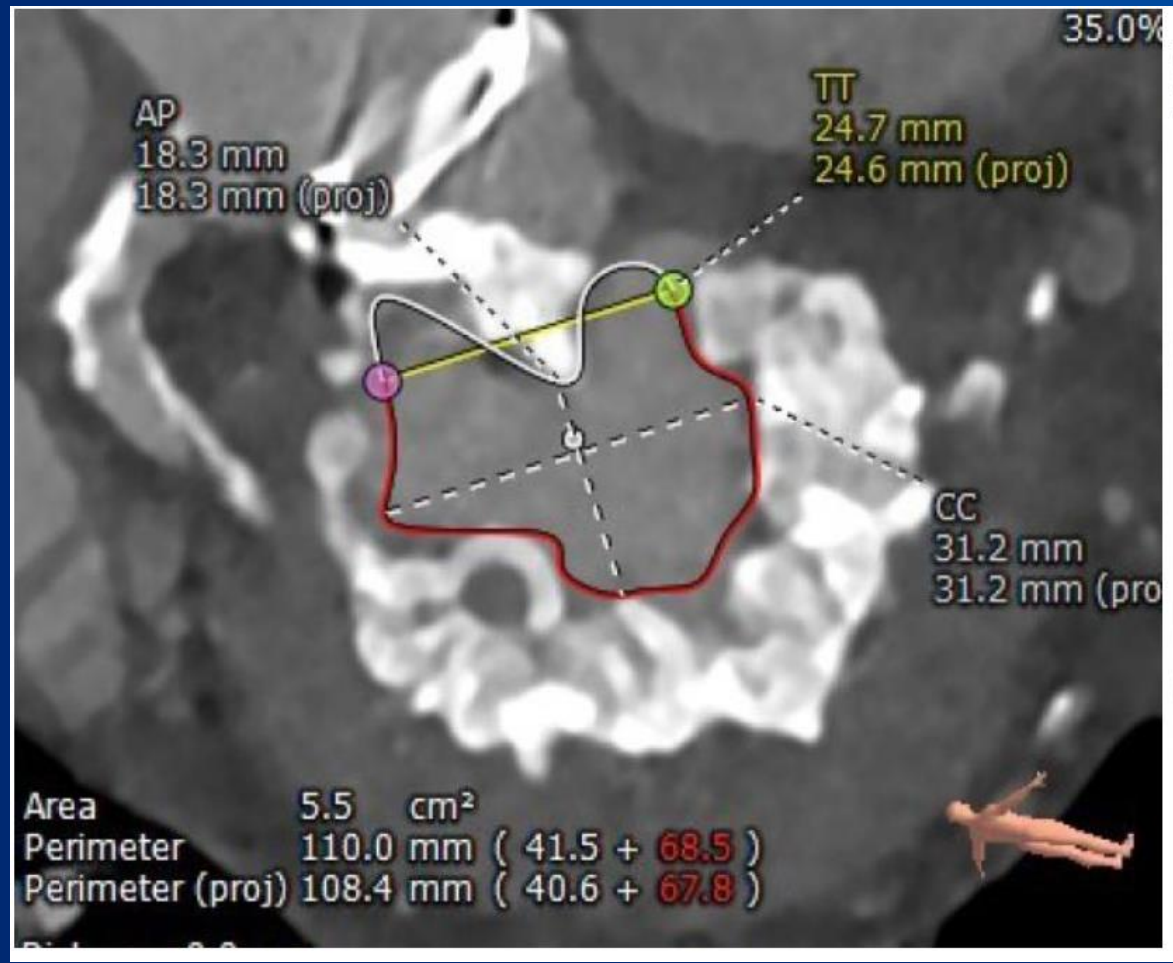
- 63 year old male; BSA 1.91m2, Ht 169cm, Wt 78kg

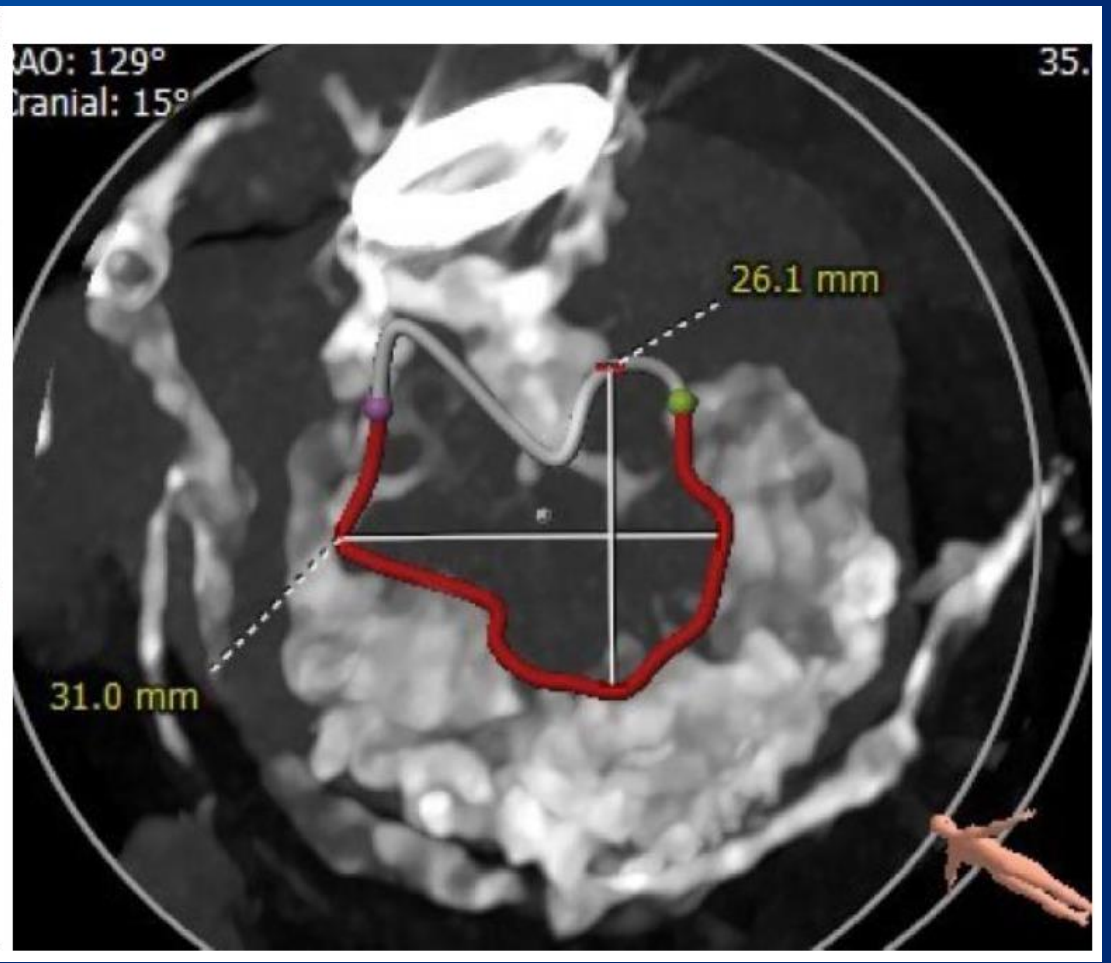
- CABGX2/AVR 21mm StJ 2007
- PCI from LM into LCx
- Hemodialysis

- Now mitral stenosis; significant MAC

- Inoperable (but highly functional)

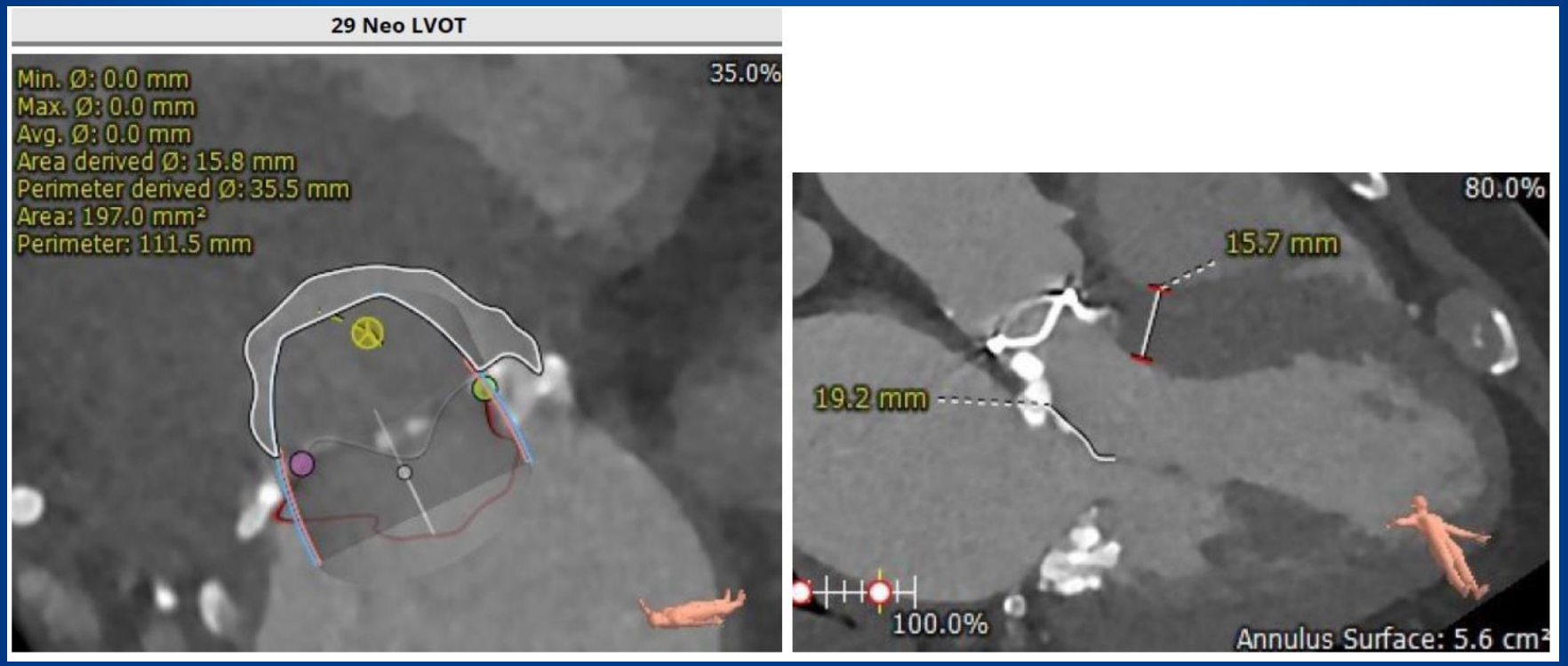
Case Six – MAC


35.0%
AP
18.3 mm
18.3 mm (proj)
TT
24.7 mm
24.6 mm (proj)
CC
31.2 mm
31.2 mm (pro
Area 5.5 cm²
Perimeter 110.0 mm (41.5 + 68.5)
Perimeter (proj) 108.4 mm (40.6 + 67.8)


AO: 129°
35.
26.1 mm
31.0 mm

Case Six – MAC

- Concern about mechanical AVR interaction with a 29mm S3



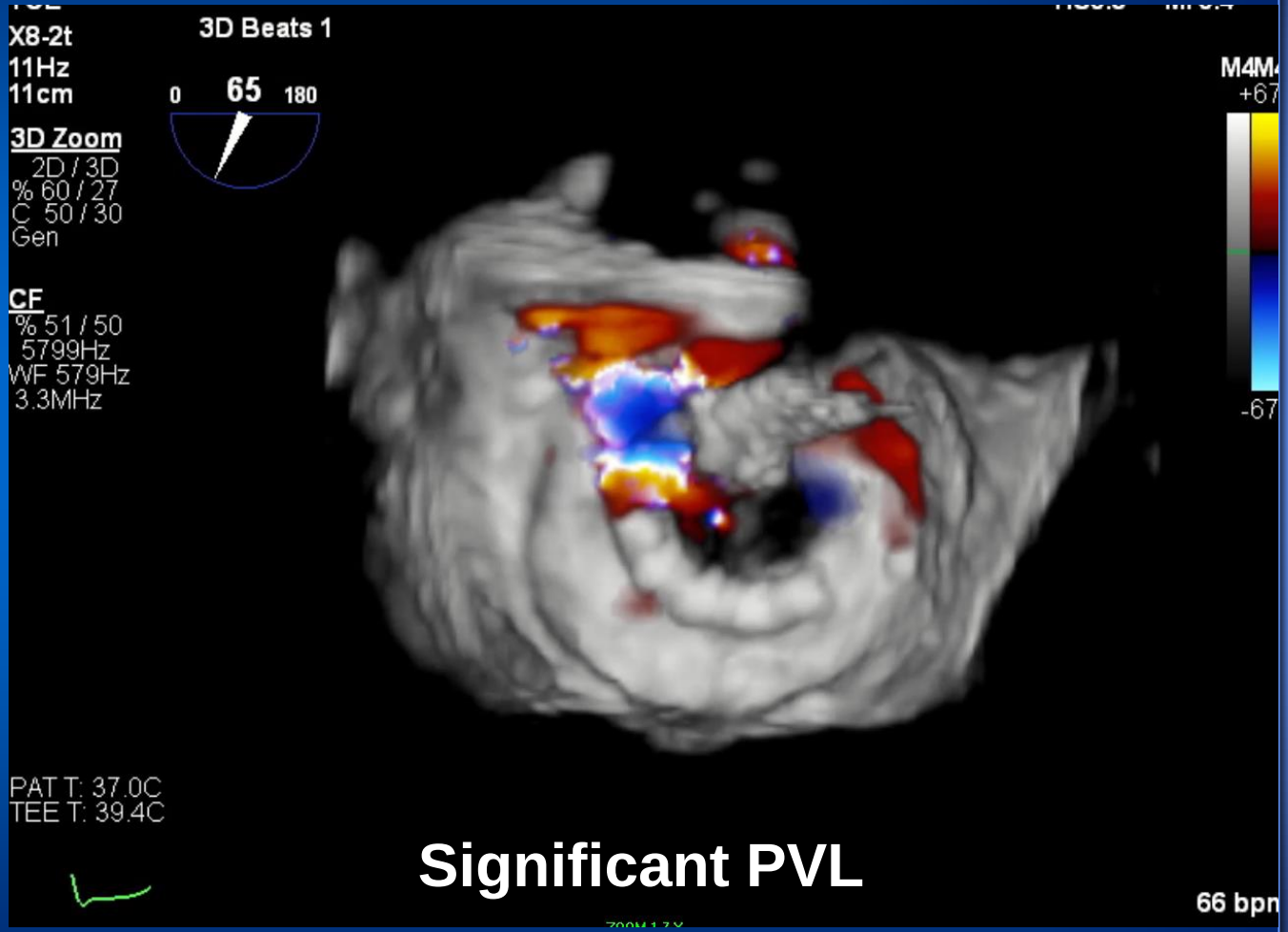
- But risk of LVOTO should be low

Case Six – MAC

- **Procedural plan**
  - R TF TSMVinMAC 26 or 29mm S3 depending on PBAV result and waist
  - Test interaction with St Jude AVR
- **Pre PBAV with 28 mm Valver balloon**
  - No waist at all
- **29mm S3 THV**

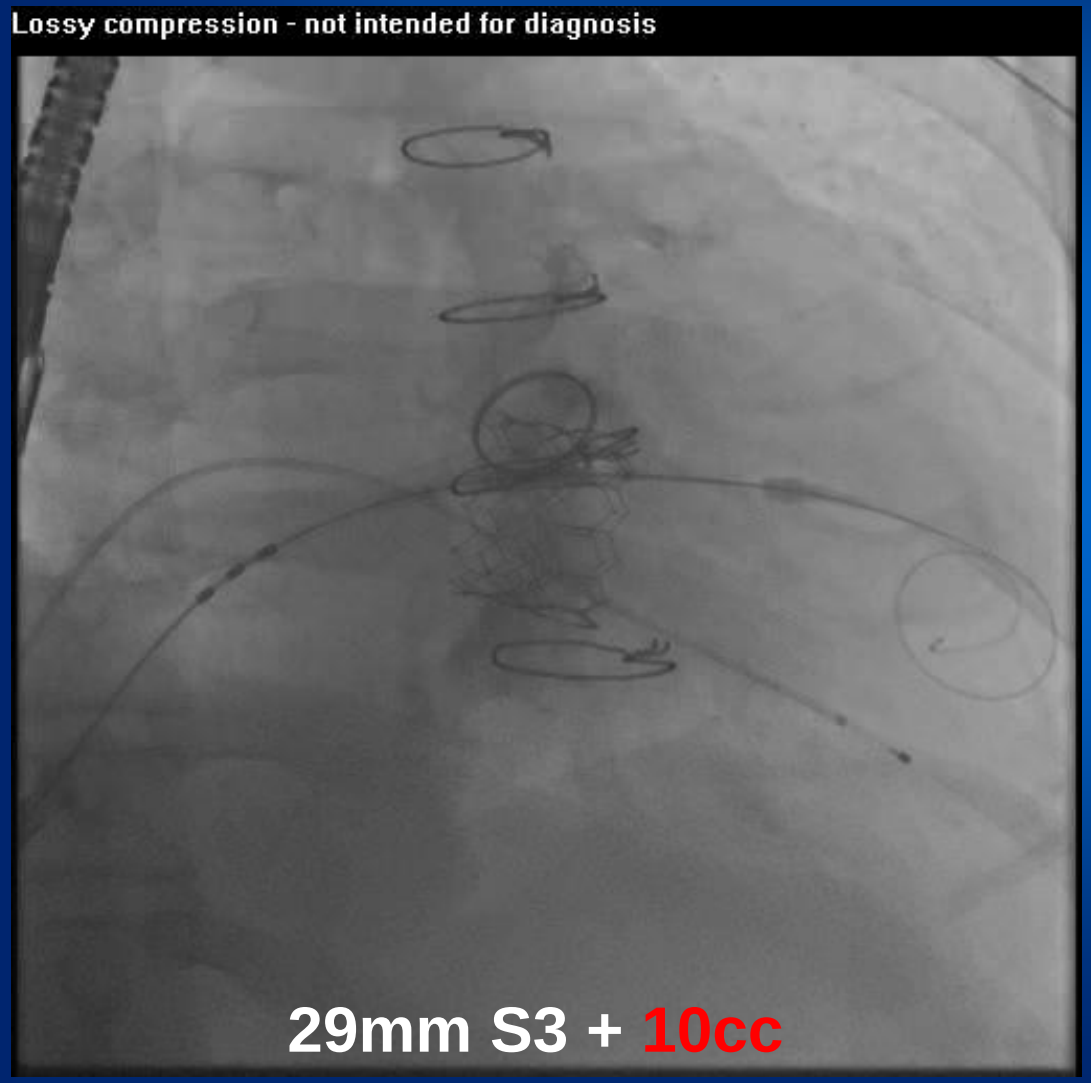
Case Six – MAC

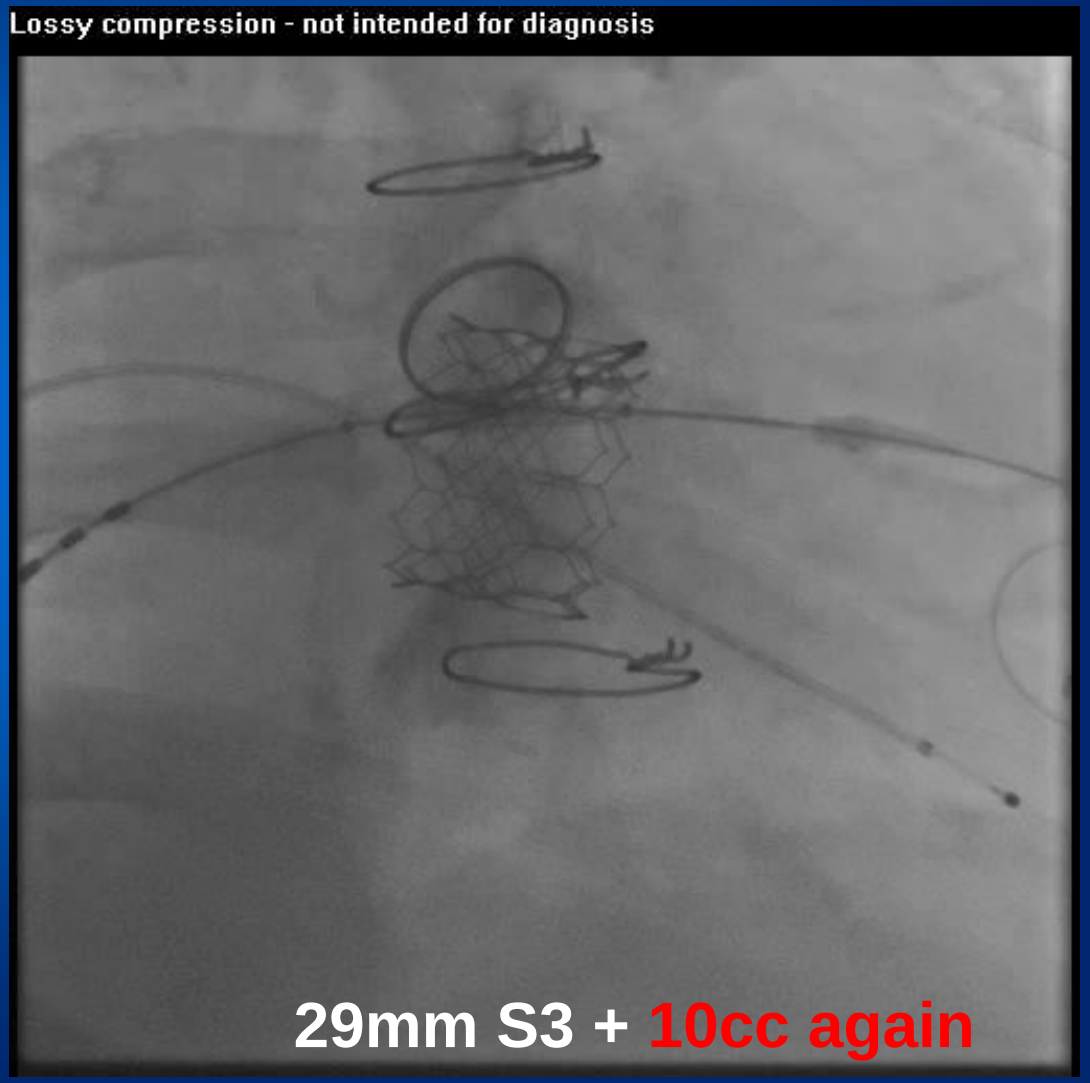
29mm S3 – 2cc



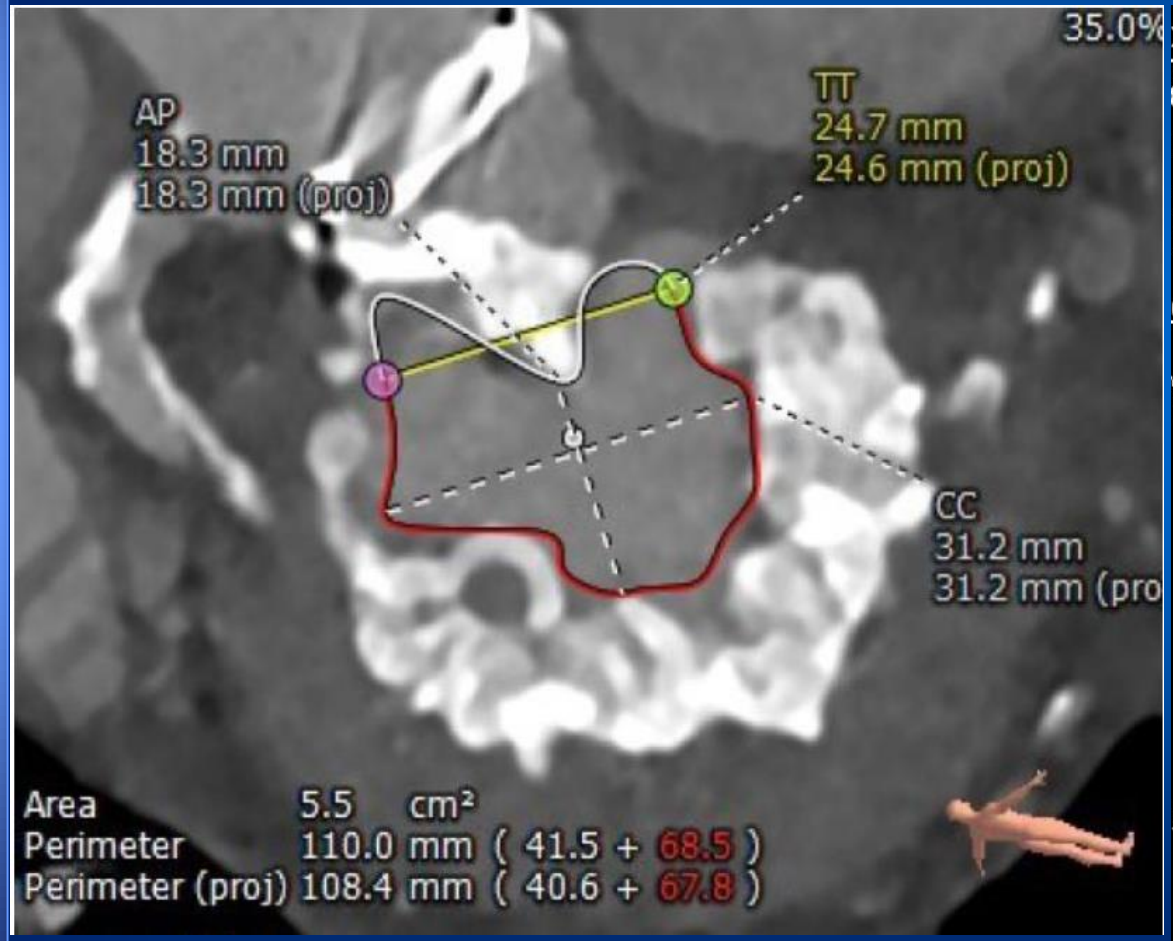
Significant PVL

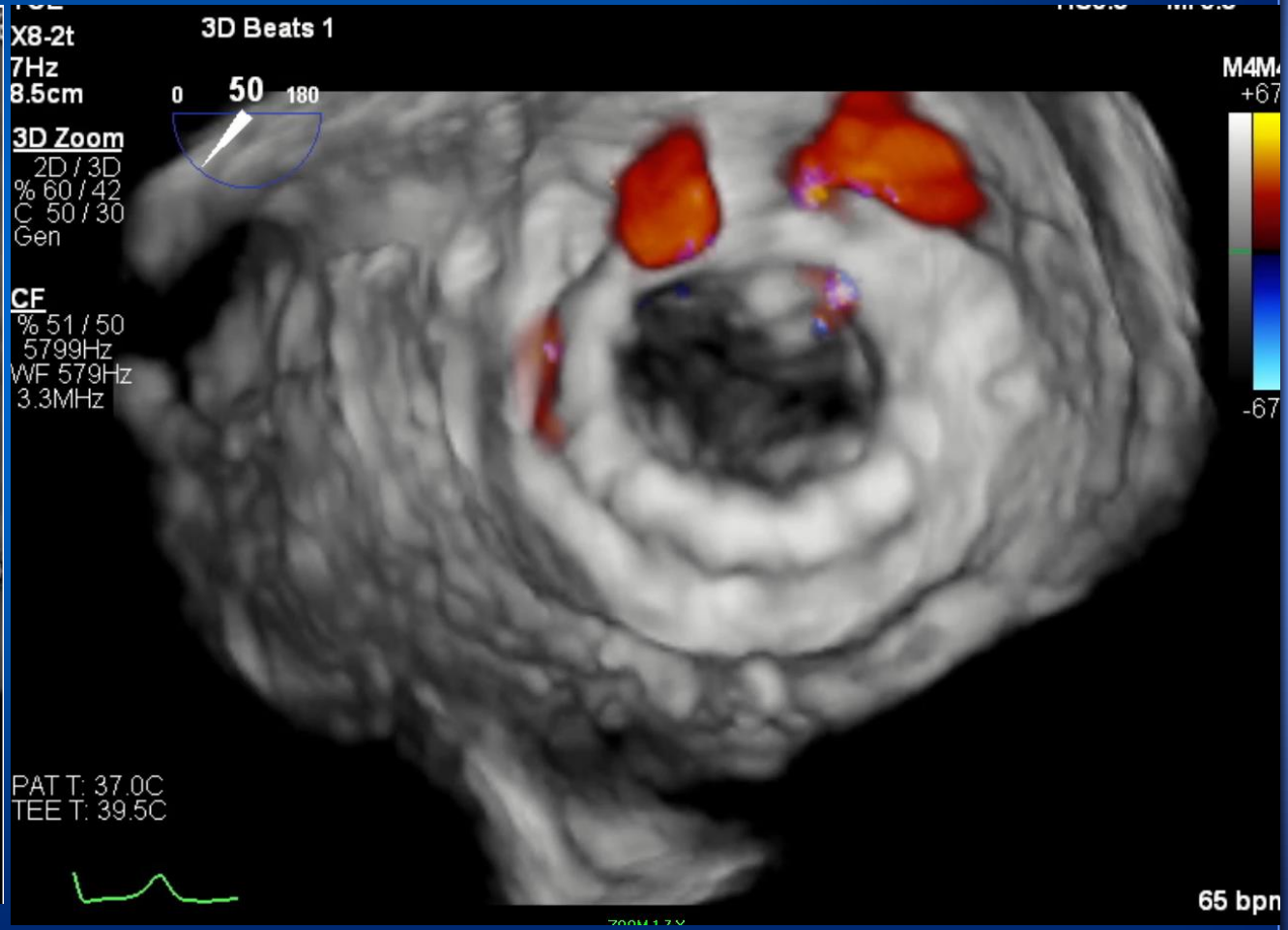
Case Six – MAC


Lossy compression - not intended for diagnosis
29mm S3 + 10cc


Lossy compression - not intended for diagnosis
29mm S3 + 10cc again

Case Six – MAC – TEE result

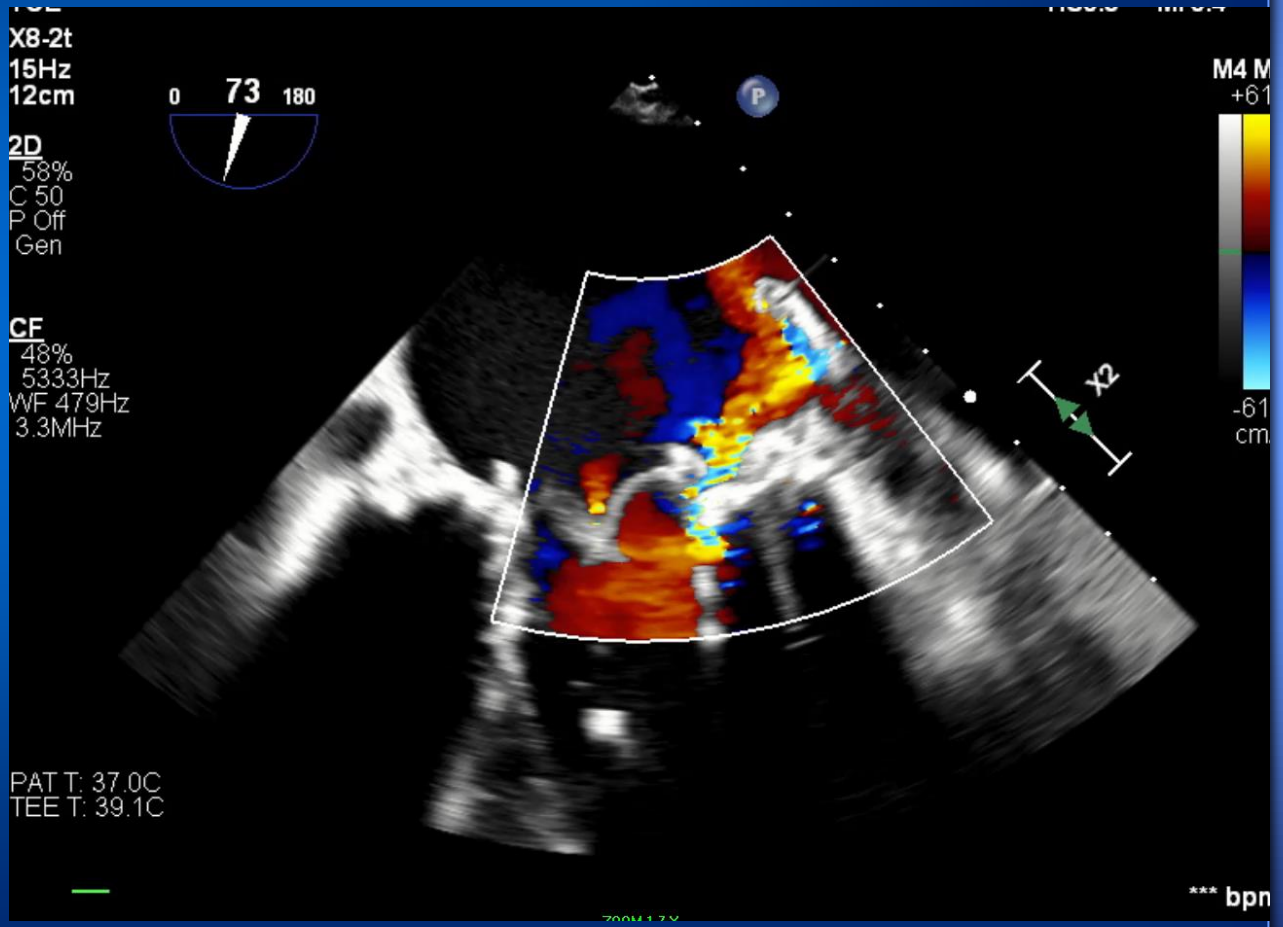




Case Six – MAC – take two…

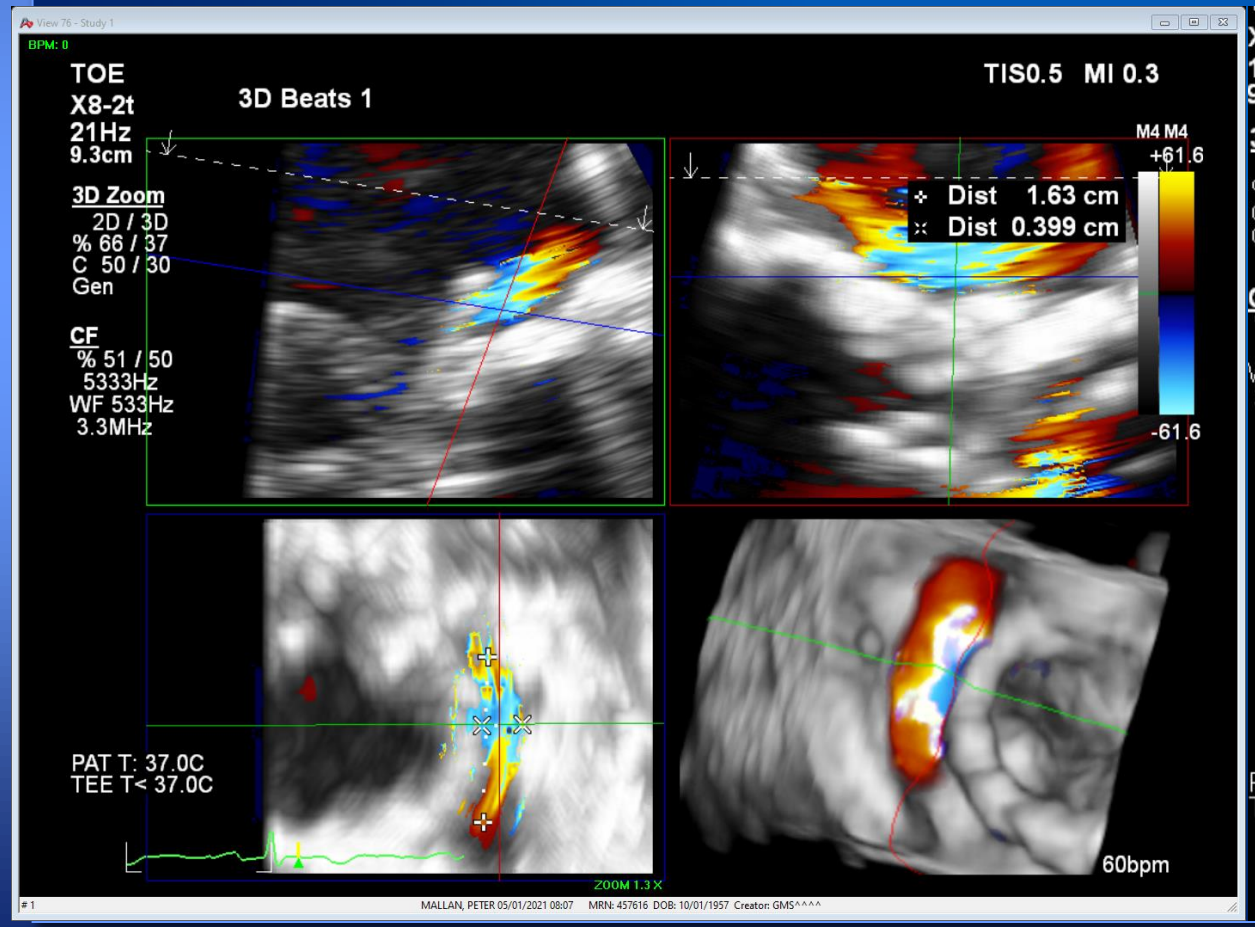
- Ongoing hemolysis/hemoglobinuria
- Transfusion dependence 4/week

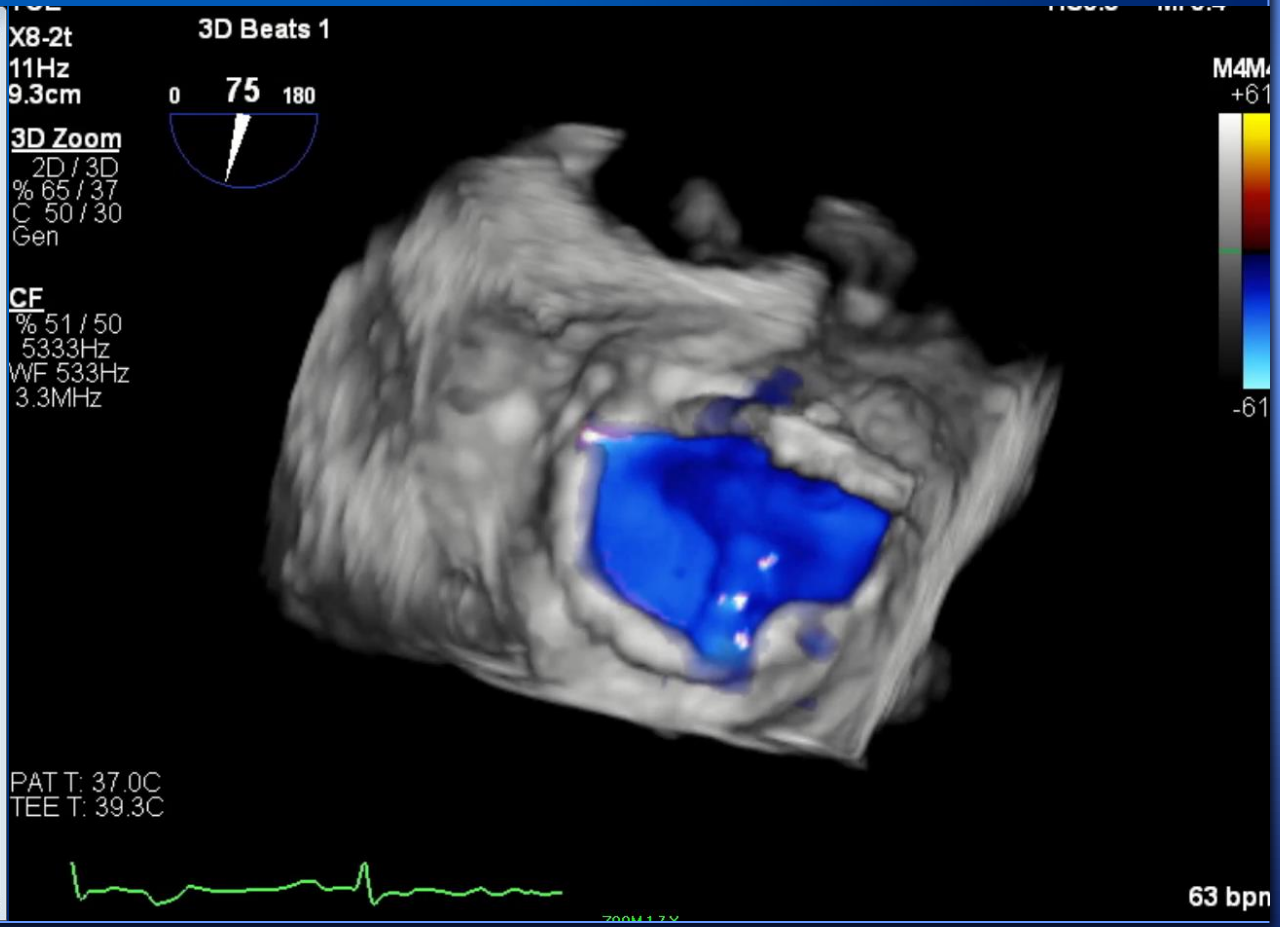
- TTE – not severe
- TEE – severe PVL



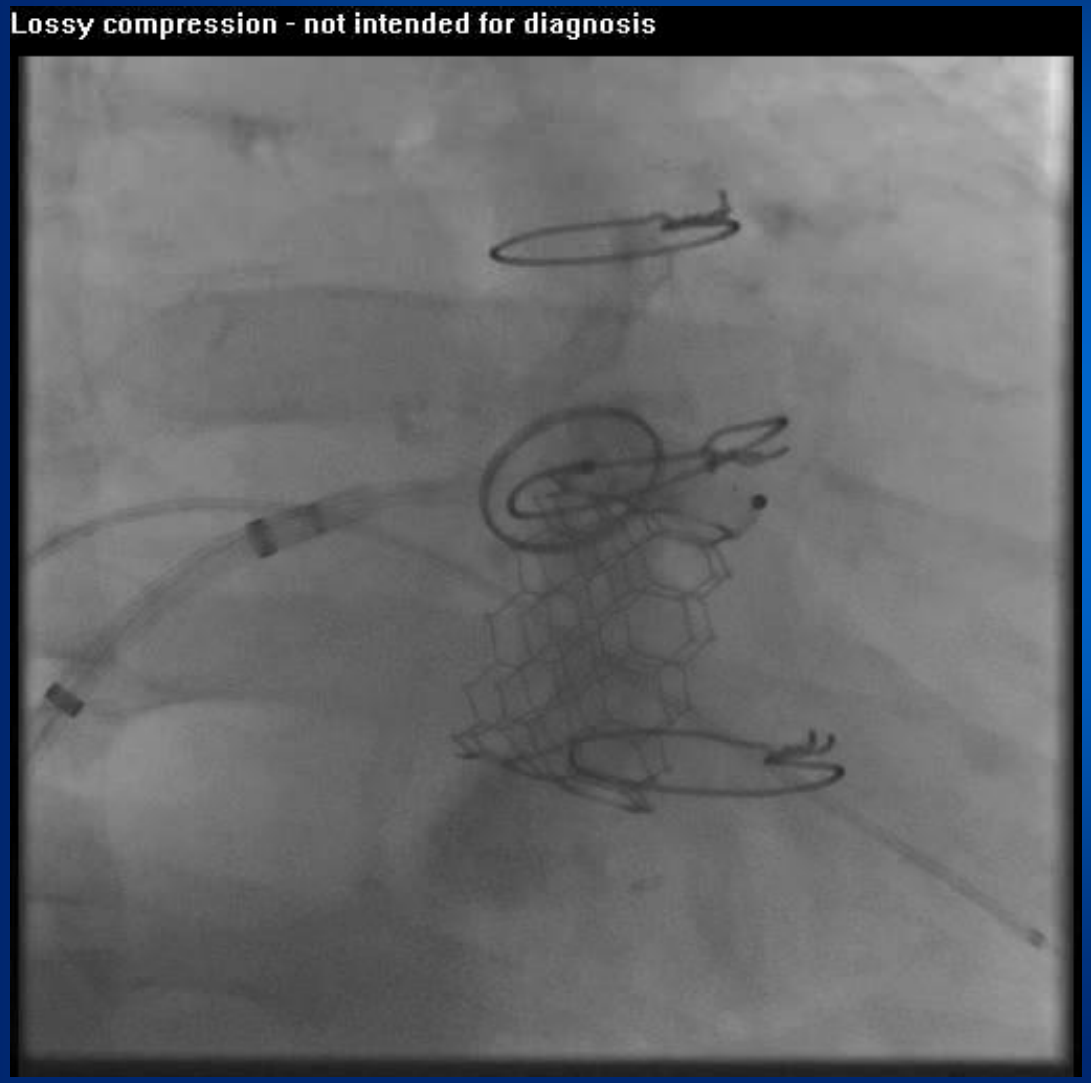
Case Six – MAC – take two…

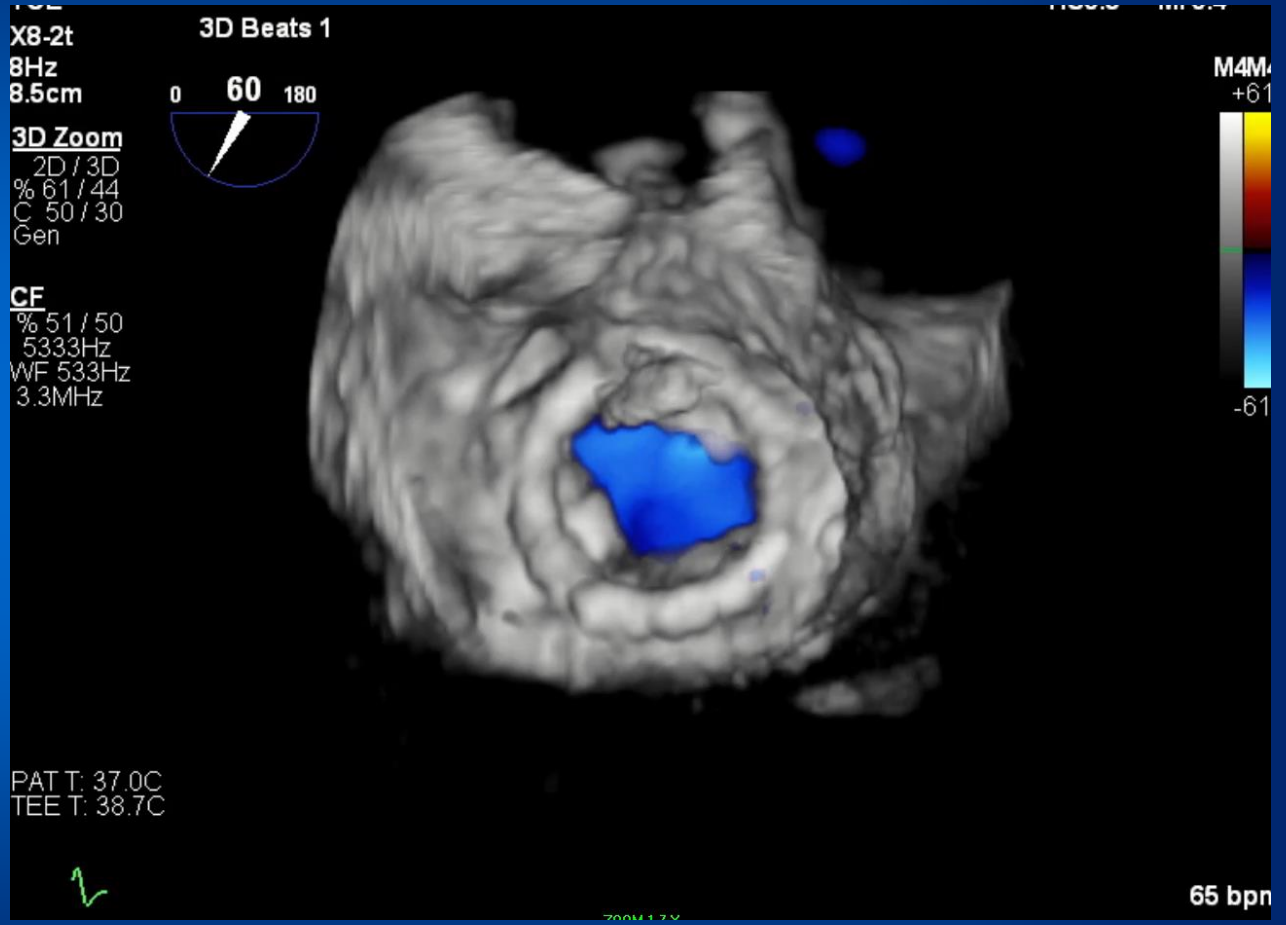
- Two jets – lateral first





Case Six – MAC – take two…





14mmX5 AVPIII

Case Six – MAC – outcome

- Reduced blood transfusion requirement down to once a week
- Occluded LM stent (protected) 8 months later – not to restent
- Unfortunately RIP found unresponsive at home 9 months post TSMVinMAC

Summary – complex TSMVIV/Ring/MAC

1. Importance of follow up
   - TSMVIV ongoing surveillance – although delayed embolization is very very rare
2. Iatrogenic ASDs are usually benign
   - Except when they are not!
3. LAMPOON tip to base
4. TSMVIV valve sizing dilemma
   - consider upsizing/BVF
5. TSMVinRing
   - late anchoring – worse/worst outcome?
6. TSMVinMAC

TSMVIV – what about intermediate risk?

- Whilst TSMVIV approved in the USA since 2017 for high risk surgical candidates, little data for intermediate risk candidates
- 50 patients multicentre prospective study, core lab adjudicated, intermediate risk patients TSMVIV
- 2018 to 2021
- Embargo results: but 30D and 1Y mortality… ☺
- 10 year follow up

Title: One-year Outcomes of Transseptal Transcatheter Mitral Valve Replacement for Bioprosthetic Valve Failure in Intermediate-Risk Patients

Brief Title: Mitral Valve-in-Valve in Intermediate-risk Patients

Authors and Affiliations:
S. Chris Malaisrie, MD[a] and Mayra Guerrero, MD[b]; Charles Davidson, MD[a]; Mathew Williams, MD[c]; Fabio Sândoli de Brito Jr, MD, PhD[d]; Alexandre Abizaid, MD, PhD[d]; Pinak Shah, MD[e]; Tsuyoshi Kaneko, MD[e]; Karl Poon, MD[f]; Justin Levisay, MD[g]; Xiao Yu, PhD[h]; Philippe Pibarot, DVM, PhD[i]; Rebecca Hahn, MD[j,k]; Philipp Blanke, MD[l]; Martin B. Leon, MD[j,k]; Michael J. Mack, MD[m]; Alan Zajarias, MD[e] on behalf of the PARTNER 3 Mitral Valve-in-Valve Study Investigators

[a]Northwestern University, Chicago, IL, USA
[b]Mayo Clinic, Rochester, MN, USA
[c]NYU Langone Medical Center, New York, NY, USA
[d]Instituto do Coração da Universidade de São Paulo, São Paulo, Brazil
[e]Washington University, Barnes-Jewish Hospital, St. Louis, MO, USA
[f]Prince Charles Hospital, Brisbane, Australia
[g]NorthShore Univ Health System, Evanston, IL, USA

Late-Breaking Clinical Science III: Early Human Experiences – Mitral Valve Replacement Innovation

Room: Innovation & Clinical Science, Room 106, 100 Level, Phoenix Convention Center – West Building

11:00 AM	**Late-Breaking Clinical Science III: Early Human Experiences – Mitral Valve Replacement Innovation**
11:30 AM	Bioprosthetic Surgical Valves in Intermediate-risk Patients: 1-Year Outcomes of the PARTNER 3 Mitral Valve-in-Valve Study