CardioVascular Learning Network | CME

Left Ventricular (LV) Pacing During TAVR: Learning from the Experience in the EU

Faculty

James E. Harvey, MD, MS
Interventional Cardiologist
Vice President and Chief Medical Officer
Heart and Vascular Service Line
WellSpan Health
York, Pennsylvania

Ander Regueiro, MD, PhD, FESC
Interventional Cardiologist
Hospital Clínic Barcelona
University of Barcelona
Barcelona, Spain

Ruby Satpathy, MD, FACC, FSCAI
Interventional Cardiologist
Medical Director, Structural Heart Program
Chair, Cardiology Board
Baptist Medical Center
Jacksonville, Florida

Faculty Disclosures

- **James E. Harvey, MD, MS**: Advisory Board—Abbott, Haemonetics Corporation, Medtronic
- **Ander Regueiro, MD, PhD, FESC**: Consultant—Abbott, Edwards Lifesciences, Haemonetics Corporation, Medtronic, Meril Life Sciences
- **Ruby Satpathy, MD, FACC, FSCAI**: Consultant—Medtronic, Abbott, Boston, Edwards Lifesciences, Haemonetics Corporation; Grant/Research Support—Edwards Lifesciences, Boston, Abiomed, Medtronic, Abbott

This CME activity includes brand names for participant clarity purposes only.
No product promotion or recommendation should be inferred.

Program Information

- This program is provided by HMP Education, an HMP Global company
- Supported by an educational grant from Haemonetics Corporation

Learning Objectives

- Define left ventricular (LV) pacing and describe how it differs from conventional right ventricular pacing during TAVR
- Explain the rationale for LV pacing during TAVR, including physiological benefits and potential impact on hemodynamic stability
- Interpret available European clinical and safety data on LV pacing in TAVR, including procedural outcomes, complication rates, and patient populations studied
- Apply practical implications for clinical practice, including patient selection, procedural workflow, and device management when incorporating LV pacing

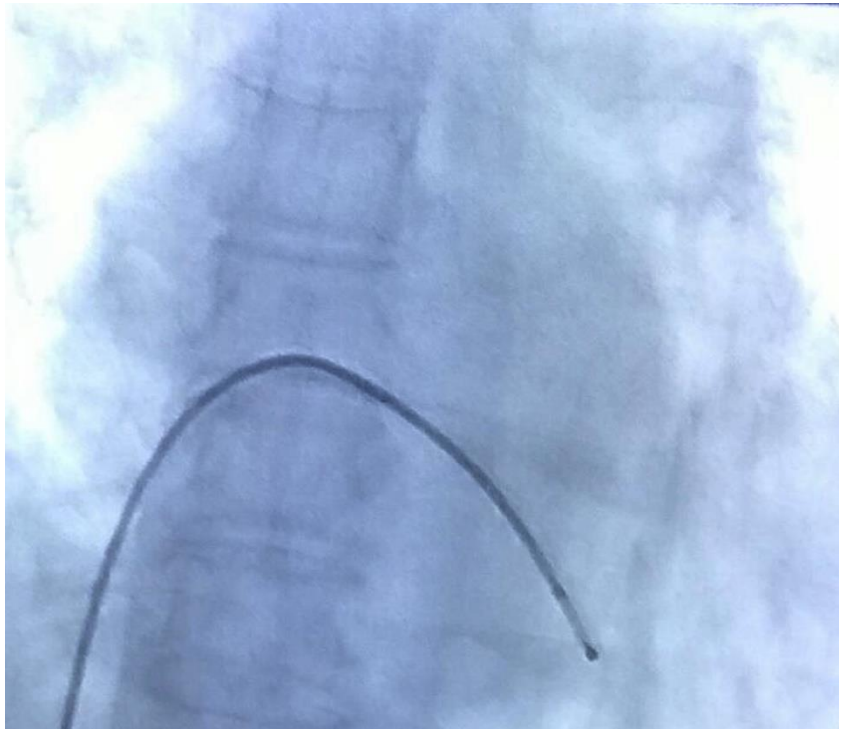
TAVR = transcatheter aortic valve replacement.

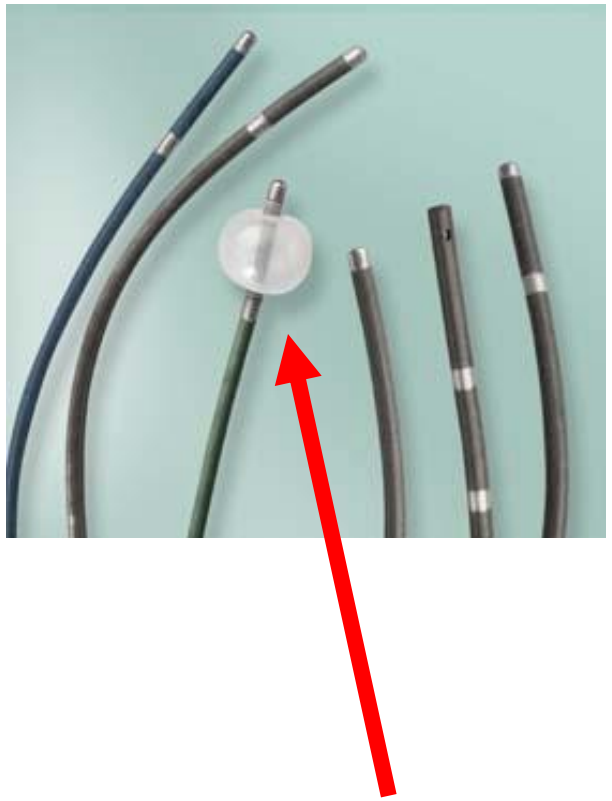
CardioVascular Learning Network | CME

The Rationale for LV Pacing

James E. Harvey, MD, MS
Interventional Cardiologist
Vice President and Chief Medical Officer
Heart and Vascular Service Line
WellSpan Health
York, Pennsylvania

TAVR Standard Pacing Techniques: RV Pacing

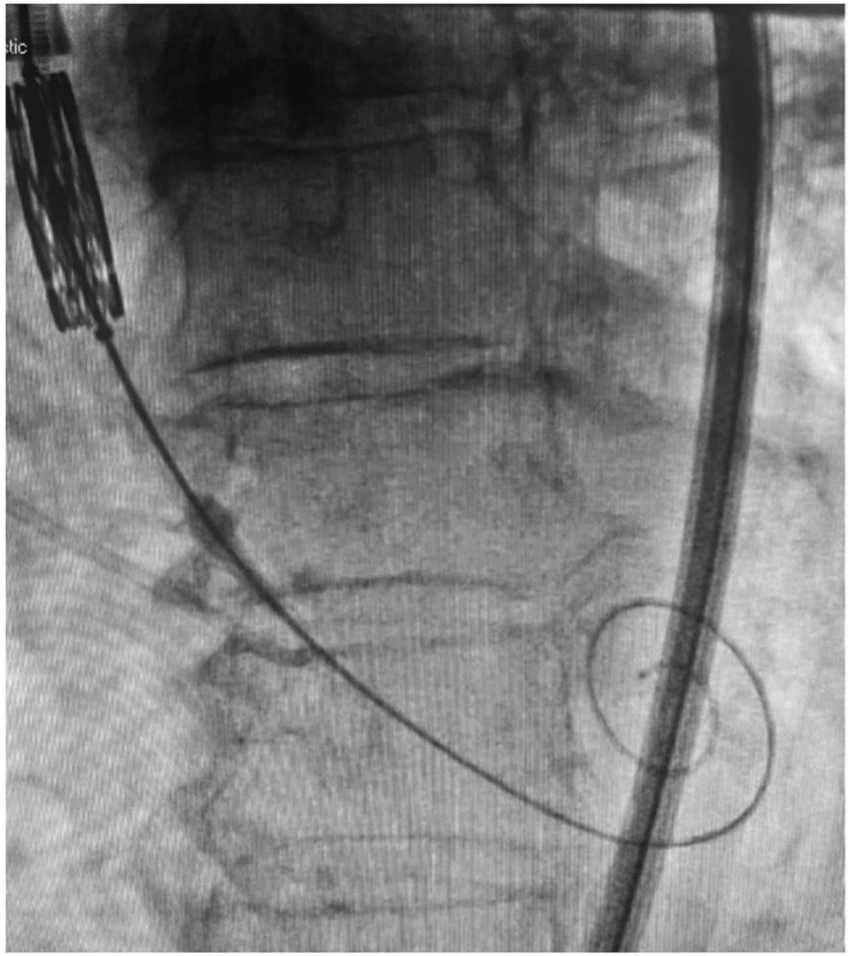




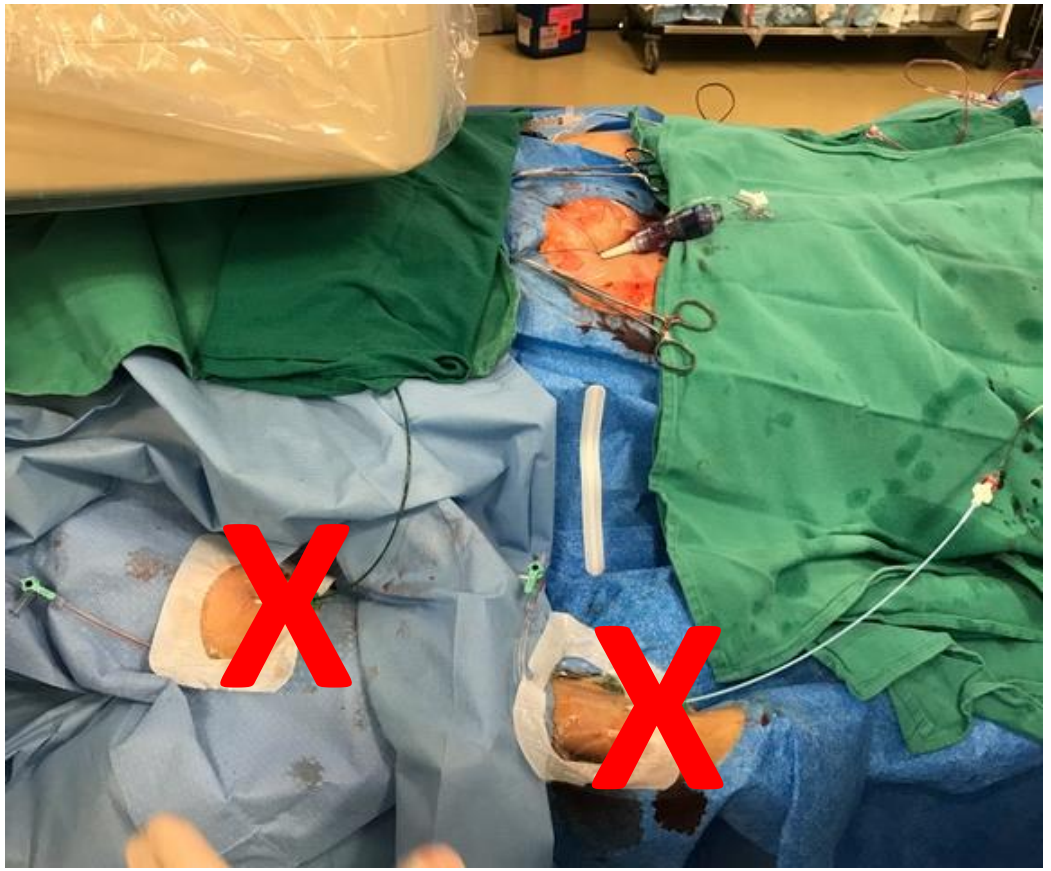
RV = right ventricular.

TAVR Standard Pacing Techniques: LV Pacing

LV pacing in TAVR: Using a left ventricular guidewire as a temporary pacing lead to directly stimulate the LV muscle, enabling rapid pacing during valve deployment or valve dilation.



Why the shift?

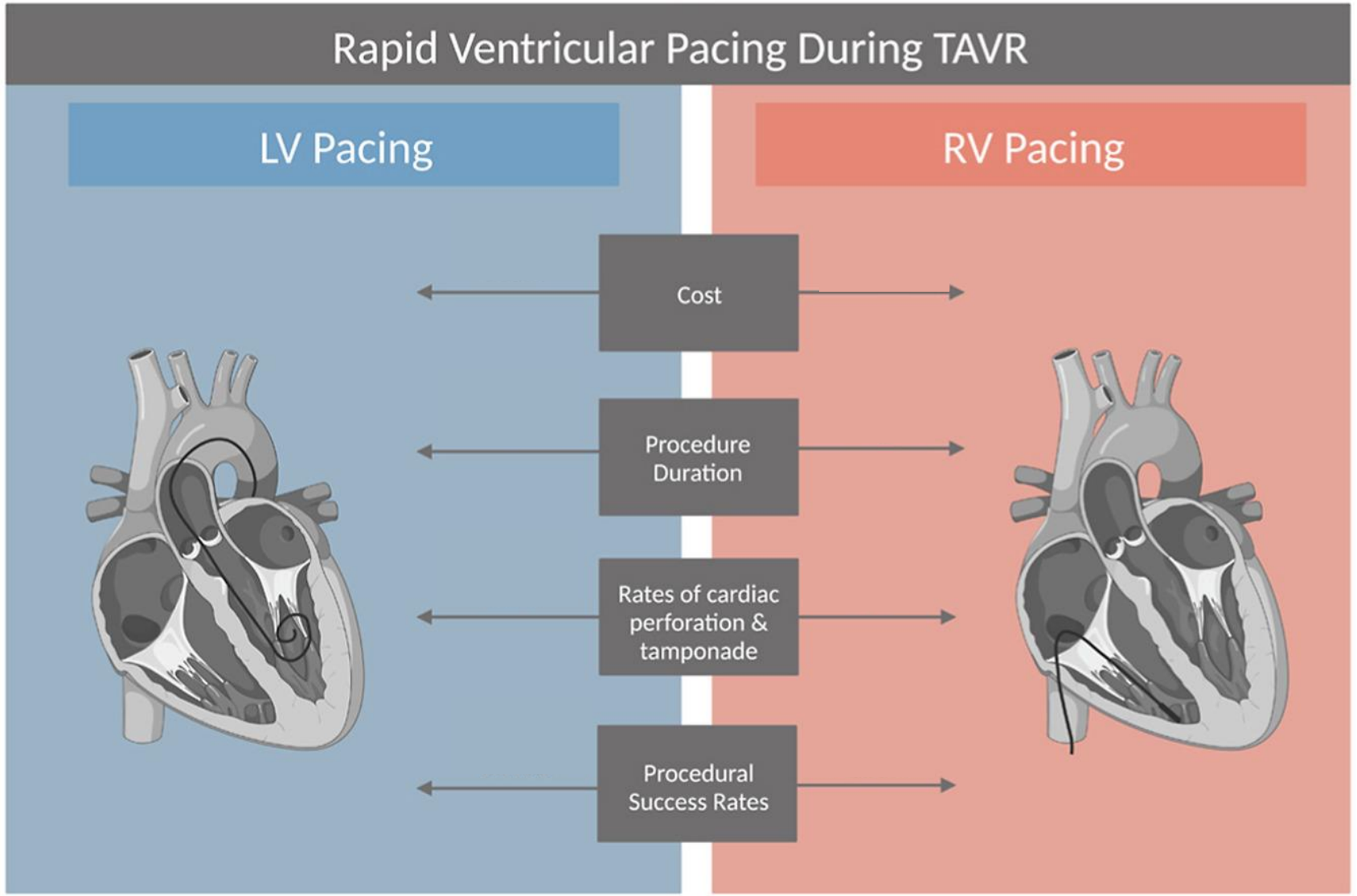


The Rationale for LV Pacing

- Physiologic depolarization and conduction
  - More homogenous depolarization with faster conduction
  - Improved stroke volume
  - More beneficial for long-term pacing than procedural pacing
- Removes need for venous access
  - Less bleeding, vascular complication, etc.
- Reduced risk of RV perforation and tamponade
- Shortens procedural time
- However, RV pacing necessitates venous access and conveys risks related to the access site (bleeding, vascular complication, thrombosis, or infection) and to the placement of the lead in the RV (RV perforation)
- What's coming?

Finamora I, et al. *Eur Heart J Suppl*. 2025;27(Suppl 3):iii126–iii130.

The Rationale for LV Pacing



Berman E, et al. *Struct Heart*. 2024;9(2):100306.

CardioVascular Learning Network | CME

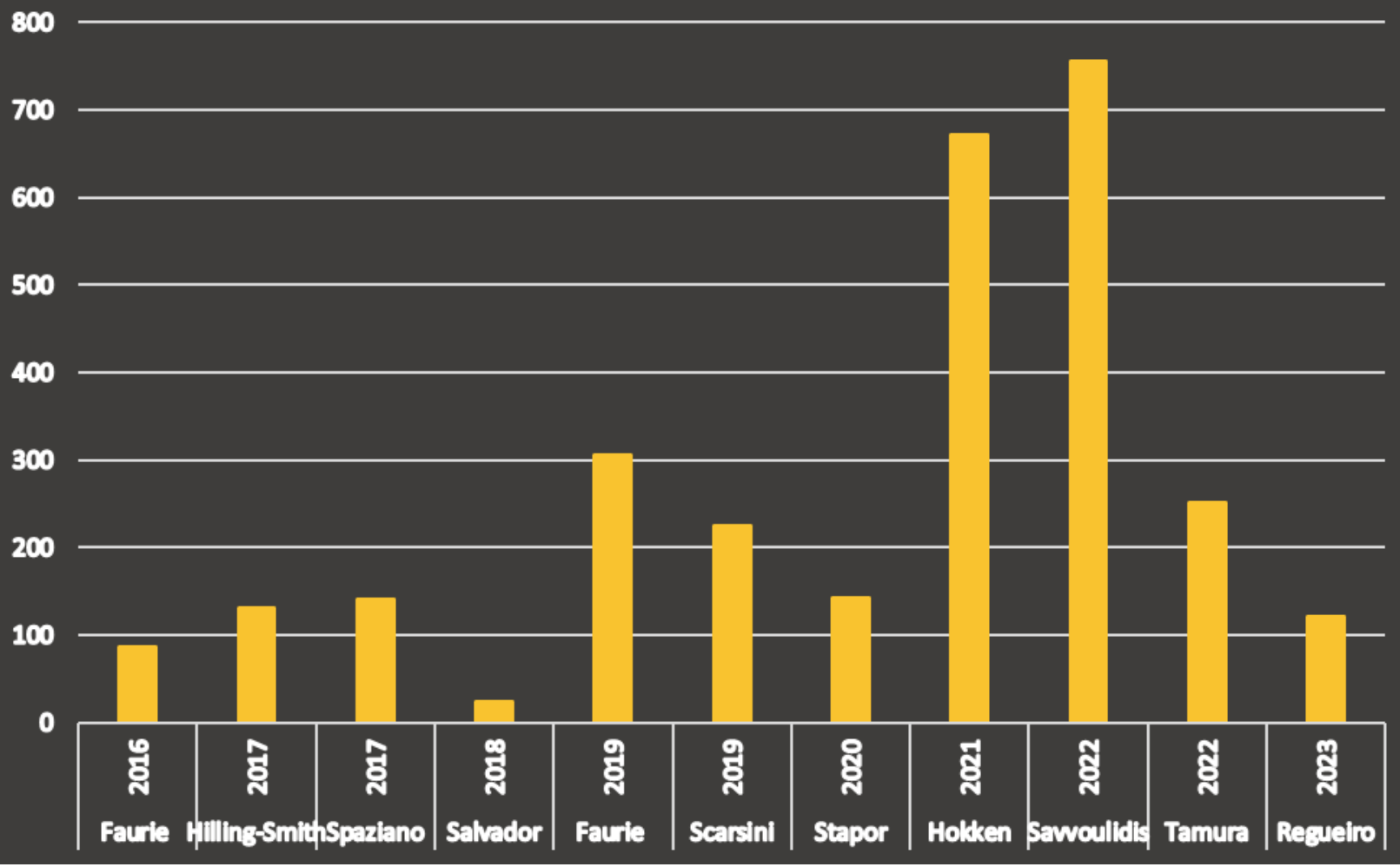
Clinical Evidence and Safety Data

Ander Regueiro, MD, PhD, FESC
Interventional Cardiologist
Hospital Clínic Barcelona
University of Barcelona
Barcelona, Spain

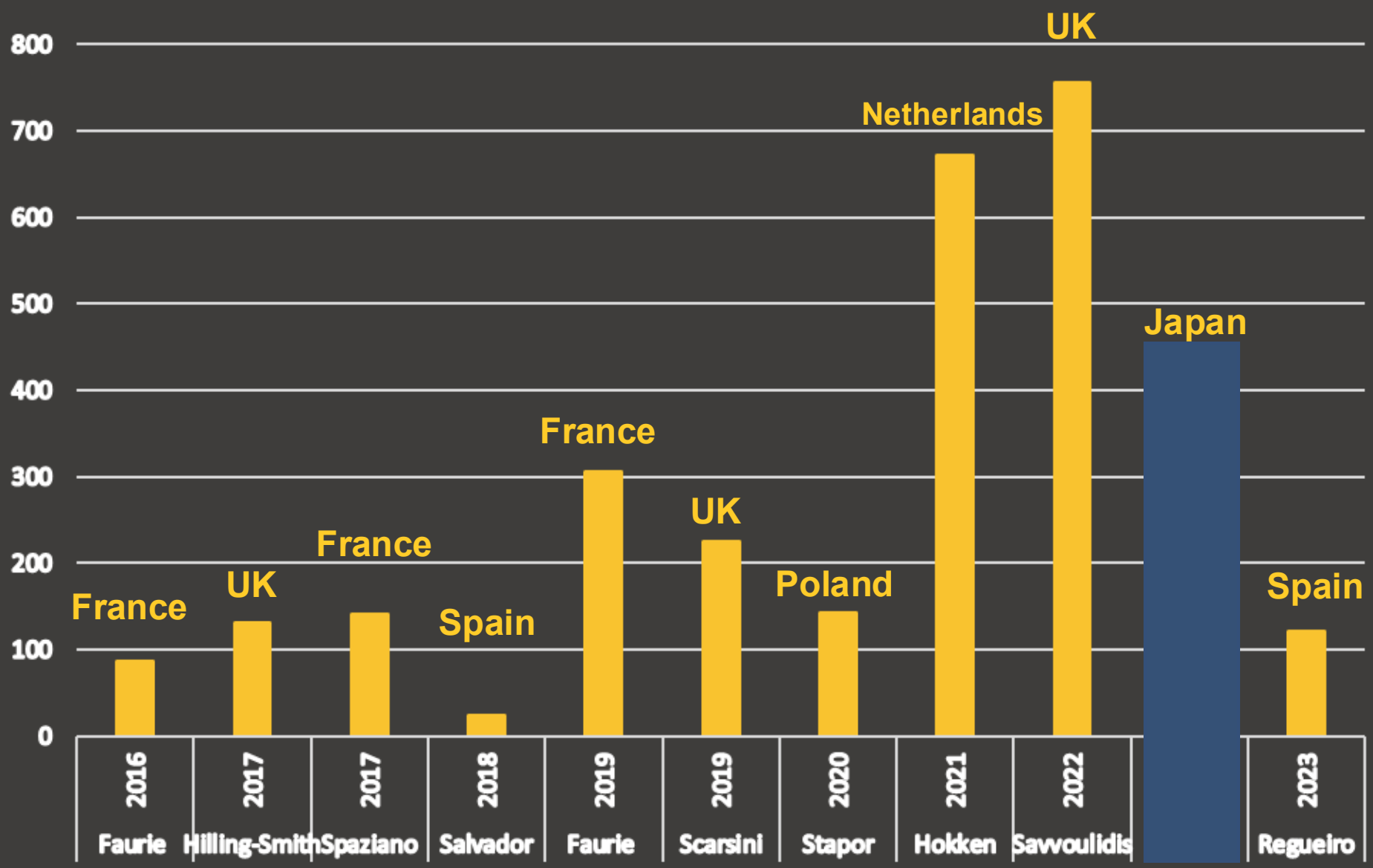
Overview

- Current evidence on LV pacing
- LV pacing registries
- LV pacing with dedicated pacing guidewire
- LV pacing vs RV pacing trial

Current Evidence on LV Pacing



Current Evidence on LV Pacing



LV Pacing: Pooled Data

- 2863 patients
- More than 10 years of experience
- Multicenter and international experience

Current Evidence: Type of Study

LV Pacing Registry (no dedicated wire)

Faurie, 2016. N=87
Hilling-Smith, 2017. N=132
Spaziano, 2017. N=142
Salvador, 2018. N=25
Scarsini, 2019. N=226

LV vs RV Randomized Clinical Trials

Faurie, 2019. N=307

LV vs RV Observational Registries

Stapor, 2020. N=143
Hokken, 2021. N=672
Savvoulidis, 2022. N=1222

LV Pacing Registry (dedicated pacing guidewire)

Regueiro, 2023. N=105

LV Pacing Registries

Type of THV

Review Article

Contemporary Review of the Methods for Rapid Ventricular Pacing During Transcatheter Aortic Valve Replacement

Eliza Berman, BSc [a,b], Arsalan Abu-Much, MD [c], Mark Reisman, MD [a], Nathan E. Matzko, BSc [a], Jose M. Dizon, MD [d], Bjorn Redfors, MD, PhD [c,e], Maria C. Alu, MS [c], Tamim M. Nazif, MD [d], Martin B. Leon, MD [c,d], Shmuel Chen, MD, PhD [a,c,*]

[a] *Weill-Cornell Medical Center/New York-Presbyterian Hospital, New York*
[b] *University of British Columbia, Vancouver, British Columbia, Canada*
[c] *Cardiovascular Research Foundation, New York*
[d] *Division of Cardiovascular Medicine, New York-Presbyterian Hospital, Columbia University Irving Medical Center, New York*
[e] *Department of Cardiology, Sahlgrenska University Hospital, Gothenburg, Sweden*

THV = transcatheter heart valve.

Berman E, et al. *Struct Heart*. 2024;9(2):100306.

Procedural Success

90.9%-100%

The definition across studies varied
Comparable between RV and LV pacing

Berman E, et al. *Struct Heart*. 2024;9(2):100306.

Valve Embolization

0.4-2.2%

Comparable between RV and LV pacing

Berman E, et al. *Struct Heart*. 2024;9(2):100306.

Crossover to RV due to Failure of LV

1%

Berman E, et al. *Struct Heart*. 2024;9(2):100306.

Crossover to RV due to Conduction Disturbances

1-14%

Berman E, et al. *Struct Heart*. 2024;9(2):100306.

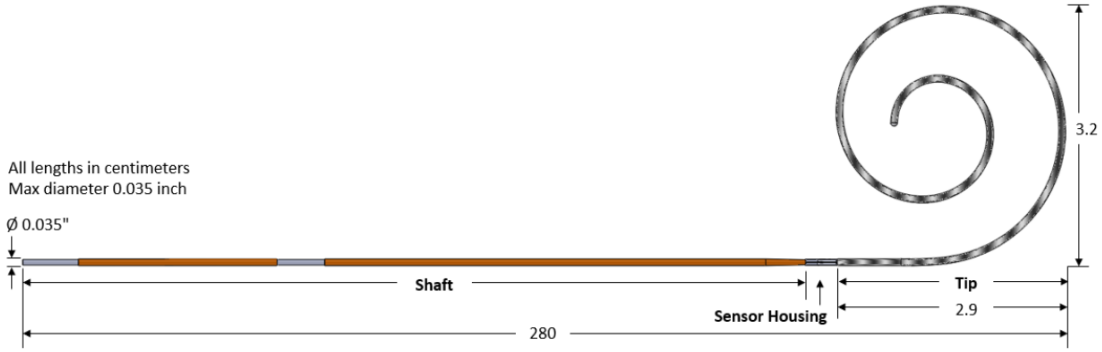
LV Pacing with Dedicated Pacing Guidewire

SavvyWire® Efficacy and Safety in Transcatheter Aortic Valve Implantation Procedures:

The SAFE-TAVI Trial

NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

SavvyWire®

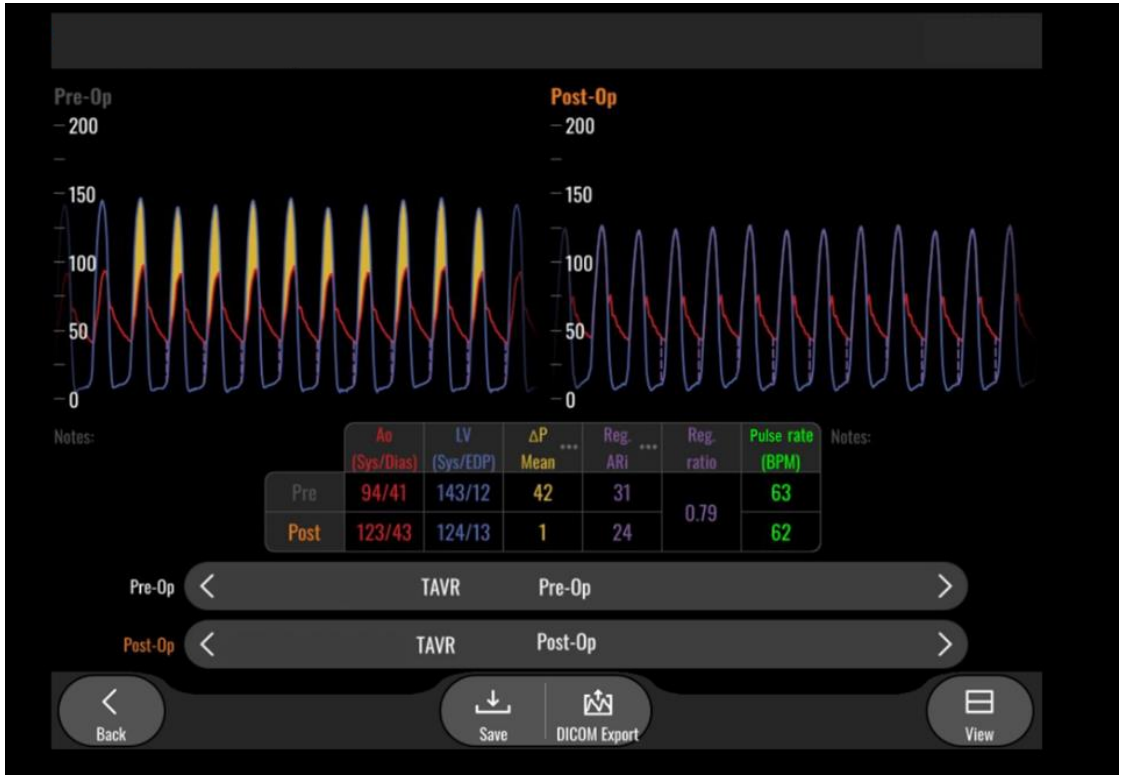


Three capabilities

1. Guidewire for prosthetic valve delivery and positioning
2. Fiber optic pressure sensor for continuous hemodynamic monitoring
3. Left ventricle pacing capabilities

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

OptoMonitor™ III



- Specific TAVR interphase
- Pressure measurements
- Calculate indices
- Visual comparison

Study Objective

- Evaluate the safety and efficacy of a dedicated pacing guidewire (SavvyWire®) in TAVI using balloon- and self-expandable valve systems

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

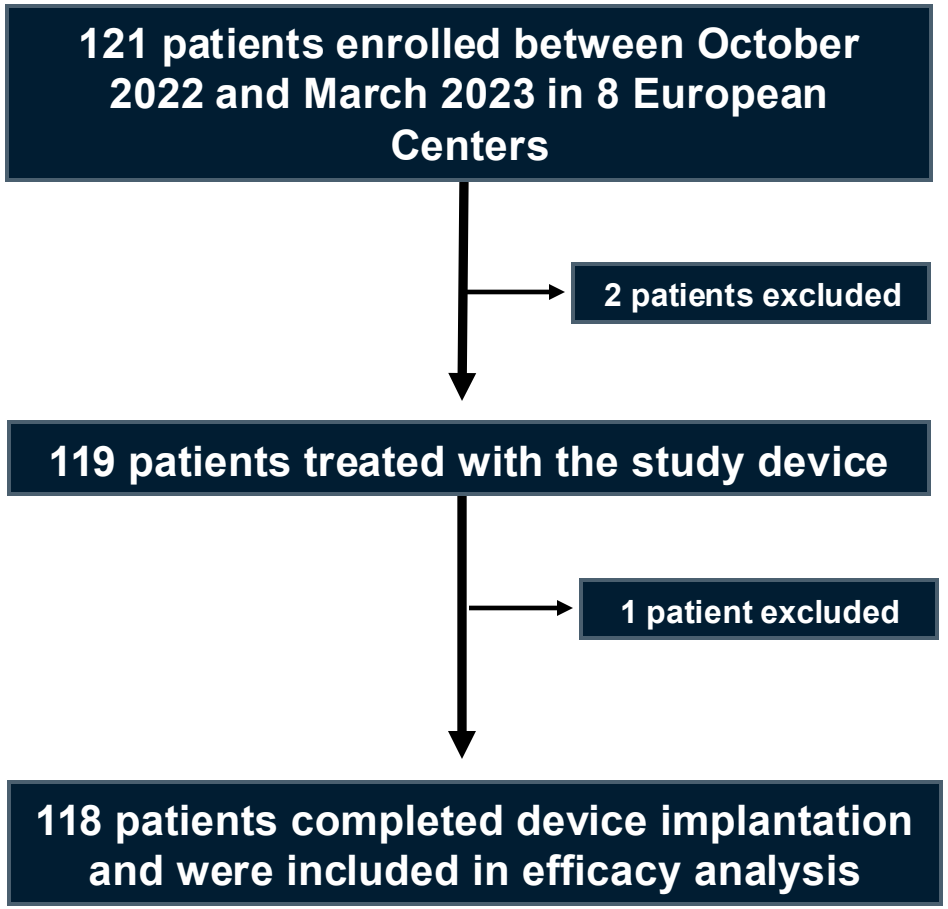
Study Design

- Prospective, premarket, multicenter, clinical study
- Independent data and safety monitoring board
- Inclusion criteria
  - Patients with severe symptomatic AS undergoing transfemoral TAVR
- Exclusion criteria
  - Extreme horizontal aorta or extreme tortuosity at the level of iliofemoral arteries or aorta

AS = aortic stenosis.

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

Study Flowchart



Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

Baseline Demographics

	N=121
Age, years	82.2 ± 5.9
Female, (%)	60 (49.6)
STS PROM, (%)	3.85 (2.23-4.34)
Prior pacemaker	14 (11.6%)
LVEF, (%)	57.0 ± 12.0
Aortic mean pressure gradient, (mm Hg)	47.0 ± 14.1

STS PROM = Society of Thoracic Surgeons Predicted Risk of Mortality; LVEF = left ventricular ejection fraction.

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

Procedural Characteristics

	N=119
Balloon-expandable valve	45 (37.8%)
SAPIEN 3/SAPIEN 3 Ultra	37 (31.1%)
Myval	8 (6.7%)
Self-expanding valve	74 (62.2%)
Evolut PRO/Evolut PRO+	37 (37.1%)
Navitor	19 (16%)
ACURATE Neo	18 (15.1%)
Pre-dilatation	89 (74.8%)
Post-dilatation	14 (11.8%)

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

Procedural Characteristics

	N=119
Need of a second valve	2 (1.7)
Major or life-threatening bleeding	8 (6.7%)
Major vascular complications	2 (1.7%)
Permanent pacemaker implantation	21 (17.6%)

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

Primary Endpoint

	N=118
Adequate ventricular pacing capture by the SavvyWire® leading to a reduction of systolic aortic pressure <60 mm Hg	116 (98.3%)

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

Secondary Endpoints

Efficacy	N=118
Successful invasive hemodynamic assessment without additional catheter exchange	117 (99.2%)
Successful valve advancement and positioning into the intended position	117 (99.2%)
Safety	**N=118**
Freedom from major complications related to the SavvyWire®	117 (99.2%)

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

Conclusions

- The use of a dedicated pacing guidewire during TAVI procedures appeared to be efficacious and safe
- This device could help minimize interventions during the procedure and improve clinical decision-making after THV deployment

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.

SAFE-TAVI Registry

ORIGINAL RESEARCH

FOCUS ON TRANSCATHETER AORTIC VALVE REPLACEMENT

Safety and Efficacy of TAVR With a Pressure Sensor and Pacing Guidewire

SAFE-TAVI Trial

Ander Regueiro, MD, PhD,[a] Alberto Alperi, MD, PhD,[b] Victoria Vilalta, MD, PhD,[c] Luis Asmarats, MD, PhD,[d] Jose Antonio Baz, MD,[e] Luis Nombela-Franco, MD, PhD,[f] Alvaro Calabuig, MD, PhD,[g] Antonio Muñoz-García, MD,[h] Manel Sabaté, MD, PhD,[a] Cesar Moris, MD, PhD,[b] Maxime Picard-Deland, MSc,[i] Emilie Pelletier-Beaumont, MSc,[j] Josep Rodés-Cabau, MD, PhD[j]

Regueiro A, et al. *JACC Cardiovasc Interv*. 2023;16(24):3016-3023. NIH. Accessed November 18, 2025. https://www.clinicaltrials.gov/study/NCT05492383.


FOV
LAO
CRA
L
20
30
13
90

Randomized Clinical Trial

EASY TAVI Trial

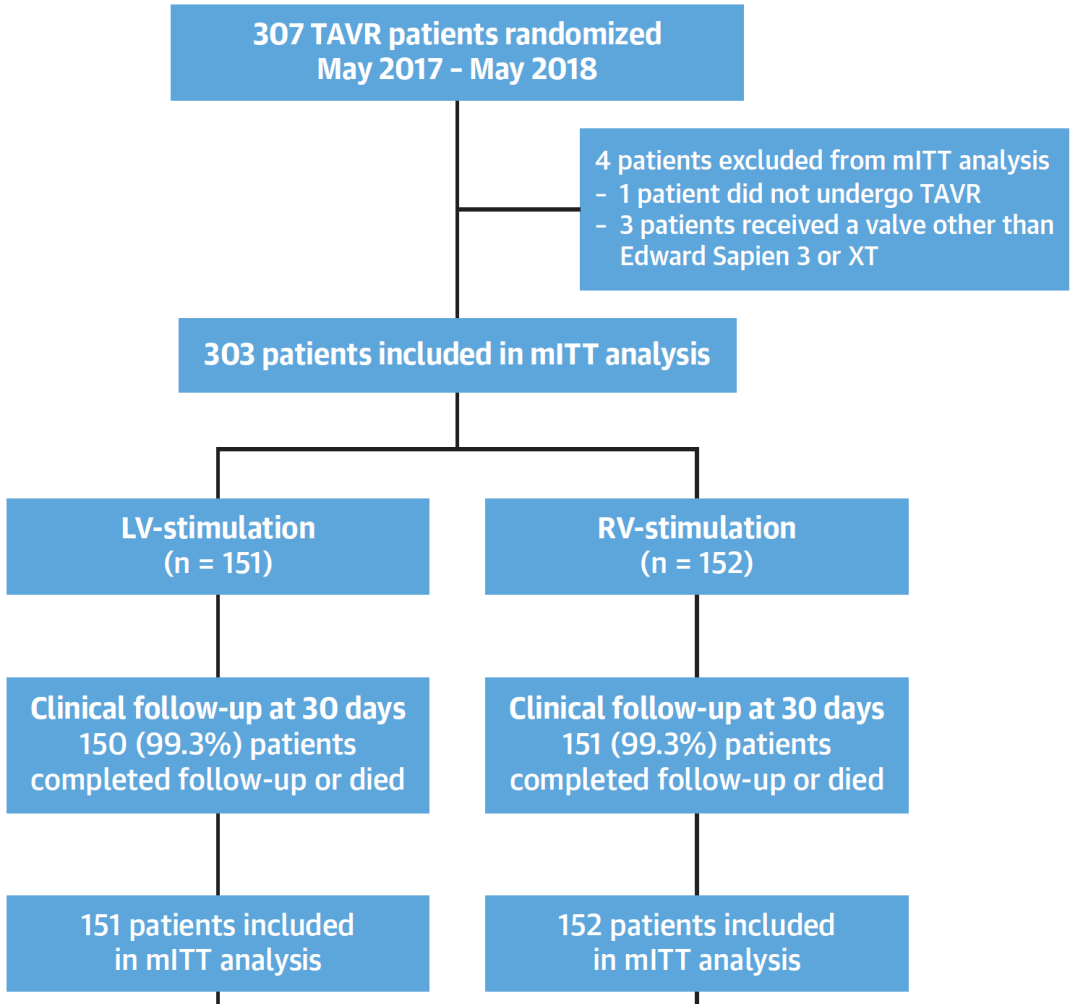
STRUCTURAL

Left Ventricular Rapid Pacing Via the Valve Delivery Guidewire in Transcatheter Aortic Valve Replacement

Benjamin Faurie, MD,[a,b] Géraud Souteyrand, MD,[c] Patrick Staat, MD,[b] Matthieu Godin, MD,[d] Christophe Caussin, MD,[e] Eric Van Belle, MD, PhD,[f] Lionel Mangin, MD,[g] Pierre Meyer, MD,[h] Nicolas Dumonteil, MD,[i] Mohamed Abdellaoui, MD,[a,b] Jacques Monségu, MD,[a,b] Isabelle Durand-Zaleski, MD, PhD,[j] Thierry Lefèvre, MD,[k] for the EASY TAVI Investigators

Faurie B, et al. *JACC Cardiovasc Interv*. 2019;12(24):2449-2459. NIH. Accessed November 18, 2025. https://clinicaltrials.gov/study/NCT02781896.

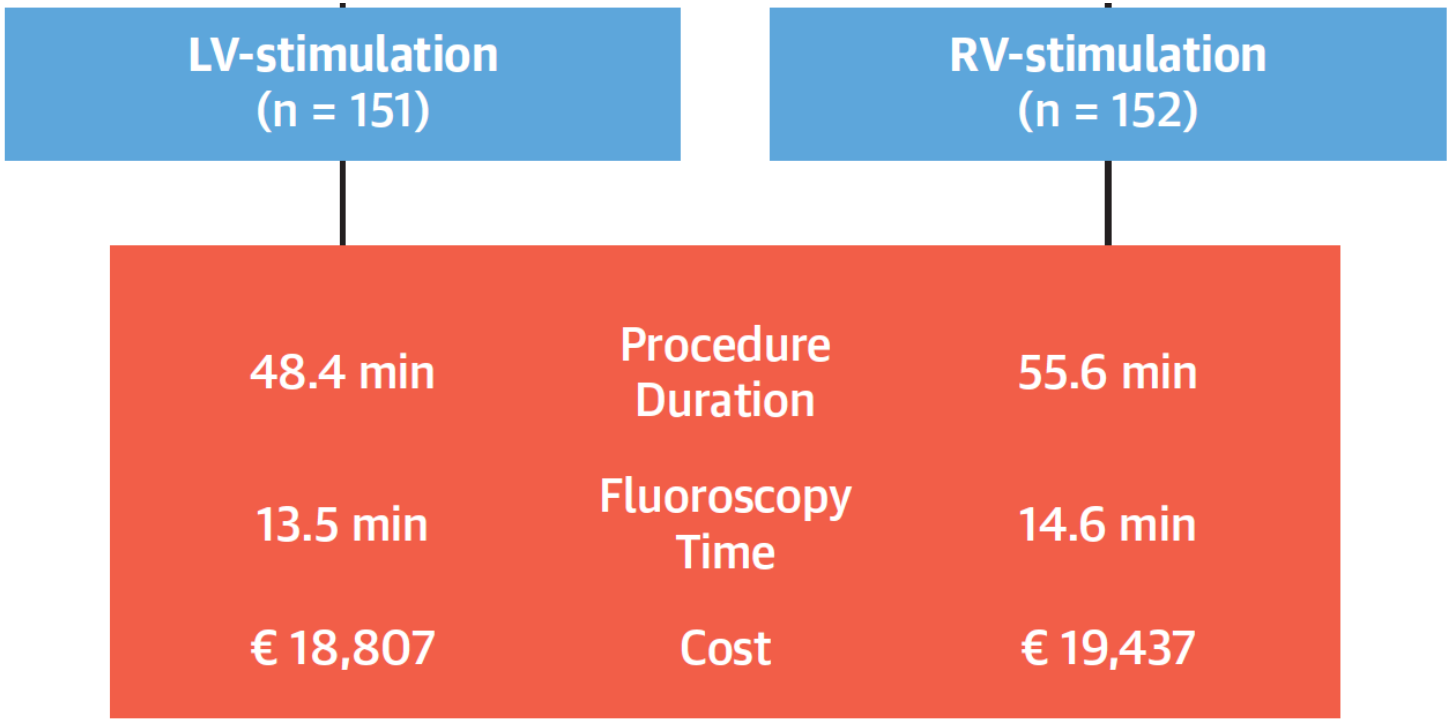
EASY TAVI Trial



mITT = modified intention-to-treat.

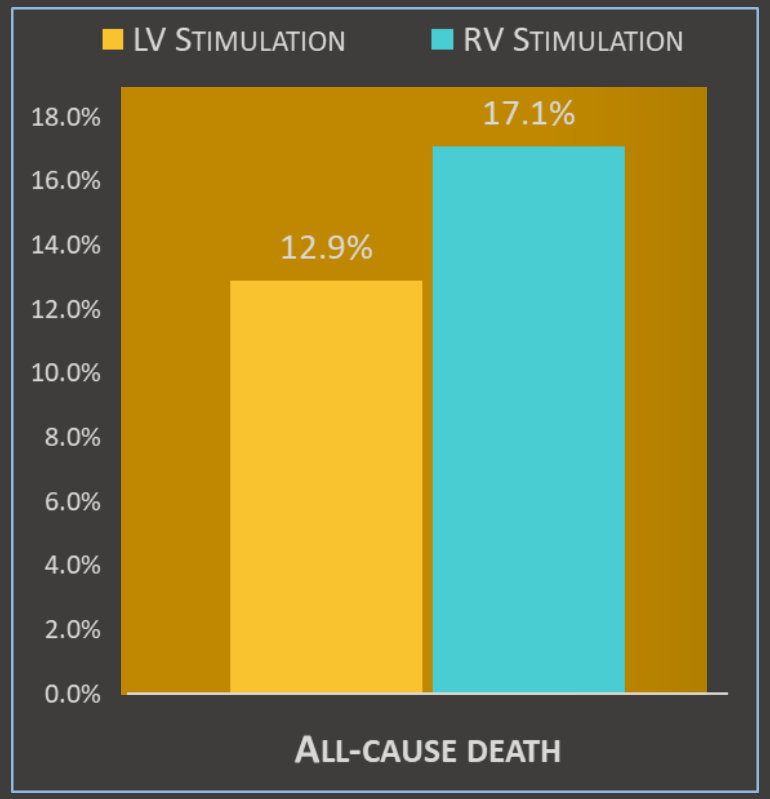
Faurie B, et al. *JACC Cardiovasc Interv*. 2019;12(24):2449-2459. NIH. Accessed November 18, 2025. https://clinicaltrials.gov/study/NCT02781896.

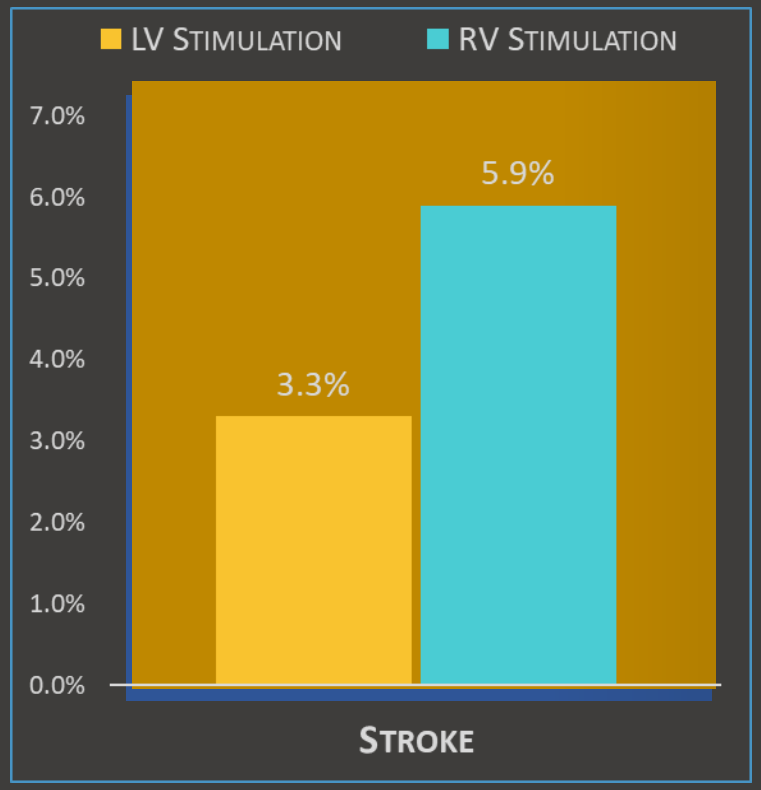
EASY TAVI Trial

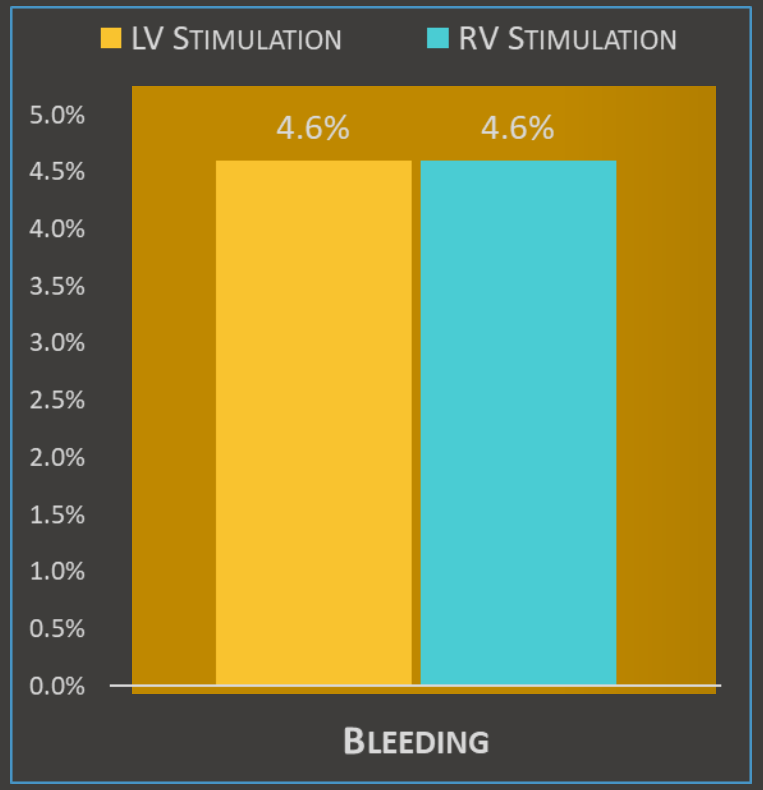


Faurie B, et al. *JACC Cardiovasc Interv*. 2019;12(24):2449-2459. NIH. Accessed November 18, 2025. https://clinicaltrials.gov/study/NCT02781896.

EASY TAVI Trial

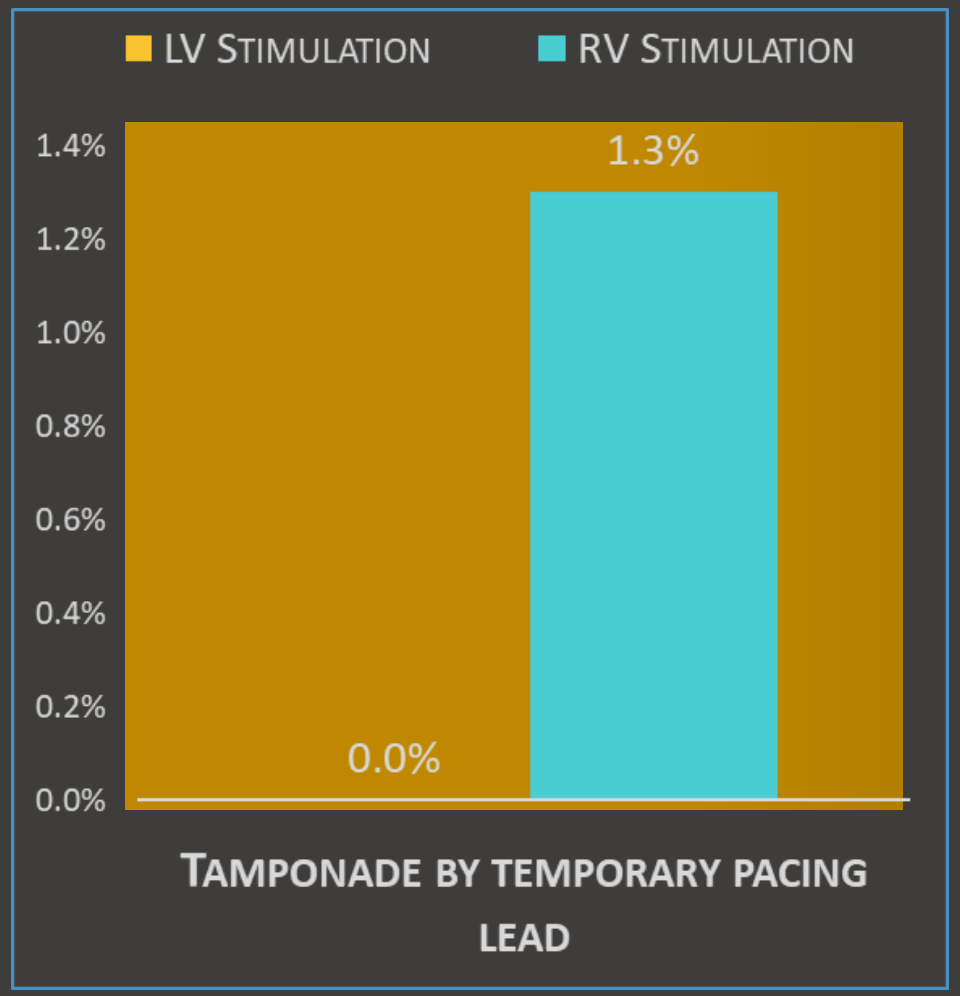


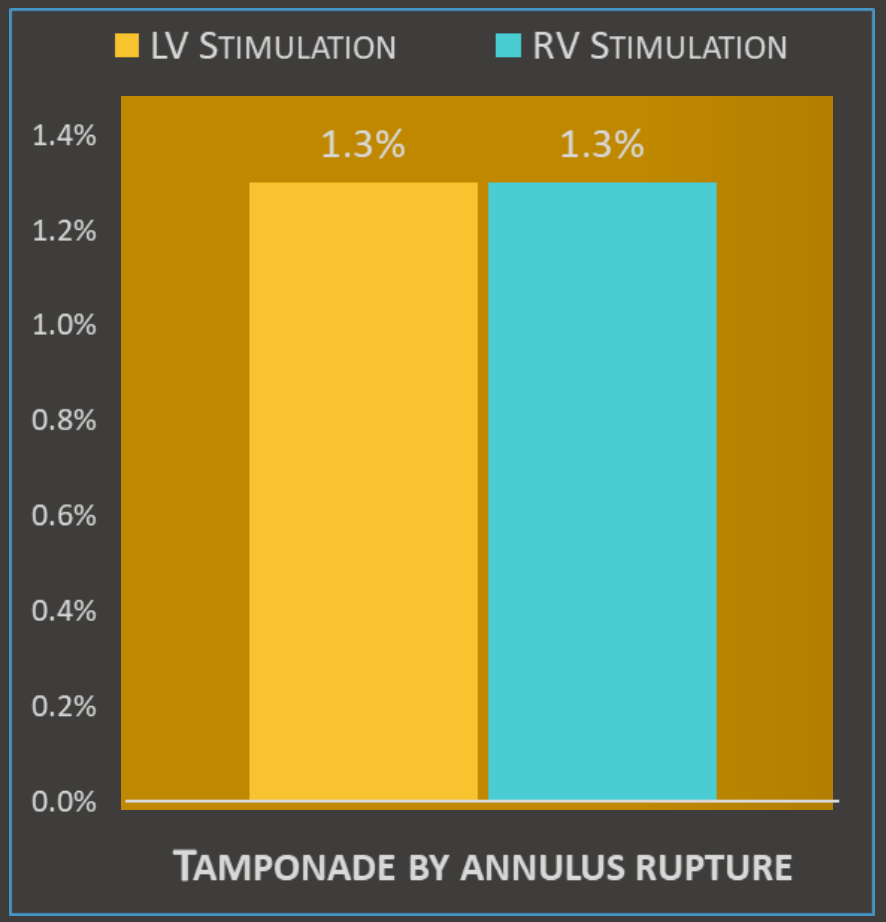




Faurie B, et al. *JACC Cardiovasc Interv*. 2019;12(24):2449-2459. NIH. Accessed November 18, 2025. https://clinicaltrials.gov/study/NCT02781896.

EASY TAVI Trial

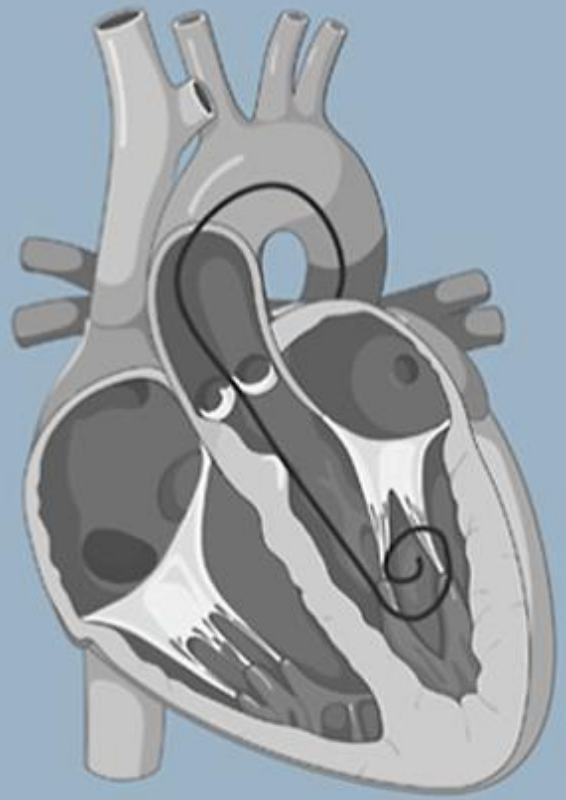




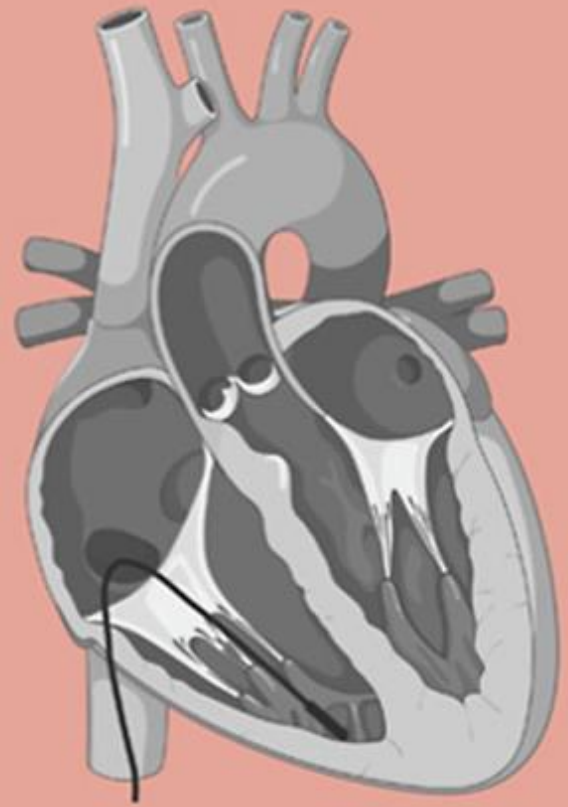
Faurie B, et al. *JACC Cardiovasc Interv*. 2019;12(24):2449-2459. NIH. Accessed November 18, 2025. https://clinicaltrials.gov/study/NCT02781896.

LV Pacing

RV Pacing



LV Pacing		RV Pacing
Lower	Cost	Higher
Shorter	Procedure Duration	Longer
Lower	Rates of cardiac perforation & tamponade	Higher
Similar	Procedural Success Rates	Similar



Berman E, et al. *Struct Heart*. 2024;9(2):100306

Summary

- The safety and efficacy of LV pacing during TAVR have been demonstrated over the past years
- LV pacing has been demonstrated to reduce costs, procedural duration, and rates of cardiac complications with the same success rates as RV pacing

CardioVascular Learning Network | CME

Practical Implications for Clinical Practice

Ruby Satpathy, MD, FACC, FSCAI
Interventional Cardiologist
Medical Director, Structural Heart Program
Chair, Cardiology Board
Baptist Medical Center
Jacksonville, Florida

The Argument for LV Pacing in TAVR: Use of Guidewire with Dedicated Pacing Properties

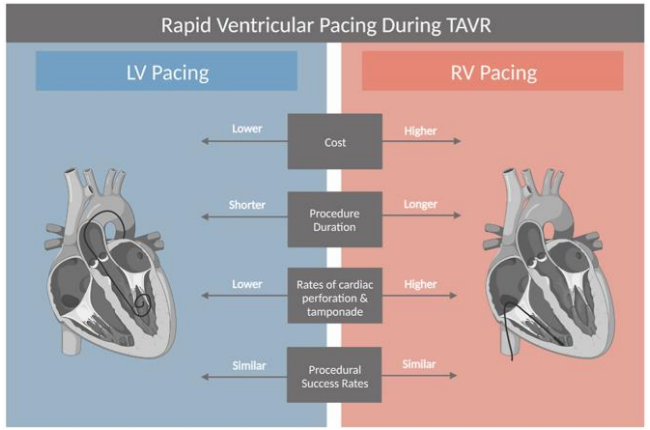
- Optimizing TAVR workflow/efficiency with the accelerated growth in TAVR volume and now expanded indications

- When to use LV pacing?
- Advantage over traditional RV pacing
- When is RV pacing preferred?
- BEV and SEV strategies
- Invasive hemodynamics

BEV = balloon-expandable valve; SEV = self-expandable valve.

Temporary Pacing in TAVI

- Cardiac pacing is necessary during THV implantation
- Rapid pacing to ensure transient cardiac standstill during
- THV implant and pre/post valvuloplasty
- Backup pacing post-implant due to conduction disturbances
- RV pacing requires the use of dedicated pacing lead and venous access, and may increase risk of cardiac tamponade and vascular complications
- LV pacing may streamline the procedure by reducing procedural steps and improving efficiency



RBBB = right bundle branch block.
Berman E, et al. *Struct Heart*. 2024;9(2):100306.

Transvenous Access for Temporary Pacing

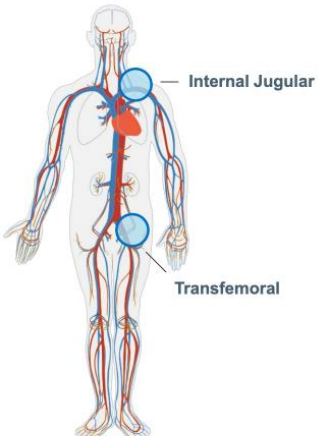
Internal Jugular

- Preferred for patients with pre-existing arrhythmias such as RBBB
- Can remain in body for extended time and allows patient mobility post-procedure
- Doesn't allow sterile access for readjustment by implanters (inserted and adjusted by anesthesia)

Transfemoral

- Most commonly used access site
- Can be left in, but will need to be removed prior to patient mobility post procedure
- Allows sterile access for readjustment by implanters

Direct LV pacing during valve deployment is increasingly being adopted, as it may reduce procedure cost, duration, and radiation exposure, and potentially mitigate the risks associated with RV pacing.

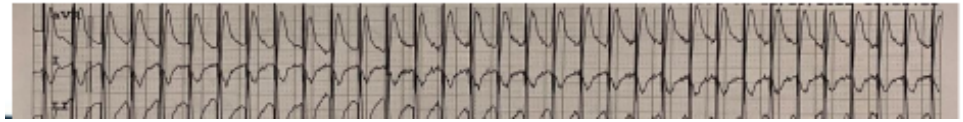


Rapid Ventricular Pacing

LV Pacing

- Does not require dedicated pacing lead
- Does not require venous access
- Less traumatic to ventricle
- Allows contact with thicker LV muscular wall
- Reduces risks of venous access complications, including
  - Bleeding
  - Pseudoaneurysm
  - AV fistula
  - Thrombosis
  - Infection

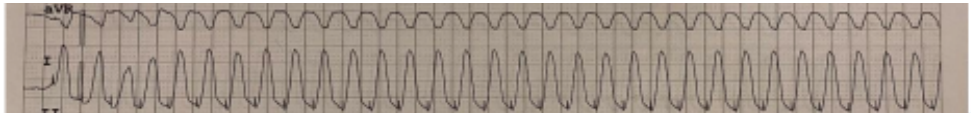
- Potentially higher threshold due to inherent higher-impedance circuit from heart to groin
- Can cause muscular contraction during pacing



RV Pacing

- Lower threshold and no needle in the groin: No muscle contraction during pacing

- Requires dedicated pacing lead and venous access
- Can cause
  - Ventricular perforation
  - Pneumothorax
  - Ectopic beats/PVCs
- Increases risks of venous access complications, including
  - Bleeding
  - Pseudoaneurysm
  - AV fistula
  - Thrombosis
  - Infection

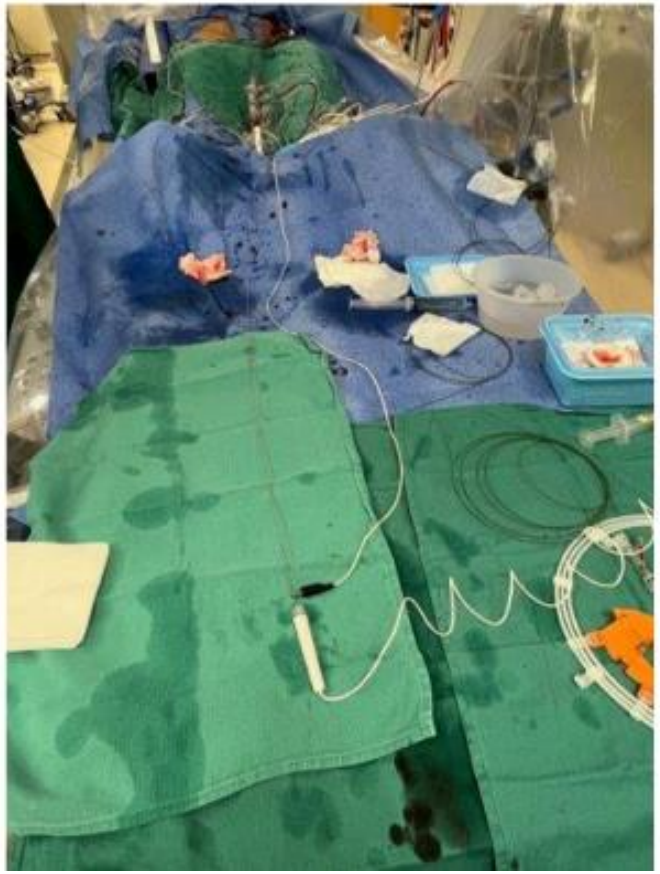


AV = aortic valve; PVCs = premature ventricular contractions.

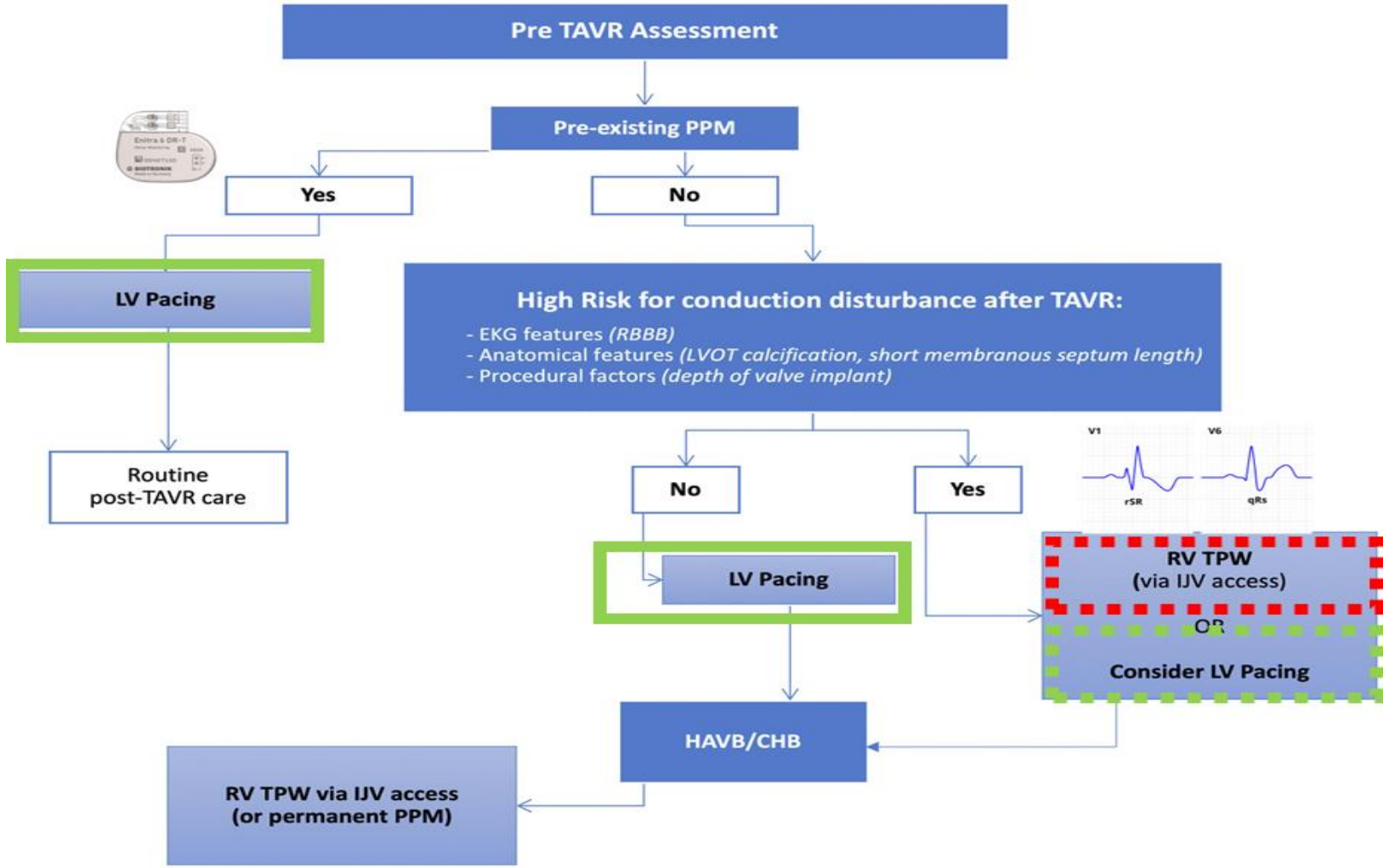
Berman E, et al. *Struct Heart*. 2024;9(2):100306.

LV Pacing during TAVI: Procedural Steps

Attach Electrodes



LV vs RV Pacing during TAVI



PPM = permanent pacemaker; EKG = electrocardiogram; LVOT = left ventricular outflow tract; TPW = temporary pacing wire; IJV = internal jugular vein; HAVB/CHB = high-grade atrioventricular block/complete heart block.

Blusztein D, et al. *Struct Heart*. 2023;7(6):100213.

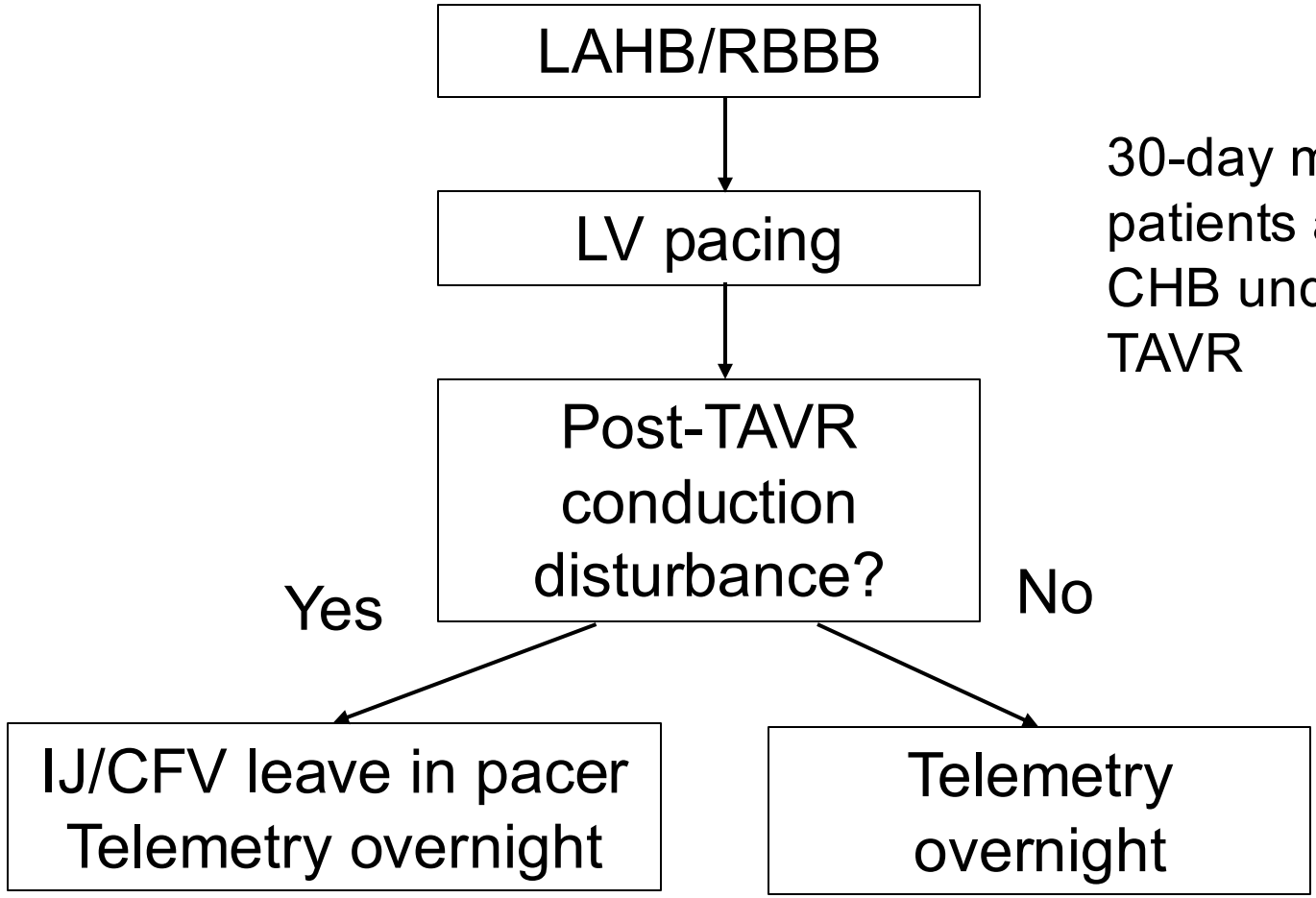
My Approach in 2025 for Patients at High Risk: LAHB/RBBB

<u>100% LV pacing</u>

Strategy for minimizing right IJ pacers

Not everyone will get a conduction disturbance

Reserve IJ pacing for those who will need it post-TAVR



30-day monitor on patients at high risk for CHB undergoing TAVR

IJ = internal jugular; LAHB = left anterior hemiblock; CVF = common femoral vein.

Guidewire: Structural Heart, LV Pacing, and Hemodynamics

- What was the “aha” moment that initially drew me to try a guidewire with dedicated pacing properties in my structural heart procedures?
- **Workflow simplicity, LV pacing, procedural time savings, cost savings, patient safety**
- How did I first adopt LV pacing in my TAVI practice, and what gave me the confidence to make the switch?
- **A particular case, then trial, got over my original skepticism, and then just a matter of repeated exposure**
- What was the learning curve like for me and my team?
- **Handful of cases (5) – team needs more training than the operators (at first, I was skeptical about the ground cable!)**
- What specific value do I see in invasive hemodynamic monitoring during structural heart cases?
- **Decision about BAV, additional volume to BEV TAVR, small valves in high BMI patients (? PPM), ARi**

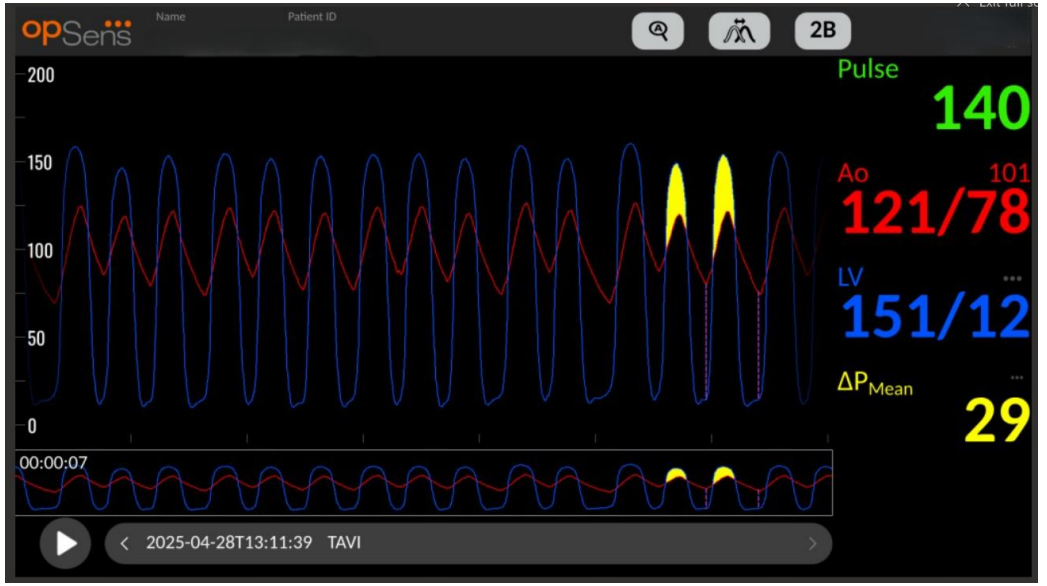
BAV = balloon aortic valvuloplasty; BMI = body-mass index; ARi = activation recovery interval.

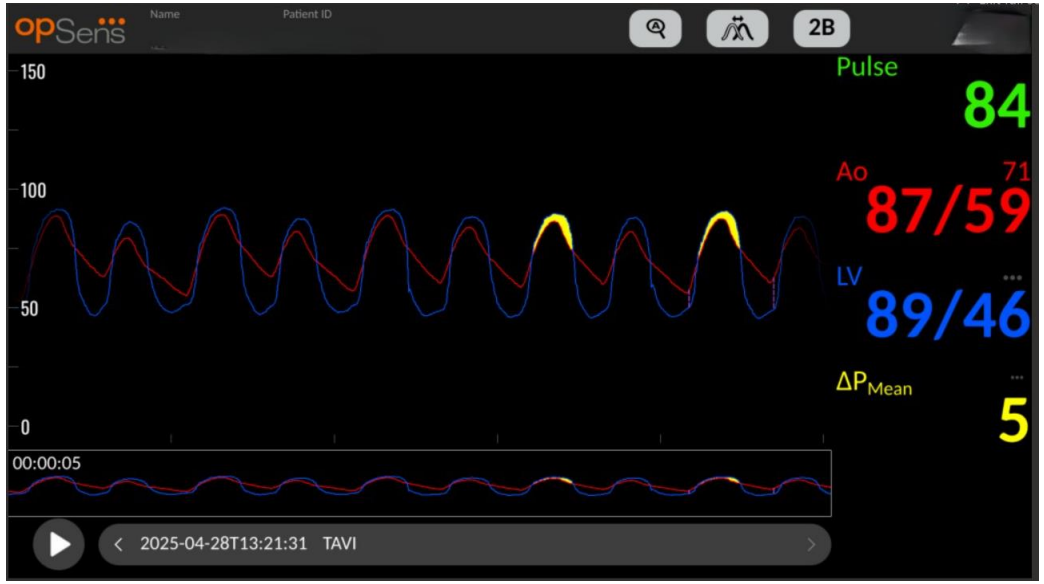
Patient JT History

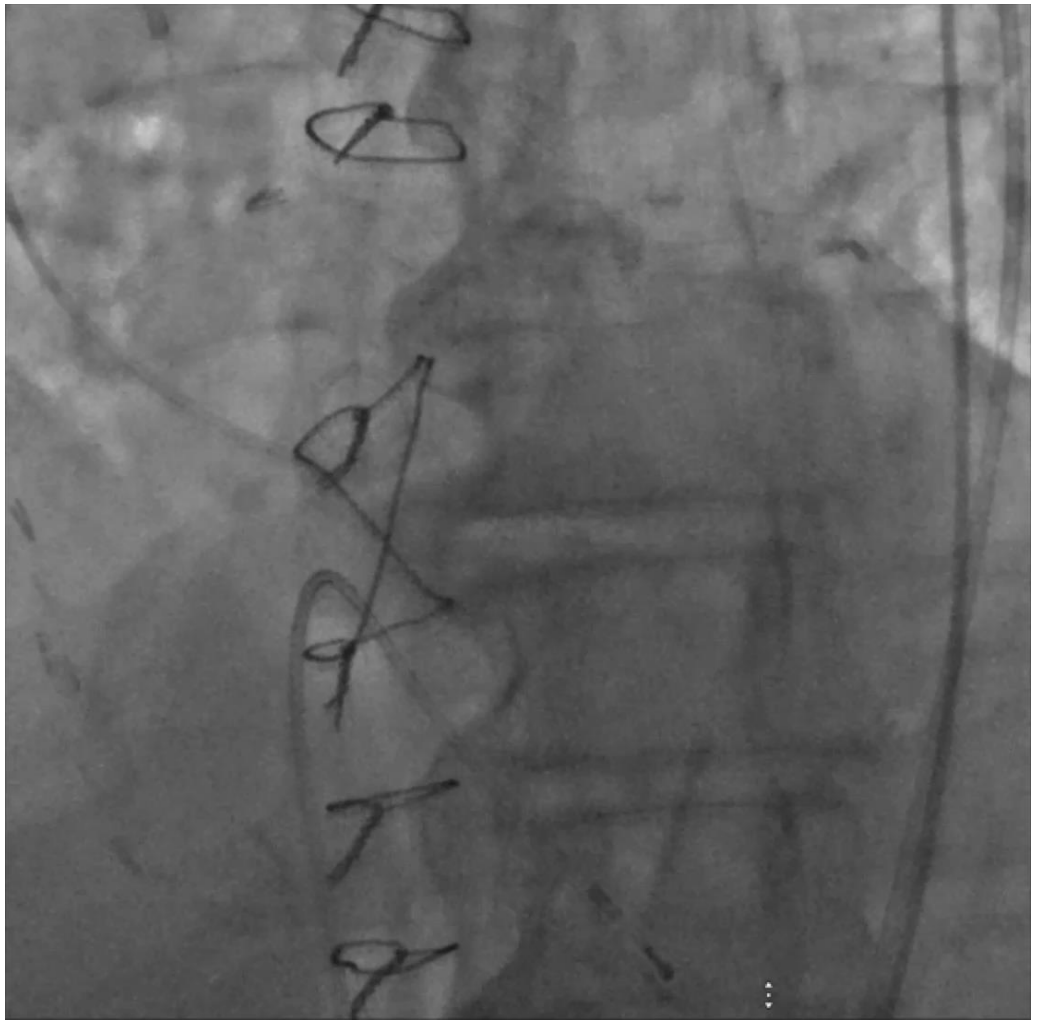
- 78-year-old Female
- NYHA FC III – cardiogenic shock
- AFIB RFA 2023
- HTN, DM, COPD,CKD
- OSA, osteoarthritis
- Normal coronaries
- hx Trifecta #23 2010 – severe AS/AR
- Frail
- STS 8

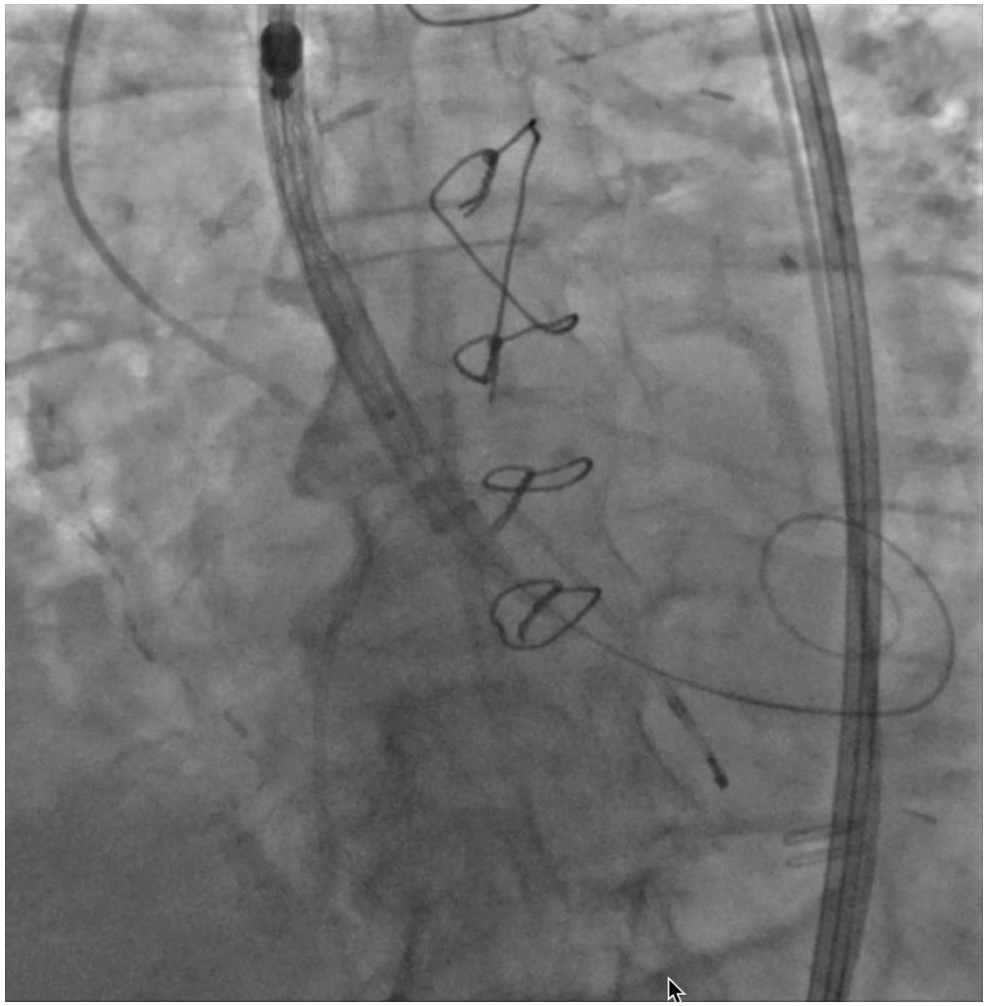
NYHA FC = New York Heart Association functional class; AFIB = atrial fibrillation; RFA = radiofrequency ablation; HTN = hypertension; DM = diabetes mellitus; COPD = chronic obstructive pulmonary disease; CKD = chronic kidney disease; OSA = obstructive sleep apnea; hx = history; AS/AR = aortic stenosis/aortic regurgitation; STS = Society of Thoracic Surgeons.

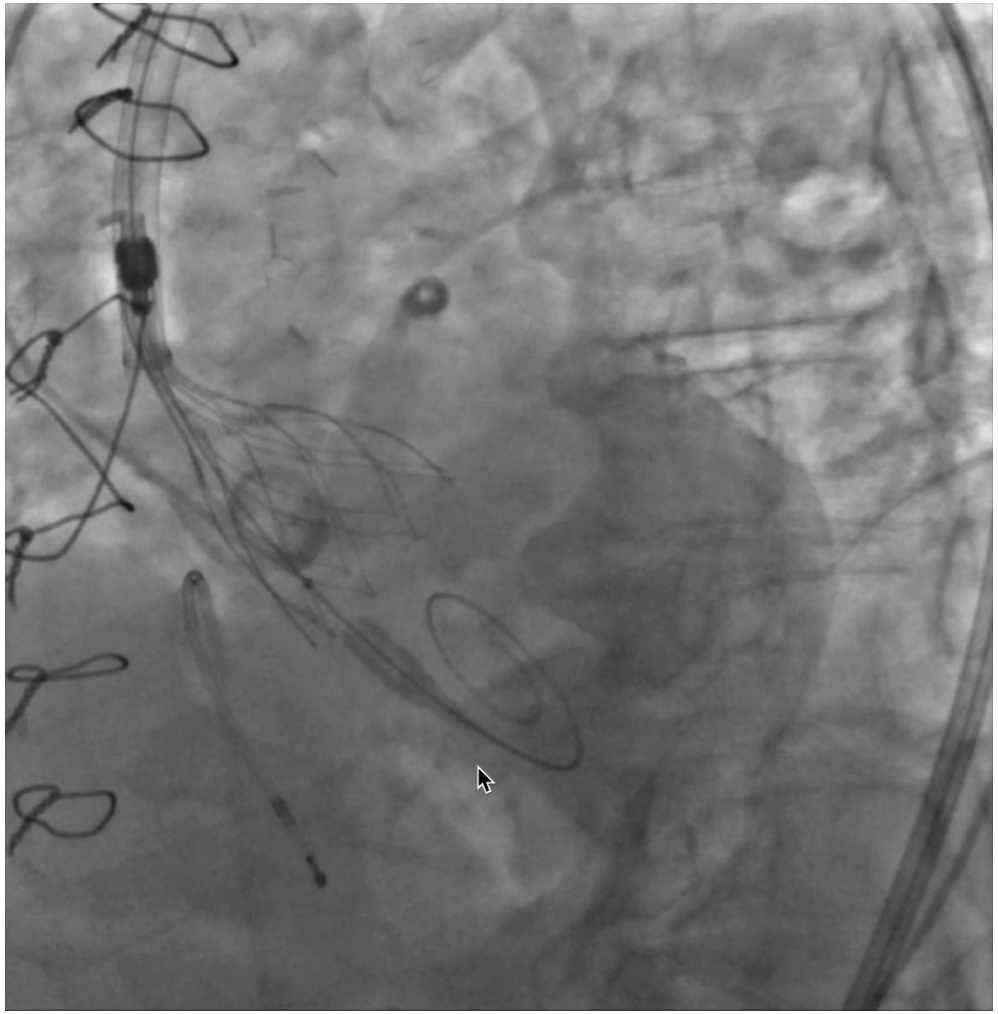

F

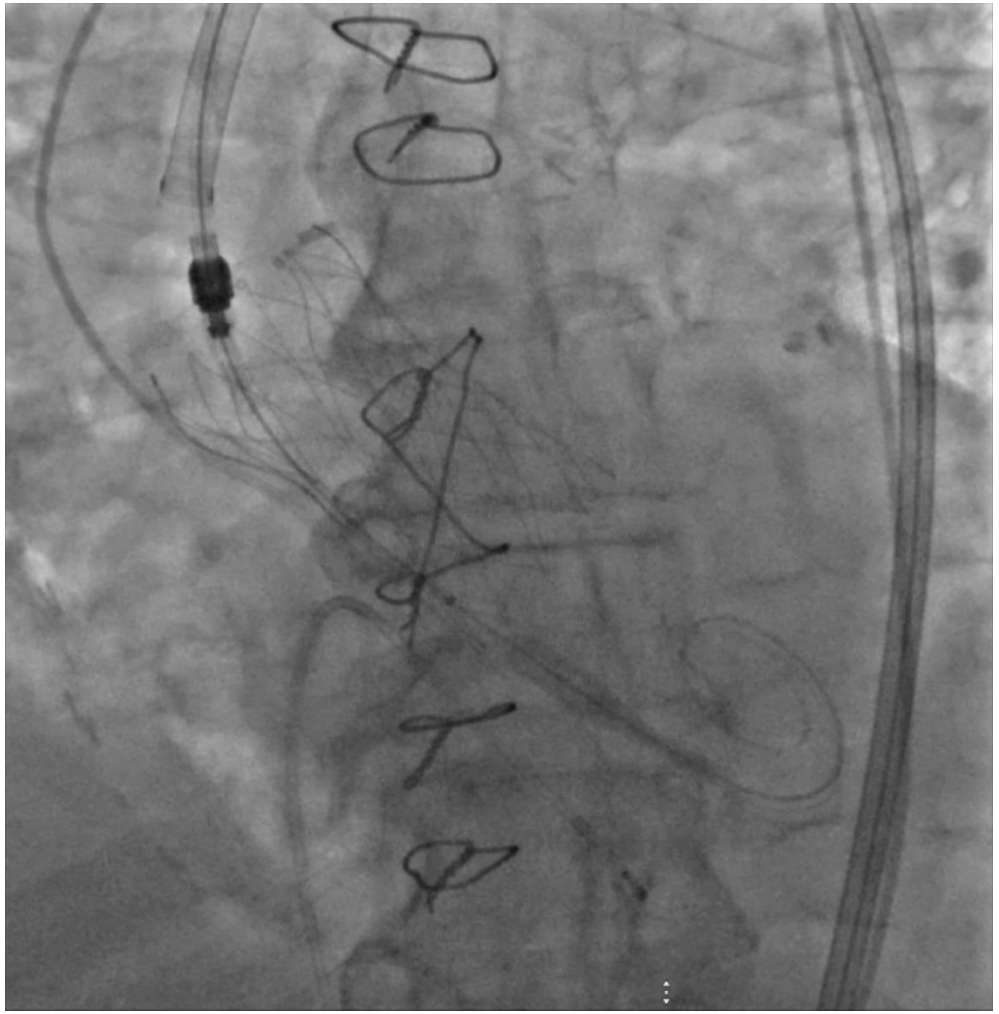

opSens
Name
Patient ID
2B
Pulse
140
200
150
100
50
0
Ao
101
121/78
LV
151/12
ΔP Mean
29
00:00:07
2025-04-28T13:11:39 TAVI


opSens
Name
Patient ID
2B
Pulse
84
150
100
50
0
Ao
71
87/59
LV
89/46
ΔP Mean
5
00:00:05
2025-04-28T13:21:31 TAVI





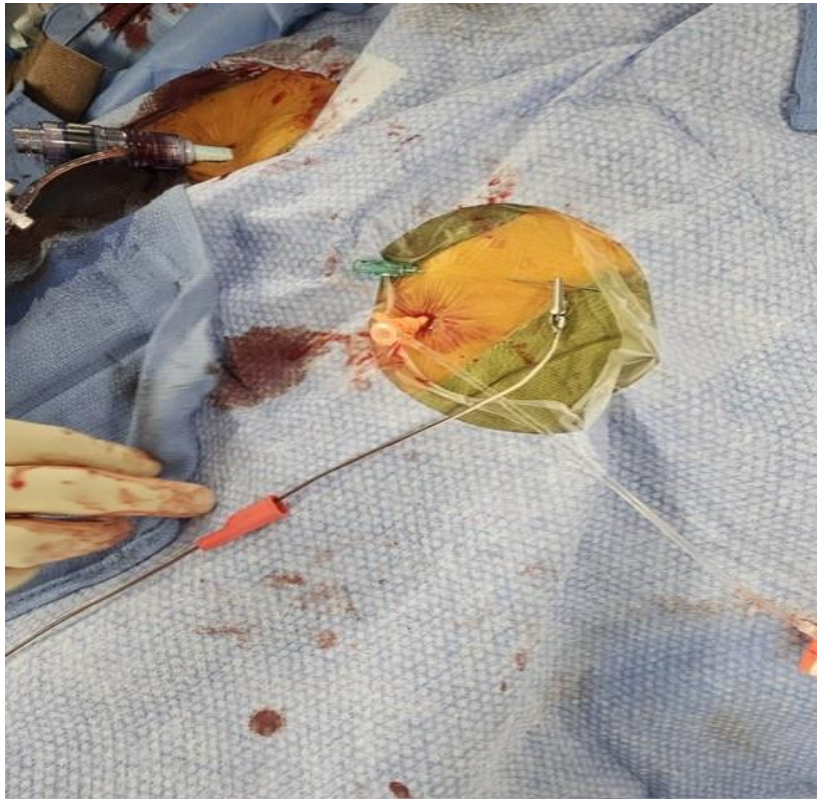


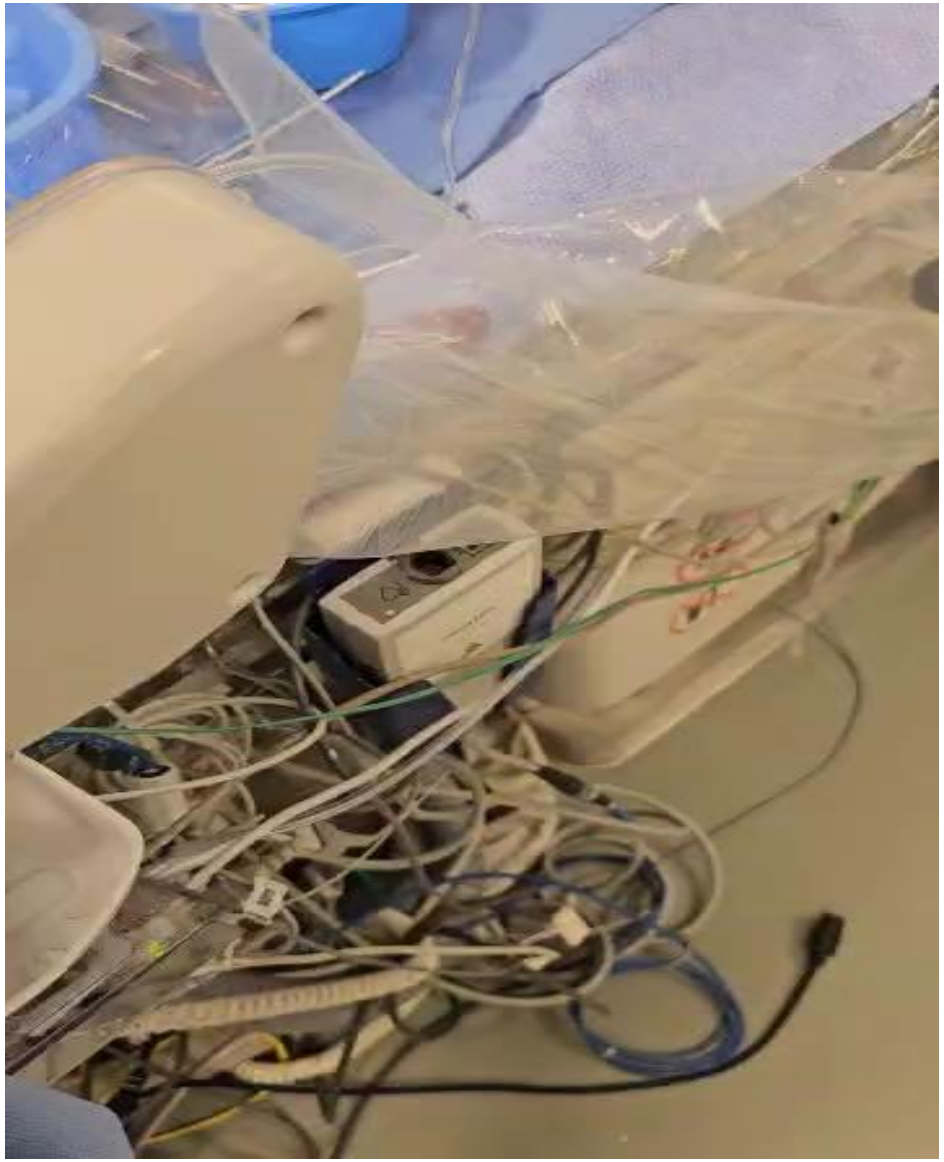


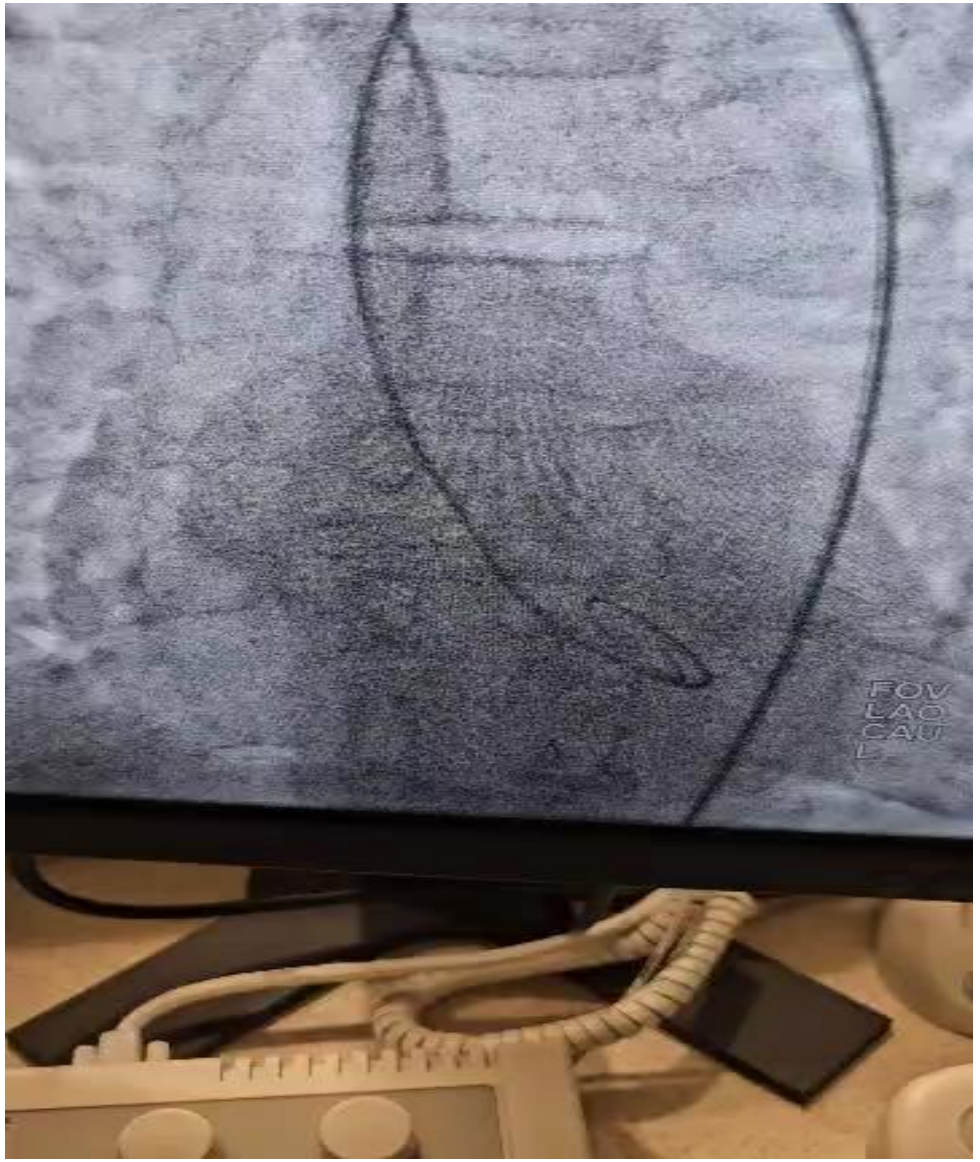
Tips and Tricks

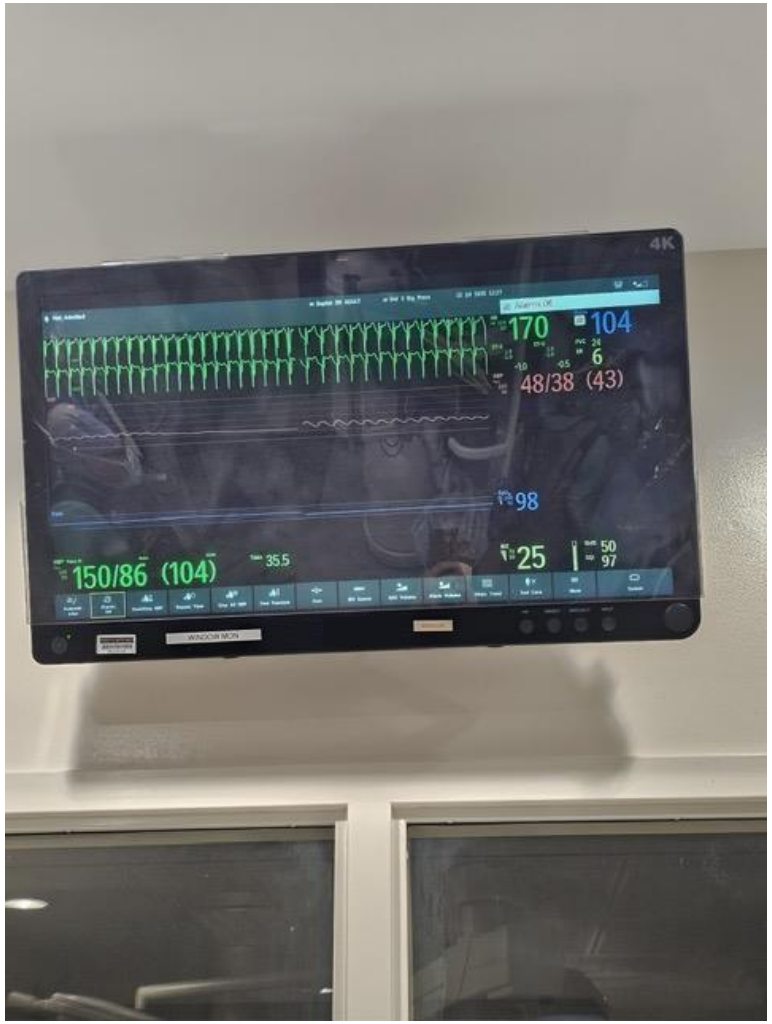
- Grounding techniques and setup
- Prepping guidewire by techs/nurses
- Procedural steps for 15-20 minutes TAVR
- Pressure monitoring before and after BAV/TAVR, equalization
- Mean gradient comparison with echocardiogram
- How should ARi be used?
- How to manage the wire during advancing the valve/balloon
- Appropriate wire position in LV
- Special cases of tortuous aorta and horizontal aortic root
- How to manage pacing – no extra test needed
- All kinds of valves BEV/SEV can be done – BEV is easier than SEV
- Can do for alternate access as well
- When to leave a TVP at the end of the case

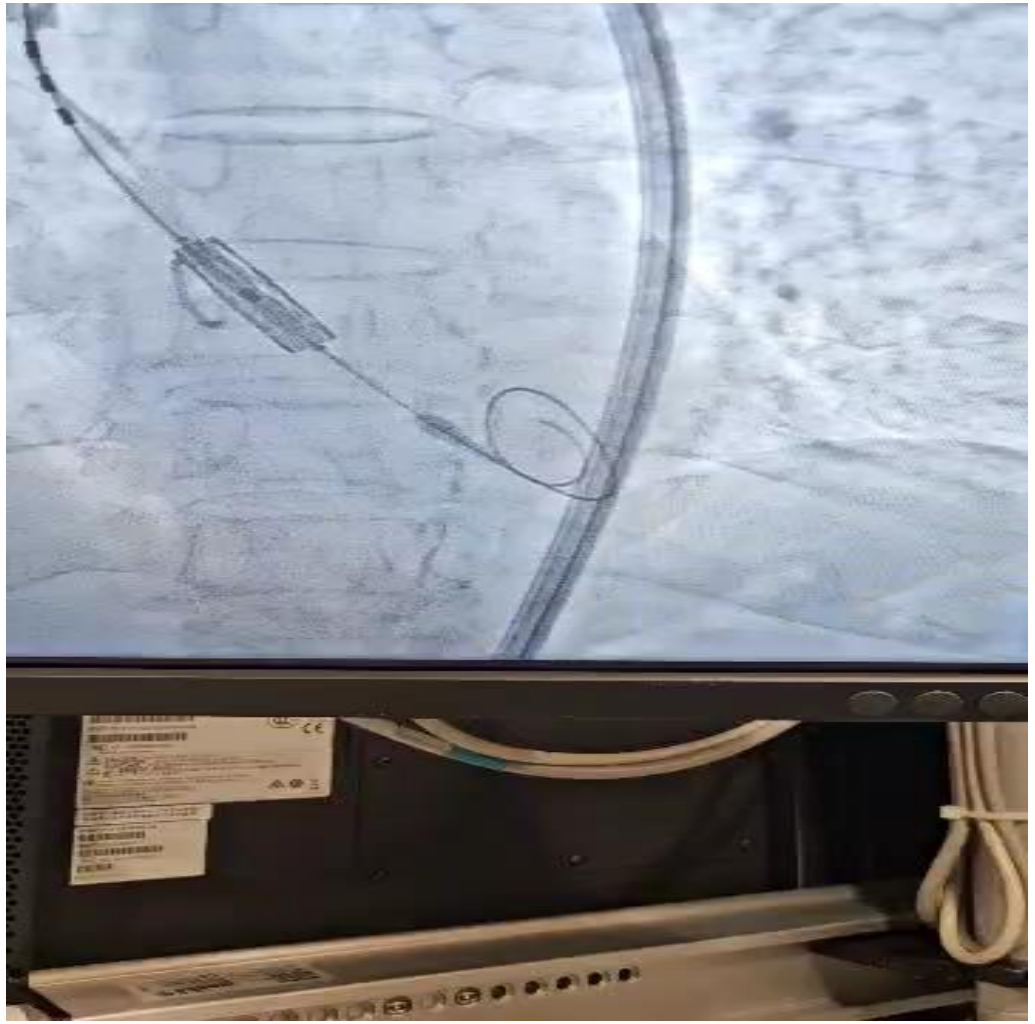

15/15
opSens



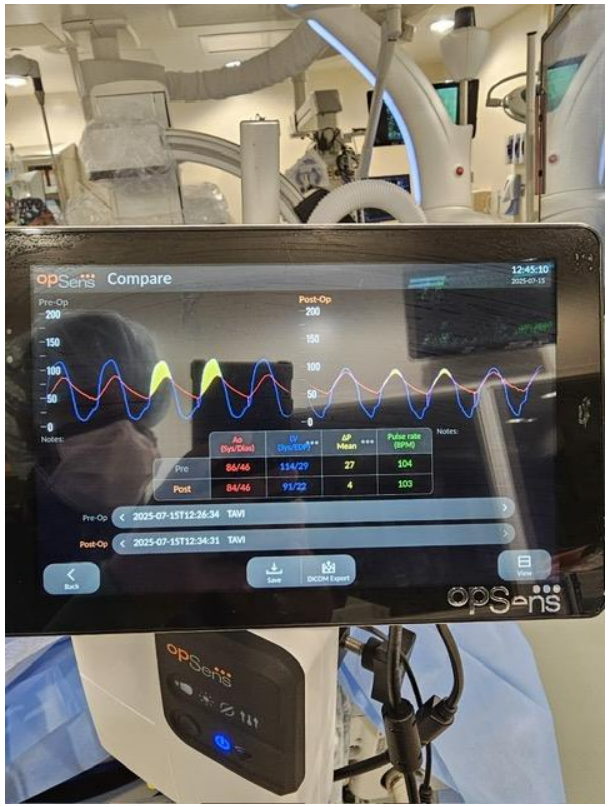



FOV
LAO
CAU
L


4K
170
104
6
48/38 (43)
98
150/86 (104)
35.5
25
50
97




Equalization completed:
High correction applied. Please verify signals
Patient
AO Zero
Equalize
Delay


opSens
Compare
12:45:10
Pre-Op
Post-Op
Pre
Post
86/46
114/29
27
104
84/46
91/22
4
103
2025-07-15T12:26:34 TAVI
2025-07-15T12:34:31 TAVI
opSens

Tips and Tricks

- Grounding techniques and setup
- Prepping guidewire by techs/nurses
- Procedural steps for 15-20 minutes TAVR
- Pressure monitoring before and after BAV/TAVR, equalization
- Mean gradient comparison with echocardiogram
- How should ARi be used?
- How to manage the wire during advancing the valve/balloon
- Appropriate wire position in LV
- Special cases of tortuous aorta and horizontal aortic root
- How to manage pacing – no extra test needed
- All kinds of valves BEV/SEV can be done – BEV is easier than SEV
- Can do for alternate access as well
- When to leave a TVP at the end of the case

Special Uses: Balloon Aortic Valvuloplasty

Ideal platform for BAV

Single access FA

Pre- and post-HDs

Rapid pace for optimized BAV

FA = femoral artery; HD = hemodialysis.

Special Uses: VIV (TAVR in SAVR and TAVR in TAVR)

Ideal platform for VIV

Single access FA

Pre- and post-HDs

Rapid pace for optimized VIV

Immediate post-dilatation/fracking based on HD post-TAVR deployment

SAVR = surgical aortic valve replacement; VIV = valve-in-valve.

Summary

- In an era of minimalist approaches, expanding indications of TAVR, and increased growth of TAVR volume, we need to optimize procedural efficiencies
- LV pacing can
  - Shorten procedure time
  - Reduce radiation risk
  - Reduce cost
  - Without compromising outcomes!
  - A guidewire with dedicated pacing properties offers a purpose-built platform for LV pacing with additional real-time hemodynamics

Q&A