

**TTT @ TCTAP Challenging issues in TAVR**

# **Valve in Valve for degenerative bioprosthetic valve**

**Wei-Hsian Yin (殷偉賢), MD, PhD, FESC.**

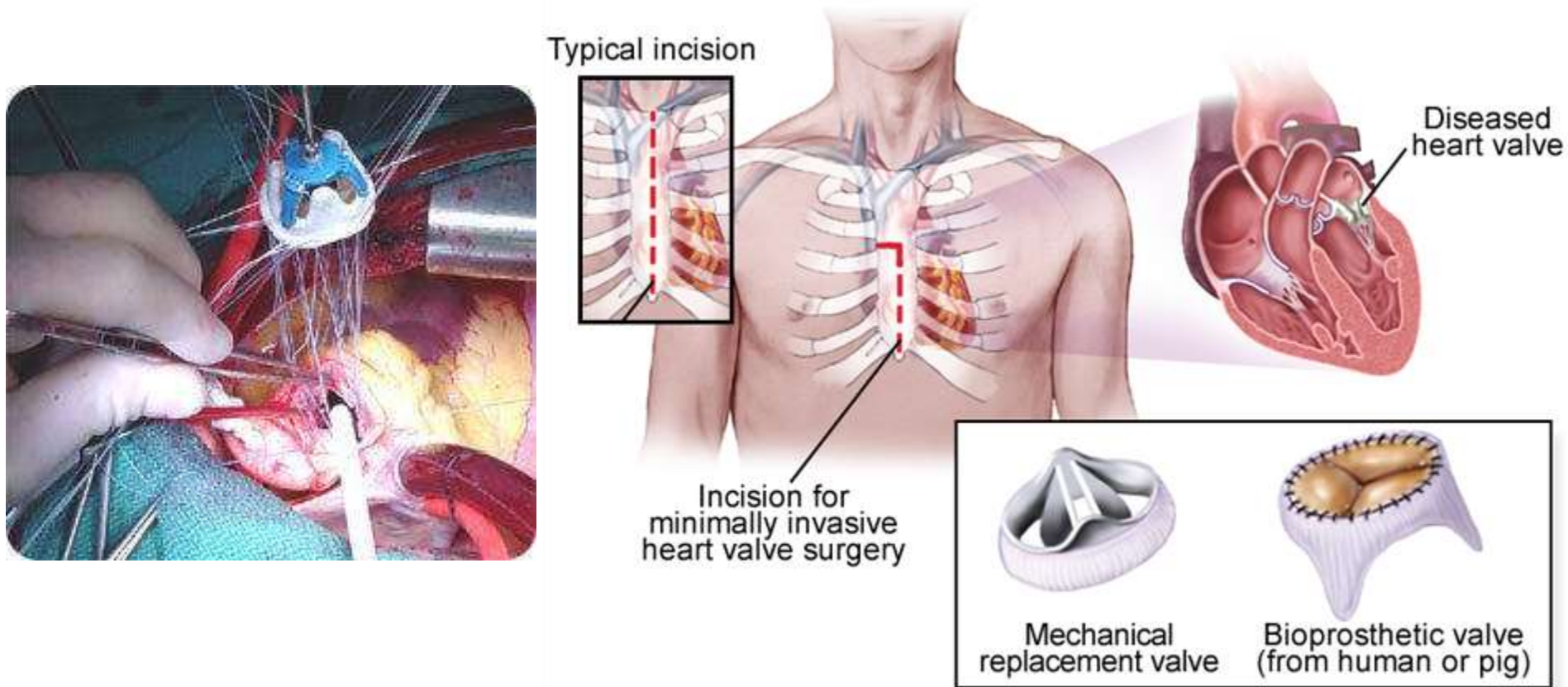


**Heart Center, Cheng Hsin General Hospital  
Professor of Medicine, National Yang Ming University,  
Taipei, Taiwan**



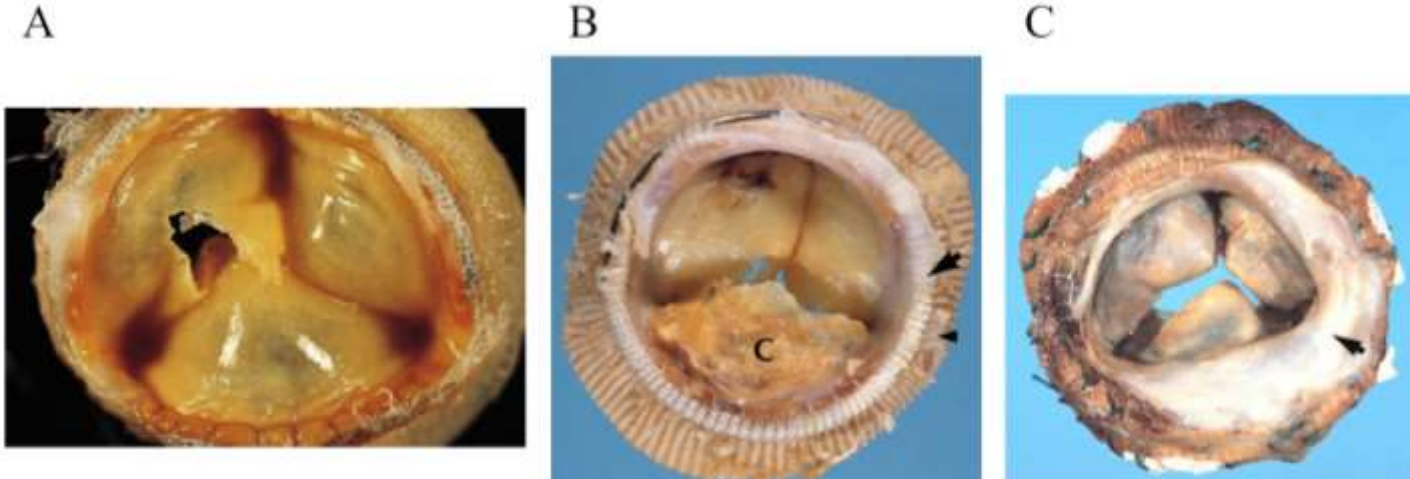
# Valve in Valve for degenerative bioprosthetic valve

- The clinical use of bioprosthetic valves in the treatment of valvular heart disease has been growing during the past 2 decades.



- At the same time, there is an expanding population of complex and high-risk elderly patients who require redo operations because of bioprosthetic valve dysfunction.

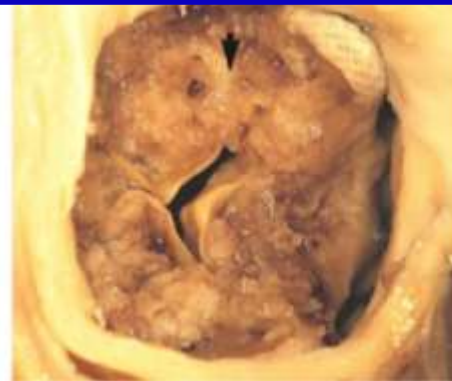
**With time, bioprosthetic tissue can be expected to deteriorate and eventually fail.**



➤ The operative mortality for an elective redo aortic valve surgery ranged from **2% to 7%**, but the risk in **high-risk and non-elective patients** may increase to **> 30%**.



Endocarditis



Thrombus

# Various bioprostheses

J Am Coll Cardiol Intv 2011;4:721-32

stented

A



CE Perimount



CE Perimount  
Magna



CE Perimount  
Magna Ease



Sorin Mitroflow

B



Medtronic  
Hancock II



Medtronic Mosaic



CE Porcine SAV



Biocor

C



Edwards Prima  
Plus



Medtronic  
Freestyle



St. Jude Toronto  
SPV



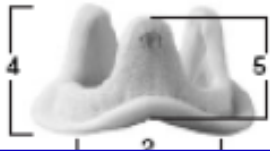
Sorin Freedom

stentless

**Figure 2.** Types of Stented and Stentless Valves

(A) Stented pericardial bovine bioprosthetic valves. (B) Stented porcine aortic valve bioprostheses. (C) Stentless bioprosthetic valves. These lists are nonexhaustive. CE = Carpentier-Edwards; SPV = stentless porcine valve.

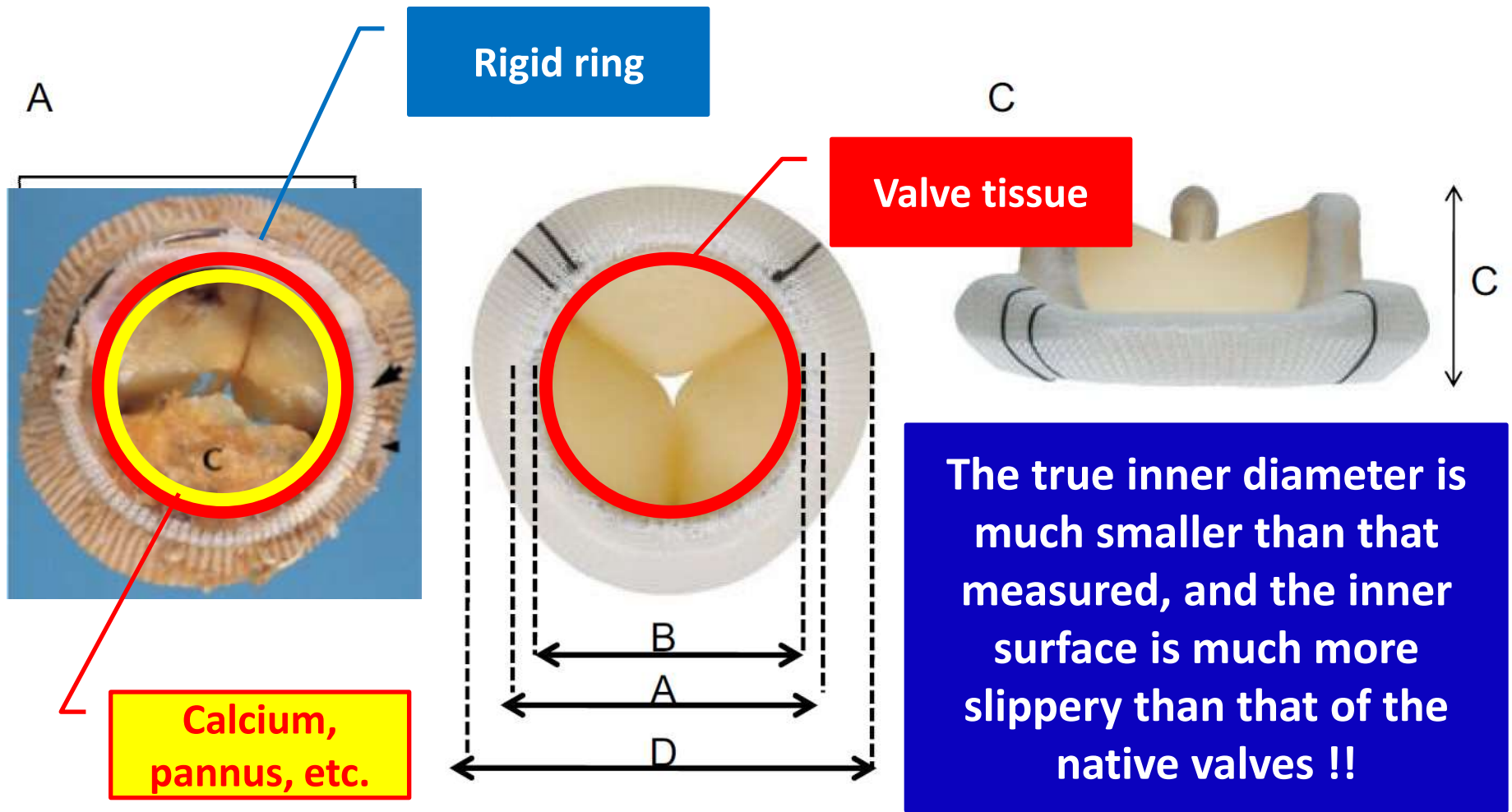
# The labeled valve size $\neq$ inner base ring diameter!



## Size 23 mm

The manufacturer's labeled valve size (in millimeters) does not match the inner base ring diameter or any significant hemodynamic-related dimension of the valve.

	Labeled Valve Size	Stent Outer Diameter (1)	Stent Inner Diameter (2)	Suture Ring Outer Diameter (3)	Valve Height (4)
Porcine Aortic Valves					
Medtronic Mosaic	23	23	20.5	28	16
Medtronic Hancock II	23	23	20.5	28	16
Medtronic Hancock Modified Orifice	23	23	20	29.2	16/18
Edward's Porcine	23	23	21		16 ( <i>implant height</i> )
St. Jude Biocor/Epic	23	23	21		15



**Figure 4. Dimensions of Stented Bioprosthetic Valves**

(A) Diagrammatic representation of stented bioprosthetic valve dimensions where A = outer stent diameter; B = inner stent diameter; C = prosthesis height; and D = outer sewing ring diameter. (B) Inferior (ventricular) view of stented bioprostheses. (C) Side view of stented bioprostheses.

# Valve In Valve

By UBQO Limited

Open iTunes to buy and download apps.

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# App for transcatheter VIV measurements



[View in iTunes](#)

+ This app is designed for both iPhone and iPad

Free

Category: [Medical](#)

Updated: May 18, 2015

Version: 4.0

Size: 89.6 MB

Language: English

Seller: UBQO Limited

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[Rated 12+ for the following:](#)

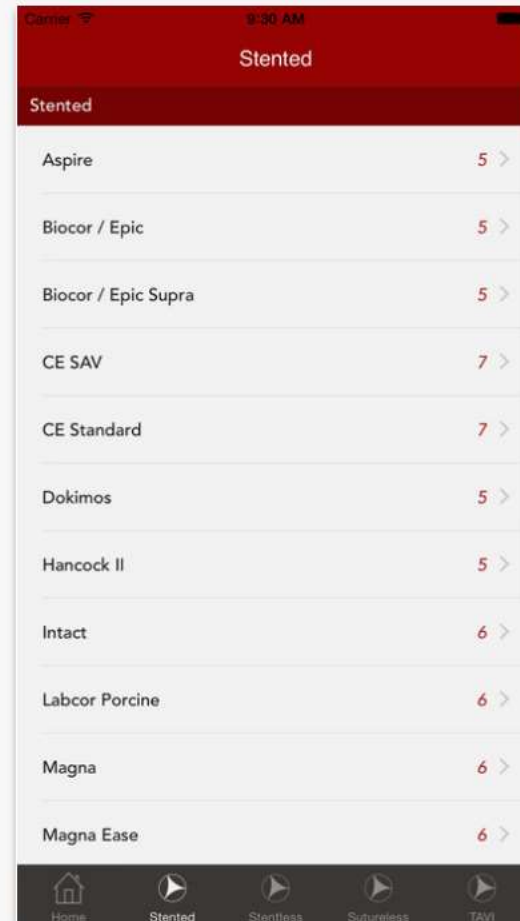
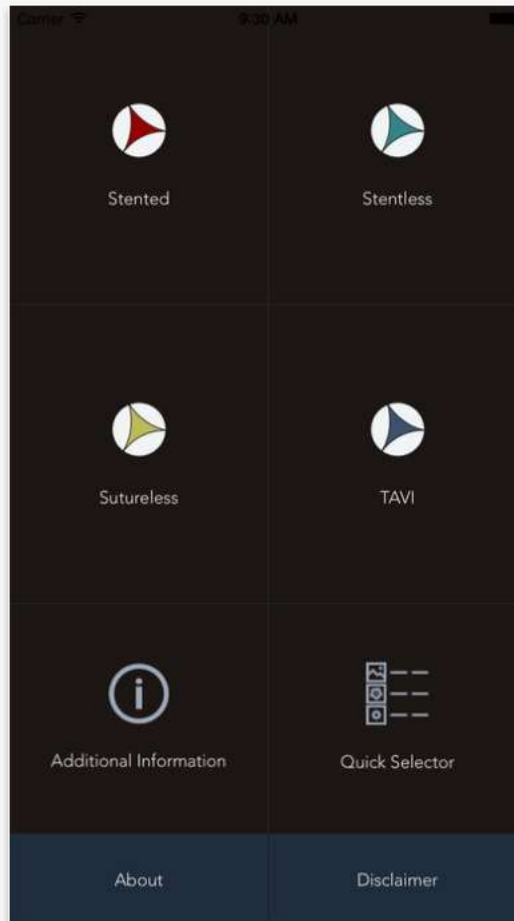
Infrequent/Mild

Medical/Treatment Information

## Description

An instant guide to Valve in Valve procedures for clinicians

## Screenshots



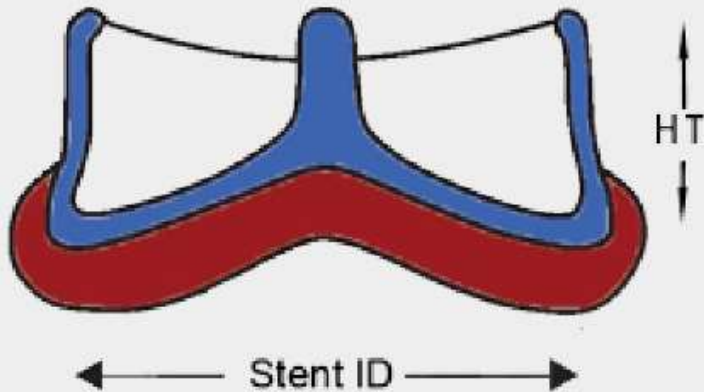
iPhone | iPad



# App-derived vs. CT-derived measurements

M91, admitted for Fc III heart failure,  
underwent Medtronic Hancock II, **21mm**, implantation 11 yrs ago

Trans- prosthetic AV MPG=30mmHg , PPG= 57mmHg; estimated AVA= 0.9cm<sup>2</sup>.



Min. Ø: 15,4 mm

Max. Ø: 17,3 mm

Perimeter derived Ø **16,5 mm**

Perimeter: 51,9 mm

Stent Internal Diameter

18.5

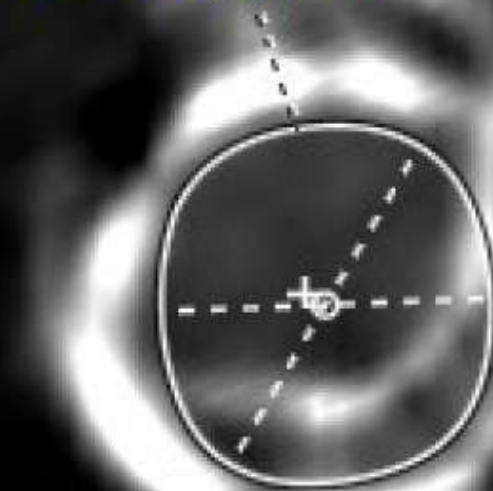


True ID

16.5

Height

15





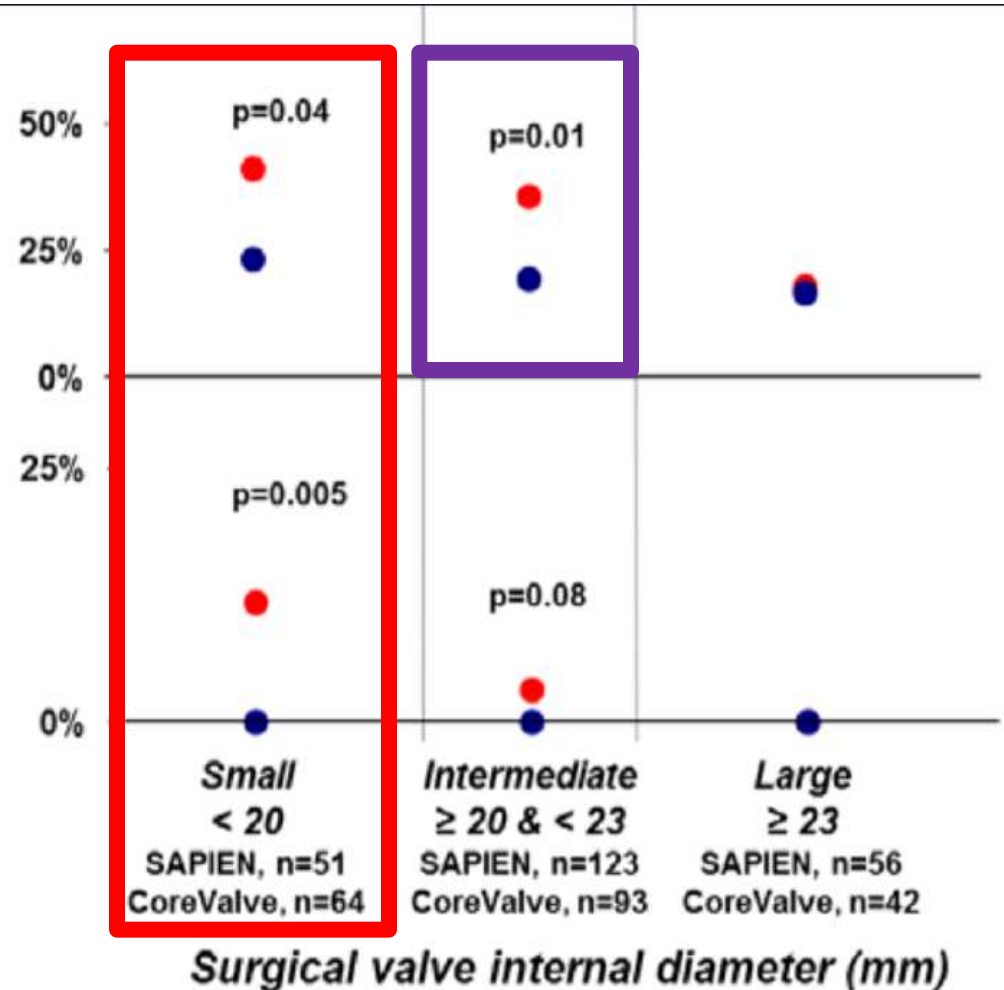
# The device chosen matters, especially in smaller surgical valves!



Rate of Post-procedural mean gradients  $\geq 20\text{mmHg}$



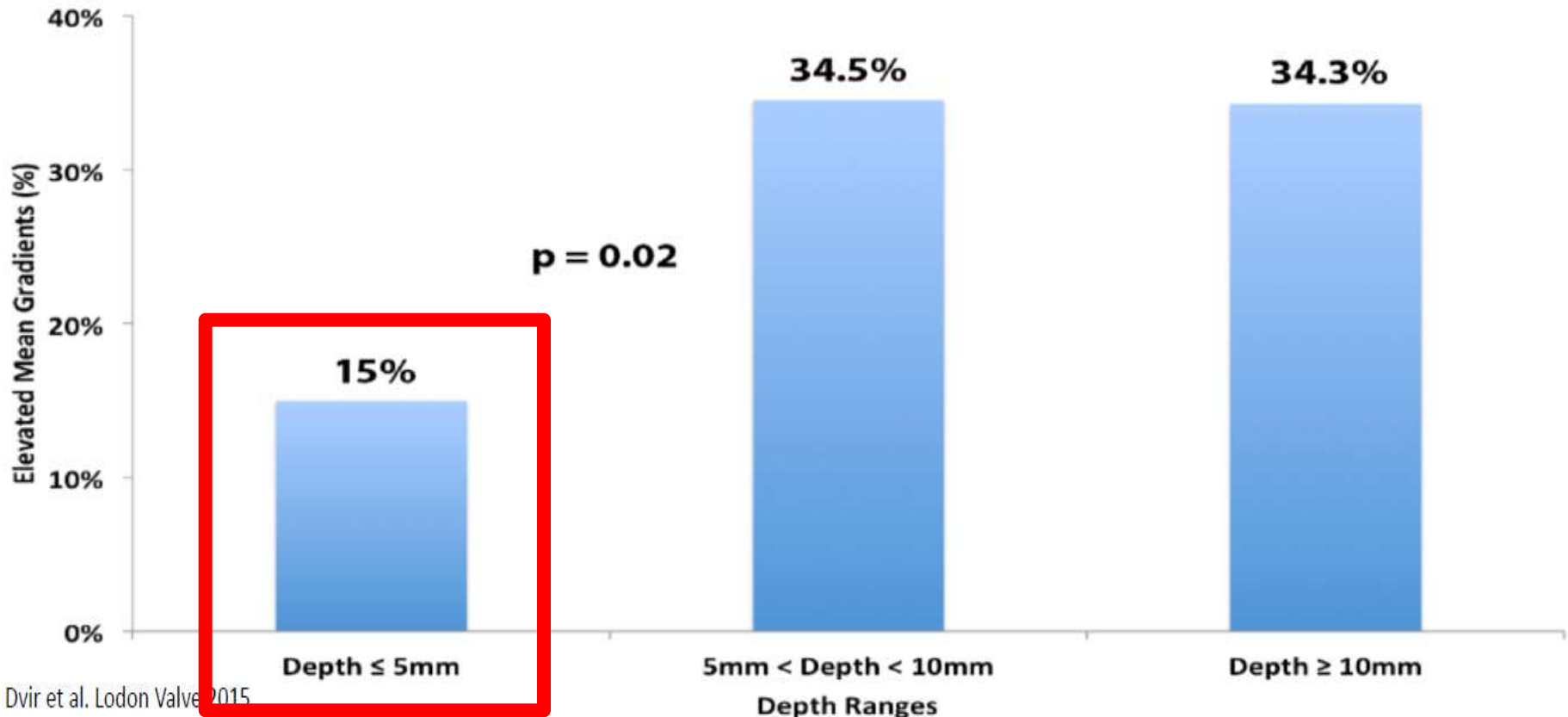
Rate of Post-procedural mean gradients  $\geq 40\text{mmHg}$



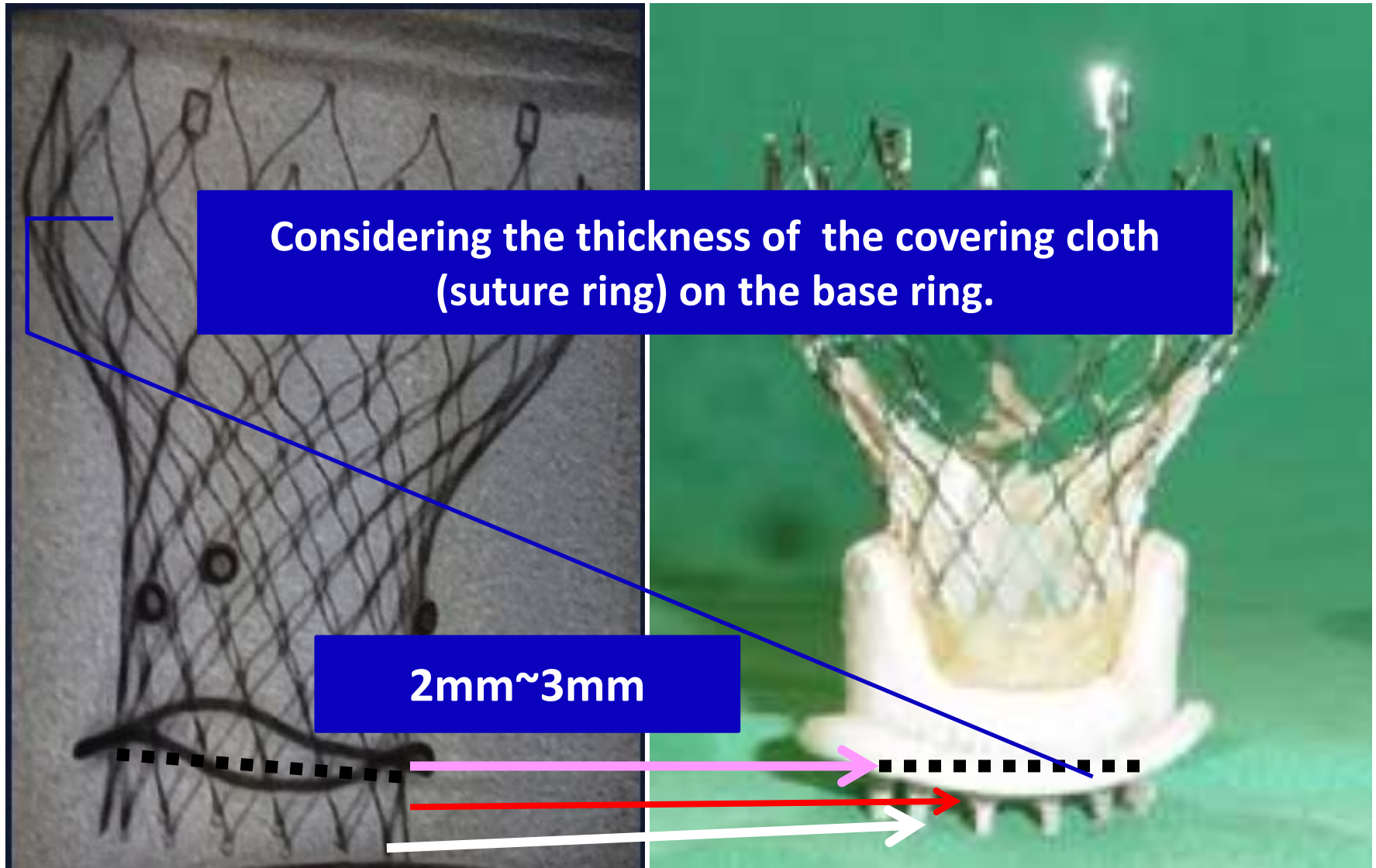
# The implantation depth matters!

## Implantation Depth and Gradients

CoreValve Evolut (n = 159)



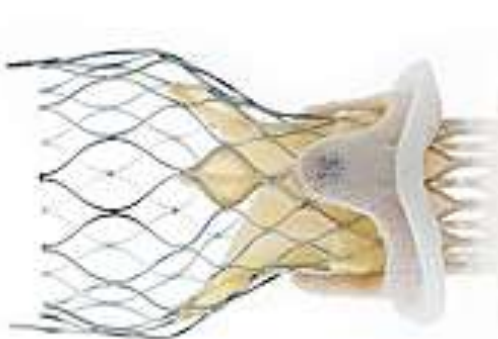
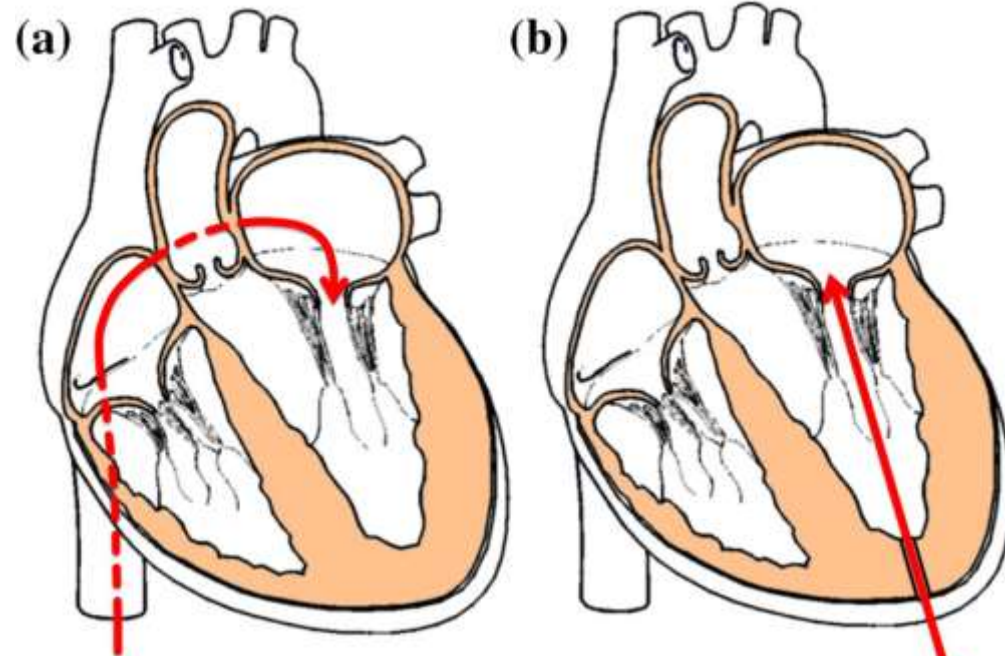
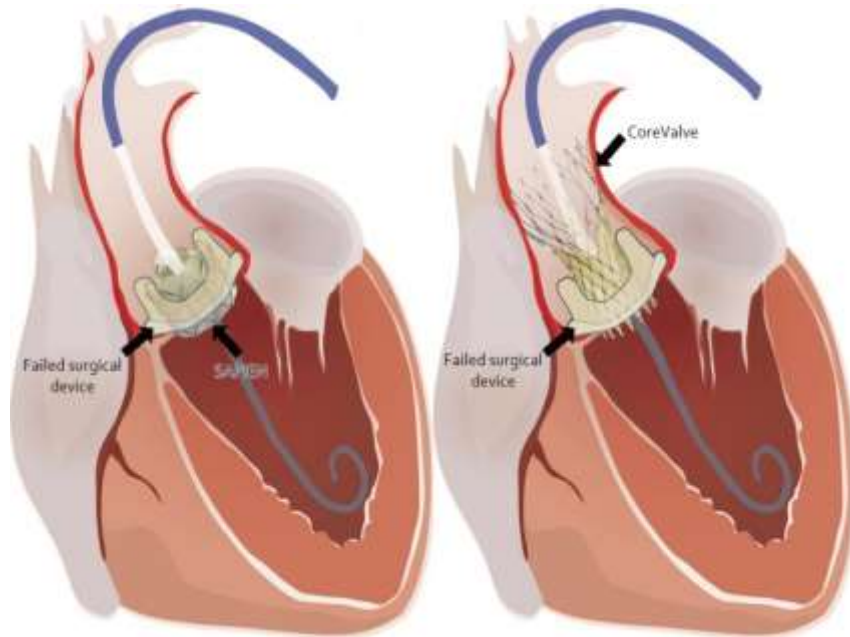
# The implantation depth should not $< 2\text{mm}$ below the valve stent under fluoroscopy !



# Transcatheter VIV is feasible and safe in high-risk & inoperable patients for redo surgery.

## Aortic Valve-in-valve

## Mitral Valve-in-valve



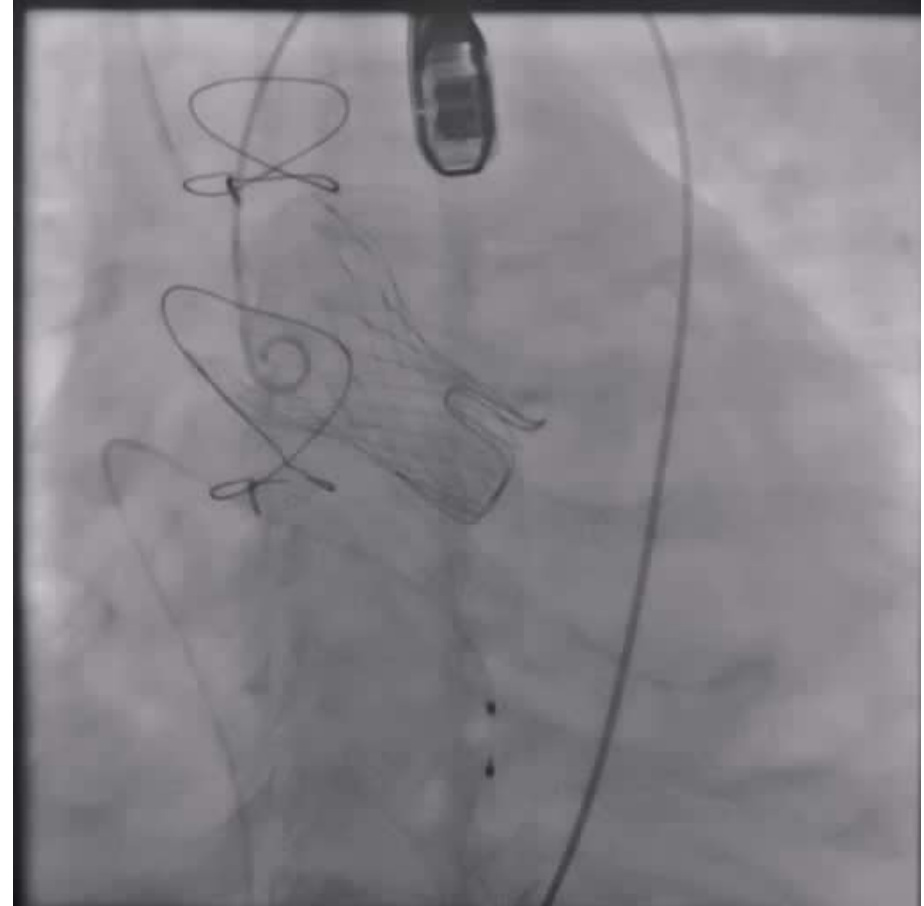
# TAVI for failed aortic bioprosthesis

## Medtronic CoreValve

Before



After



# TAVI for failed aortic bioprosthesis

## Edwards Sapien XT

Before

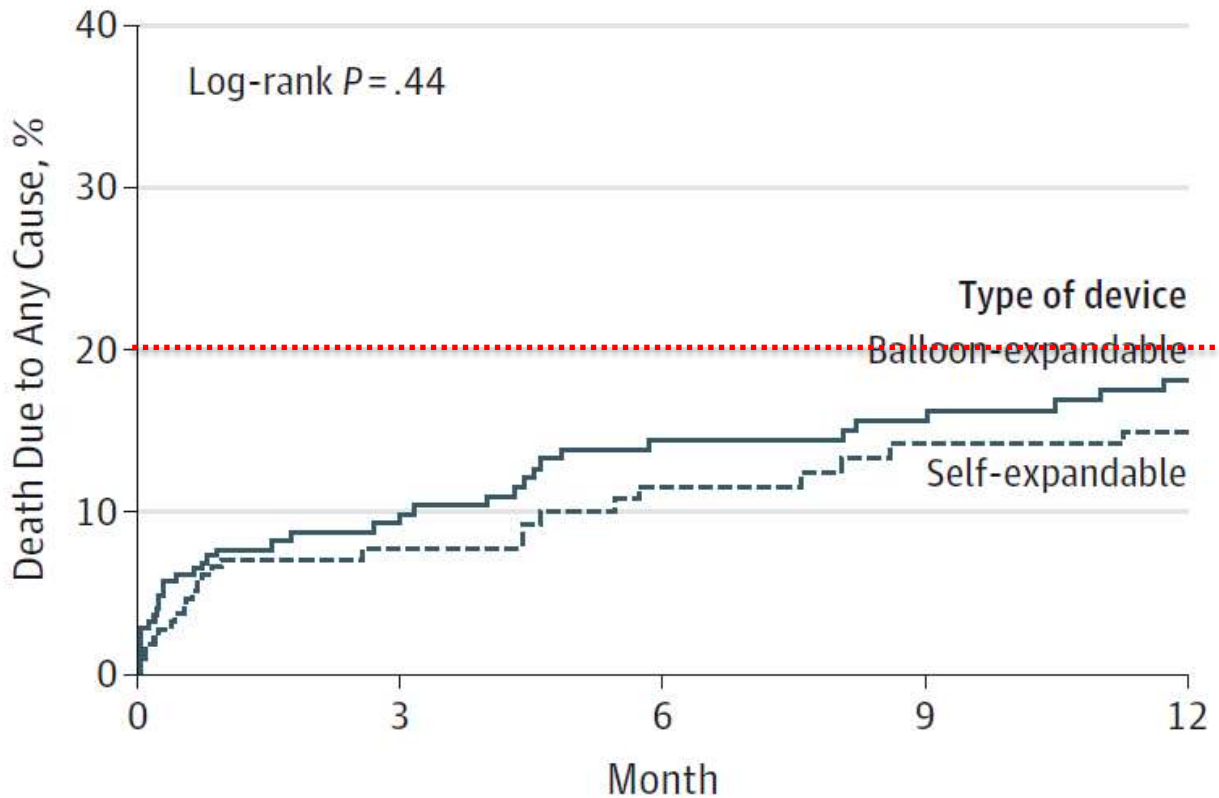
During

After



# Transcatheter Aortic Valve Implantation in Failed Bioprosthetic Surgical Valves

**C** Device used during valve-in-valve implantation



No. at risk by type of device

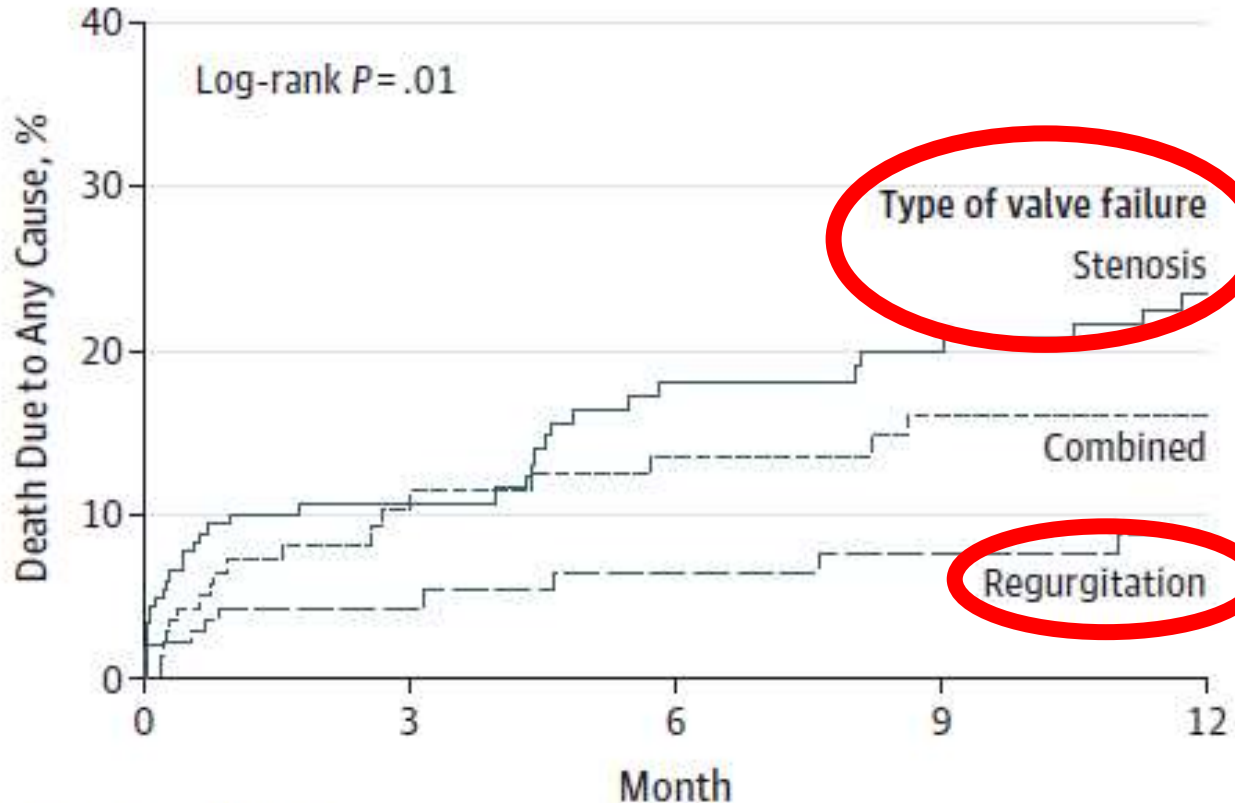
Balloon-expandable	246	163	146	136	130
Self-expandable	213	126	112	101	98

13 in  
ons

≥25

# Transcatheter Aortic Valve Implantation in Failed Bioprosthetic Surgical Valves

## A Mechanism of surgical valve failure



### No. at risk by type of valve failure

Stenosis	181	112	98	91	86
Regurgitation	139	92	84	78	76
Combined	139	85	76	68	66

banti, MD;

P;

Presbitero, MD;

Juel Wilbring, MD;



# Transcatheter Aortic Valve Implantation in Failed Bioprosthetic Surgical Valves

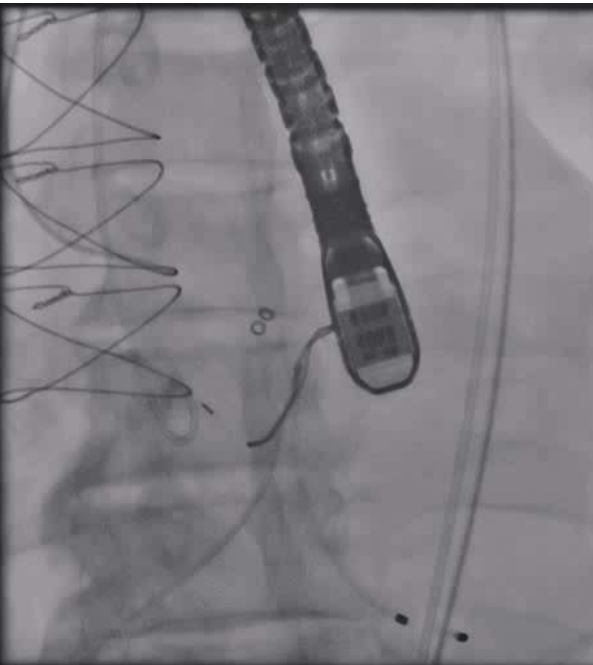
Danny Dvir, MD; John G. Webb, MD; Sabine Bleiziffer, MD; Miralem Pasic, MD, PhD; Ron Waksman, MD; Susheel Kodali, MD; Marco Barbanti, MD; Azeem Latib, MD; Ulrich Schaefer, MD; Josep Rodés-Cabau, MD; Hendrik Treede, MD; Nicolo Piazza, MD, PhD; David Hildick-Smith, MD; Dominique Himbert, MD; Thomas Walther, MD; Christian Hengstenberg, MD; Henrik Nissen, MD, PhD; Raffi Bekeredjian, MD; Patrizia Presbitero, MD; Enrico Ferrari, MD; Amit Segev, MD; Arend de Weger, MD; Stephan Windecker, MD; Neil E. Moat, FRCS; Massimo Napodano, MD; Manuel Wilbring, MD; Alfredo G. Cerillo, MD; Stephen Brecker, MD; Didier Tchetché, MD; Thierry Lefèvre, MD; Federico De Marco, MD; Claudia Fiorina, MD; Anna Sonia Petronio, MD; Rui C. Teles, MD; Luca Testa, MD; Jean-Claude Laborde, MD; Martin B. Leon, MD; Ran Kornowski, MD; for the Valve-in-Valve International Data Registry Investigators

- Device retrieval was attempted in **10.3%** of **self-expandable** procedures.
- **A second transcatheter device was implanted in 5.7% of the total patients (self-expandable, 7.5% vs. balloon-expandable, 4.1%;  $P = .05$ ), which is significantly higher than those in the CHOICE randomized trial (self-expandable, 5.8% vs. balloon-expandable, 0.8%).**

# TAVI for failed aortic bioprosthesis

M89, with dysfunctional aortic bioprosthesis and severe AR

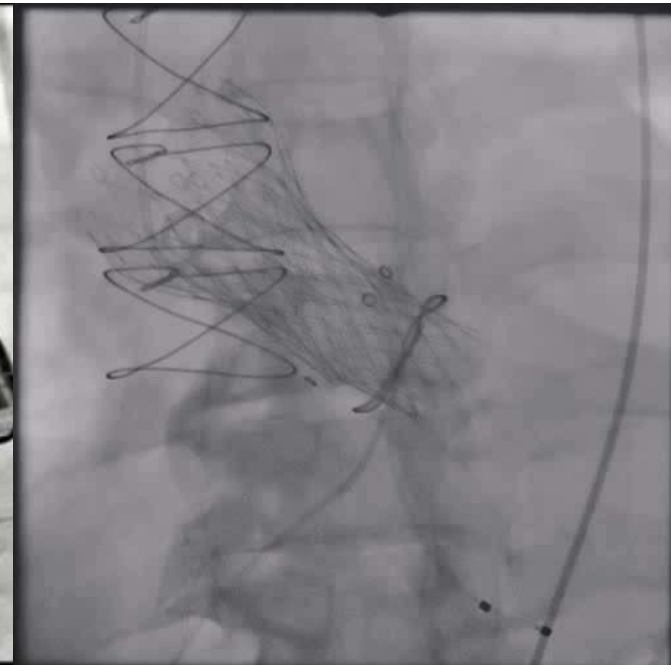
Baseline aortogram



Pop out of the first  
26mm CoreValve



Final AoG after  
CoreValve-in-CoreValve



Final implant  
depth = 6-7mm

# 5-Year Experience With Transcatheter Transapical Mitral Valve-in-Valve Implantation for Bioprosthetic Valve Dysfunction

23 cases in 5 years

Melanie Freeman, MD,  
Wood, MD, Jian Ye, MD

**Table 3**

**Clinical Events, as Estimated  
According to Kaplan-Meier Method**

	In-Hospital	Cumulative Event Rate at Last Follow-Up
All-cause death	0 (0.0)	2 (9.6)
Cardiovascular death	0 (0.0)	1 (4.5)*
Myocardial infarction	0 (0.0)	0 (0.0)
Major stroke	1 (4.4)	1 (4.4)
Minor stroke	0 (0.0)	0 (0.0)
TIA	0 (0.0)	0 (0.0)
Life-threatening bleeding	0 (0.0)	0 (0.0)
Major bleeding	6 (26.1)	6 (26.1)
Minor bleeding	0 (0.0)	0 (0.0)
Reintervention	0 (0.0)	1 (4.4)
PM implantation	1 (4.4)	1 (4.4)

# TAVI for failed mitral bioprosthesis

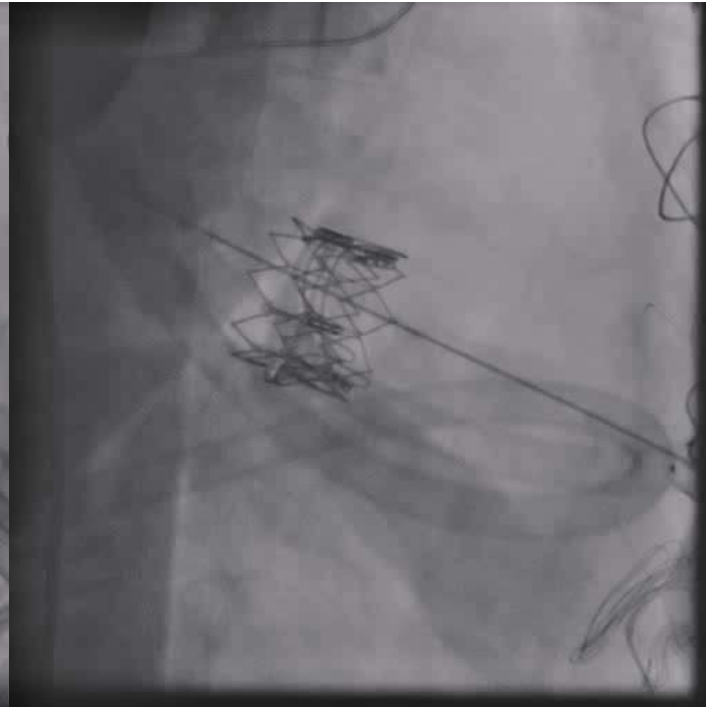
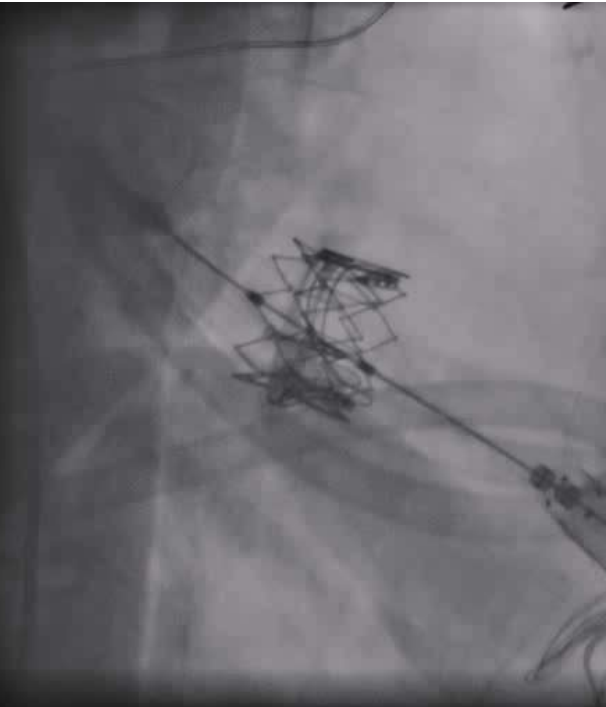
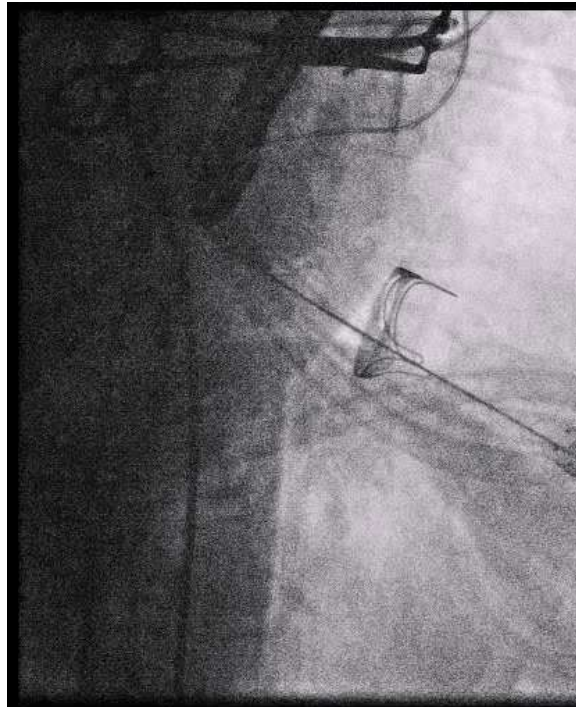
Most of the reported series used Edwards SAPIEN balloon-expandable valve for TM VIV.

M 82, presented with progressive dyspnea for 4 months, Fc III-IV, due to dysfunctional mitral bioprosthesis

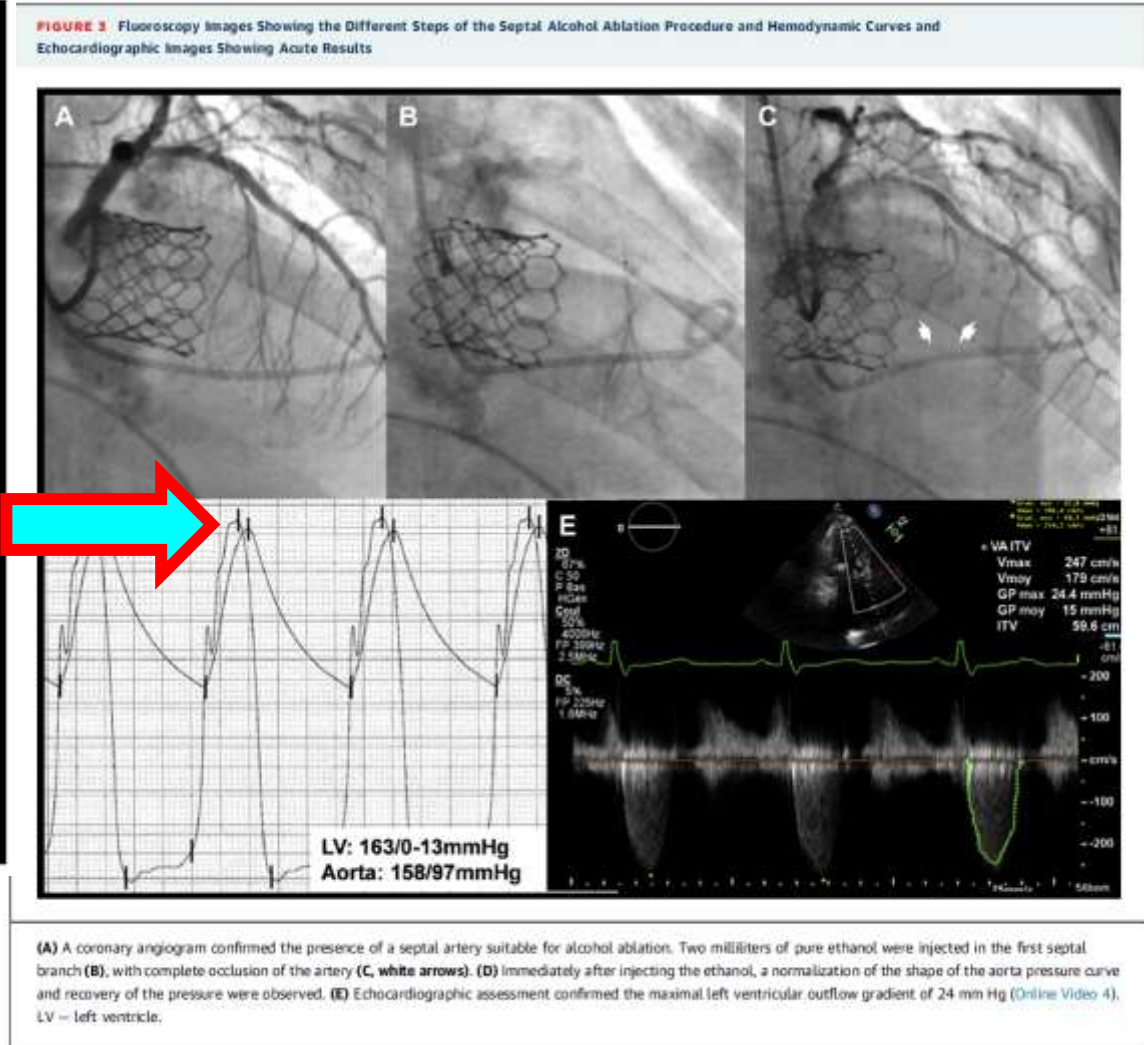
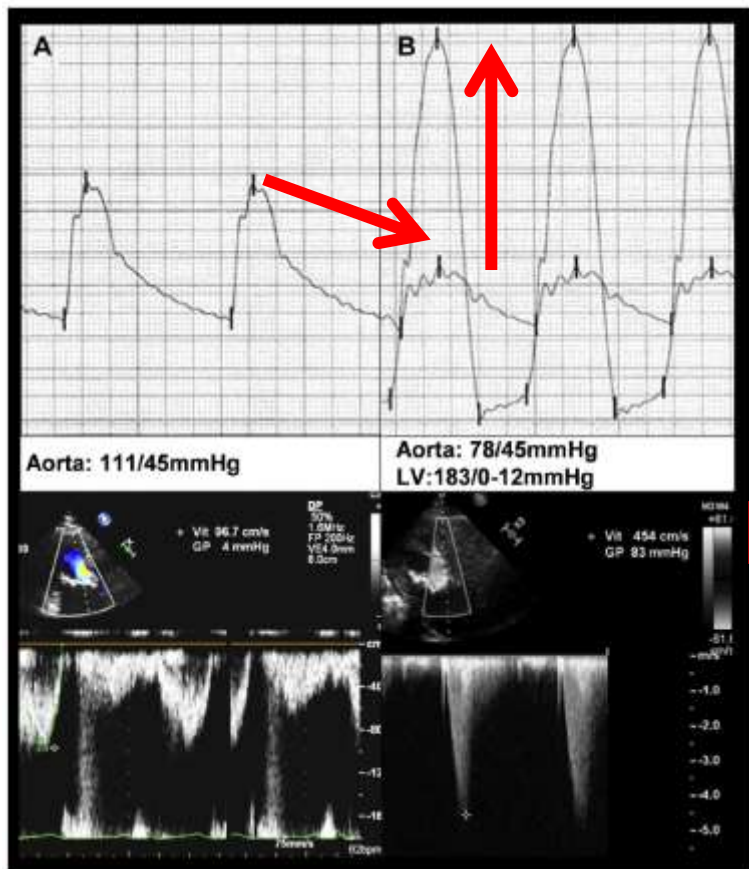
Before

During

After



# Life-threatening complication of transcatheter mitral VIV – LVOT obstruction

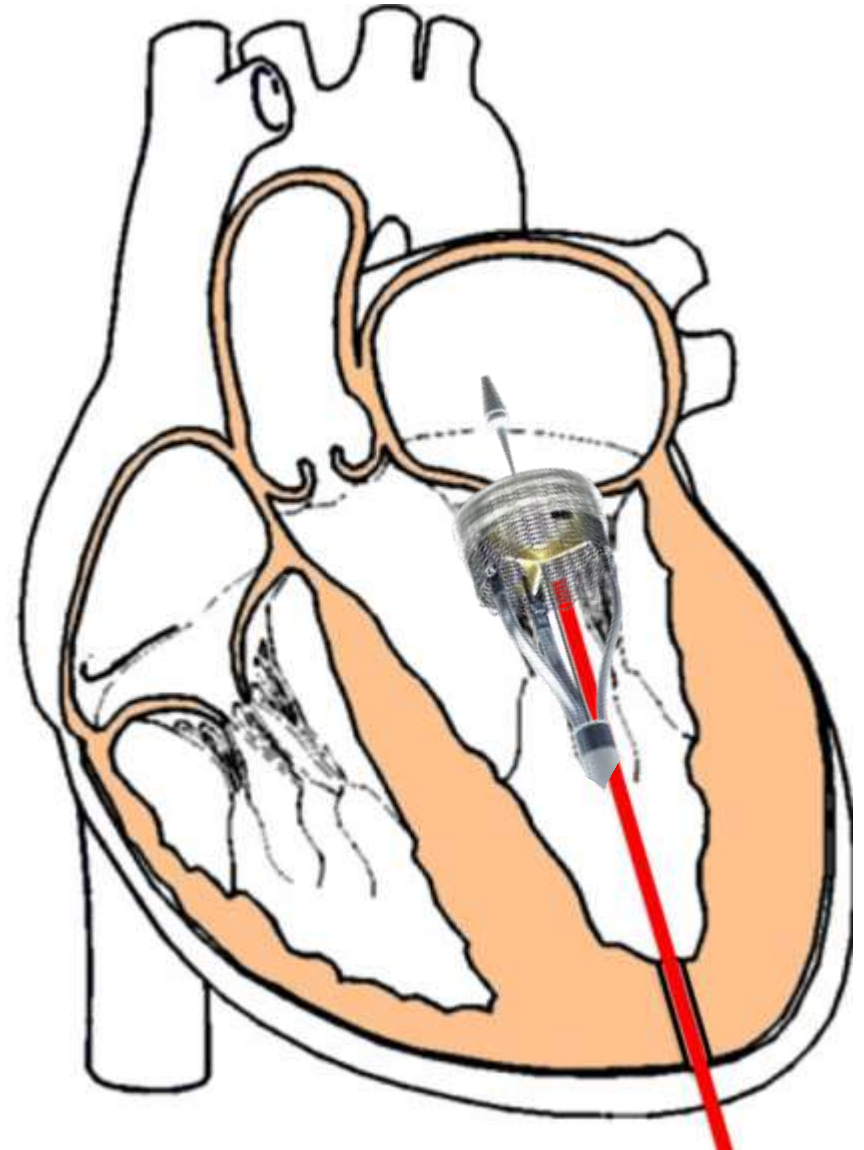
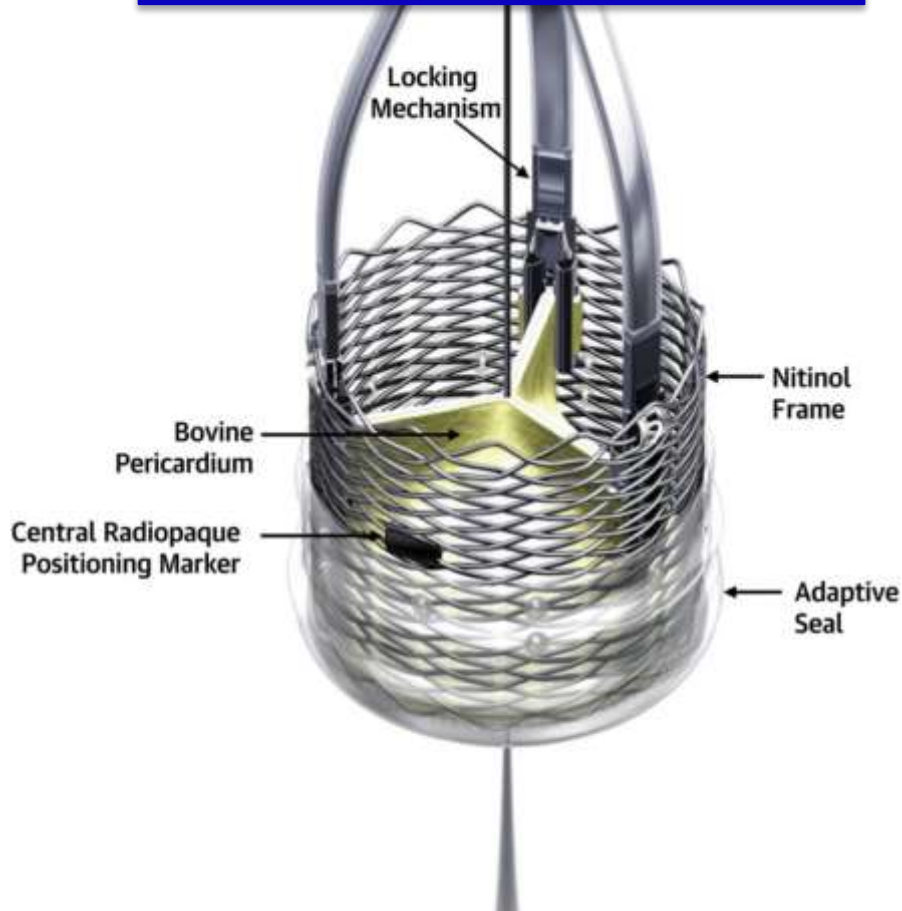


**Bail-Out Alcohol Septal Ablation for Left Ventricular Outflow Tract Obstruction After Transcatheter Mitral Valve Replacement**

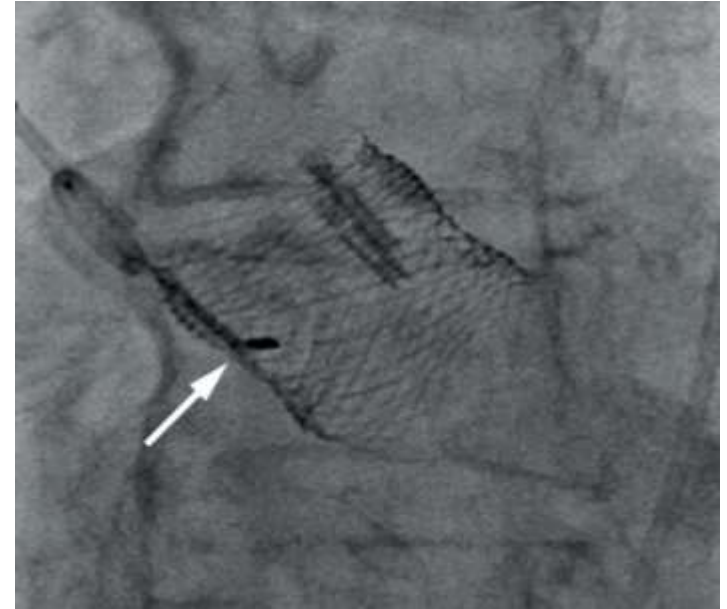
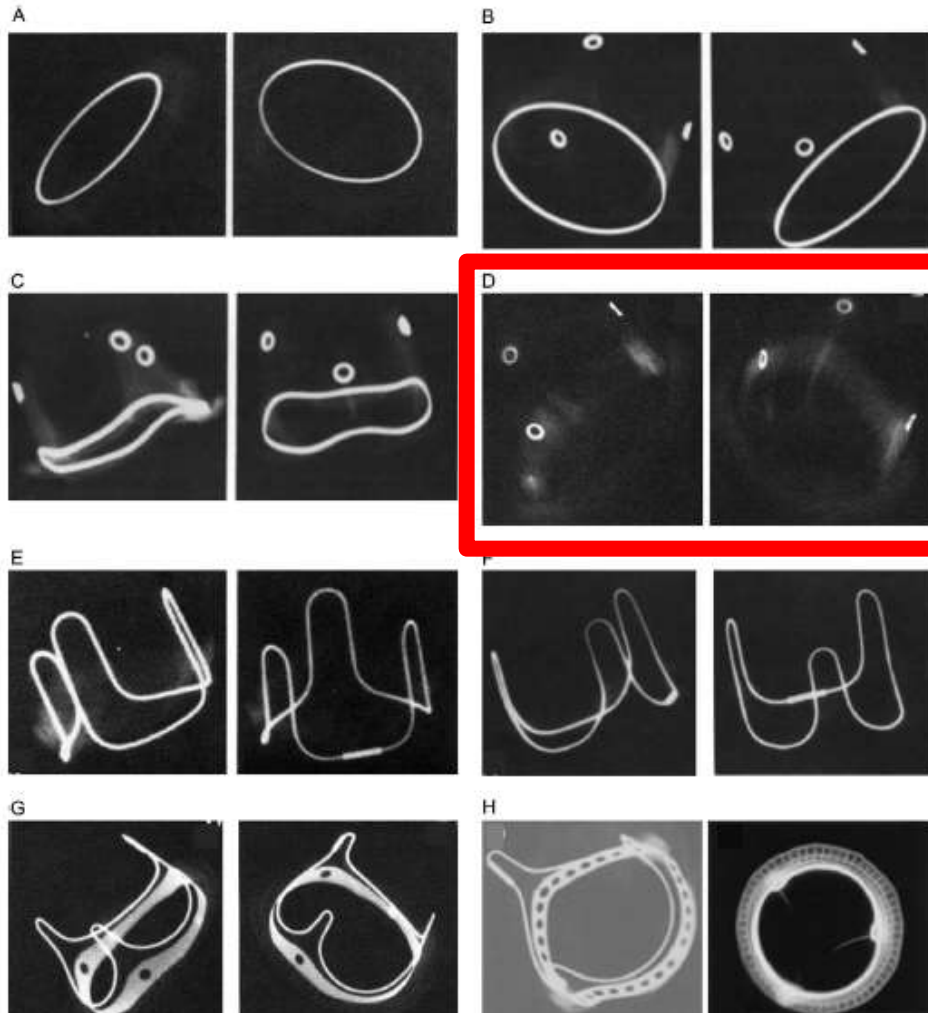
(A) A coronary angiogram confirmed the presence of a septal artery suitable for alcohol ablation. Two milliliters of pure ethanol were injected in the first septal branch (B), with complete occlusion of the artery (C, white arrows). (D) Immediately after injecting the ethanol, a normalization of the shape of the aorta pressure curve and recovery of the pressure were observed. (E) Echocardiographic assessment confirmed the maximal left ventricular outflow gradient of 24 mm Hg (Online Video 4). LV = left ventricle.

# Advantage of using Lotus valve for Transcatheter mitral VIV

Retrievable and repositionable



# Radiographic appearance of stented bioprosthesis



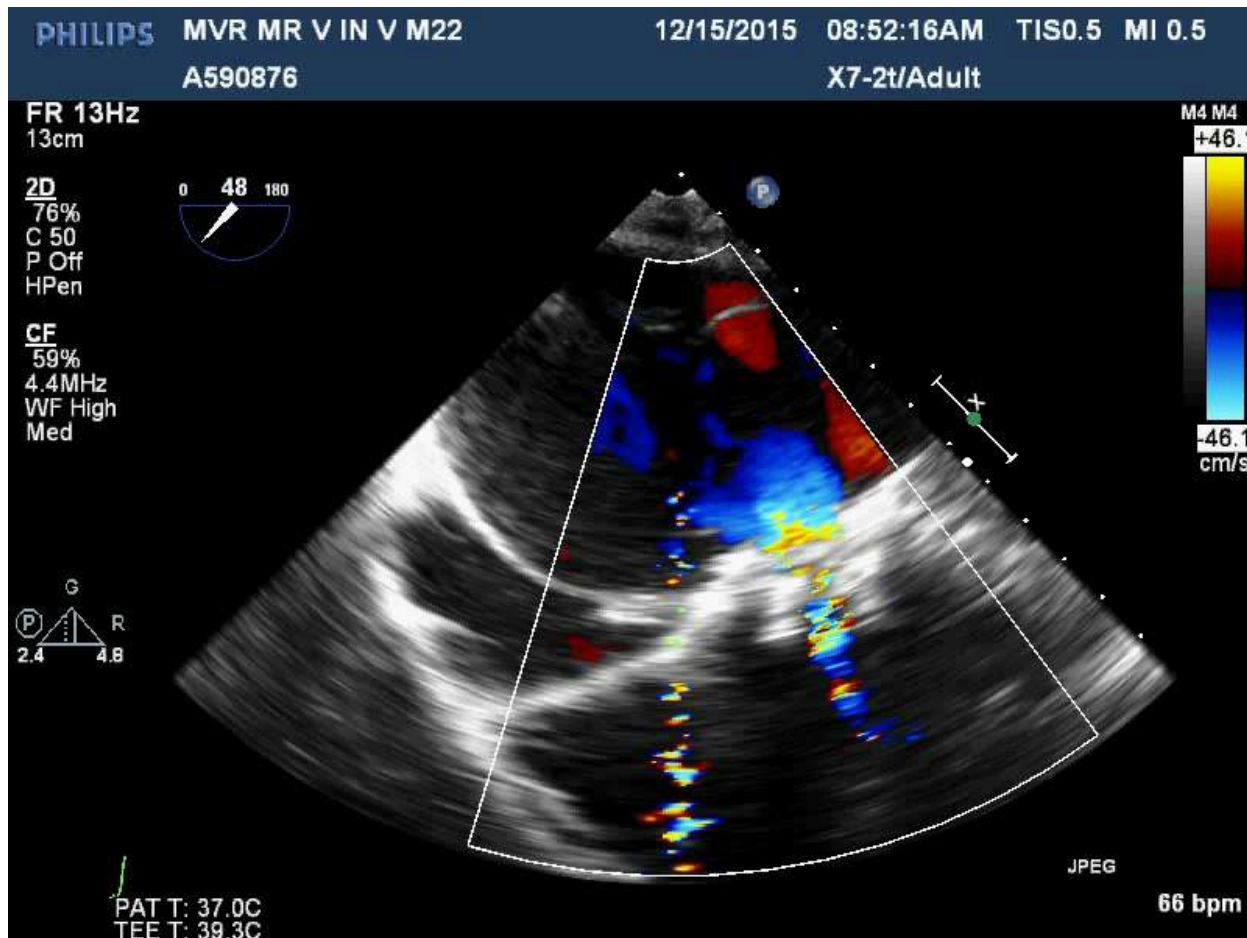
**The waist and marker can tell you where the Lotus is !**

Correct positioning and deployment of transcatheter valves during a TAV-in-SAV procedure requires correct radiographic recognition of stented bioprostheses.

# Transcatheter valve-in-valve for failed mitral bioprosthesis with Lotus valve

F 78, presented with progressive dyspnea for 3 months, Fc III-IV

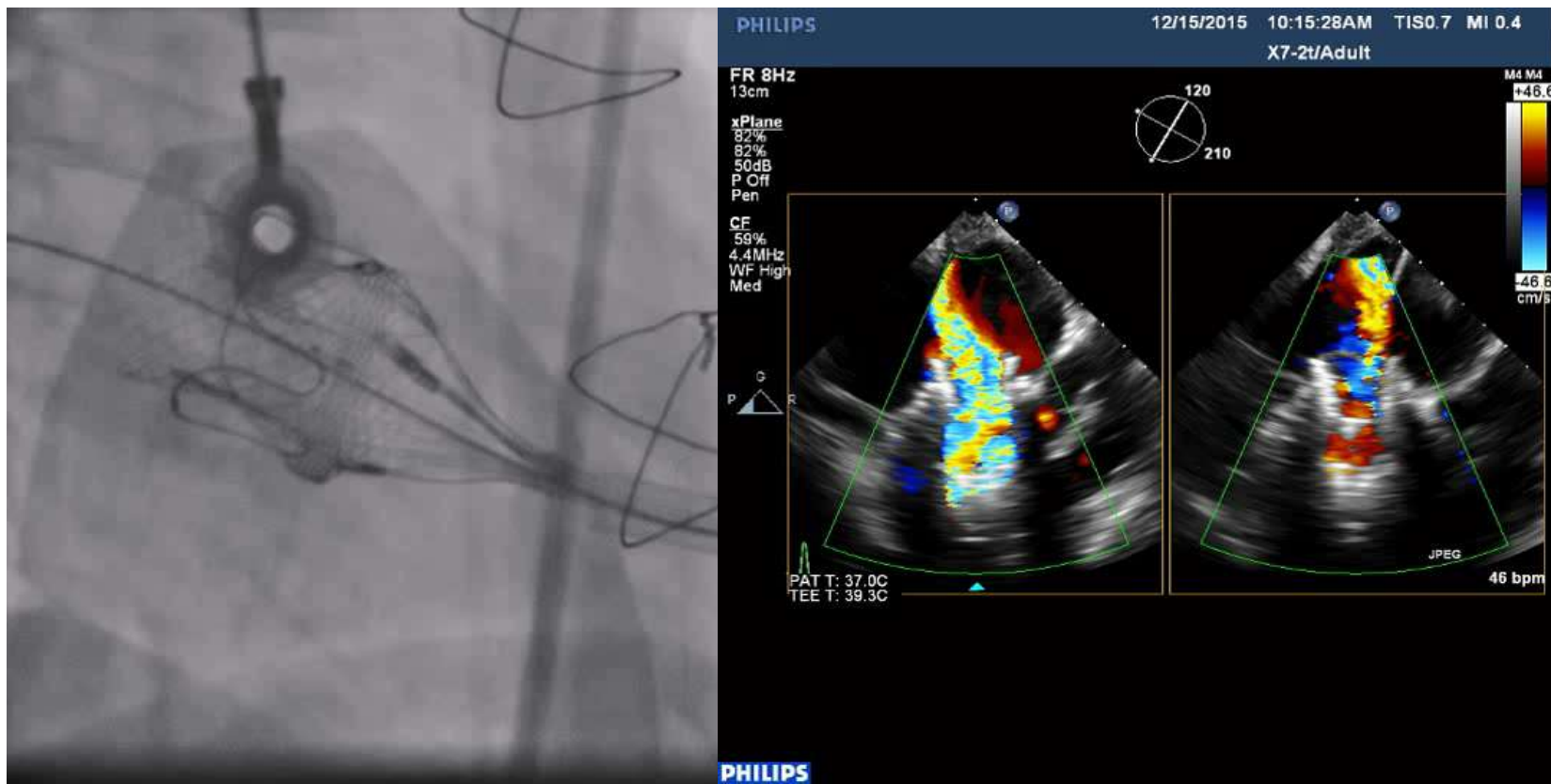
## Baseline TEE





# Transcatheter valve-in-valve for failed mitral bioprosthesis with Lotus valve

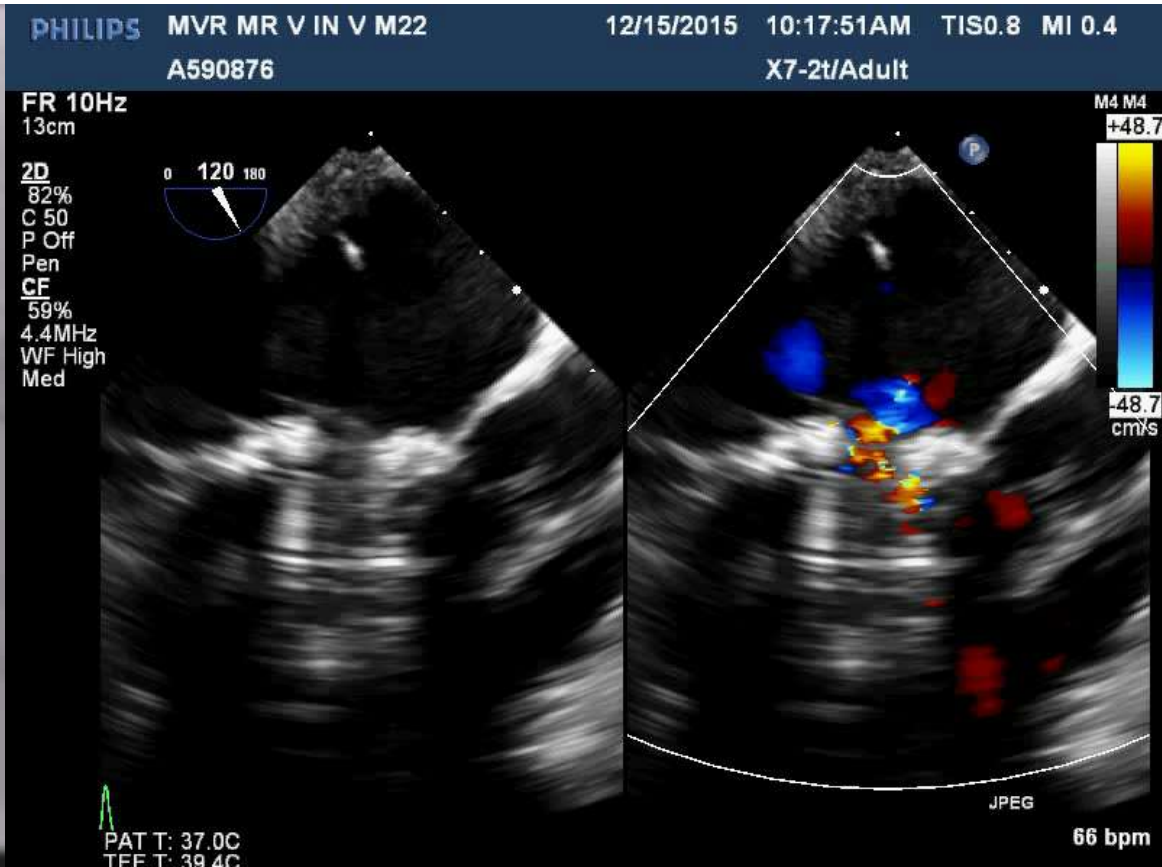
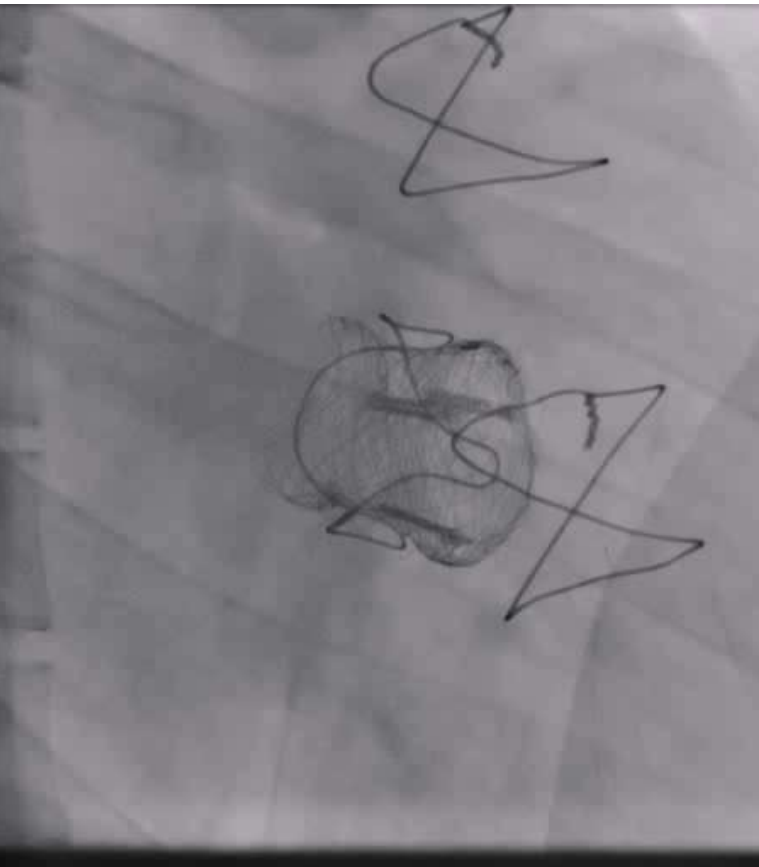
Positioned a little high in LA



# Transcatheter valve-in-valve for failed mitral bioprosthesis with Lotus valve

Re-sheathed and re-positioned

After final releasing, TEE demonstrated good positioning of the Lotus valve



# Transcatheter valve-in-valve for failed aortic and mitral bioprostheses @ CHGH

Patient	Patient Age, yrs	Valve Position	Valve Age, yrs	STS Score	Logistic Euroscore	Prior Revascularization	Prior Thoracotomy	Diabetes Mellitus	eGFR ml/min	LVEF
1	83	Aortic	12.3	10.026	20.53	No	1	No	43	53
2	77	Aortic	3.5	7.151	10.06	No	1	No	27	>55
3	88	Aortic	11.2	6.223	22.34	No	1	No	66	>55
4	70	Aortic	8.1	3.519	9.8	No	1	Yes	46	>55

➤ 29 Valve-in-valve implantations were performed in 28 patients (mean STS = 7%, mean Logistic EuroScore = 25) between 2014 to Apr. 2017.

11	62	Aortic	3	2.079	4.84	No	1	No	71	50
12	84	Aortic	11.8	24.524	70.97	No	1	Yes	14	>55

➤ Failed valves were aortic (n=12) or mitral (n=17) bioprostheses.

15	63	Mitral	2.2	12.339	31.5	Yes	1	Yes	49	55
16	78	Mitral	7.8	8.4	45.11	No	2	No	61	>55
17	73	Mitral	5	24.12	63.22	Yes	1	Yes	24	42
18	55	Mitral	7.2	16.05	30.78	Yes	1	No	6 (HD)	55
19	22	Mitral	9.2	1.74	14.27	No	1	No	186	>55
20	42	Mitral	5	2.91	18.81	No	2	No	137	>55
21	67	Mitral	4.9	10.29	15.48	Yes	1	No	74	>55
22	45	Mitral	14	2.83	18.81	No	2	No	122	>55
23	65	Mitral	10	3.814	11.81	Yes	1	No	124	>55
24	83	Mitral	11	10.373	30.76	No	1	No	59	>55
25	67	Mitral	7.3	5.316	18.87	Yes	1	No	96	35
26	67	Mitral	9.6	4.942	17.55	No	1	No	97	>55

# Transcatheter valve-in-valve for failed aortic bioprosthesis @ CHGH (N=12)

Patient	Failed Aortic Valve Type	Failed Valve Size, mm	Failure Mode	Implanted Valve Size, mm	2 stent valves, THV implantation	Access Site	Baseline Mean Gradient, mmHg	Final Mean Gradient, mmHg	Baseline Area, cm <sup>2</sup>	Final Area, cm <sup>2</sup>	Baseline Regurgitant Grade	Final Regurgitant Grade
1	Edwards SAV tissue	21mm	critical AS	CoreValve 26mm	No	TF	43	32	0.8	1.2	1	0
2	Edwards SAV	23mm	severe AR	CoreValve	No	TF	5	7	2.2	1.9	4	1

➤ Modes of bioprosthesis failure were stenosis (n = 4), regurgitation (n = 7), and combined (n = 1).

- Implantation was successful with immediate restoration of satisfactory valve function in all patients.
- No patient had more than mild regurgitation after implantation.
- No patients died during the procedure.

8	Medtronic Hancock II	25mm	severe AR	Sapien XT 23mm	No	TF	16	13	2.27	1.8	4	0
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➤ A second transcatheter device was implanted in 2 of the 7 patients using self-expandable CoreValve, but none in the Sapien cases.

11	Edwards Magna Bovine	25mm	Moderate AS, moderate AR	Sapien XT 26mm	No	TF	9	6	1.12	1.9	3	0
12	Medtronic Hancock II	25mm	severe AR	Sapien XT 23mm	No	TA	16	12	2	1.7	4	0

# Transcatheter valve-in-valve for failed mitral bioprosthesis @ CHGH (N=15)

Patient	Failed Valve	Failed Valve Size, mm	Failure Mode	THV, mm	Access	Baseline Mean Gradient, mmHg	Final Mean Gradient, mmHg	Baseline PHT, ms	Final PHT, ms	Baseline Regurgitant Grade	Final Regurgitant Grade
13	Edwards Perimount Magna Bovine	25mm	severe MS	Sapien XT 26mm	TA	16	6	200	91.7	1	0
14	Edwards SAV tissue	31 mm	severe MR	Sapien XT 29mm	TA	9	6	110	122	4	0

- Modes of bioprosthesis failure were stenosis (n = 3), regurgitation (n = 7), and combined (n = 6).

17	Edwards tissue	29mm	severe MS	Lotus 27mm	TA	16	7	314.3	91.7	1	0
18	St Jude tissue	31mm	severe MS	Lotus 27mm	TA	15	6	160	122	3	0

- Implantation was successful with immediate restoration of satisfactory valve function in all patients.
- No patient had more than mild regurgitation after implantation.
- No patients died during the procedure. No patient needing a second device.

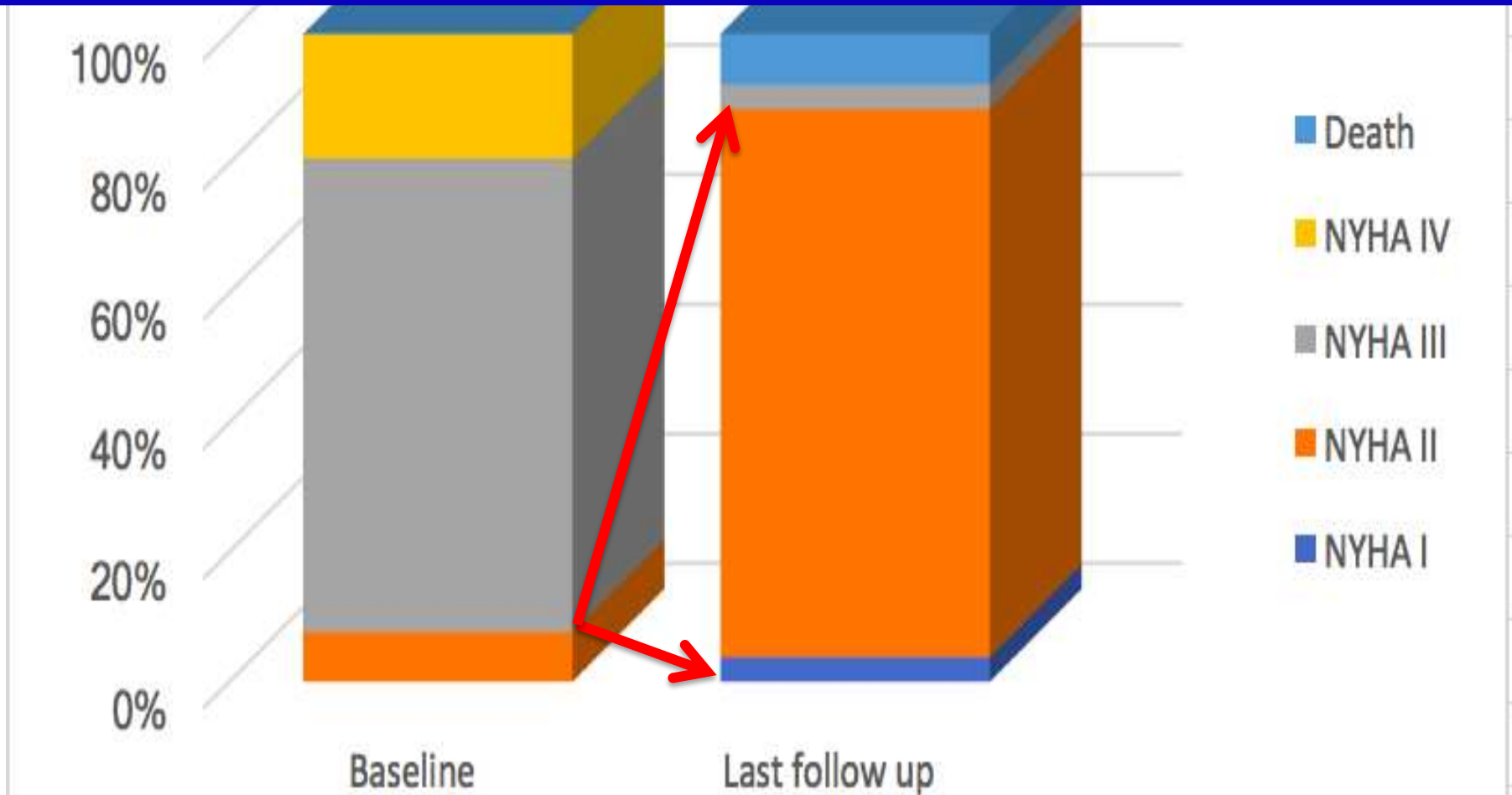
22	Edward SAV tissue	27mm	moderate MS	Lotus 25mm	TA	27	15	109	146.7	4	0
23	Medtronic Hancock	29mm	severe MR	Sapien XT 29mm	TA	10	4	104.76	146.7	4	0
24	Biocor tissue	31 mm	severe MR	Sapien XT 29mm	TA	8	6	73.3	137.5	4	0
25	Edwards Perimount	29mm	severe MS, moderate MR	Sapien XT 29mm	TA	10	6	275	129.4	3	0
26	Edward SAV tissue	29mm	severe MR	Sapien XT 29mm	TA	10	6	638	122	4	0

# Cumulative clinical outcomes of Transcatheter VIV @ CHGH (N=28)

Adverse outcomes	At a median follow-up of 187 days, n (%)
All cause mortality	2 (7.1)
Major disabling stroke	0 (0)
Non fatal myocardial infarction	0 (0)
Acute Kidney injury	0 (0)
Major bleeding	0 (0)
Vascular access injury	0 (0)
New permanent pacemaker implantation	3 (10.7)

# Significant improvement of functional status was observed

At baseline, all patients but two were in NYHA functional class III or IV; at a median follow-up of 187 days, 24/26 (92.3%) of surviving patients had good functional status (NYHA class I/II).



# Conclusions

- Valve-in-valve (VIV) implantation can be considered as **an acceptable alternative** to re-do open heart surgery for elderly high-risk surgical patients with bioprosthetic degeneration.
- **Proper sizing, selection of appropriate devices, and precise implantation depth** are the keys to success in transcatheter VIV procedures.
- However, longer term follow-up and head-to-head comparisons will be needed to establish **the true role of VIV implantation for dysfunctional bioprosthesis and the roles of different devices for this application.**



# Transcatheter Heart Valve Team at Cheng Hsin

260 THV interventions in 4 years

Team leader

Prof. Jeng Wei

程崧

曹殿萍  
主任

殷偉賢  
主任

Cardiologists

Surgeons

尤和平  
醫師

陳怡誠  
醫師

李國楨  
醫師

李永在  
醫師

熊名琛

曾芸軒

蔡勝國

周毅鵬

Imaging specialists

Anesthesiologists

Radiographers, perfusionist, nursing staffs.....

邱俊雄  
體循師



Thank You and Have a Nice Day!