TAVR 2013 - Where are We Going?

Victor Guetta, MD FESC FACC
The Chaim Sheba Medical Center

Disclosures

I have the following financial relationships to disclose:

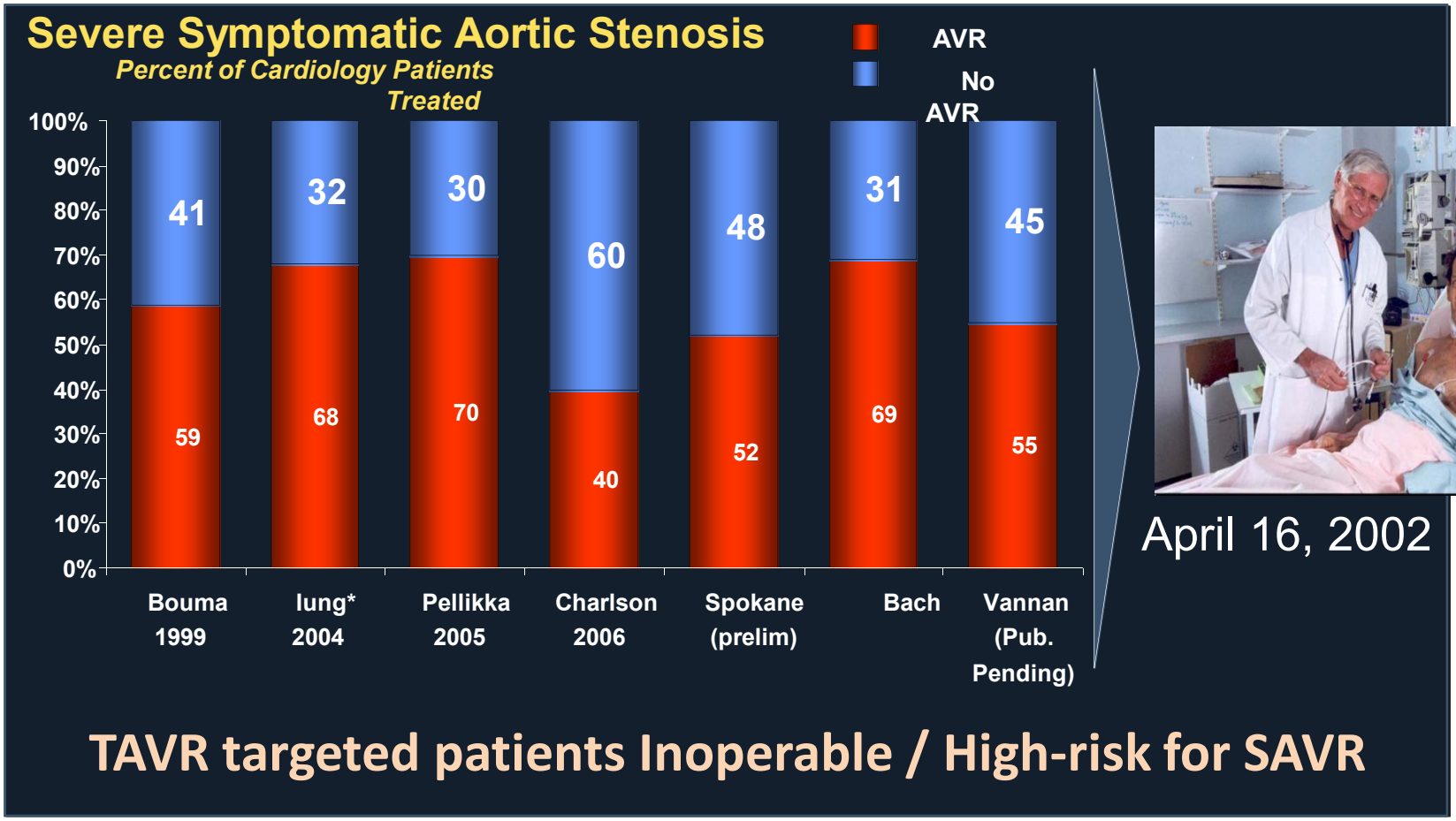
Edwards

Boston Scientific

Type of relation:

Proctor

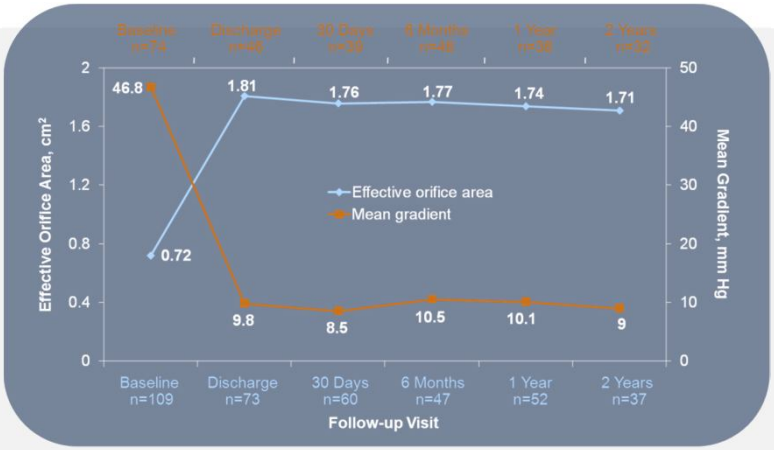
TAVR – the First Decade

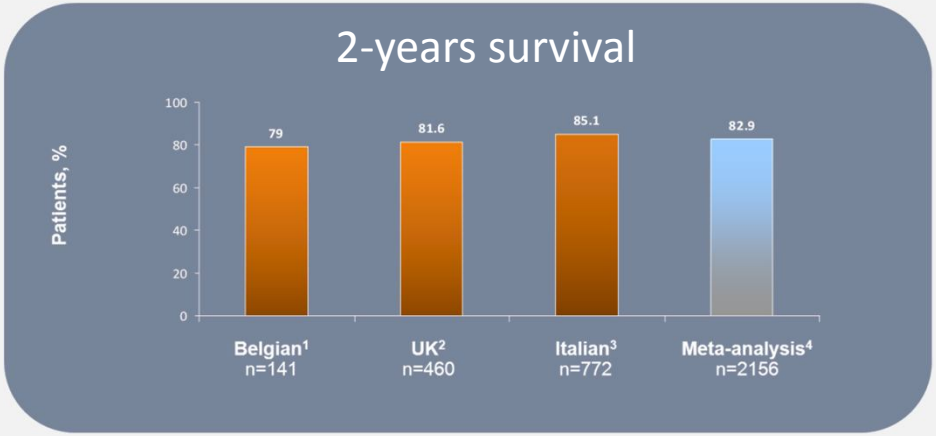


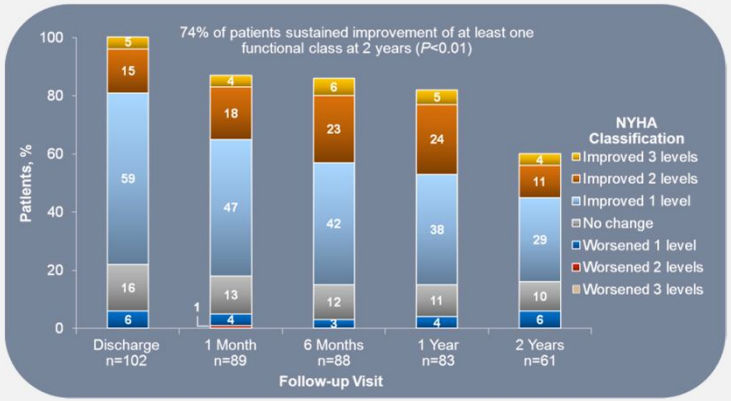
April 16, 2002

TAVR targeted patients Inoperable / High-risk for SAVR

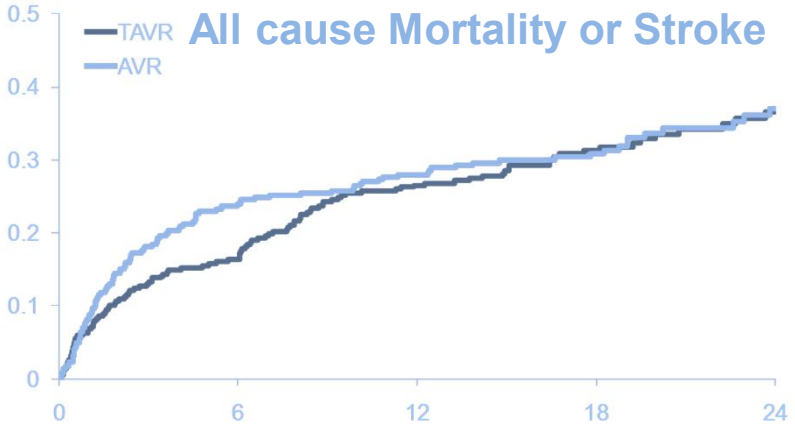
TAVR for Inoperable / High-risk for SAVR - CoreValve

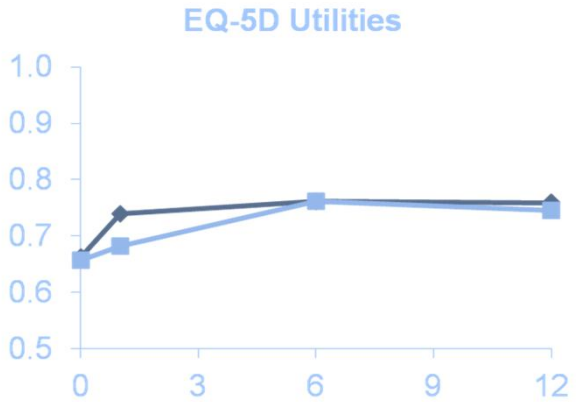






TAVR for Inoperable / High-risk for SAVR – Edwards





New (Off-Label) Indications for TAVR

Since 2002 (FIM), TAVR as emerged as a good alternative to surgical AVR in patients with severe aortic stenosis who are at high risk or inoperable.

TAVR is currently indicated for patients with tri-cuspid aortic valve stenosis.

Many patients with other aortic and mitral pathologies are also at high surgical risk and may benefit from TAVR.

New TAVR Indications

Aortic Regurgitation

Failed Bioprostetic Valves

TAVI Registry for Pure Native AR

14 European Centers

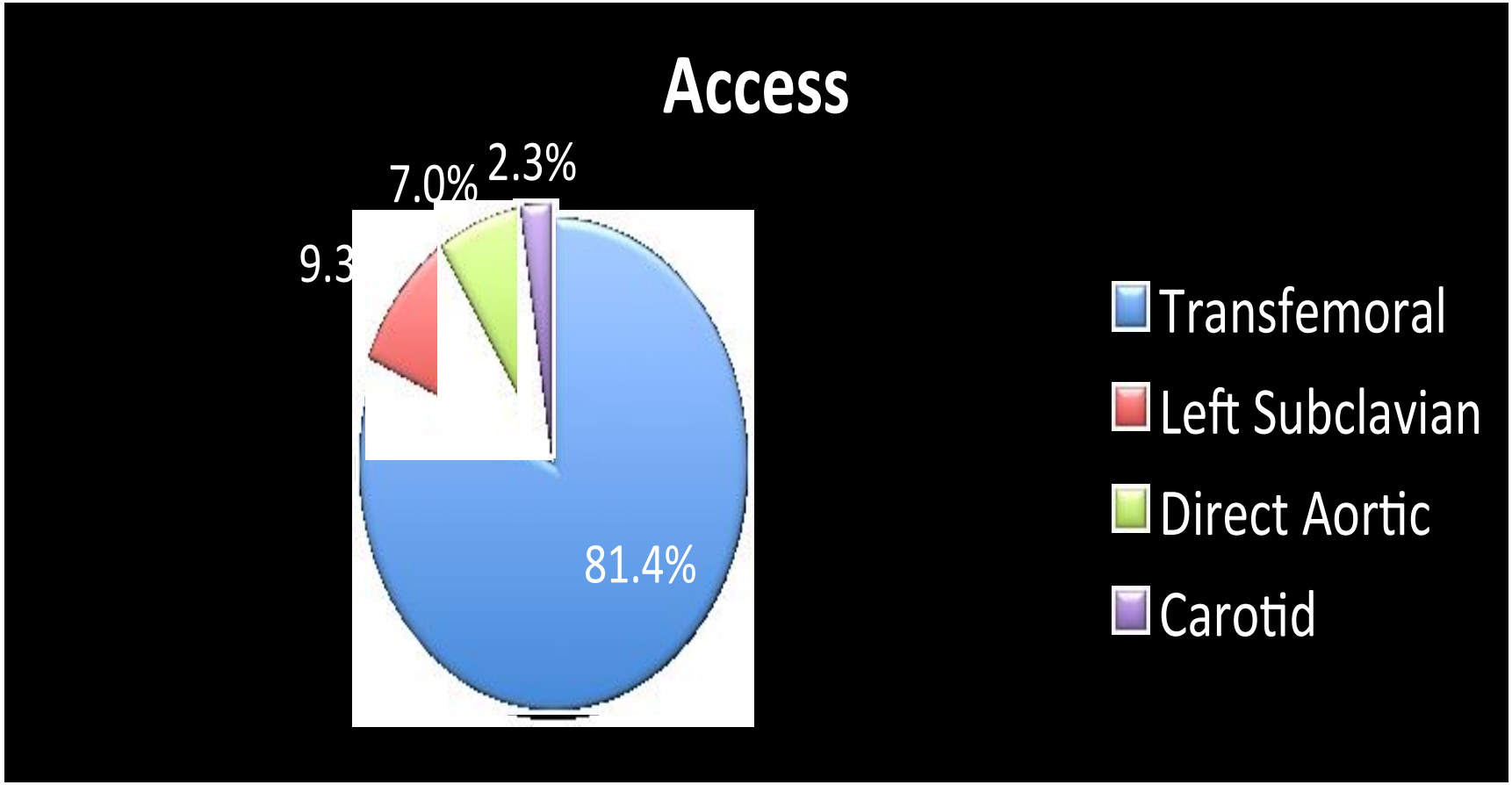
Roy DA, Hildick-Smith D, Shäfer U, Guetta V, Moellman H, Petronio AS, Dumonteil N, Modine T,Bosmans J, Moat N, Linke A, Morris C, Medvedofsky D, Patterson T, Woiték F, Jahangiri M, Laborde JC, Brecker SJD

- St George's Hospital NHS Trust, London UK
- Royal Sussex County Hospital, Brighton, UK
- St Georg Hospital Hamburg, Germany
- Sheba Medical Center, Tel Hashomer, Israel
- Kercoff Heart Center, Bad Nauheim, Germany
- CHU Rangueil, Toulouse, France
- University of Pisa, Pisa, Italy
- University Hospital, Antwerp, Belgium
- Royal Brompton Hospital, London, UK
- Hôpital Cardiologique, Lille, France
- German Heart Center, Munich, Germany
- Silesian Medical Center, Katowice, Poland
- Leipzig Heart Center, Germany
- University Hospital of Asturias, Spain

TAVI for Pure AR – Principle causes of AR

• Degenerative	28
• Post-endocarditic	6
• Aortic aneurysm	4
• Post radiotherapy	2
• Chronic aortic dissection	1
• Cusp restriction due to	
– Takayasu's disease	1
– Rheumatoid arthritis	1
Total	43

TAVI for Pure Native Valve AR



Results
TAVI for Pure Native Valve AR

- Successful implantation in 42/43 patients (97.7%).

* 1 open heart surgery and valve replacement

Results
TAVI for Pure Native Valve AR

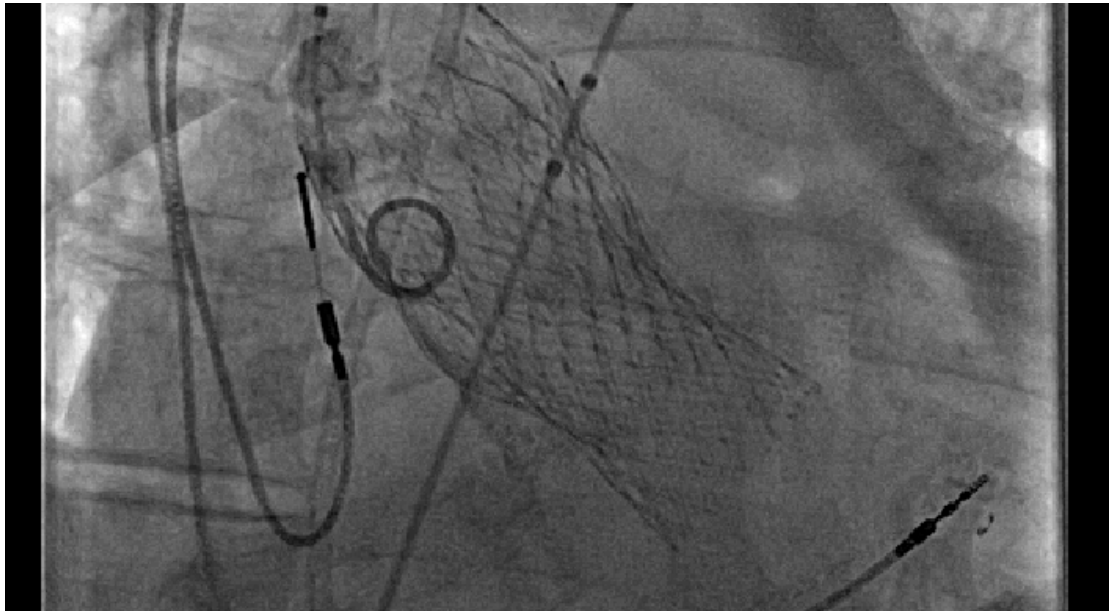
- 2nd Valve required 8 (18.6%)
- Paravalvular Leakage Grade≤ 1 34(79.1%)
  Grade 2 7(16.3%)
  Grade ≥ 3 2(4.7)*

*1 open heart surgery and valve replacement

- According to Valve Academic Research Consortium (VARC) definitions, procedural success was 76.8%

Results
TAVI for Pure Native Valve AR

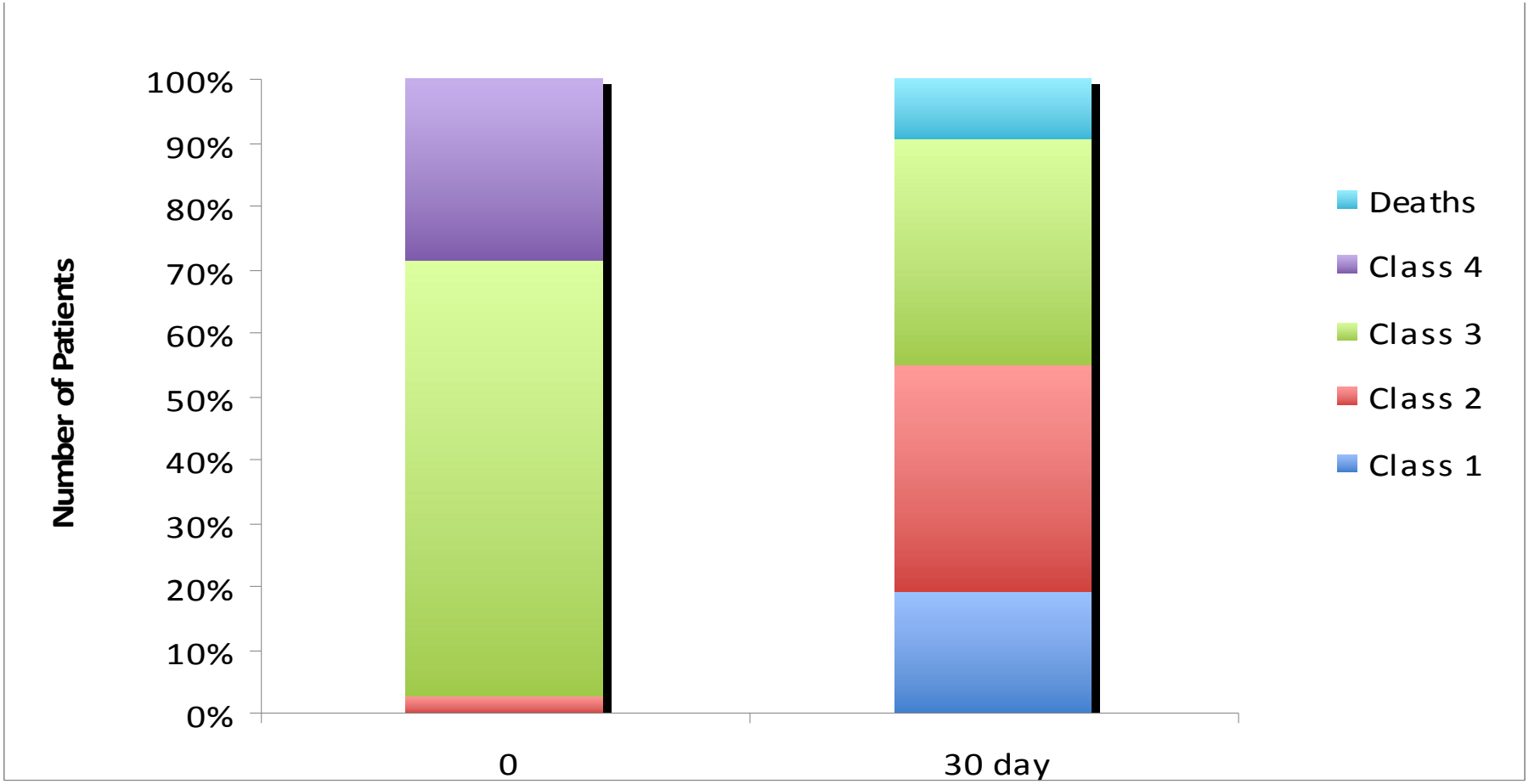
- All 8 patients (18.6%) who required a second valve had **absent** annular calcification on CT or Echo (p=0.014)



Results - VARC Outcomes
TAVI for Pure Native Valve AR

• 30-day mortality	4(9.3%)
Cardiovascular	1(2.3%)
• 30-day stroke	2(4.7%)
– Major	2(4.7%)
– Minor	0
• 1-year mortality	6/28(21.4%)
Cardiovascular	3/28(10.7%)

30 Day NYHA Functional Class



TAVR for Failed Bioprosthetic Valve

Bioprosthetic valves are increasingly implanted in aortic-valve replacement open-heart surgeries.

- **These valves commonly fail within 10-15 years, resulting in a need for a high risk "redo" operation.**
- **Transcatheter valve implantation inside a degenerated bioprosthetic valve ("valve in valve", VIV) is a less-invasive alternative approach*.**

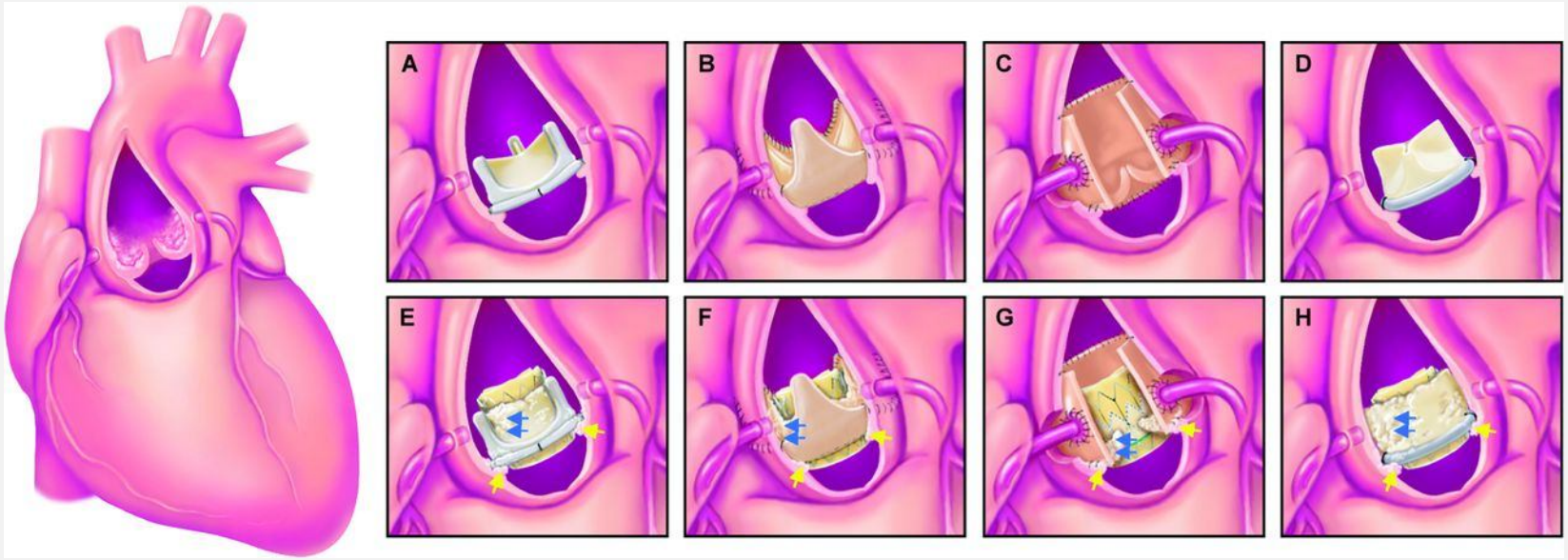
TAVR for Failed Bioprosthetic Valve

Transcatheter Aortic Valve Replacement for Degenerative Bioprosthetic Surgical Valves

Results From the Global Valve-in-Valve Registry

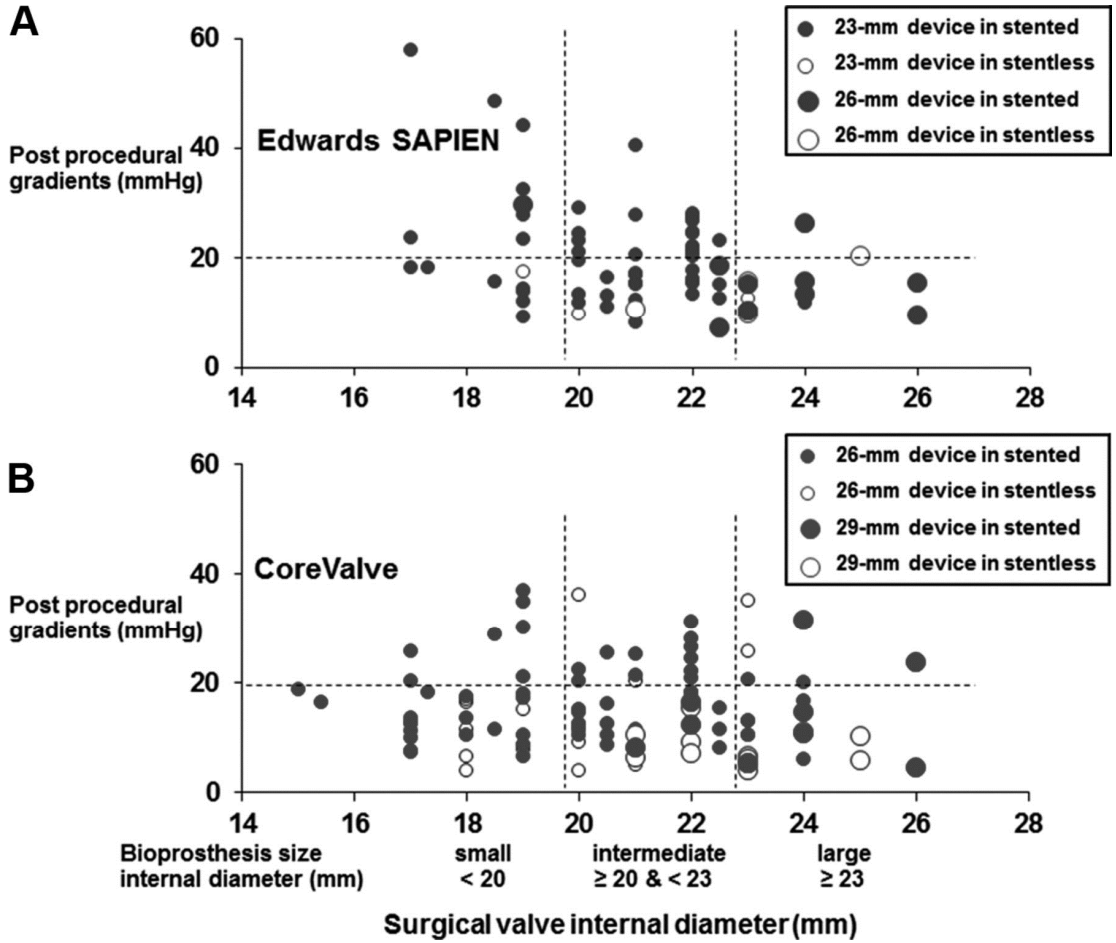
Dvir et al Circulation 2012

A, Stented bioprosthesis with leaflets mounted inside the frame struts.



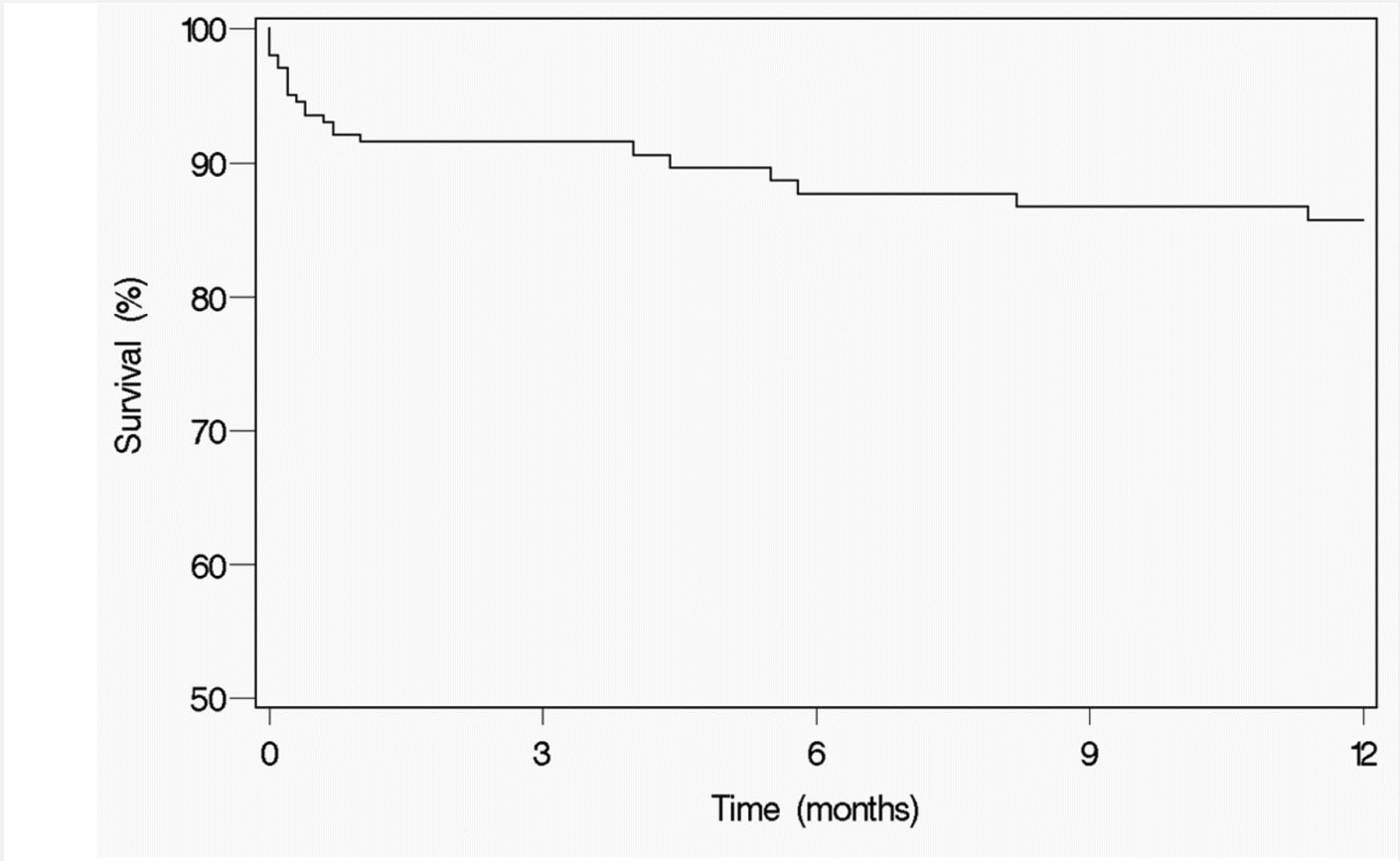
Tuzcu E M et al. Circulation 2012;126:2280-2282

Analysis of high postprocedural gradients (mean gradients ≥20 mm Hg) after valve-in-valve procedures, according to surgical bioprosthesis size: large (internal diameter ≥23 mm), intermediate (≥20 and <23), and small (<20)



Dvir D et al. Circulation 2012;126:2335-2344

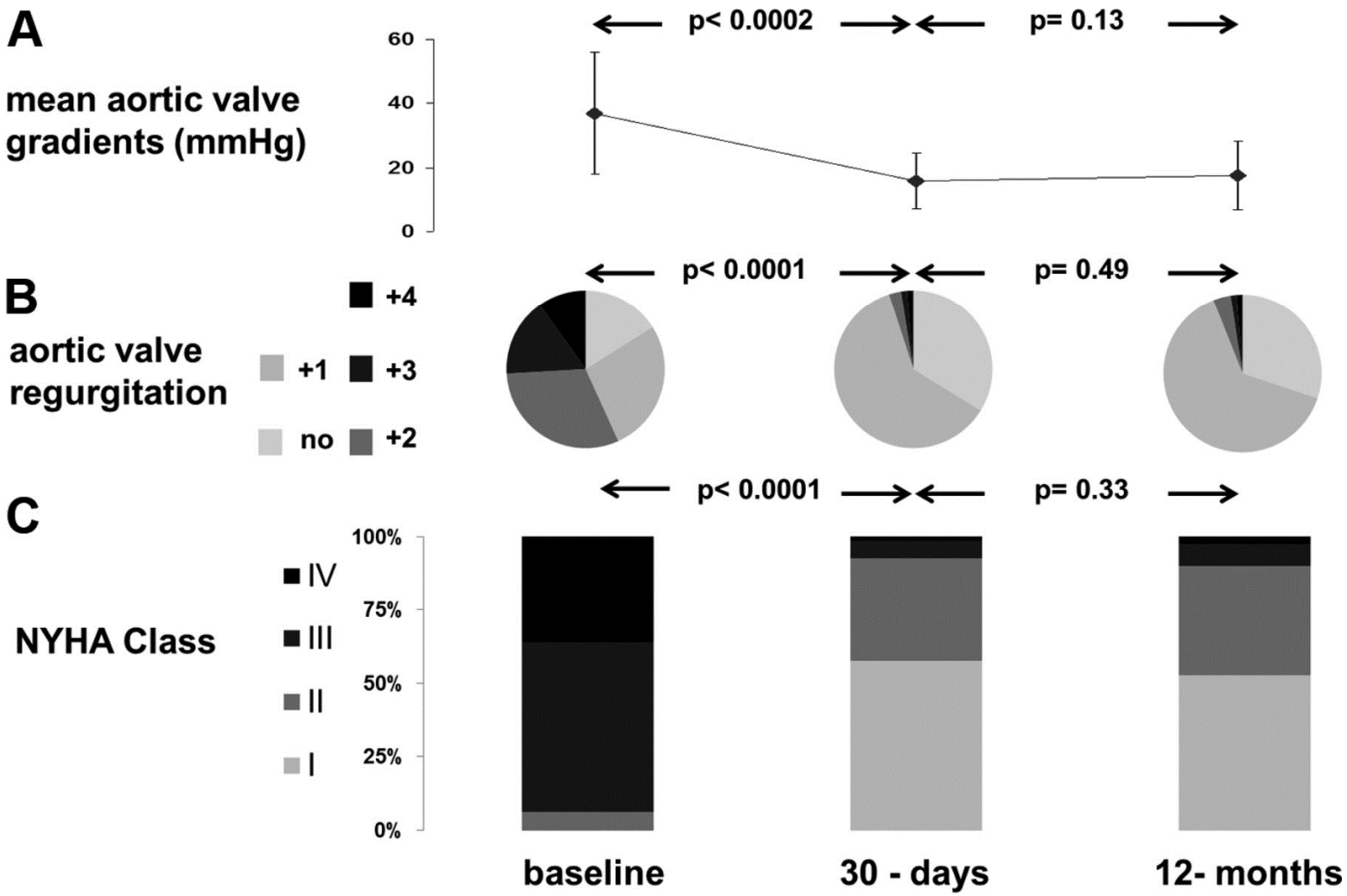
Kaplan–Meier survival curve of patients undergoing transcatheter aortic valve replacement for degenerated bioprosthetic valve (valve-in-valve).



Patient at risk:	202	163	129	102	87
Survival (%):	100	91.5	87.7	86.7	85.8

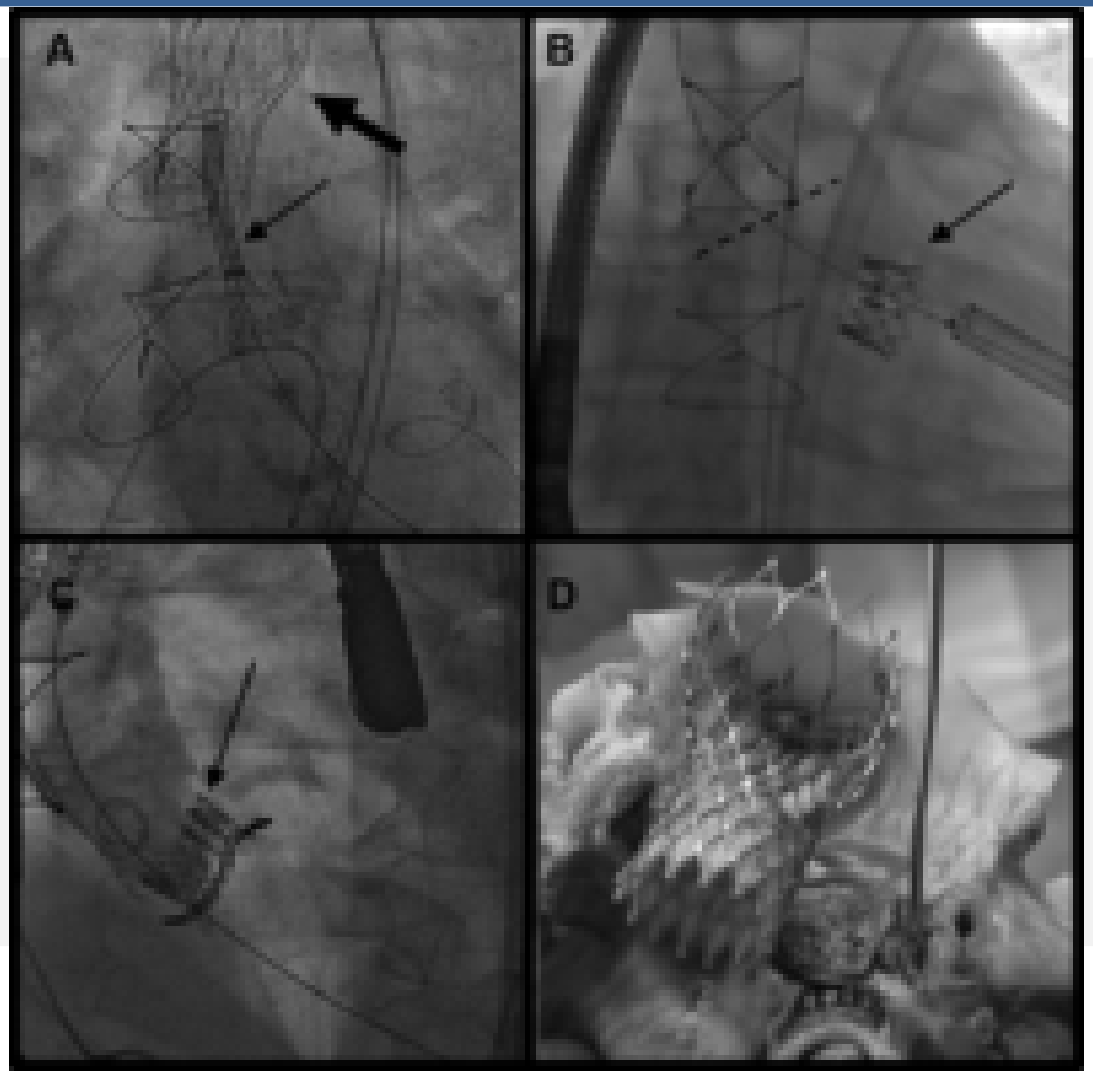
Dvir D et al. Circulation 2012;126:2335-2344

Clinical and hemodynamic results of patients undergoing transcatheter aortic valve replacement for degenerated bioprosthetic valves (valve-in-valve).

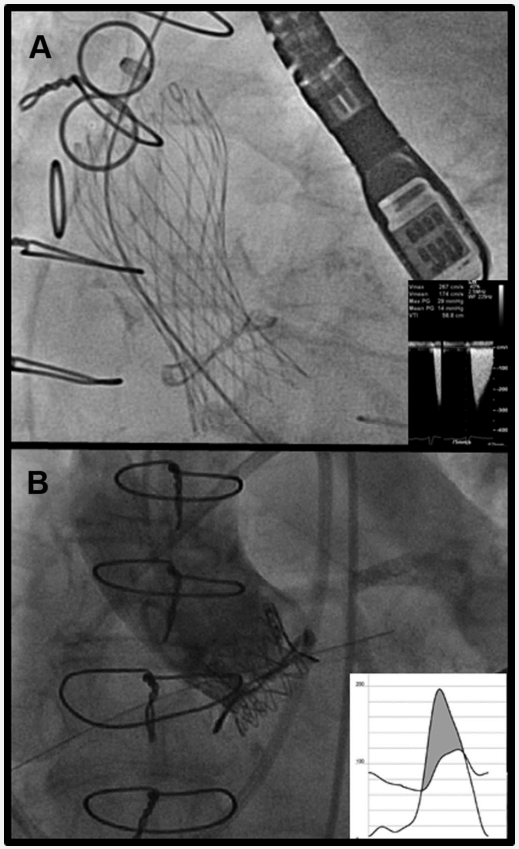


Dvir D et al. Circulation 2012;126:2335-2344

Case examples of device malposition and ostial coronary obstruction during aortic valve-in-valve implantations



Case examples of valve-in-valve procedures performed inside small surgical bioprostheses.



Dvir D et al. Circulation 2012;126:2335-2344

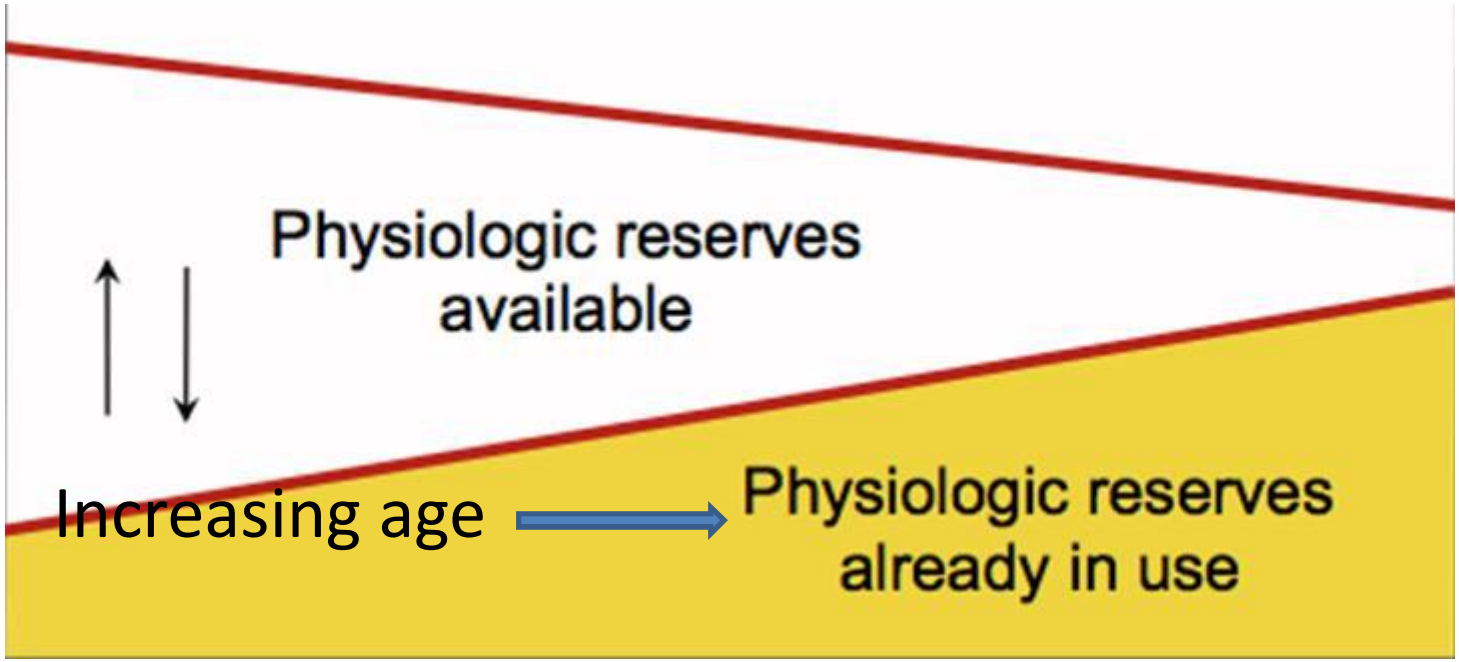
Patents selection for TAVR – the 2nd Decade

Are all Inoperable or high risk patients for SAVR, should be candidates for TAVR?

TAVR for moderate/low risk AS patients – Are we ready?

Frailty Phenotype

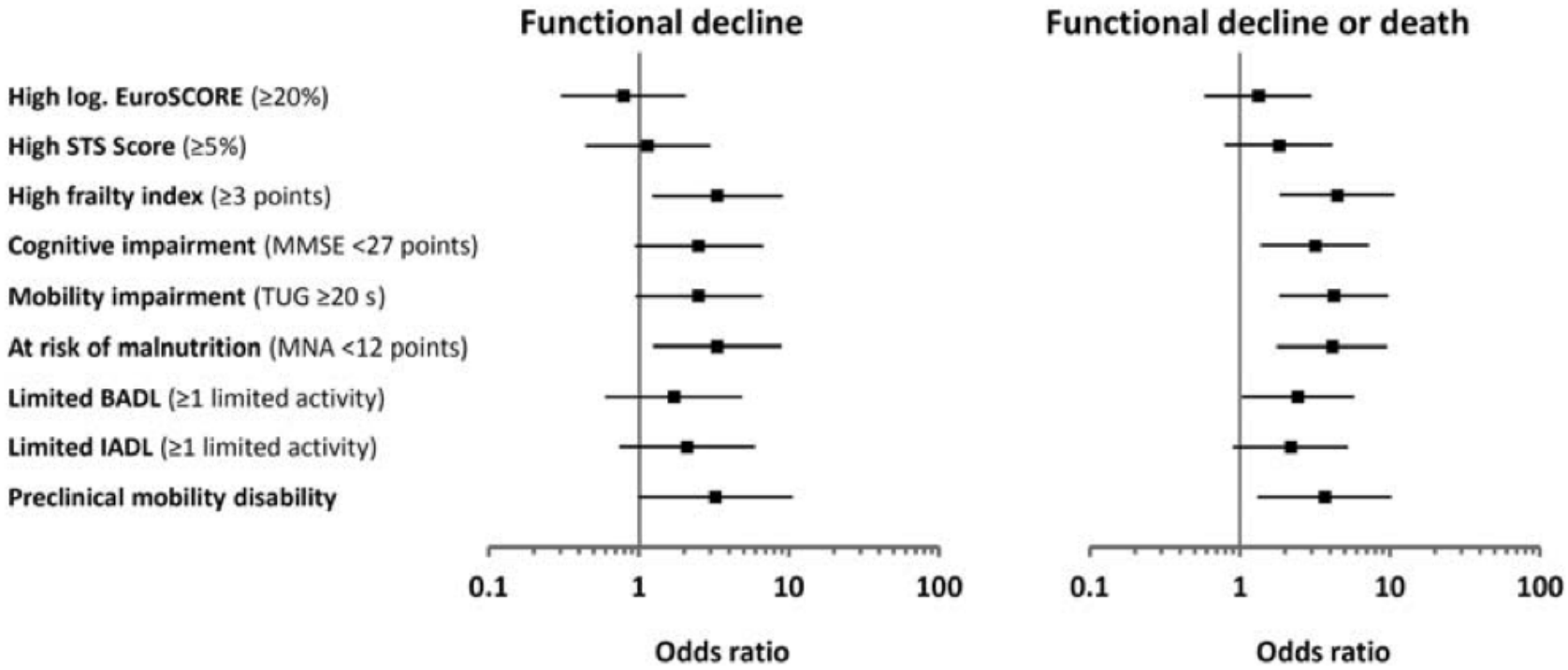
Syndrome of multisystem impairment associated with aging that results in decreased physiologic reserve and increased vulnerability to stressors.



Fried J Gerontol A Biol Sci Med Sci. 2001 Mar;56(3)

Frailty increases the risk of functional decline after TAVR

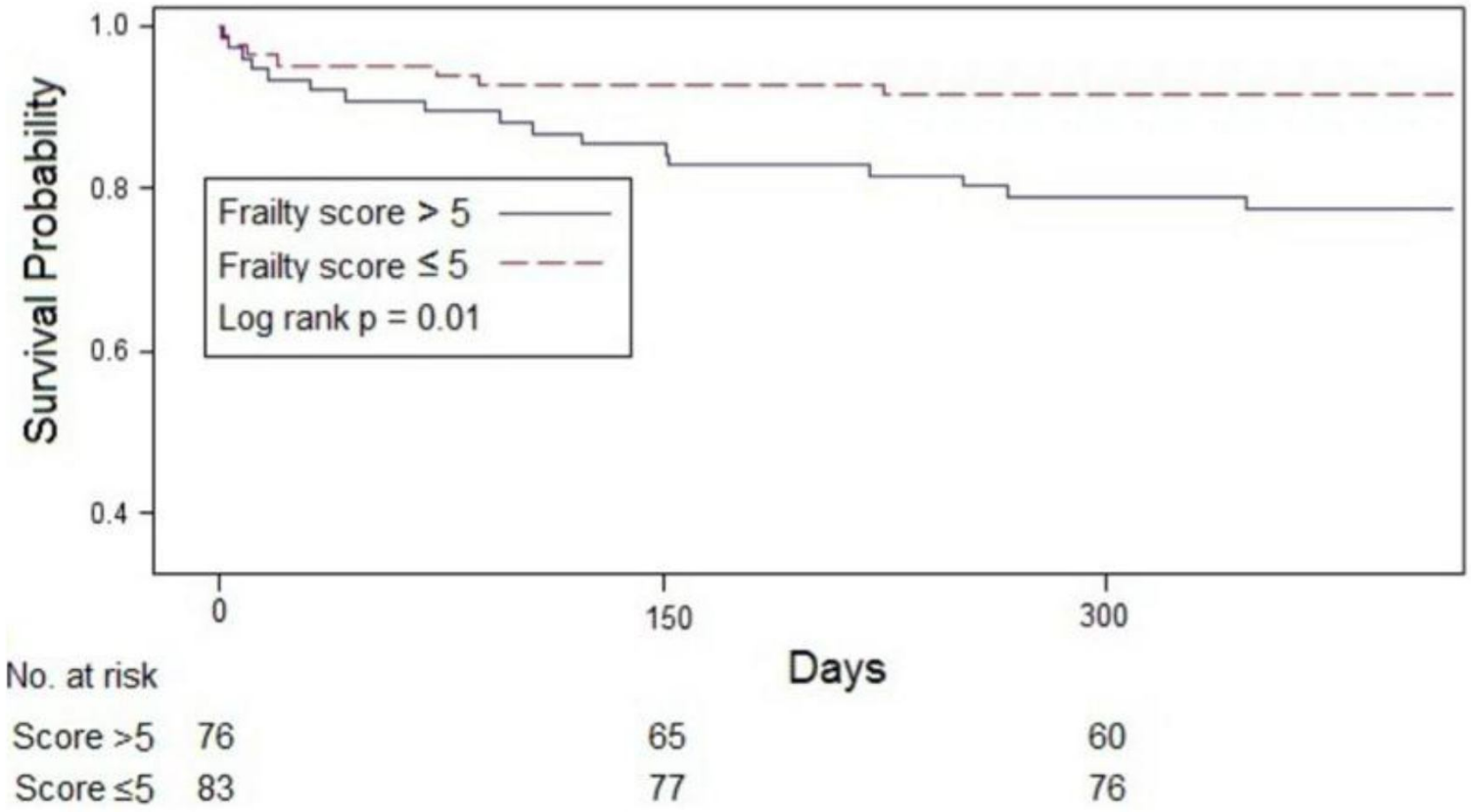
Functional decline = loss of independence in 1 or more ADL*



Schoenenberger AW, Eur Heart J 2012

*activities of daily living

Frailty: Increased mortality after TAVR



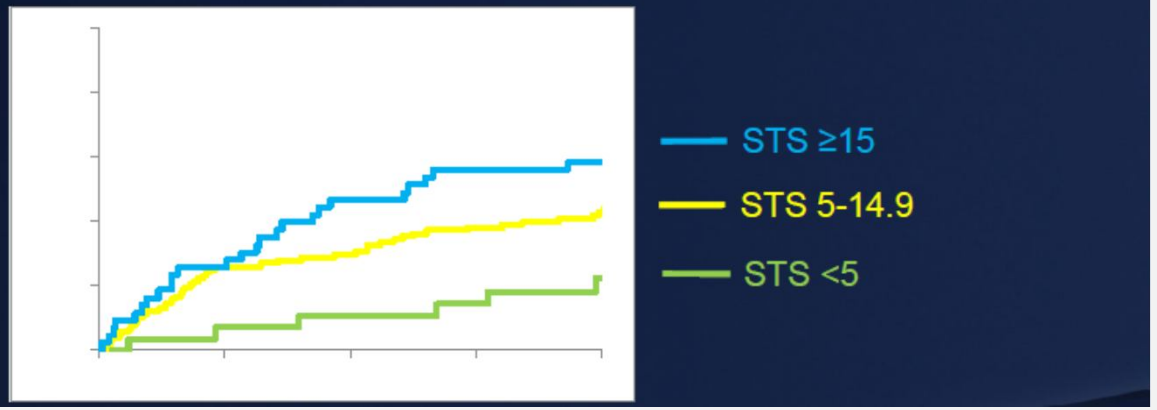
J Am Coll Cardiol Intv. 2012;5(9):974

TAVR: Futility

Futility: Inability to survive one year despite AVR

Frailty Assessments	< 80 Yrs	80-90 Years	> 90 Years
BMI < 21	4%	5%	6%
Albumin < 3.3	4%	5%	7%
Wheelchair Bound	7%	8%	10%
Does Not Live Independently	5%	6%	9%

TAVR PARTNER B Two Year Outcome



Patents selection for TAVR – the 2nd Decade

Inoperable or high risk patients for SAVR, might **not** be candidates for TAVR either.
It is difficult to accept, but some patients are beyond invasive therapy!

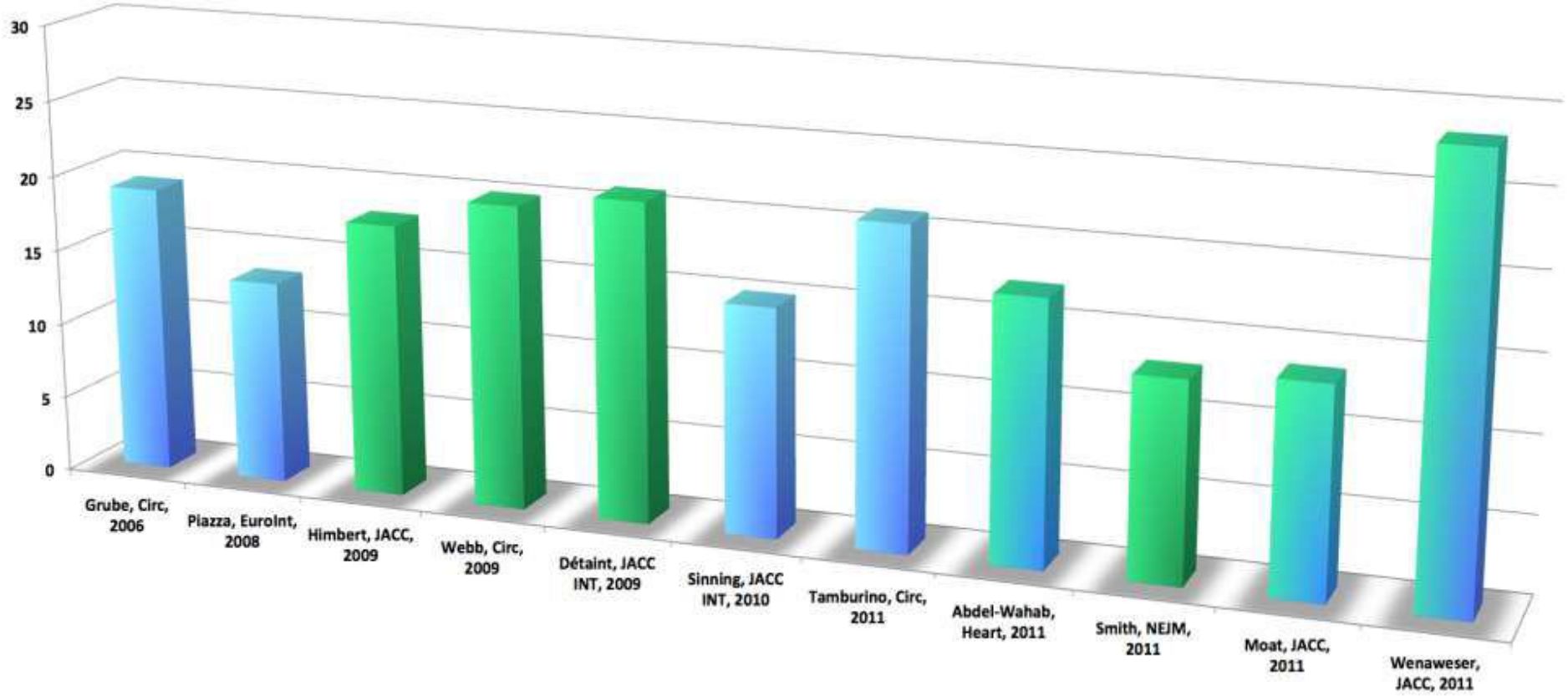
TAVR for moderate/low risk AS patients – Are we ready?

TAVR for Inoperable / High-risk Patients for SAVR - Outcomes

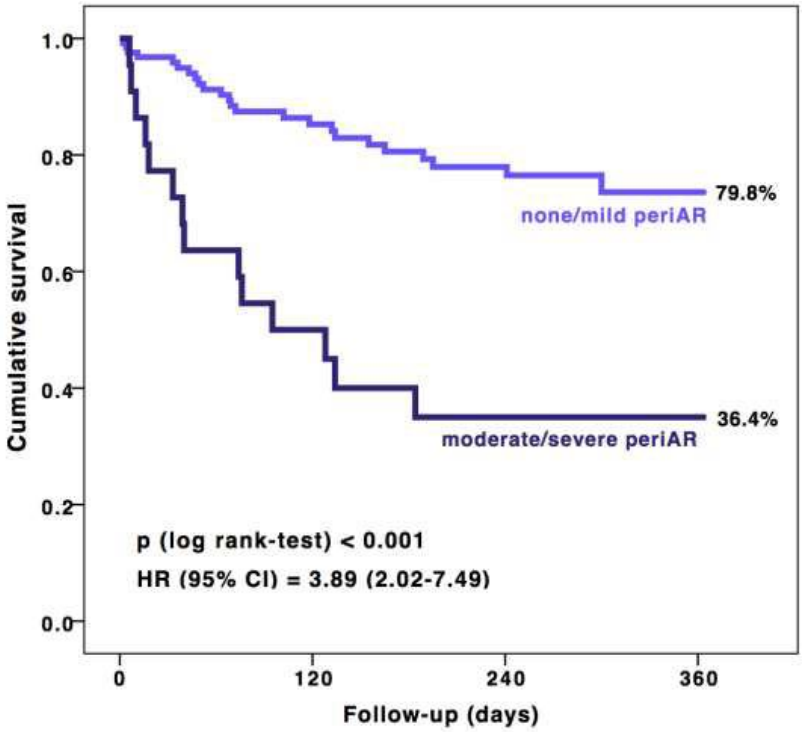
First Generation Aortic TCVs	Edwards		CoreValve
Procedure success	95 - 97.8 %		
Valve Embolization	1 %	-	0 %
Annulus rupture	1 %	-	0.2 %
Valve Dislodgment	0 %	-	3 %
Need for additional valve (2/3 valves)	2 - 3 %		
Paravalvular leak Grade ≥ 2	6 -10 %		
Coronary occlusion or sub-occlusion	1 %	-	<0.3%
Pacemaker requirement	5 %	-	35 %
Major vascular complications	~10%	-	~8 %
Stroke	3 - 6 %		
Valve Durability	bench model tests		

Moderate/Severe periprosthetic AR post TAVR

Blue: Medtronic CoreValve
Green: Edwards-SAPIEN



Impact of peri-AR on 1-year survival



No. at risk				
none/mild	124	120	77	49
moderate/severe	22	17	9	7
Total	**146**	**137**	**86**	**56**

Sinning, Grube, et al., JACC 2012

Explanations for Procedure Complications

Valve Embolization	Low or Too High + mm *
Valve Dislodgment	Technical error + Too High
Need for additional valve	Too Low or Too High
Paravalvular leak Grade ≥ 2	Too Low + mm *
Coronary occlusion	Too High + mm *
Pacemaker requirement	Too Low + mm *

Wrong measurements / Valve position / Valve design*

*measurement mistakes: undersizing, oversizing

TAVR the 2nd Decade

SAVR is an excellent therapy for symptomatic patients with severe aortic stenosis (class I a indication) – it improves survival and quality of life with acceptable procedural complications

TAVR for moderate/low risk AS patients – What should be do to be ready?

TAVR Procedures in 2013 (the 2nd decade) will have to Address:

- Pervialvular Leak
- Coronary Occlusion
- Control and Accuracy of Positioning
- Pacemaker Need
- Stroke
- Major Vascular Complications

TAVR for Moderate / Low-risk Patients for SAVR - Outcomes

Next Generation Aortic TCVs

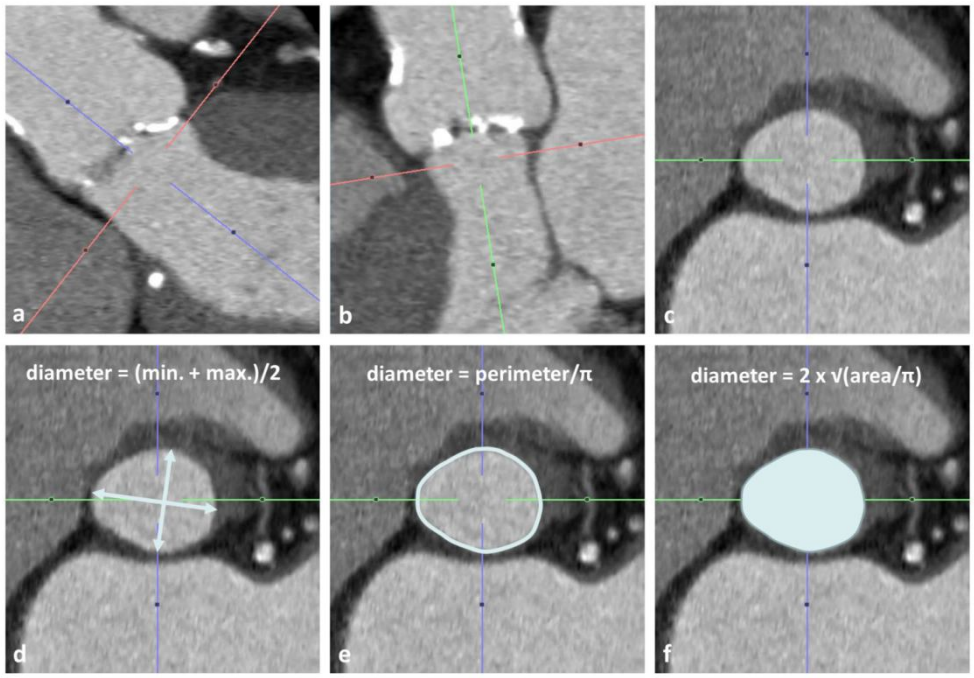
Procedure success	> 98 %
Valve Embolization	none
Annulus rupture	< 0.1 %
Valve Dislodgment	none
Need for additional valve (2/3 valves)	none
Paravalvular leak Grade ≥ 2	< 1 %
Coronary occlusion or sub-occlusion	none
Pacemaker requirement	5 - 8 %
Major vascular complications	< 1 %
Stroke	< 2 %
Valve Durability	6-12 years

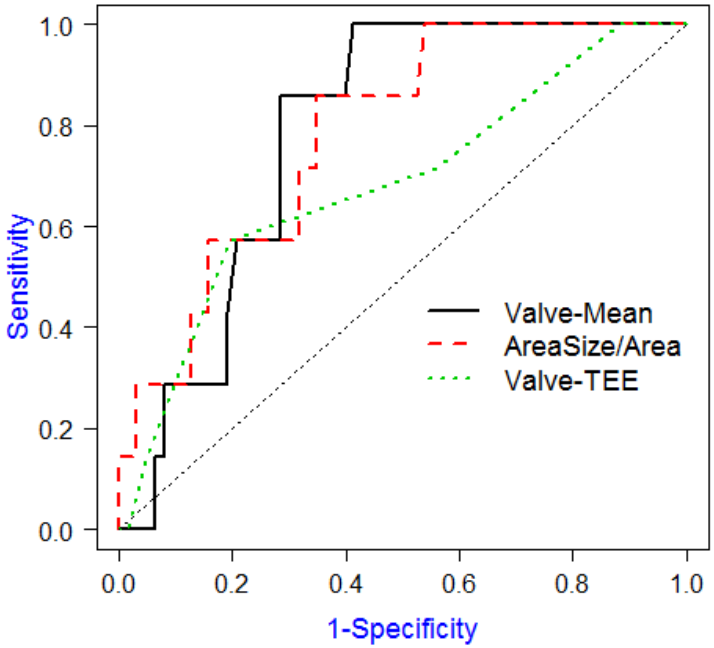
TAVR Procedure in 2013 will Require

- Advanced Imaging Modalities
- New TAVR Systems
- Cerebral Embolic Protection Devices
- Access and Closure Strategies

Better Imaging Pre/Post Procedure

CT Annular Measures Can Predict PV Leak

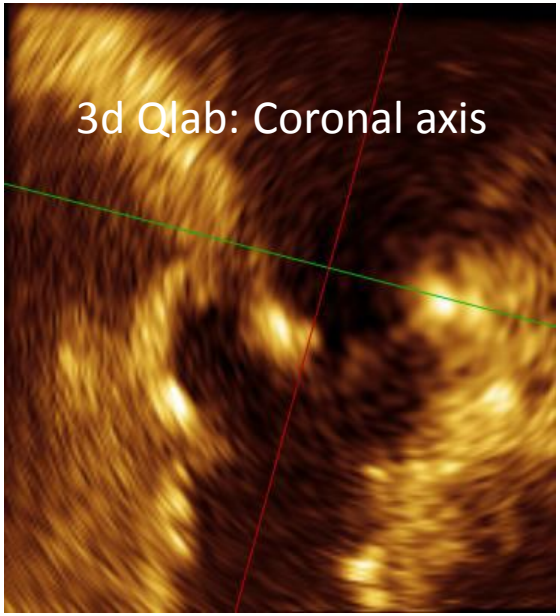


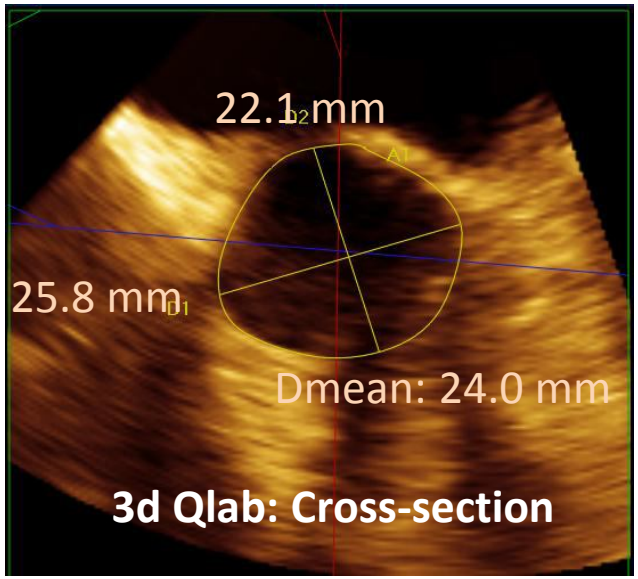


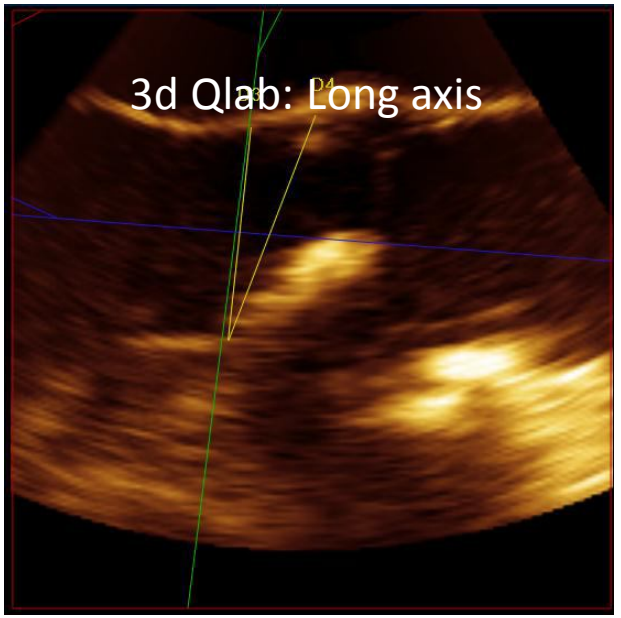
Willson et al JACC 2012

3D TE Echo (IC?)

3D TEE (Qlab): Defining the basal (annular) plane

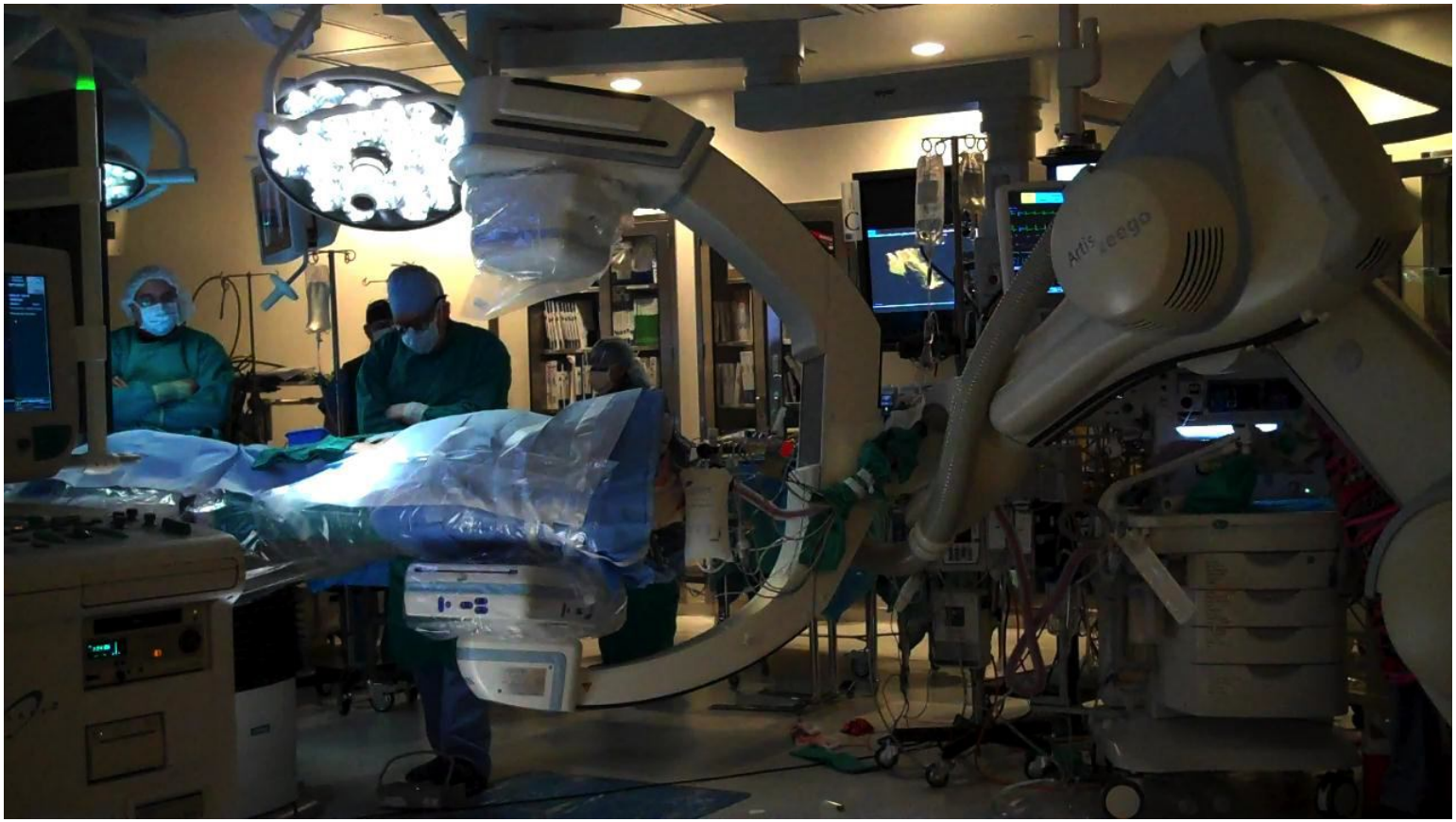






The Optimal TAVR Procedural Suite

Integrated CT/Angio Systems



Rotation, 3D reconstruction, image fusion

New Transfemoral TAVR Systems

Direct Flow Boston Sci. Lotus St. Jude Portico

Aortex Heart Leaflet Technologies EndoTech

New Transapical TAVR Systems

Jena Valve

Medtronic Engager

Symetis Accurate

Two New Edwards Valve Platforms

Edwards SAPIEN 3 Valve

Balloon Expandable

<u>Adaptive Seal</u>
conformability to irregular anatomical surfaces, and to minimize paravalvular leaks

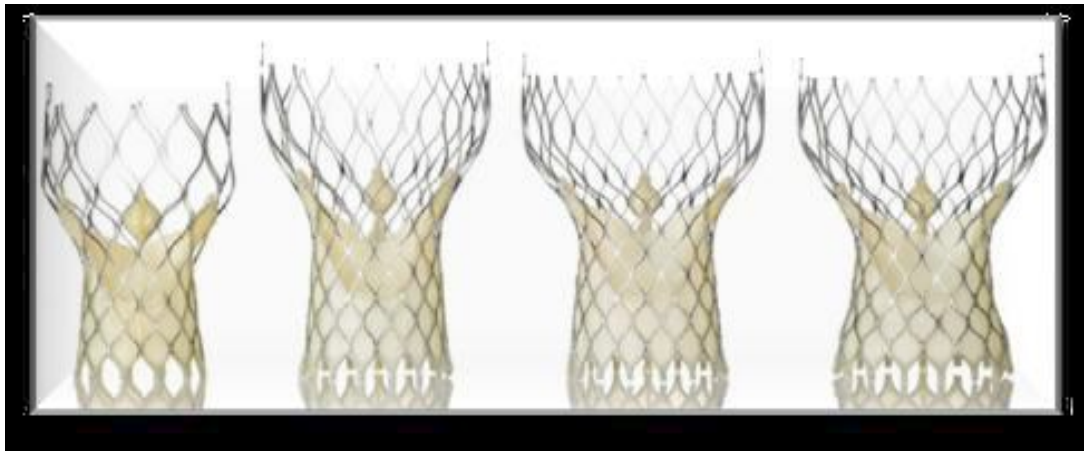
Edwards CENTRA Valve

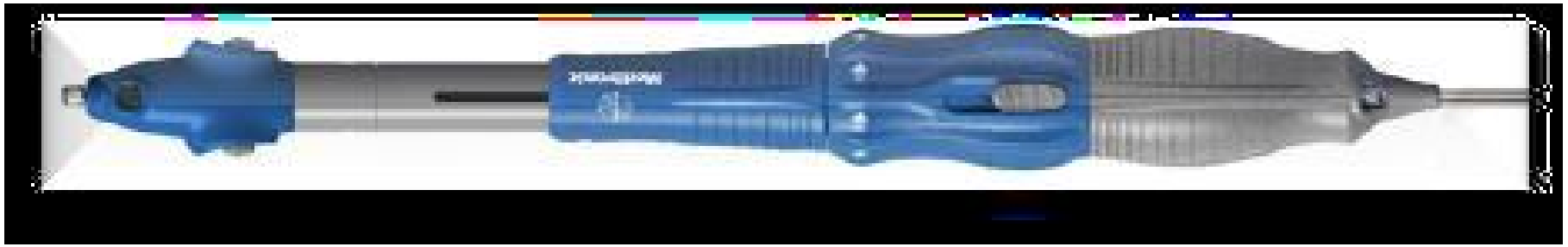
Self Expandable

New CoreValve Evolut Platforms

CoreValve Evolut Recaptureable 23/26/29/31 mm

18 mm to 29 mm Annulus Size Range to Avoid Patient Prosthesis mismatch

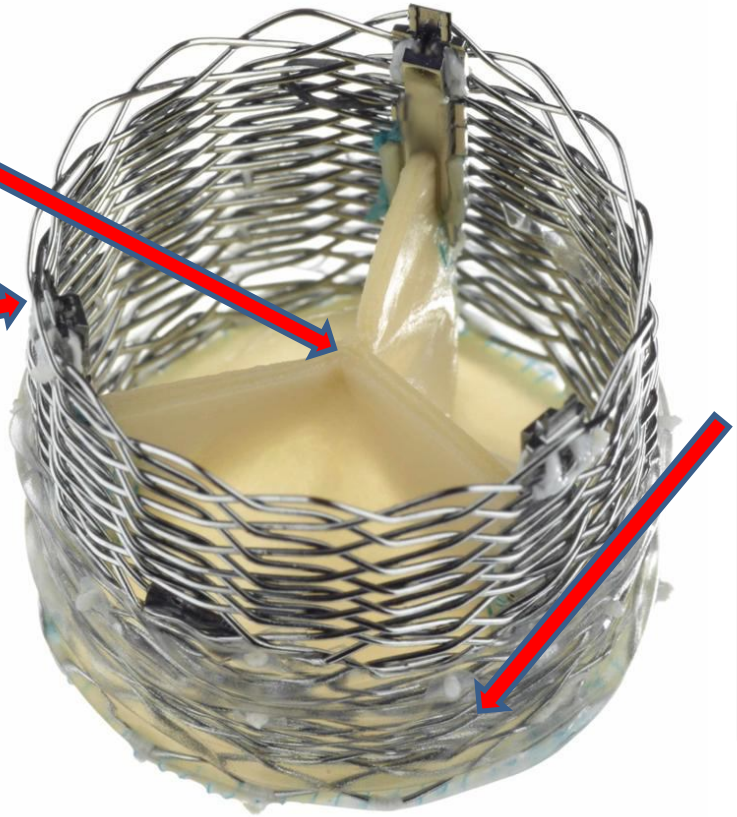




Boston Scientific Sadra Lotus™ Valve System

Bovine Pericardium
Proven durability

Nitinol Frame
for retrieval and repositioning



Adaptive Seal
conformability to irregular anatomical surfaces, and to minimize paravalvular leaks

Stroke in TAVR

Stroke Associated With Surgical and Transcatheter Treatment of Aortic Stenosis

A Comprehensive Review

Benoit Daneault, MD, Ajay J. Kirtane, MD, SM, Susheel K. Kodali, MD, Mathew R. Williams, MD, Philippe Genereux, MD, George R. Reiss, MD, Craig R. Smith, MD, Jeffrey W. Moses, MD, Martin B. Leon, MD

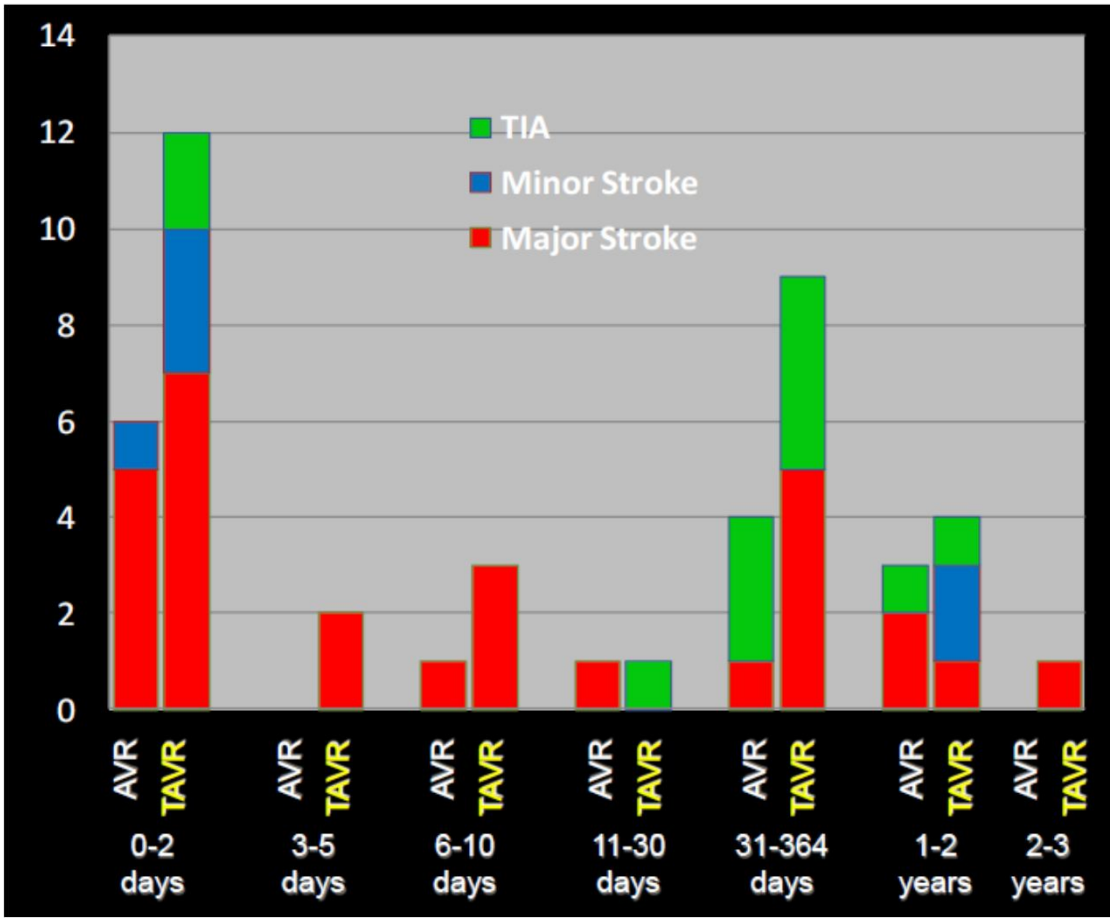
New York, New York

Etiology of Strokes

- During TAVR: TCD has shown that the majority of procedural embolic events occurred during BAV, manipulation of catheters across the aortic valve, and valve implantation.
- During AVR, TCD evidence of emboli during insertion of an aortic cannula at the start of CPB and after declamping the aorta
- Late embolic events post-AVR are presumably caused by debris from the prosthesis, *and development of AF*

Timing of Neurological Events Post TAVR

>51% Periprocedural



Miller C.D.; Transcath eter (TAVR) versus surgical (AVR) aortic valve replacement: incidence, hazard, determinants, and consequences of neurological events in the PARTNER Trial, Paper presented at: AATS 91st Annual Meeting; May 7–11 2011Philadelphia, PA

Timing, Predictive Factors, and Prognostic Value of Cerebrovascular Events in TAVI Patients

Observational study looked at stroke/TIA in 1,061 patients treated at 5 centers, January 2005-2011. Nombela-Franco L, et al. *Circulation* 2012

- Acute events (≤ 24 hours) independently predicted by balloon postdilation and valve dislodgement/embolization
- Subacute events (1-30 days) predicted by new onset A-fib, while late events (> 30 days) associated with chronic A-fib, PVD, and cerebrovascular disease
- Major stroke predicts mortality both early (OR 7.43; 95% CI 2.45-22.53) and late (HR 1.75; 95% CI 1.01-3.04)

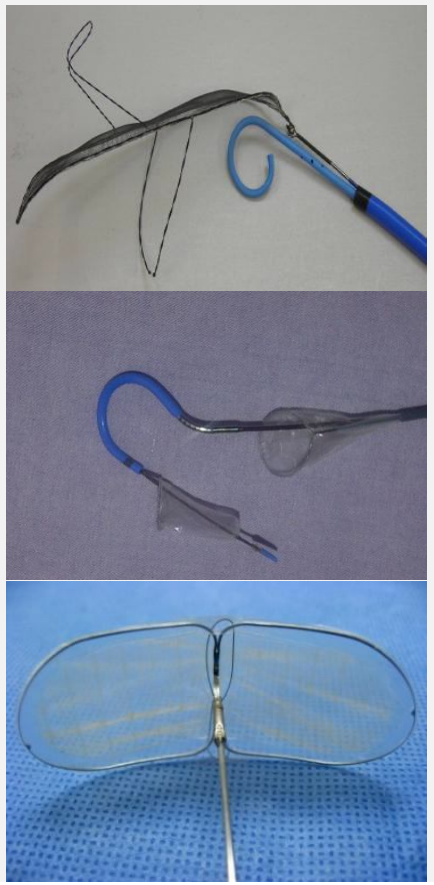
Implications: Among TAVR patients, early stroke events are connected to procedural factors and late events to comorbidities.

Embolic Protection Devices for TAVR

Keystone - Deflector
- Clinical Phase
- 9F Transfemoral delivery

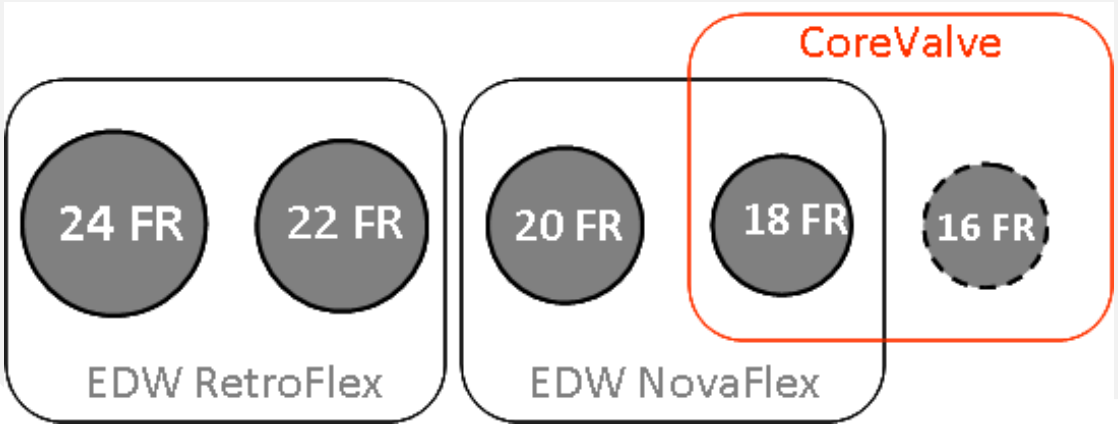
Claret Medical - Dual Filter (Montage)
- Clinical Phase
- 6F Transradial or brachial delivery

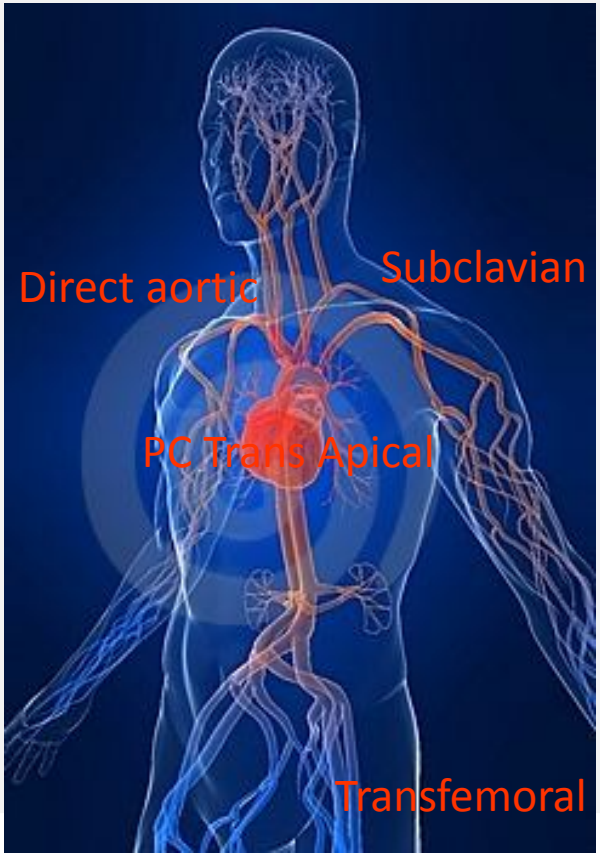
Edwards/Embrella - Deflector
- Clinical Phase
- 6F Transradial or brachial delivery



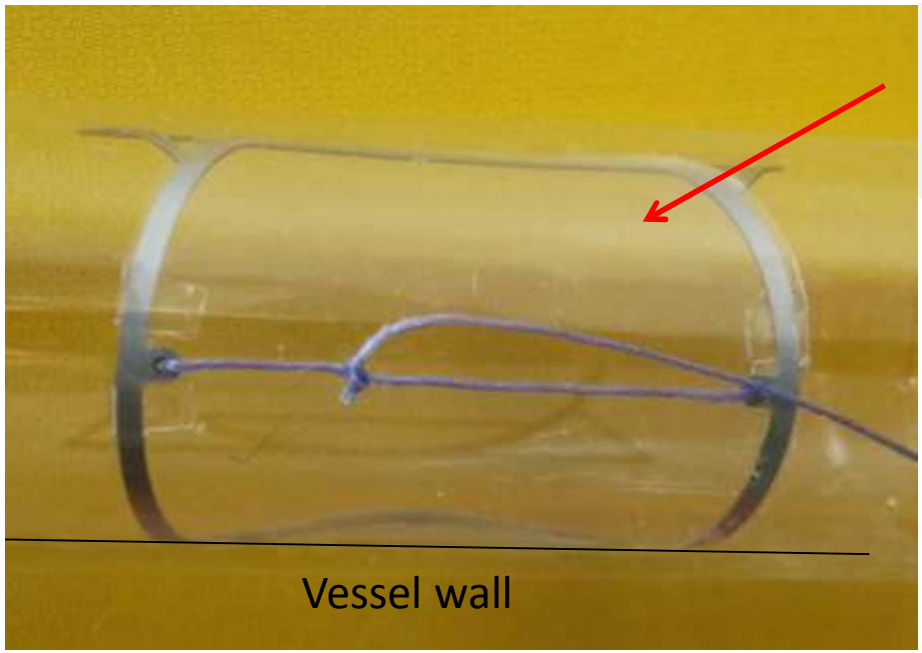
Major Vascular Complications

Additional
Access/Approaches



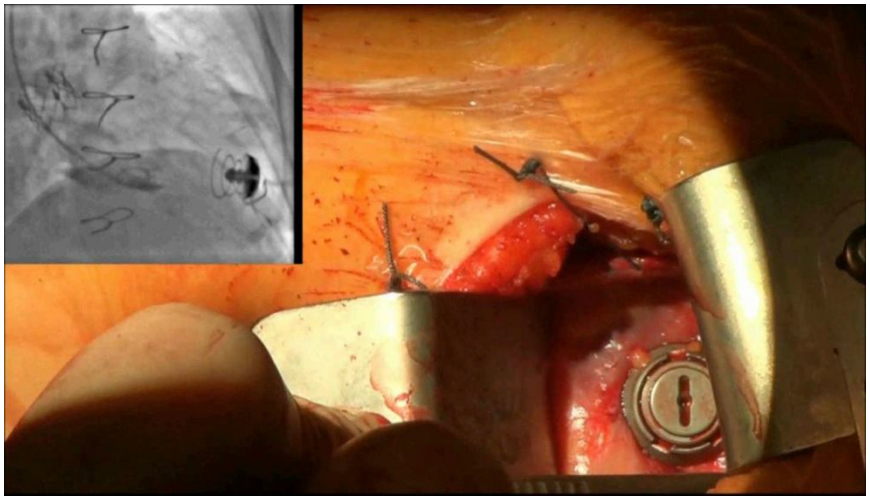


InSeal ATUM Vascular Closure Device

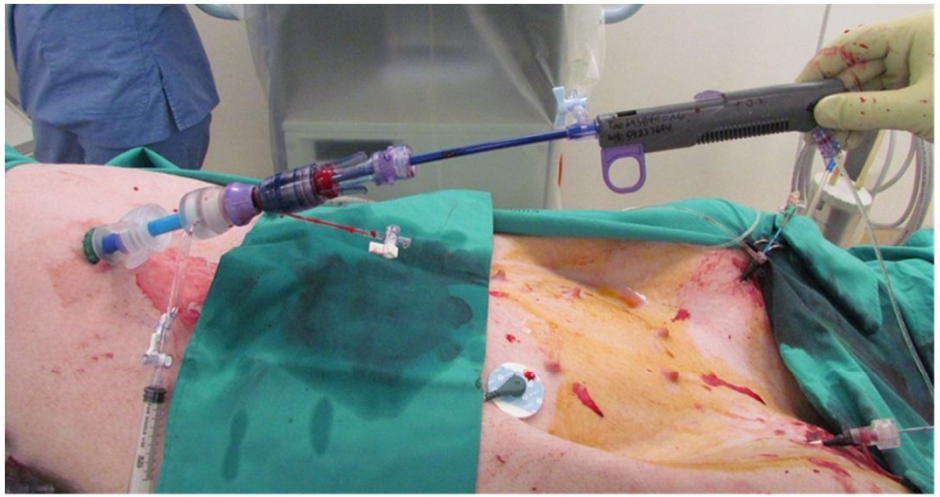


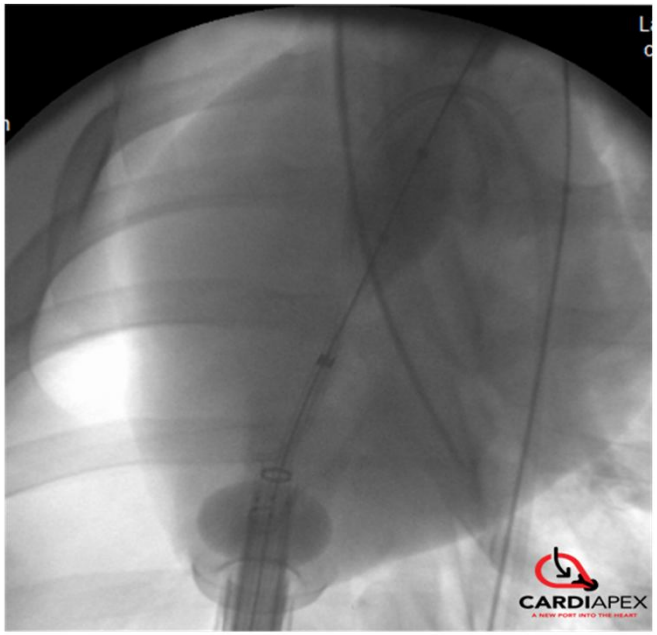
Sealing membrane (biodegradable)

APICA: Standardize the approach to apical cannulation



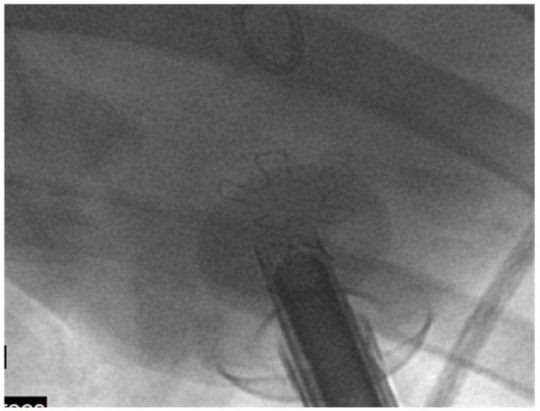
CARDIAPEX

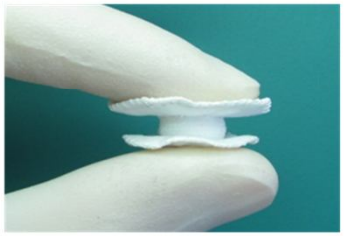




Performing TA TAVI •

Percutaneous procedure •

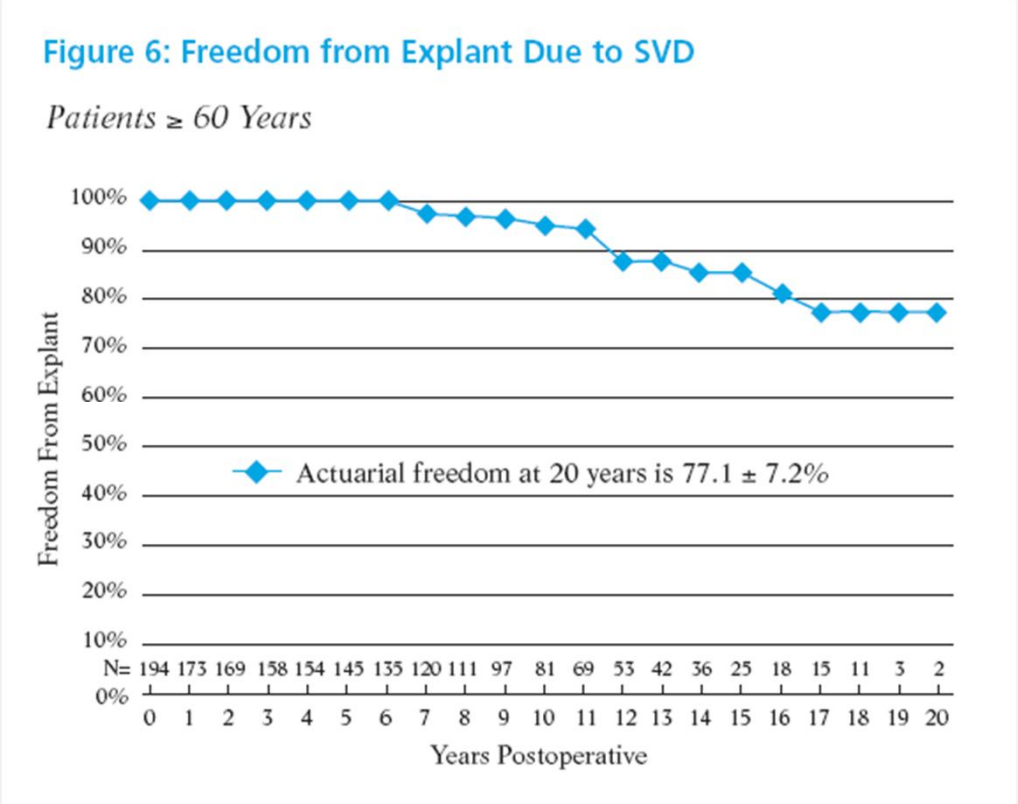




Robust Sealing

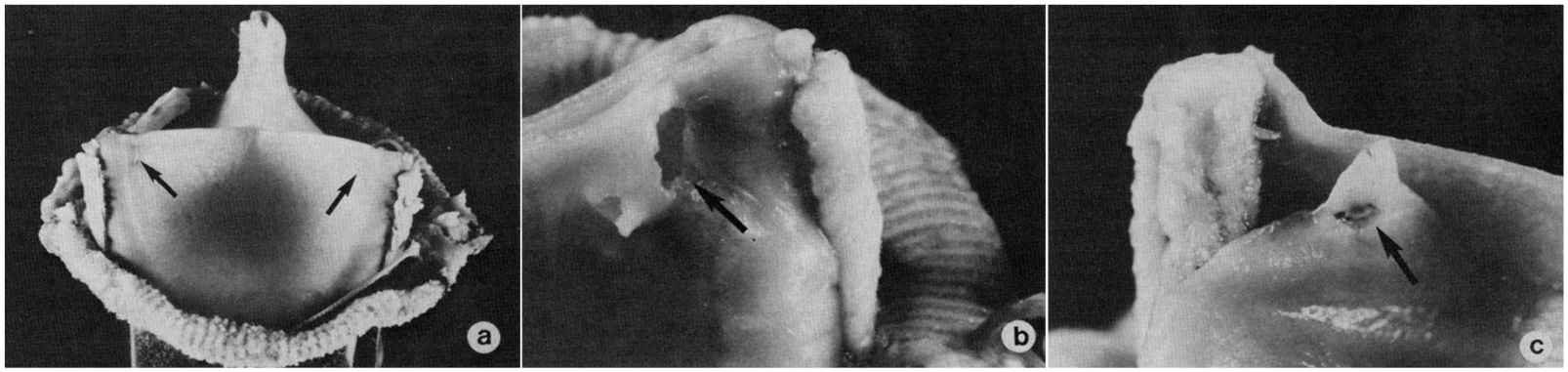
Valve Durability

Freedom from Structural Valve Deterioration – Perimount Valve



Valve Durability: A Lesson from Surgical Valves

- Maintaining Proper Leaflet Motion is Critical to Long Term Valve Durability
- Leaflet bending/folding during valve operation induces high stresses on leaflets. High bending stresses on leaflets can lead to bending fatigue and potentially delamination, calcification, and/or valve failure [1]
- Misalignment, leaflet prolapse, asynchrony, poor cooptation, high commissure stress, pinwheeling/bending may lead to early failure.



Valve Durability

TAVR Durability - ?????

Studies / Registries will tell

Thank You