Valve in Valve

Degenerated Bioprosthetic Aortic and Mitral Valves

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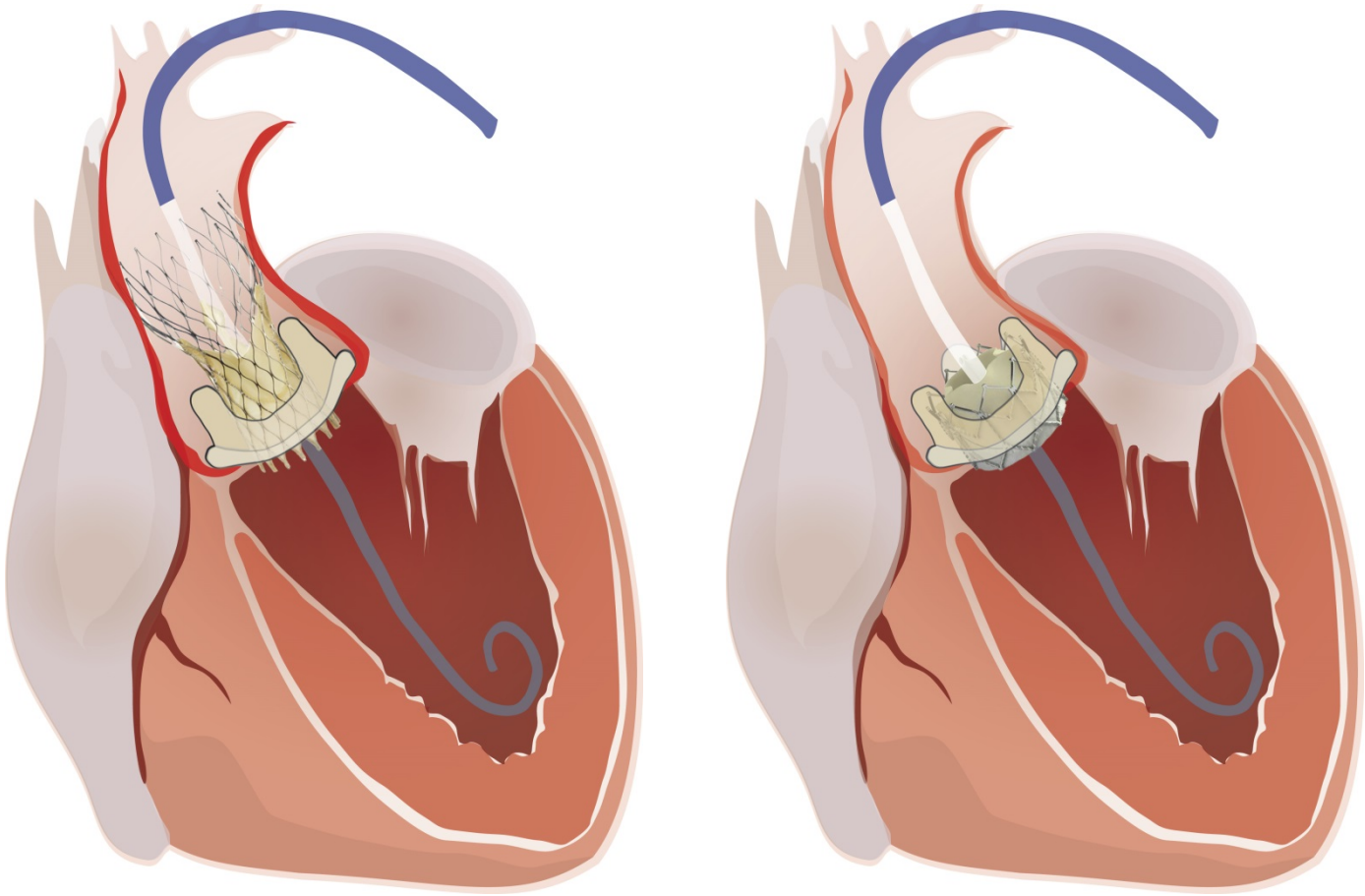
Valve-in-Valve:
a less invasive approach for failed bioprostheses

Valve-in-Valve International Data VIVID

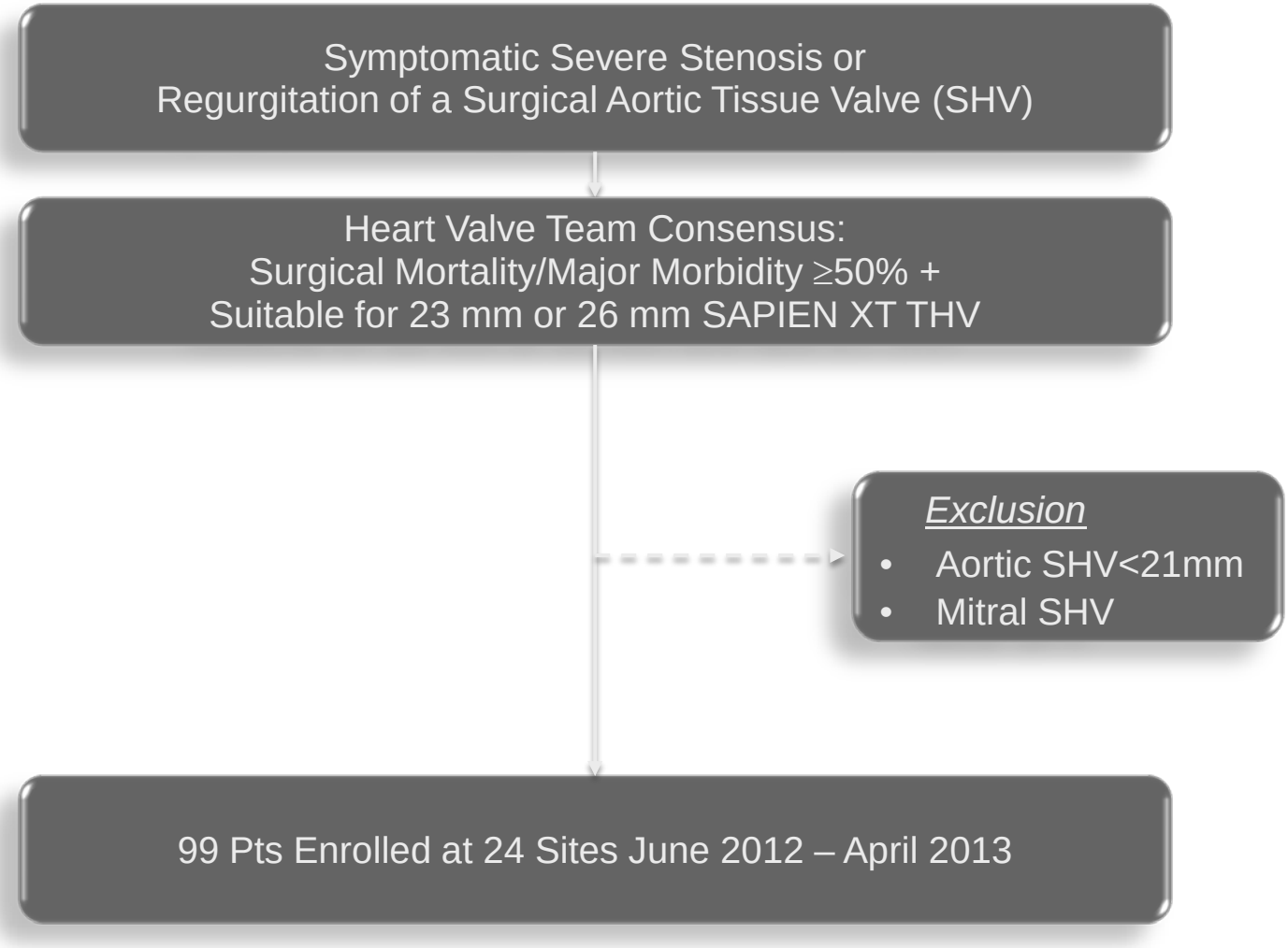


Available Data

- Retrospective registries: Valve-in-valve TAVR - alternative to reoperation for pts with surgical heart valves (SHV)
- PARTNER II Nested Registry 3 - Edwards SAPIEN XT transcatheter heart valve (THV) - *very* high risk reoperation
- CoreValve – Valve in Valve Registry (not presented yet)
- TVT – presented at TCT by Dr. Tuzcu

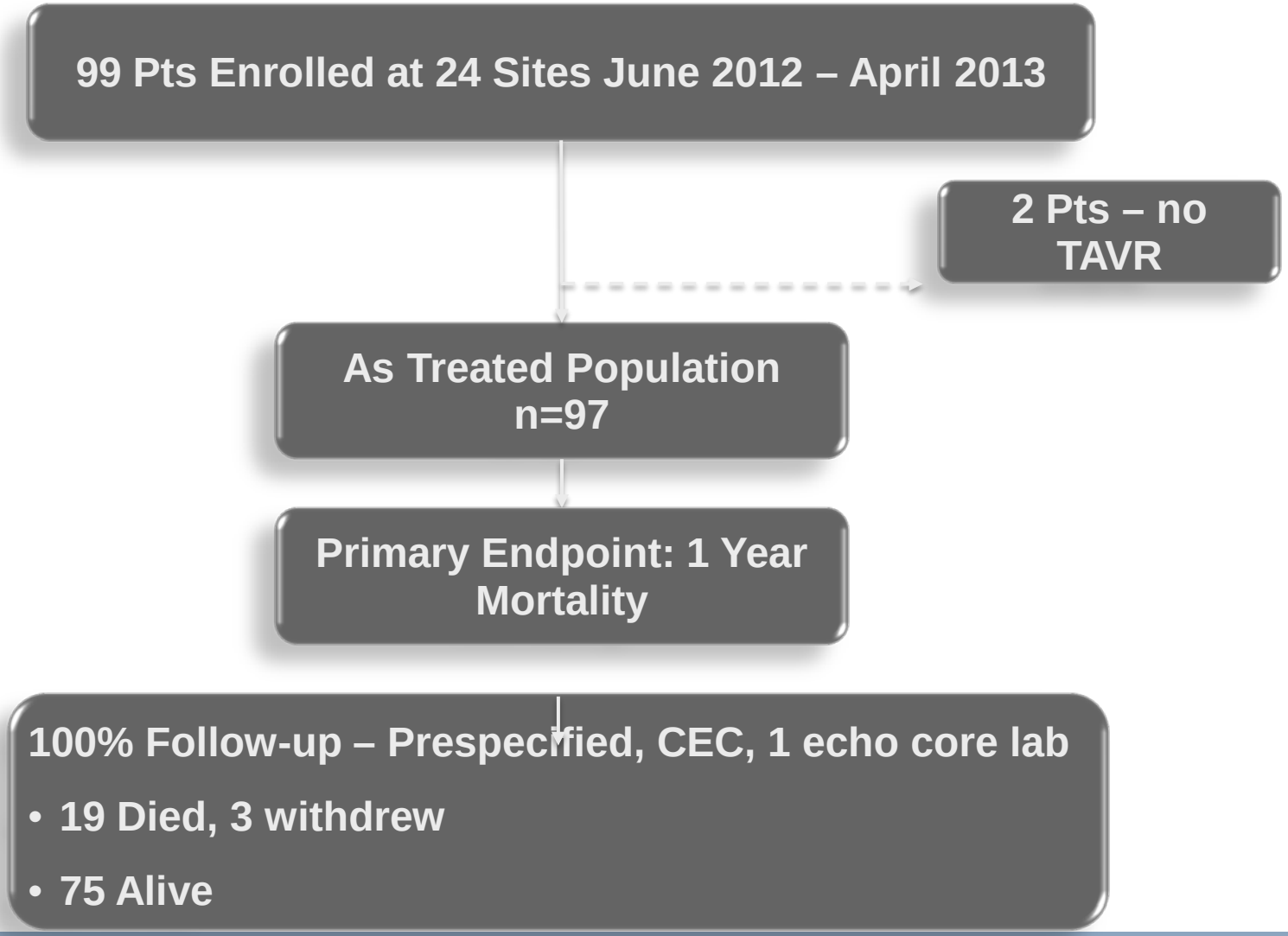
The PARTNER II Inoperable Cohort

Valve-in-Valve Nested Registry: Study Design



The PARTNER II Inoperable Cohort

Valve-in-Valve Nested Registry: Study Design



Baseline Patient Characteristics
Demographics (AT)

Characteristic	Valve-in-Valve (n=97)
Age – yr (mean ± SD)	80.1 ± 9.3
Male, %	55.7
NYHA Class III or IV, %	95.9
STS Score (mean ± SD)	9.8 ± 5.1
CAD, %	68.0
Peripheral Vascular Disease, %	28.9
COPD (O_2 Dependent), %	5.2
Renal Disease (Cr ≥2 mg/dL), %	14.4
Atrial Fibrillation (%)	50.5
Permanent Pacemaker, %	27.8
Liver Disease, %	9.3
Frailty, %	37.1

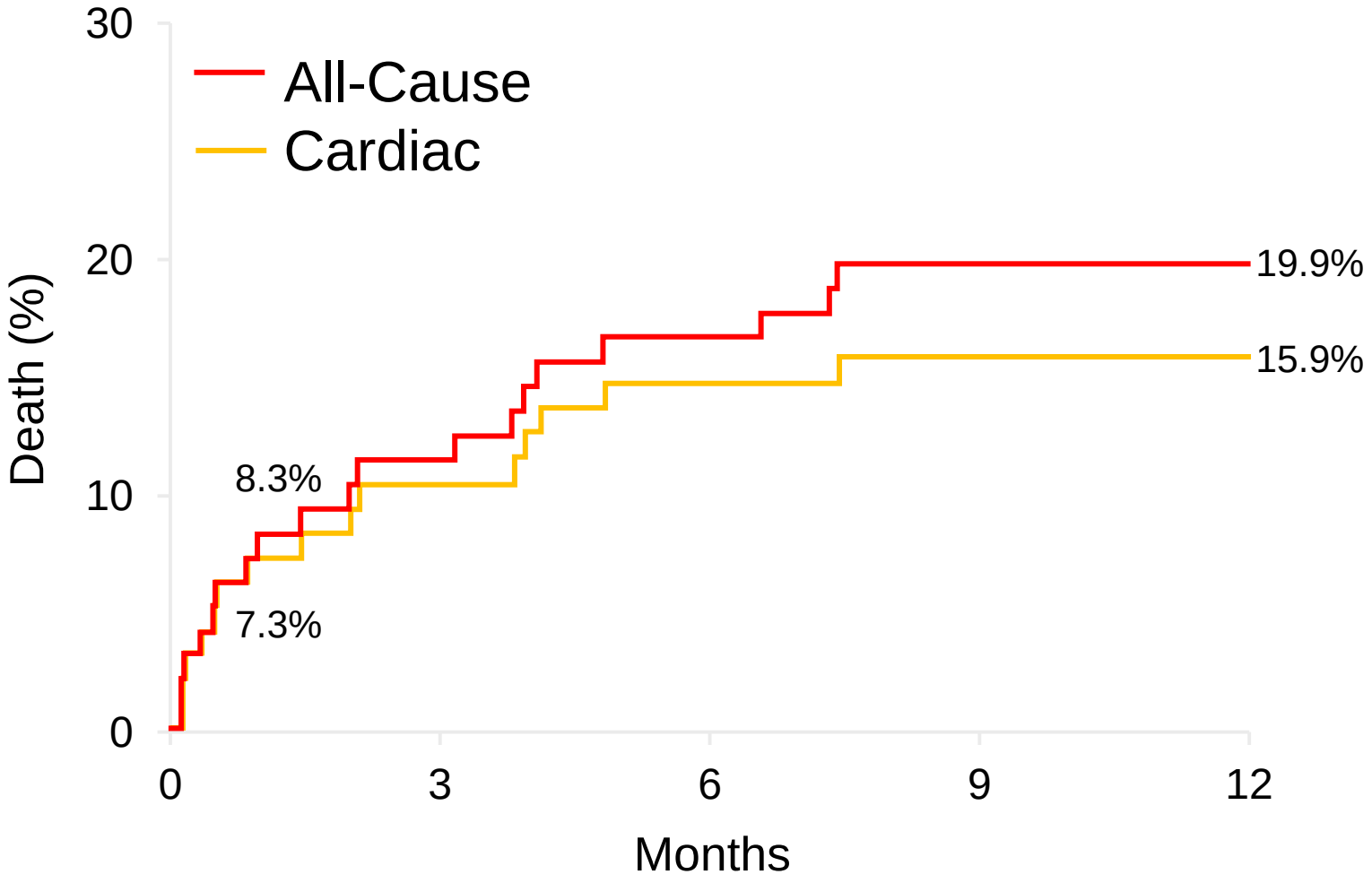
Sizing and Access

Surgical Valve Size (labeled)	%
21 mm	32
23 mm	41
>23 mm	27
THV – Sapien XT Size	
23 mm	77
26 mm	23
Access Route	
TF	62
TA	38

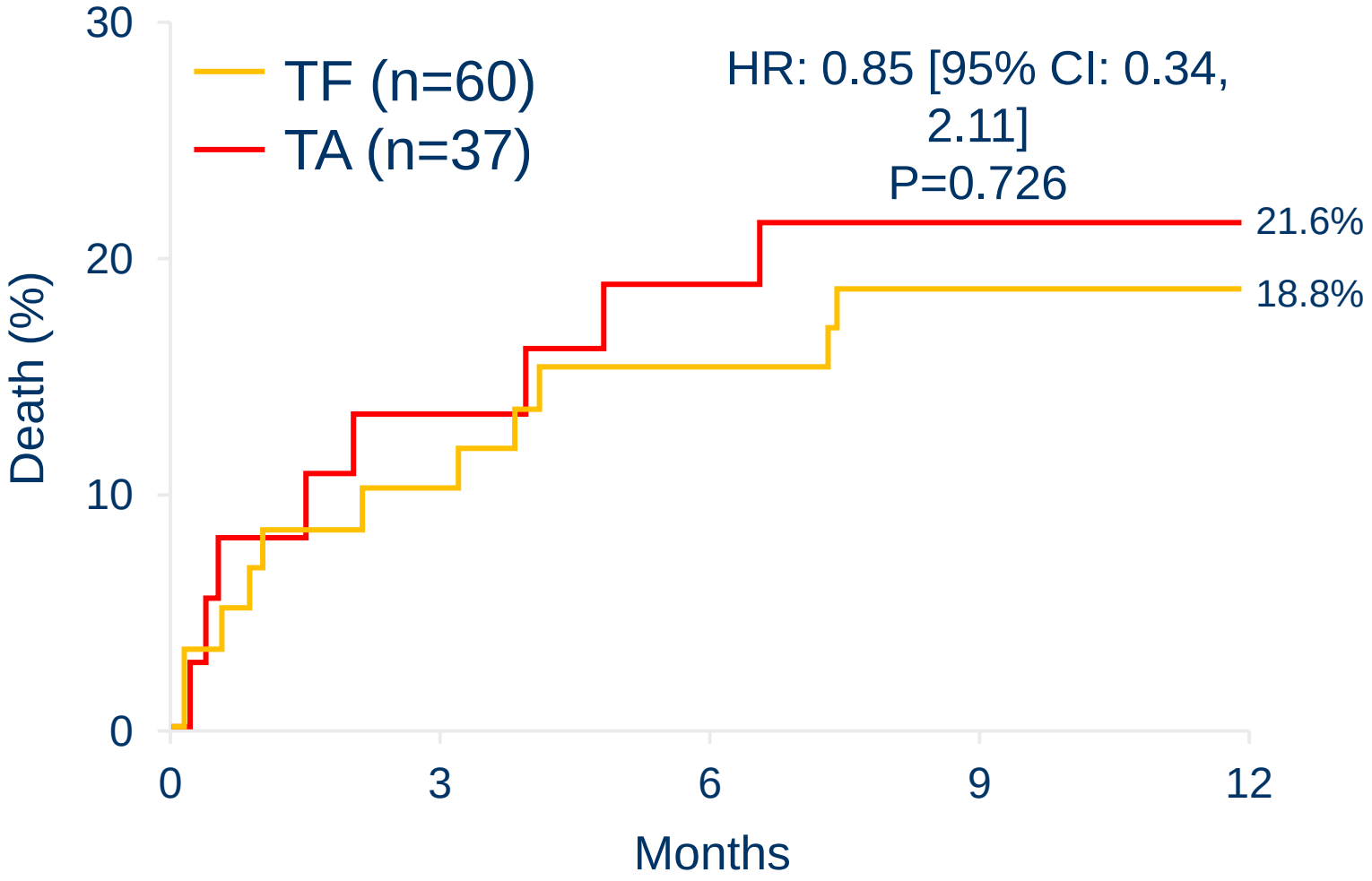
Webb and Mack, ACC 2014

One Year Results

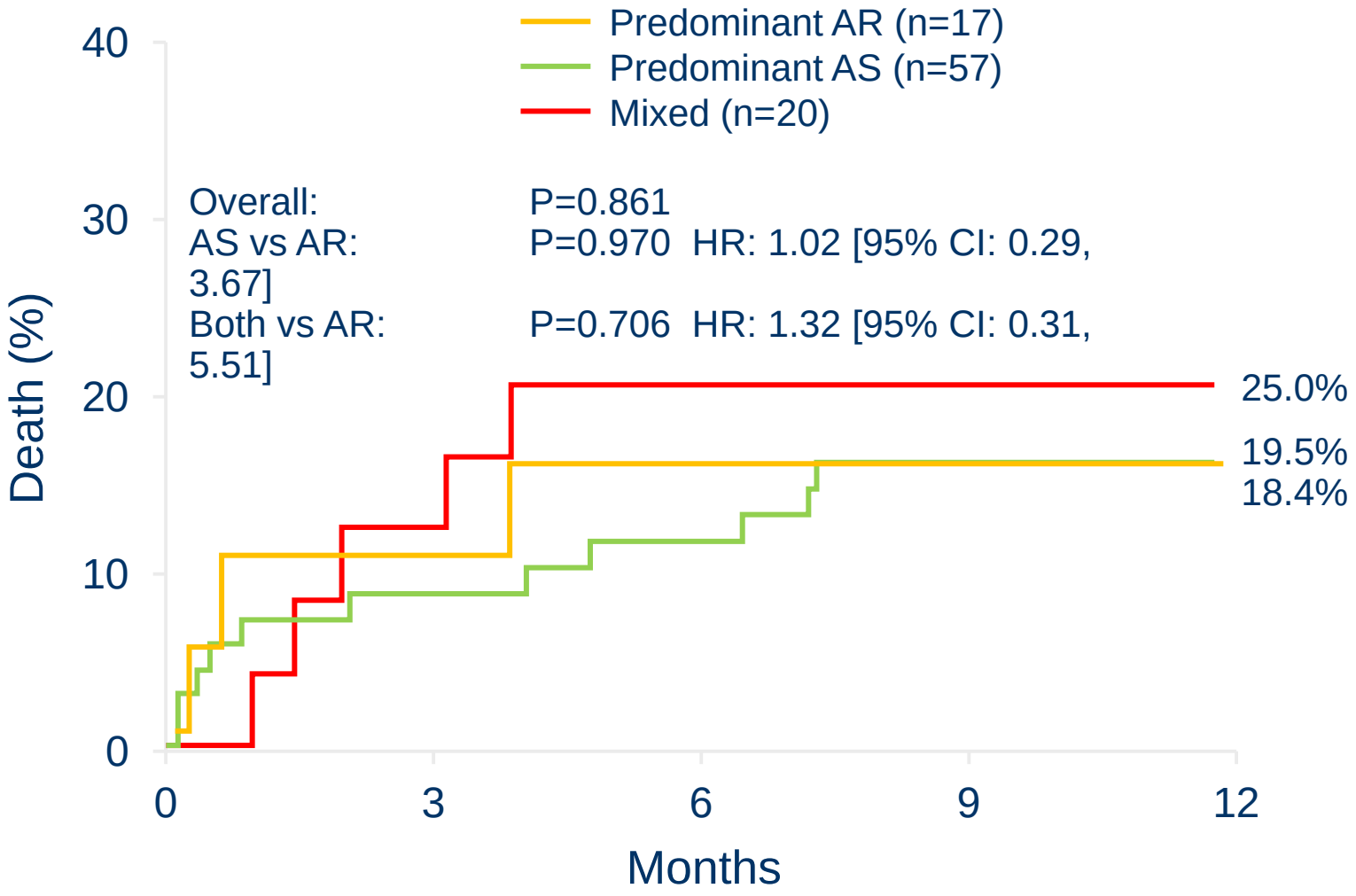
One-Year Mortality



All-Cause Mortality
By Access Approach



All-Cause Mortality
By Mode of SHV Failure

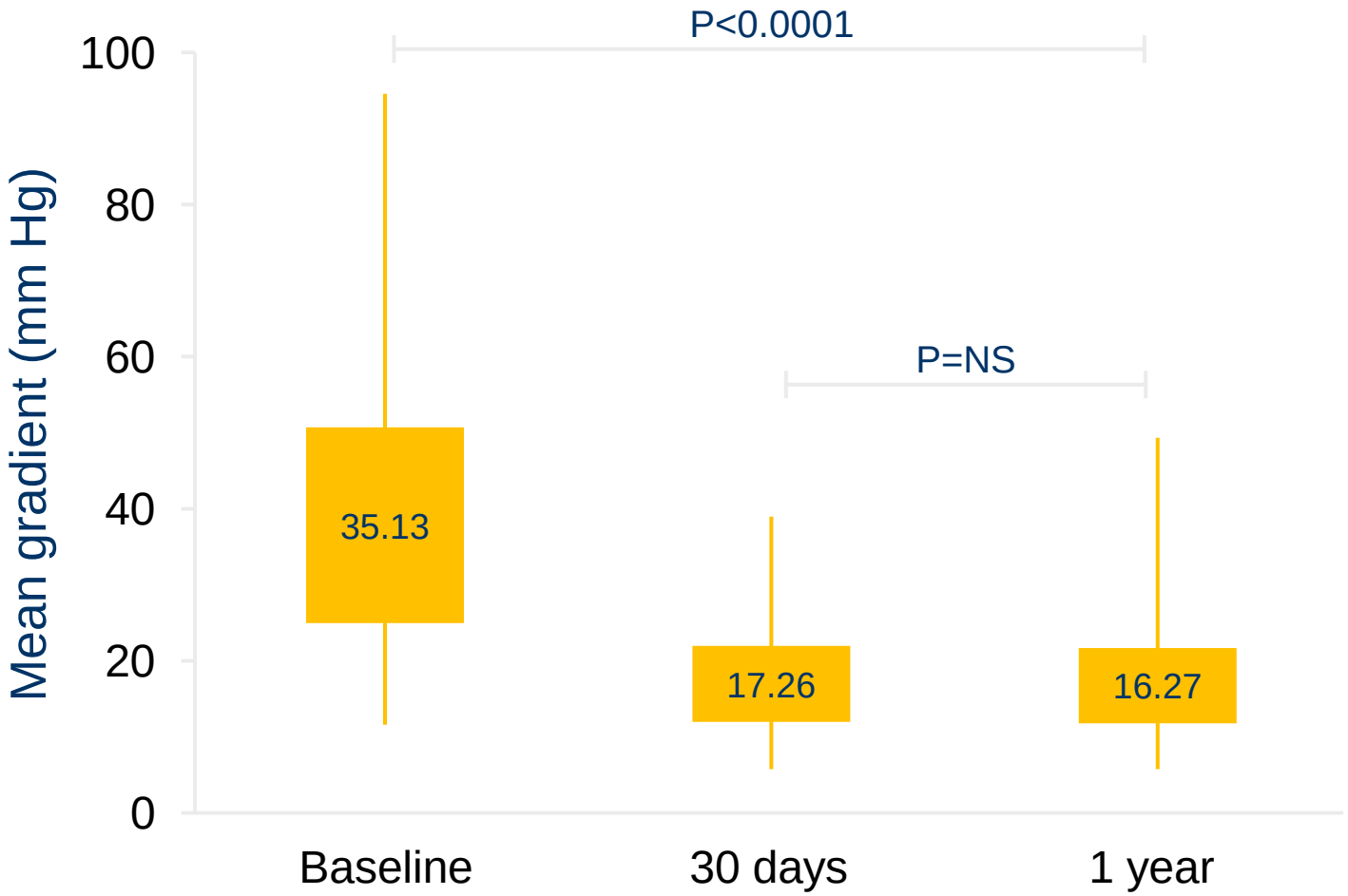


Other Adjudicated Outcomes

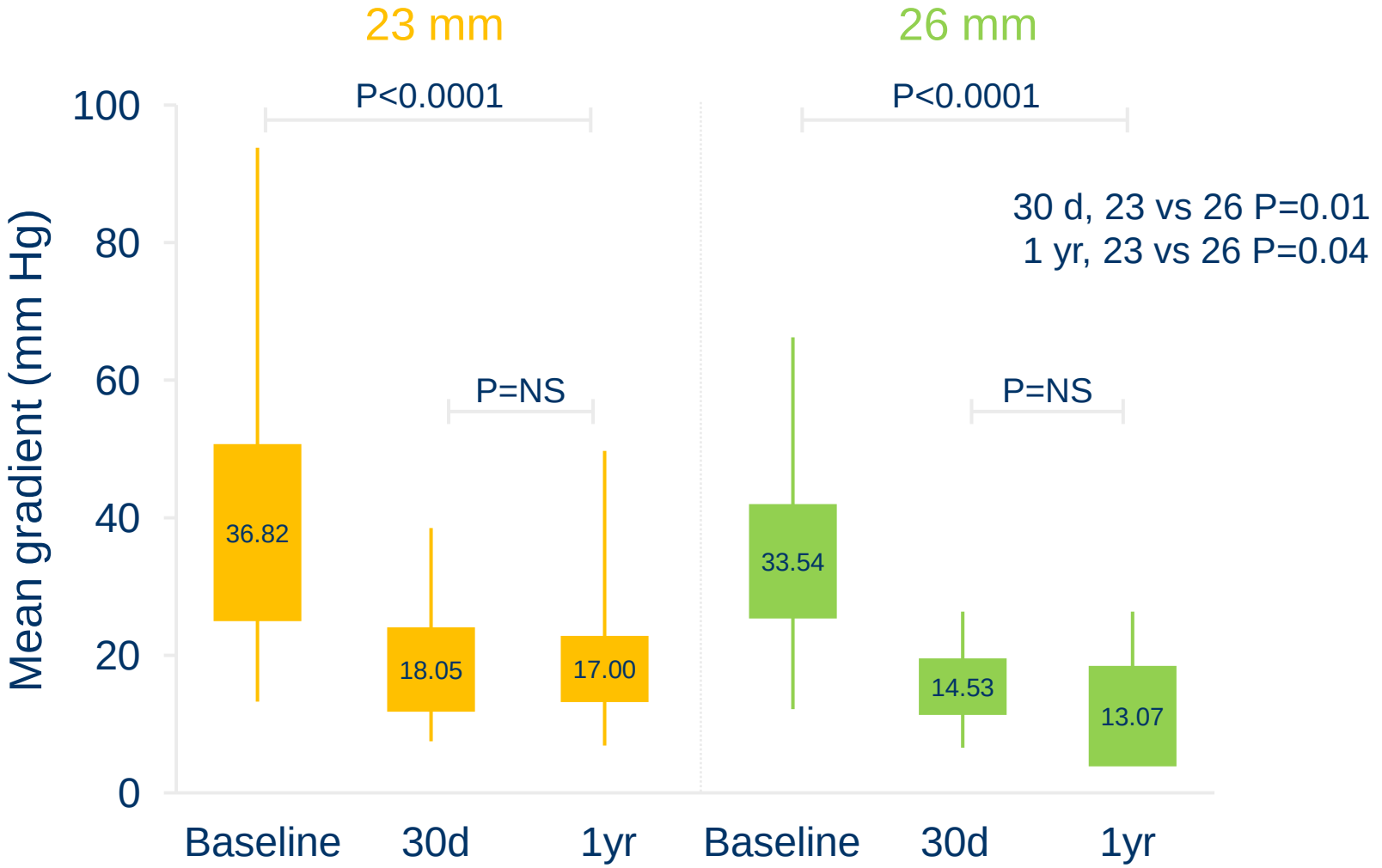
	30 Days	1 Year
Neurologic (Pre/post – VARC 2)		
Stroke/TIA, %	2.1	4.5
All Stroke, %	2.1	3.2
Disabling Stroke, %	2.1	3.2
Rehospitalization*, %	8.7	17.2
Permanent pacemaker, %	1.1	1.1

*For evaluation of aortic stenosis and/or complications of the valve procedure

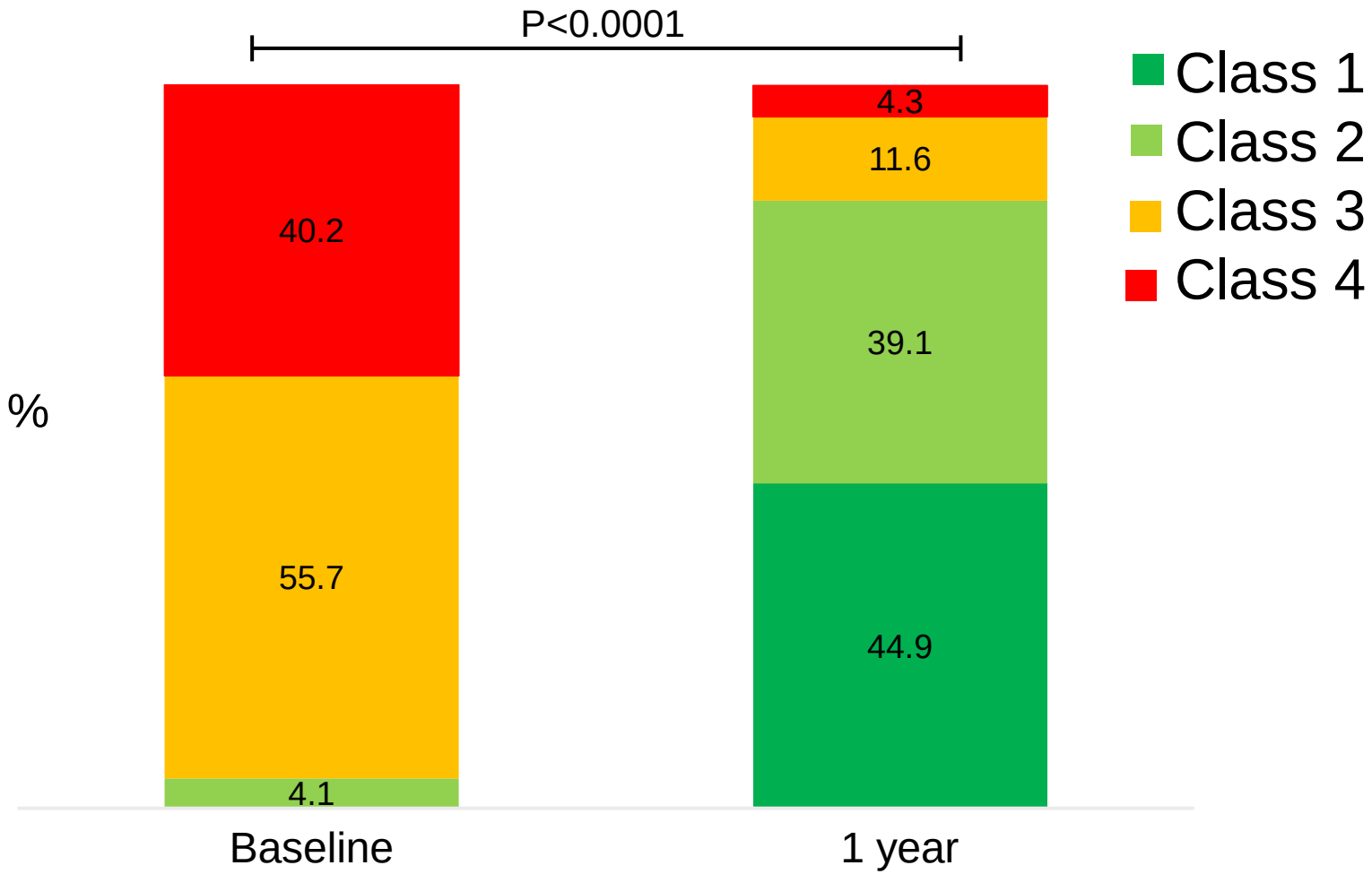
Mean Gradient
Flow Dependent



Mean Gradient
By THV Size

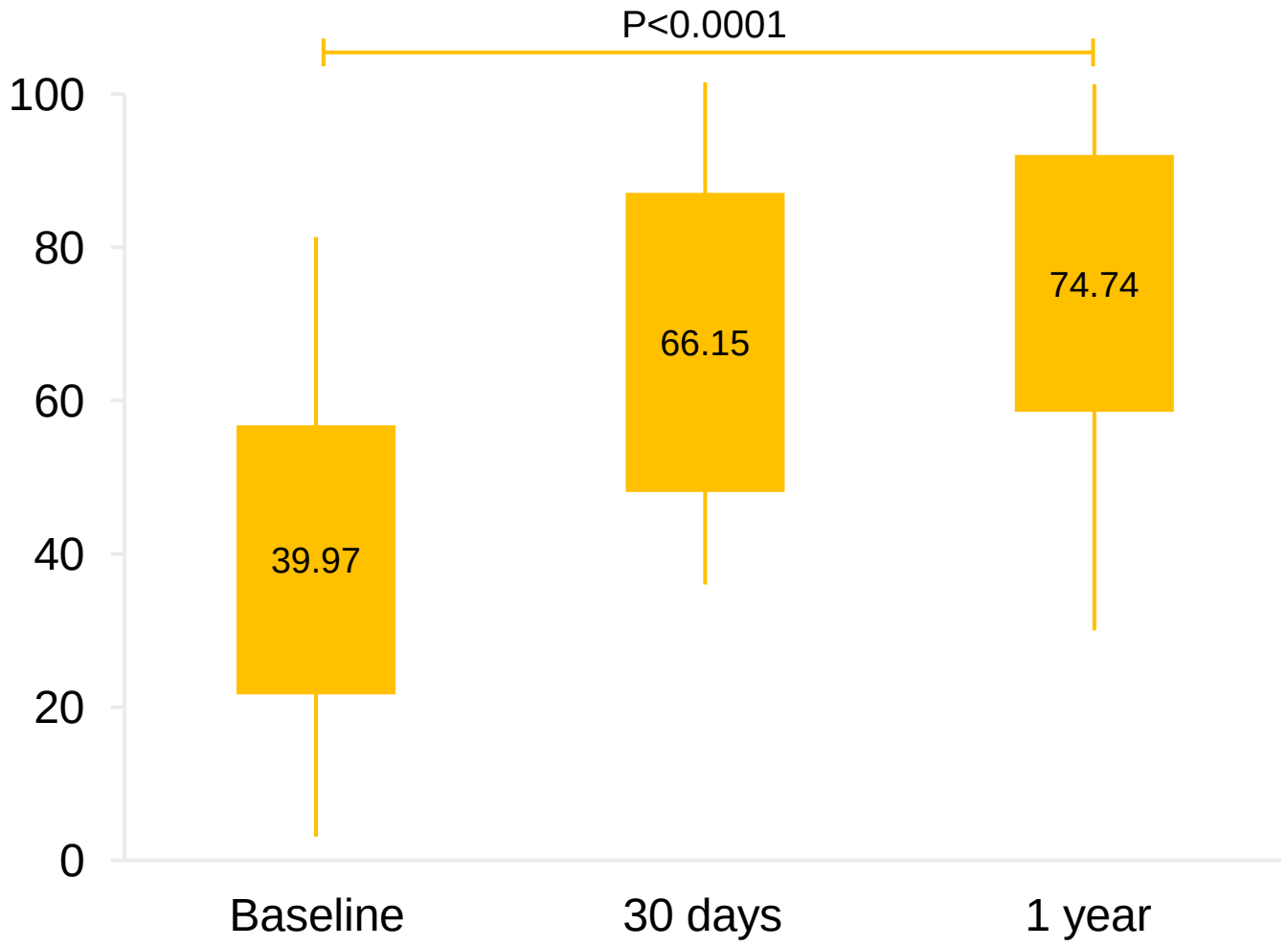


NYHA Class
Survivors



Quality of Life

KCCQ Overall Summary Score



Conclusions
VIV TAVR SAPIEN XT THV – 1 Year

- Hemodynamic improvement
- Patient benefit - NYHA fx class and QOL
- Excellent freedom from death, stroke, MAE
- Current analysis: small, prospective, adjudicated

Original Investigation

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 Tchetche, 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

IMPORTANCE Owing to a considerable shift toward bioprosthesis implantation rather than mechanical valves, it is expected that patients will increasingly present with degenerated bioprostheses in the next few years. Transcatheter aortic valve-in-valve implantation is a less invasive approach for patients with structural valve deterioration; however, a comprehensive evaluation of survival after the procedure has not yet been performed.

OBJECTIVE To determine the survival of patients after transcatheter valve-in-valve implantation inside failed surgical bioprosthetic valves.

Author Video Interview at jama.com

Supplemental content at jama.com

Baseline Demographics

Valve-in-Valve International Data VIVID

Patients included were at very high surgical risk

	Stenosis *n= 181*	*Regurgitation* *n= 139*	*Combined* *n= 139*	*P*
Age (yrs)	78.8± 7.8	77.1± 10.6	76.6± 11.1	0.10
Gender (% male)	48	66.9	55.4	0.002
LogEuroSCORE	32.3 ± 17.1	30.3 ± 18.8	34.1 ± 18.6	0.24
STS score (%)	12.3 ± 10.3	11.2 ± 8.4	13.4 ± 13.1	0.24

Dvir D et al. JAMA. 2014;312(2):162-170.

Baseline Demographics

Valve-in-Valve International Data VIVID

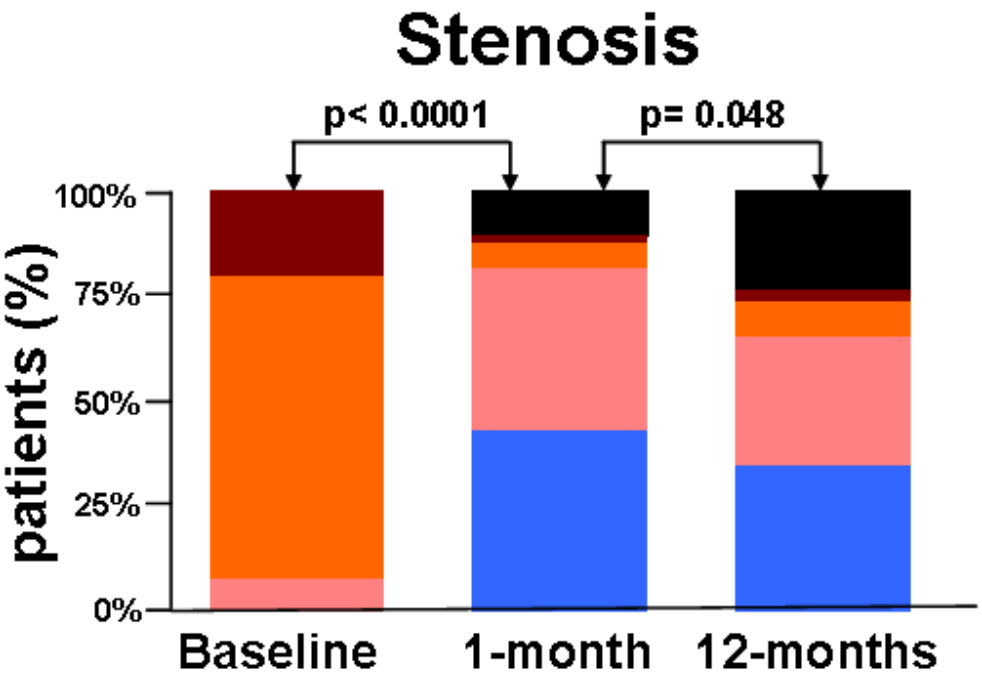
	Stenosis n= 181	Regurgitation n= 139	Combined n= 139	P
Height (cm)	167.1 ± 9.9	168.1± 9.7	166.5 ± 9.8	0.20
Weight (kg)	77.6 ± 16.5	72 ± 13.3	70.8 ± 14.1	0.0003
BMI (kg/m2)	27.7 ± 4.8	25.4 ± 3.9	25.5 ± 4.2	<0.0001
BSA (m2)	1.89 ± 0.24	1.83 ± 0.2	1.8 ± 0.21	0.002
Stented bioprosthesis	95.6%	60.4%	78.4%	<0.0001
Label size ≤ 21mm	37%	20.9%	26.6%	0.005

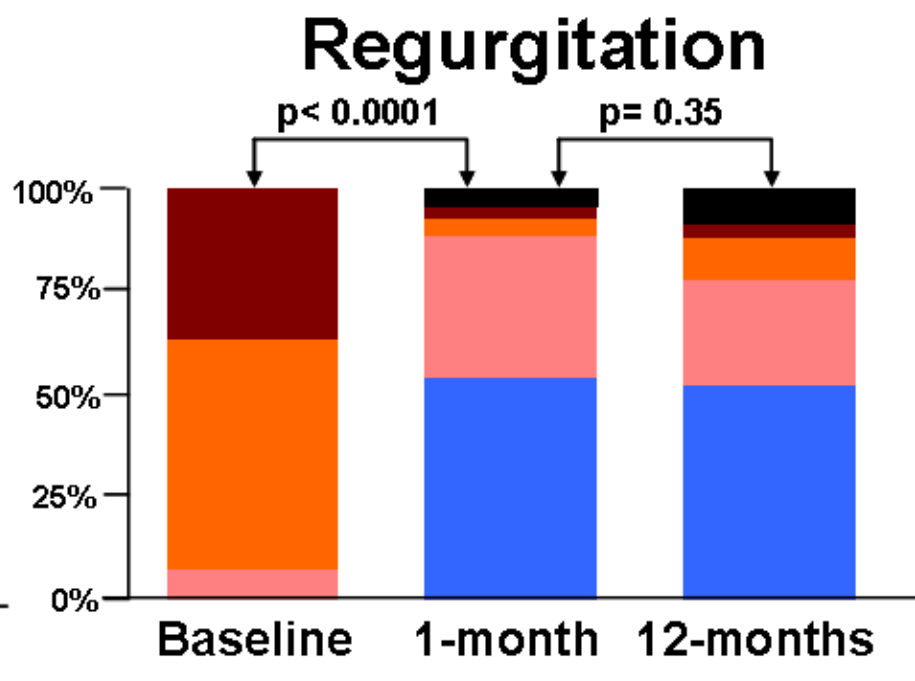
The stenosis group had patients with larger body size implanted with smaller sized surgical valves!

Dvir D et al. JAMA. 2014;312(2):162-170

Outcome Based on AS/AR

Valve-in-Valve International Data VIVID





The stenosis group was doing worse in follow-up

NYHA class I

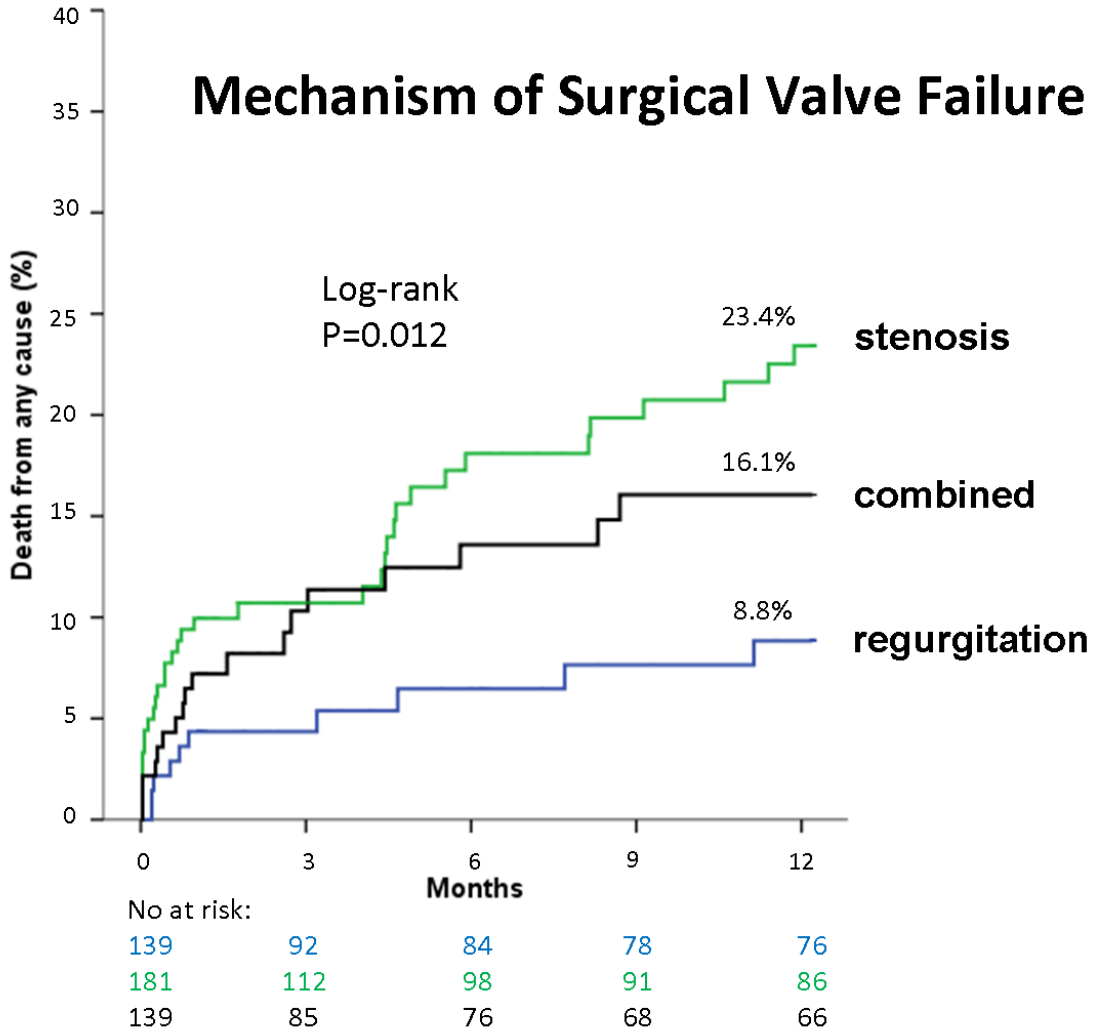
NYHA class II

NYHA class III

NYHA class IV

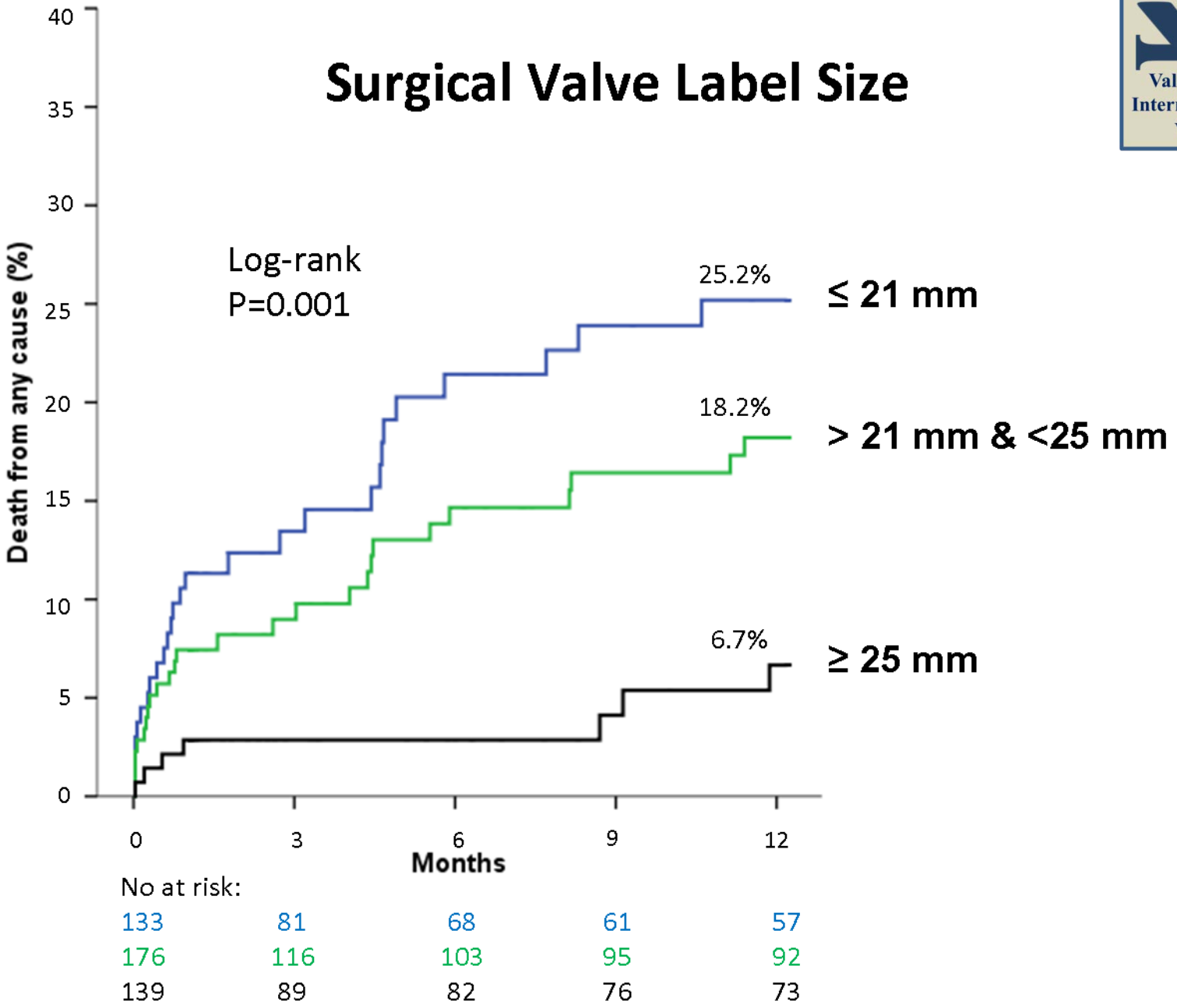
Death

Valve-in-Valve International Data
VIVID



Dvir D et al. JAMA. 2014;312(2):162-170.

Surgical Valve Label Size



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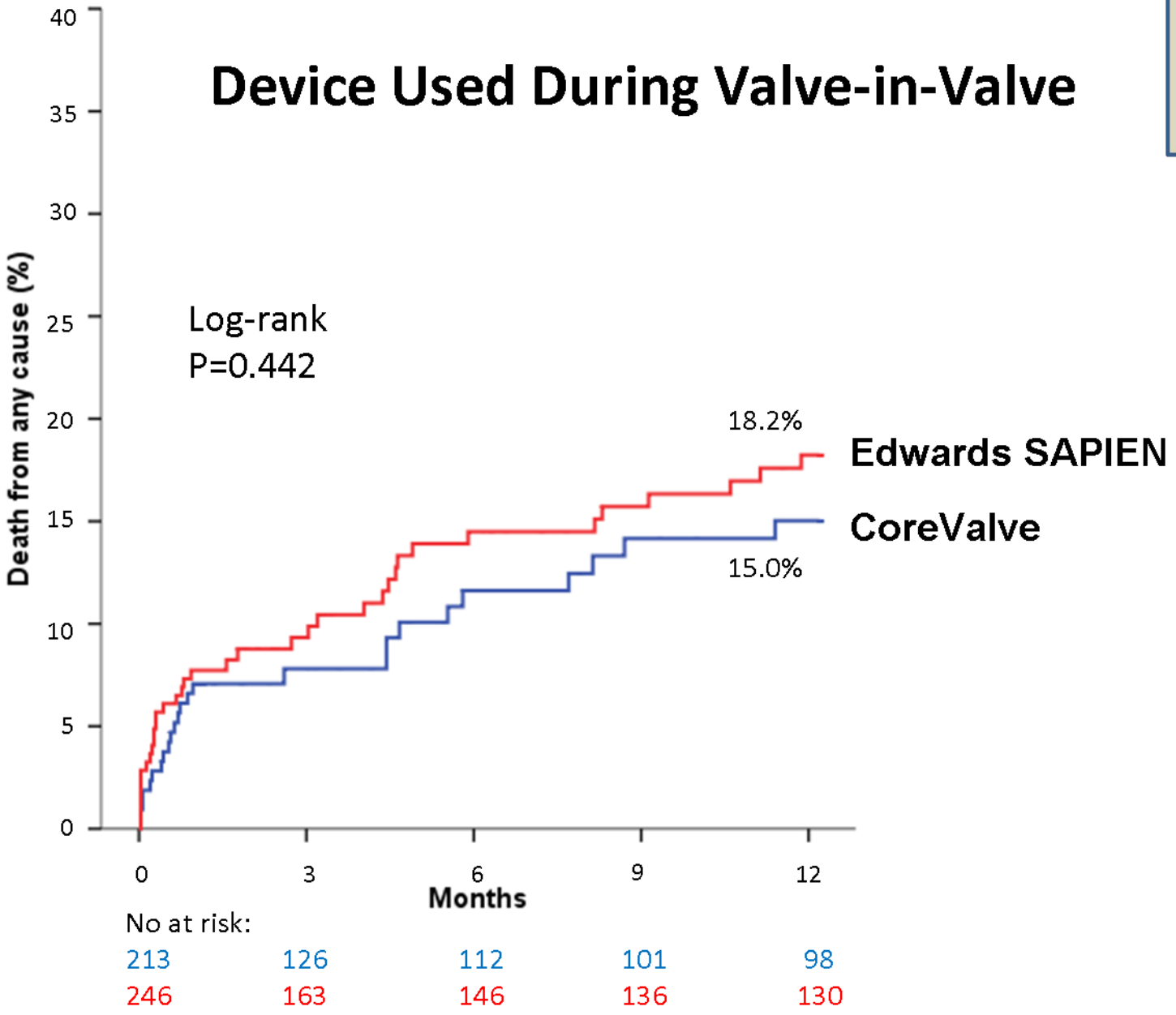
Device Used During Valve-in-Valve

Valve-in-Valve International Data VIVID



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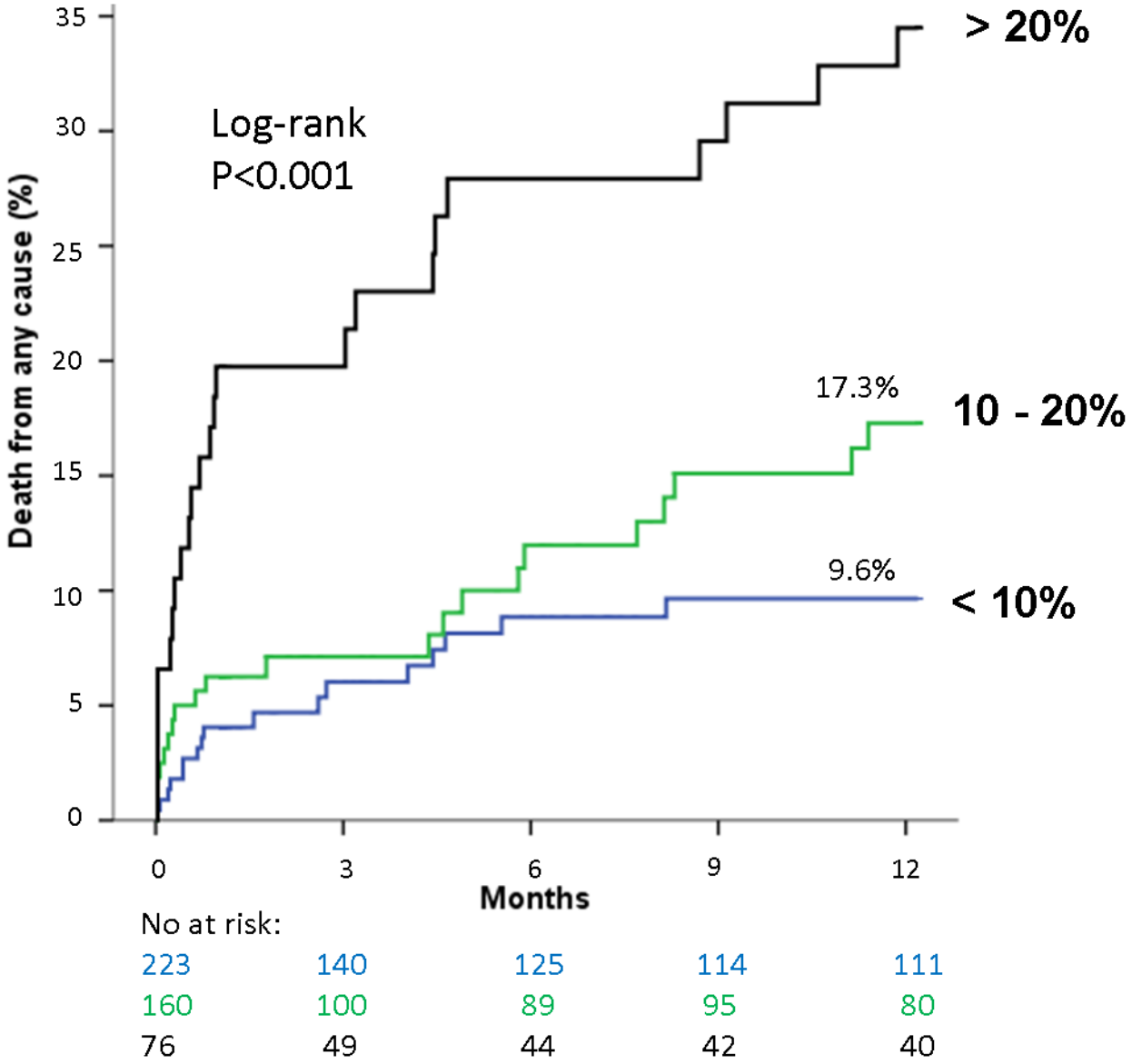
STS score



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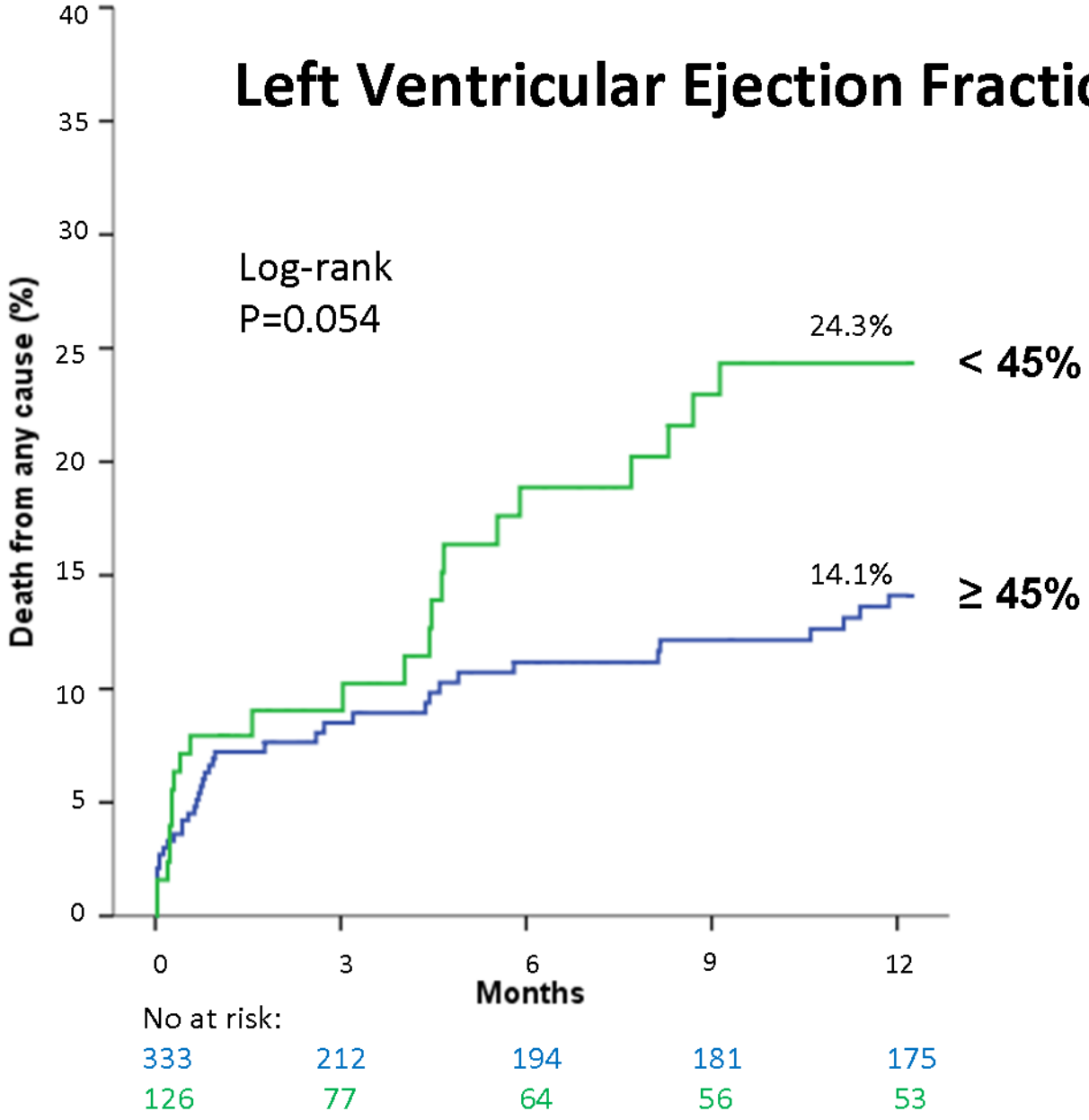
Valve-in-Valve International Data VIVID

Left Ventricular Ejection Fraction (%)



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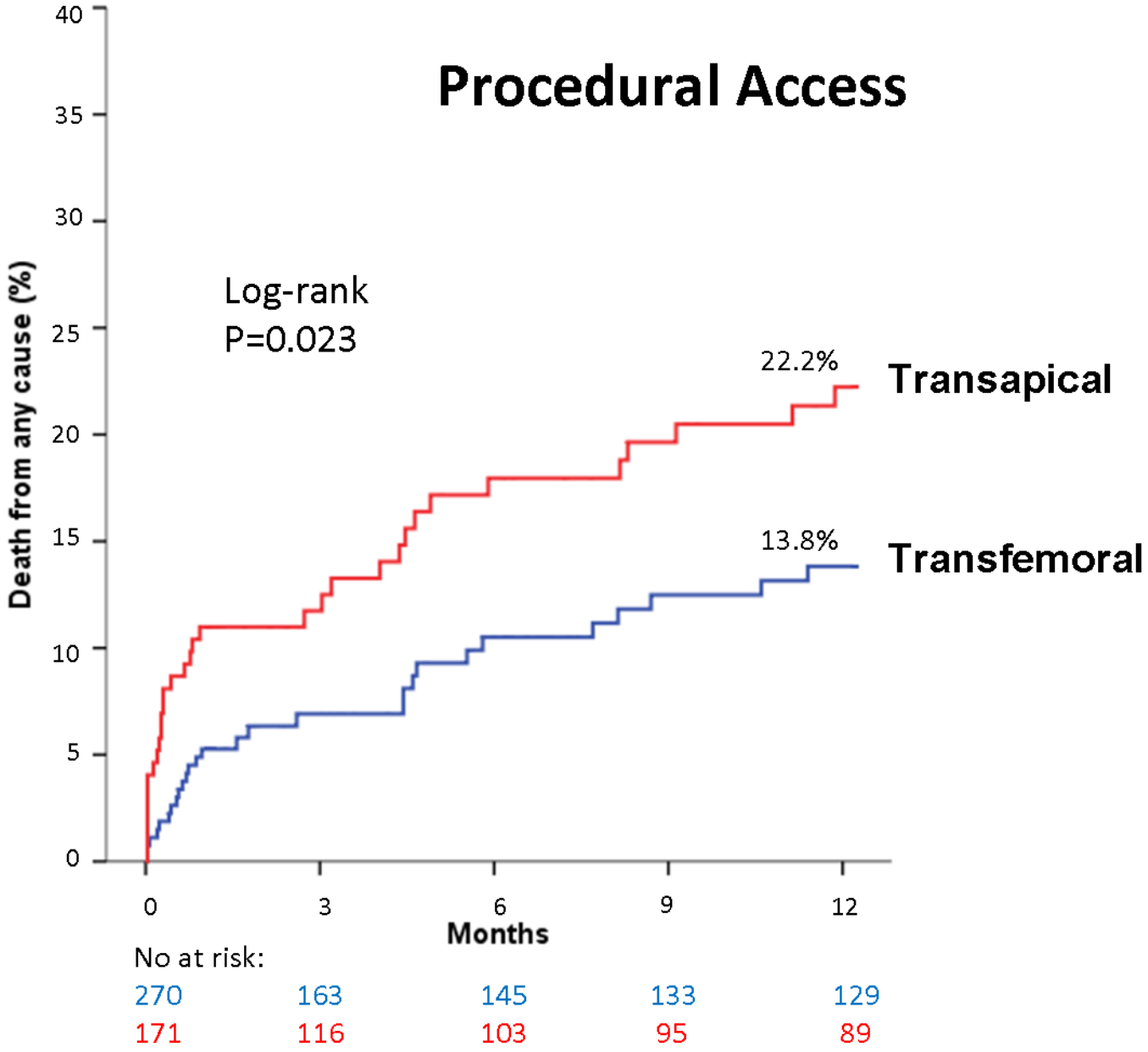
Procedural Access

Valve-in-Valve International Data VIVID



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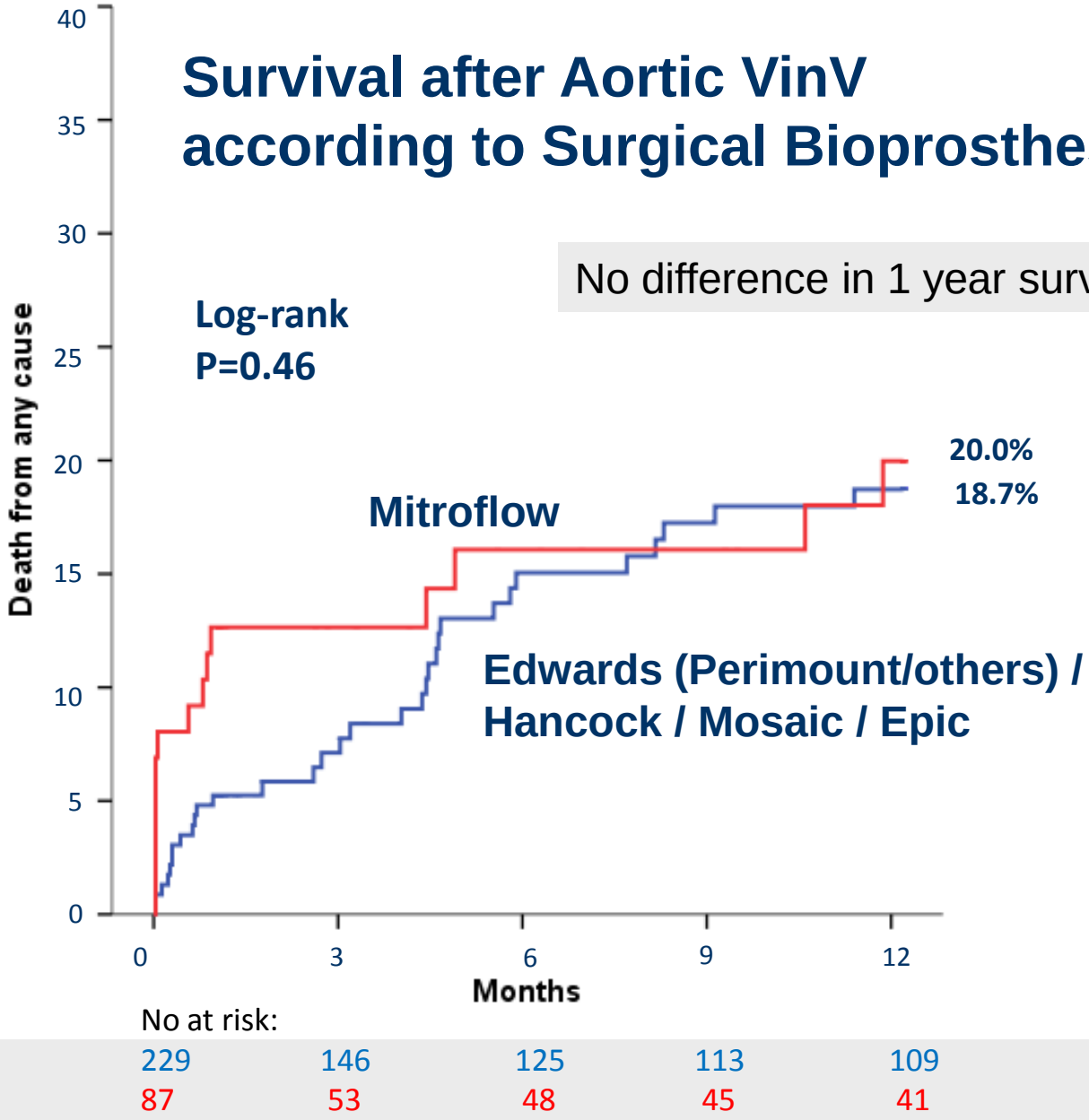
Valve-in-Valve International Data VIVID

Survival after Aortic VinV according to Surgical Bioprostheses

No difference in 1 year survival



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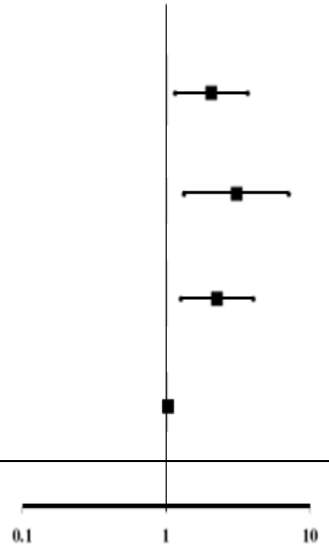
Multivariable Analyses for Correlates for Mortality After Valve-in-Valve

Valve-in-Valve International Data VIVID

	Group Events (size)	Reference Events (size)	Hazard ratio (95% Confidence Interval)	p Value
Overall mortality				
Surgical valve label size ≤ 21 mm	28 (133)	34 (315)	2.04 (1.14-3.67)	0.017
Baseline stenosis (vs. regurgitation)	34 (181)	12 (139)	3.07 (1.33-7.08)	0.008
Transapical access	34 (171)	30 (288)	2.25 (1.26-4.02)	0.006
STS score[a] (per 1% increment)	-	-	1.01 (1.00-1.01)	<0.001



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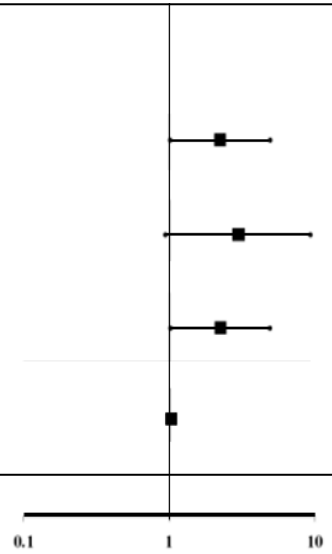
Multivariable Analyses for Correlates for Mortality After Valve-in-Valve

Valve-in-Valve International Data VIVID

	Group Events (size)	Reference Events (size)	Hazard ratio (95% Confidence Interval)	p Value
Early mortality (≤ 30 days)				
Surgical valve label size ≤ 21 mm	15 (133)	17 (315)	2.25 (1.02-4.98)	0.045
Baseline stenosis (vs. regurgitation)	18 (181)	6 (139)	2.97 (0.94-9.37)	0.063
Transapical access	19 (171)	15 (288)	2.25 (1.03-4.93)	0.043
STS score[a] (per 1% increment)	-	-	1.01 (1.00-1.01)	<0.001



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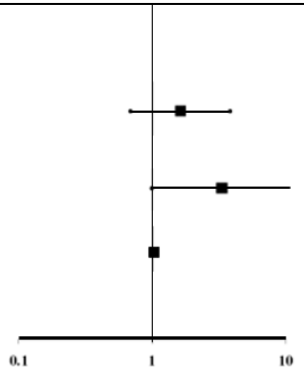
Multivariable Analyses for Correlates for Mortality After Valve-in-Valve

Valve-in-Valve International Data VIVID

	Group Events (size)	Reference Events (size)	Hazard ratio (95% Confidence Interval)	p Value
Late mortality (> 30 days)				
Surgical valve label size ≤ 21 mm	13 (133)	17 (315)	1.61 (0.68-3.8)	0.28
Baseline stenosis (vs. regurgitation)	16 (181)	6 (139)	3.33 (1.00-11.31)	0.05
STS score[a] (per 1% increment)	-	-	1.01 (1.00-1.04)	0.002



Dvir D et al. JAMA. 2014;312(2):162-170.

Conclusions and Implications

- After transcatheter valve-in-valve implantation for degenerated bioprosthetic aortic valves, overall 1-year survival was lower among patients with small bioprostheses and those with predominant surgical valve stenosis.

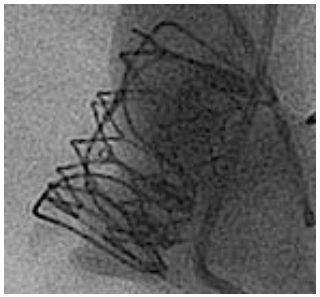
Mitral VinV / VinRing

- **Hypothetically may not have the limitations of Aortic-VinV procedures:**
  - **Lower post procedural gradients (surgical valve is large)**
  - **No LM obstruction!**
  - **Less device malposition**
  - **And also… no aortic rupture, less conduction defect**
- **However…**
  - **No trasfemoral artery delivery**
  - **No TF artery THV-device implantation**
  - **Post implantation LVOT obstruction**
  - **Thrombogenicity**

Global Valve in Valve Registry

Patients undergoing V-in-V procedures in sites in *Europe, North-America, Australia, New Zealand, South Africa, South America and the Middle-East*

Valve-in-Valve International Data VIVID



Mitral VIV / VIR*
(n=190)

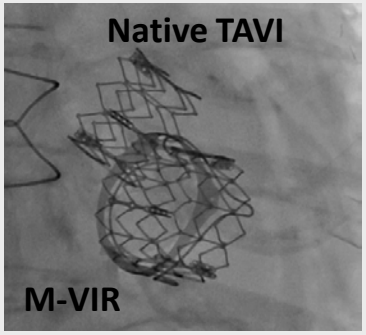
Mitral VIV
(n=157)

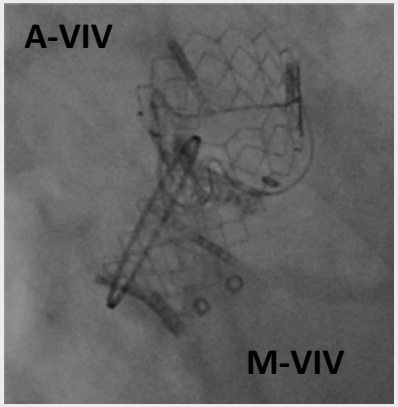
Mitral VIR
(n=33)

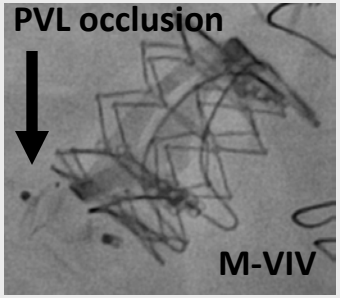
*Including combined mitral VIV / VIR and another structural procedure

Combined procedures (n=23)
Mitral VIV / VIR and…

- Native aortic valve TAVI (n=8)
- Aortic valve-in-valve (n=11)
- Tricuspid valve-in-ring (n=2)
- Mitral paravalvular leak closure (n=2)







Baseline Demographics

Valve-in-Valve International Data VIVID

	All (n=190)	M-VIV (n=157)	M-VIR (n=33)	P-value
Age (yrs)	73.6 ± 12.6	74.5 ± 12.4	69.4 ± 12.9	0.047
Female	65.2%	69.2%	45.2%	0.02
LogEuroSCORE	31 ± 20.7	30.2 ± 20.9	34.3 ± 19.7	0.29
STS score (%)	14.4 ± 11.9	14.8 ± 12.6	12.7 ± 8.7	0.28
Height (cm)	164.5 ± 9.3	164.1 ± 9.4	167.1 ± 8.2	0.13
Weight (kg)	65.8 ± 14.7	65.5 ± 14.6	68.3 ± 15.1	0.42

Baseline Demographics-2

Valve-in-Valve International Data VIVID

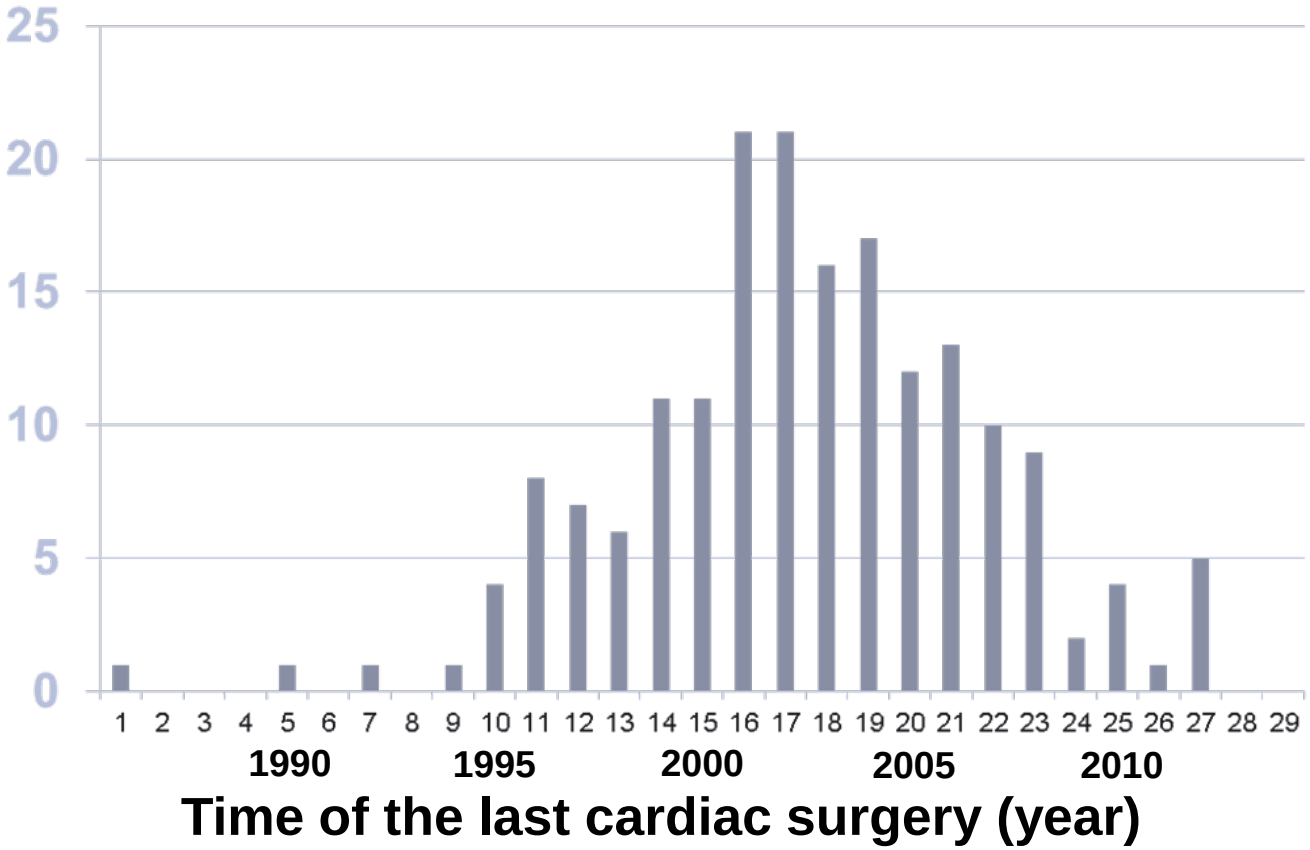
	All (n=190)	M-VIV (n=157)	M-VIR (n=33)	P-value
Diabetes Mellitus	28%	27.6%	30.3%	0.73
Peripheral Vascular Disease	20.6%	19.9%	24.2%	0.59
Chronic Renal Failure*	47.9%	45.2%	60.6%	0.09
Previous stroke	23%	24.4%	15.2%	0.26
NYHA III/IV	96.3%	95.5%	100%	0.22
Permanent Pacemaker	26.9%	22.9%	52%	0.04
Atrial fibrillation	54.2%	53.1%	57.6%	0.56
Chronic lung disease	25.1%	25.9%	24.2%	0.59

* GFR<60 cc/min

Baseline Demographics (n=190)

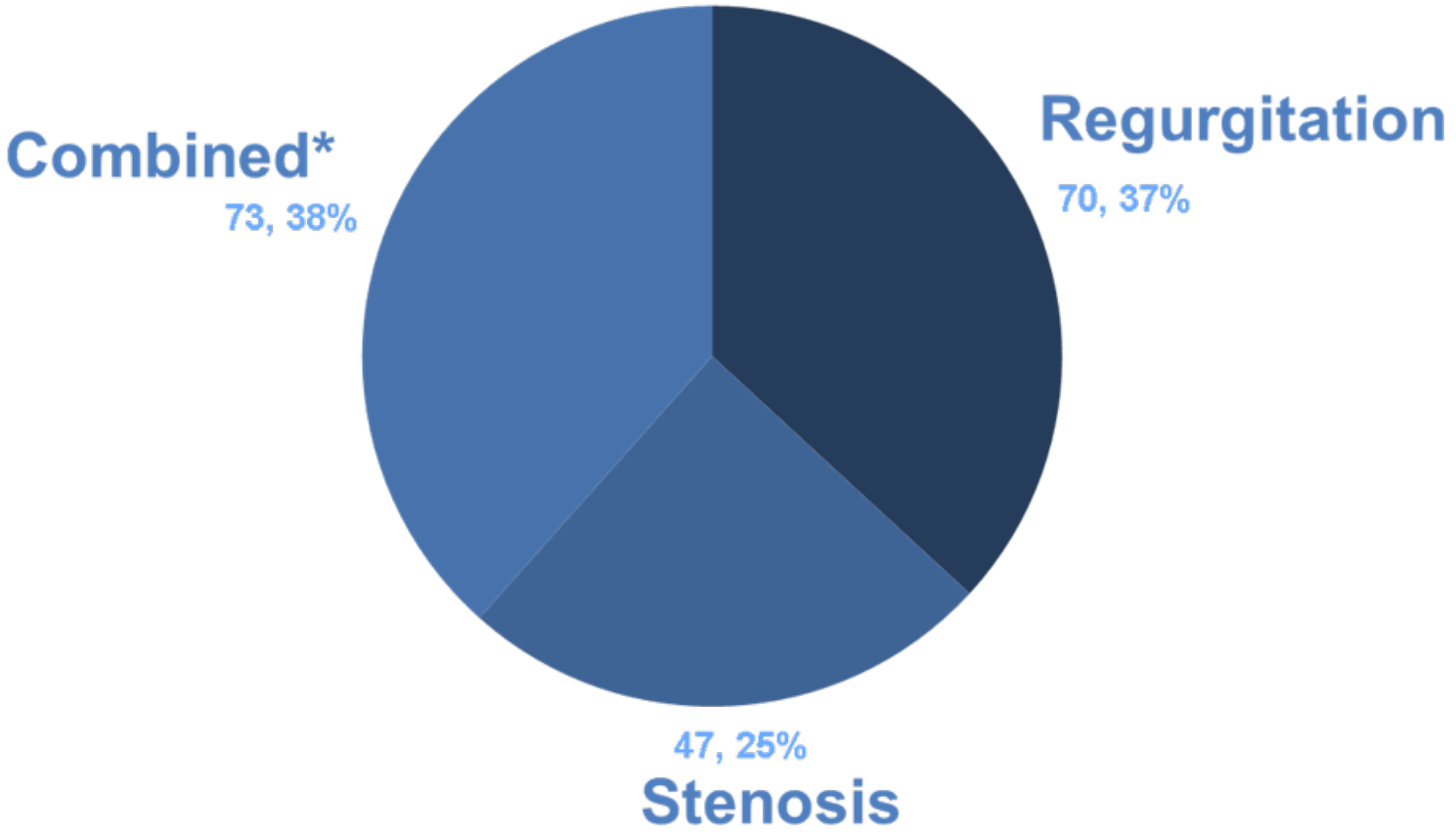
Valve-in-Valve International Data VIVID

Number of cases



- Median 9 years since last cardiac surgery (IQR 7-12).
- 1-5 previous cardiac surgeries per patients.
- 73% of patients had 1 previous cardiac surgery.

Mechanism of failure (n=190)



*At least a moderate degree of both stenosis and regurgitation

Baseline Echo Parameters (n=190)

	Regurgitation n=70	Combined n=73	Stenosis n=47
MV area (cm^2)	2.45 ± 0.92	1.45 ± 0.54	0.89 ± 0.33
MV max gradients (mmHg)	17.5 ± 8.7	26.9 ± 8.1	28.1 ± 8.8
MV mean gradients (mmHg)	6.7 ± 3	13 ± 4.6	15.3 ± 4.6
MR (≥2)	100%	100%	12.8%
Systolic pulmonary artery pressure (mmHg)	61 ± 16.5	67.2 ± 23.4	64.8 ± 21.6
LVEF (%)	46.7 ± 15.9	53.2 ± 12.6	53.2 ± 11.2

Surgical Mitral Bioprosthesis (n=157)

Type

Edwards Perimount	52.9%
Medtronic Mosaic	17.8%
Medtronic Hancock	9.6%
St Jude Epic	3.8%
Other	15.9%

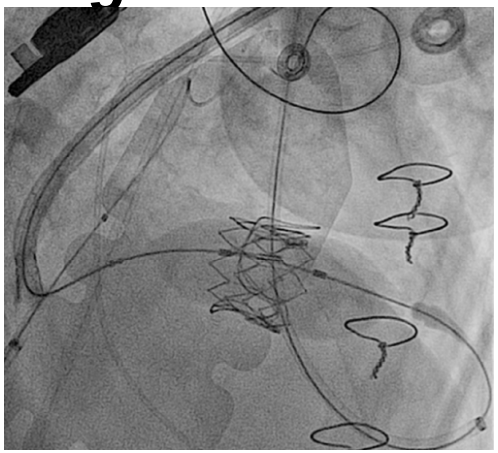
Label Size

23mm	1.3%
25 mm	10.8%
26mm	1.3%
27mm	43.3%
28mm	1.3%
29 mm	27.4%
31mm	11.5%
33mm	0.6%
Unknown	6%

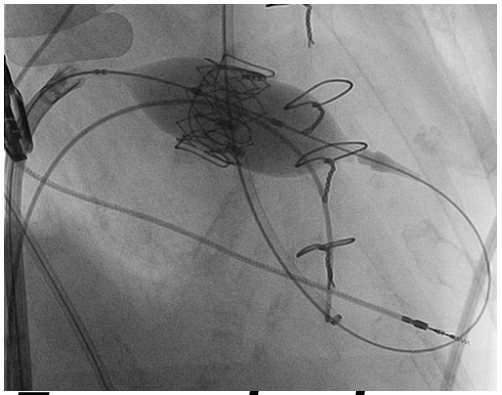
Valve-in-Valve International Data VIVID

Access during Mitral VIV / VIR procedures (n=190)

Jugular Vein



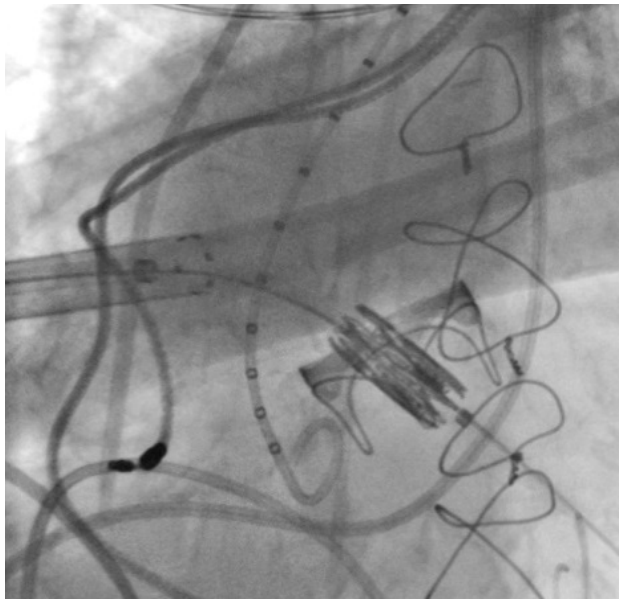
Total trans-atrial septum ***n=23 (12.1%)***



Femoral vein

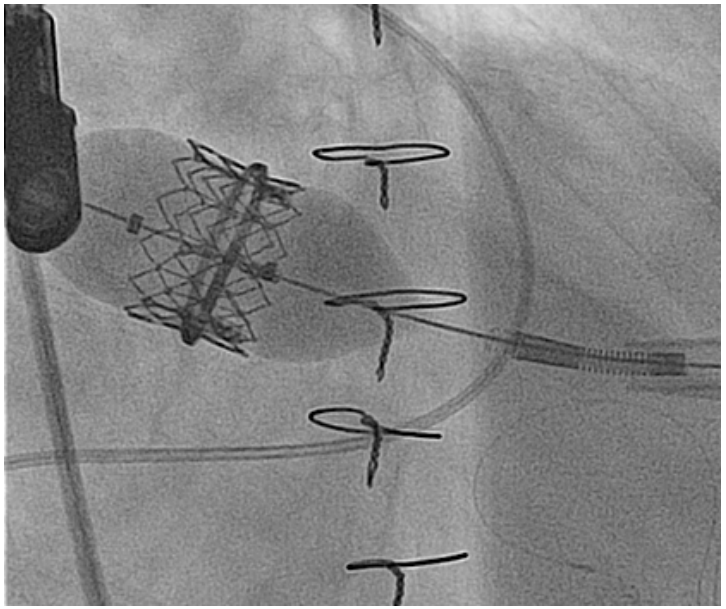
Direct left atrium

n=6 (3.2%)



Transapical

n=161 (84.7%)



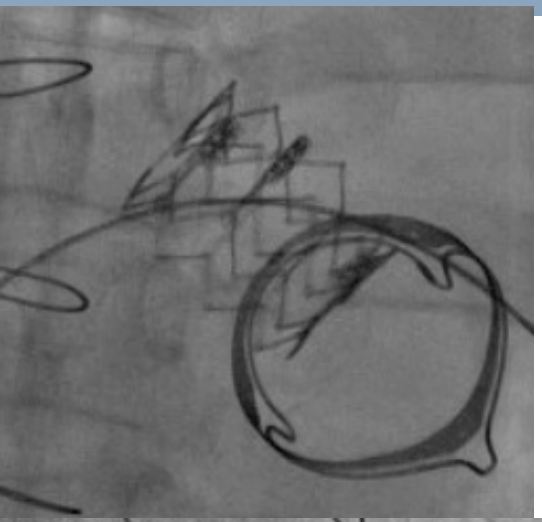
Procedural Characteristics

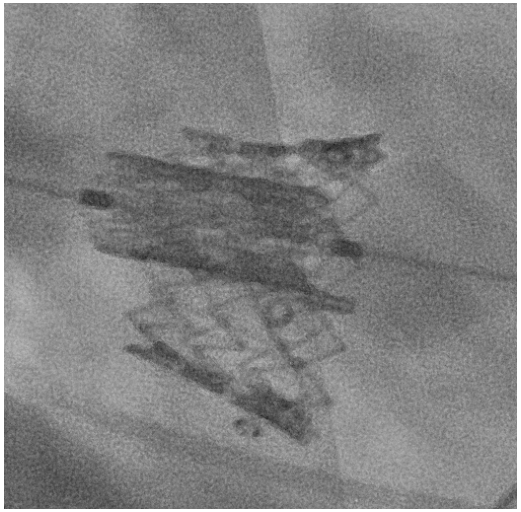
Valve-in-Valve International Data VIVID

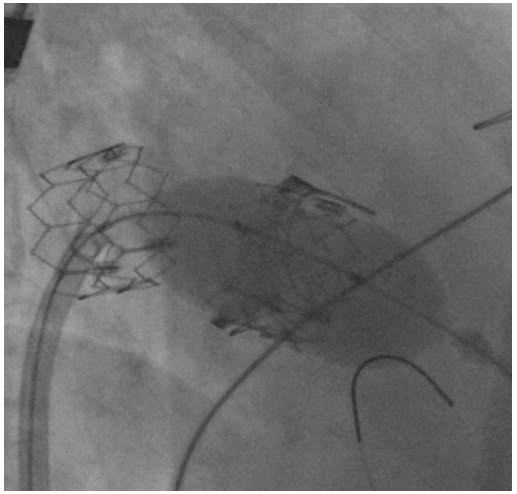
Mitral VIV / VIR Procedures (n=190)	
SAPIEN / SAPIEN XT Device*	**93.7%**
23 mm	**11.1%**
26 mm	**57.4%**
29 mm	**25.3%**
Inovare (Braile Biomedica)	**6.3%**
TEE	**97.9%**
General anesthesia	**96.8%**

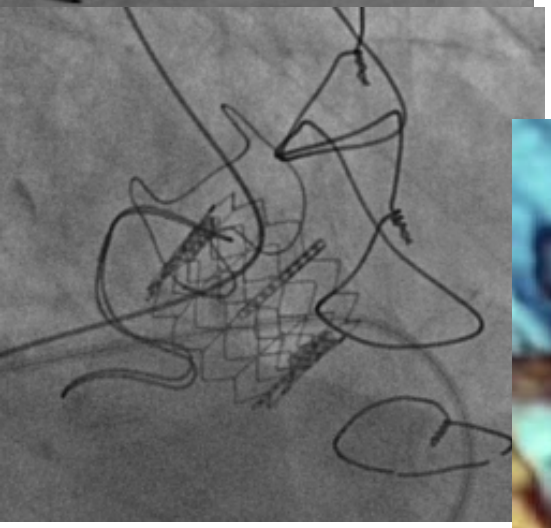
* In 71.3% of cases SAPIEN-XT device

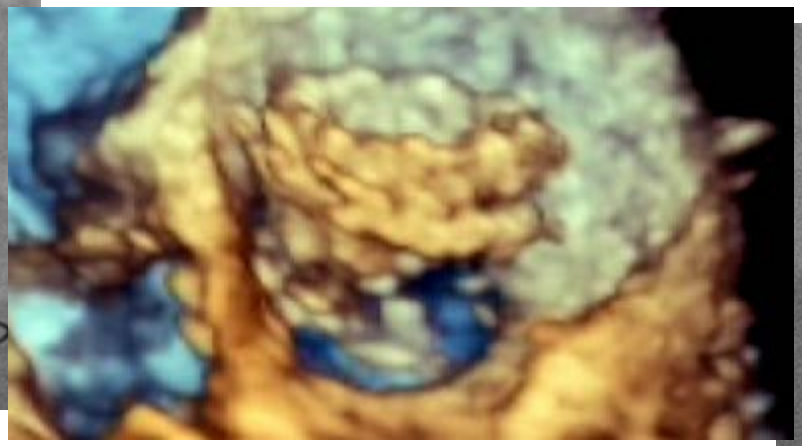
Mitral VinV Malpositioning

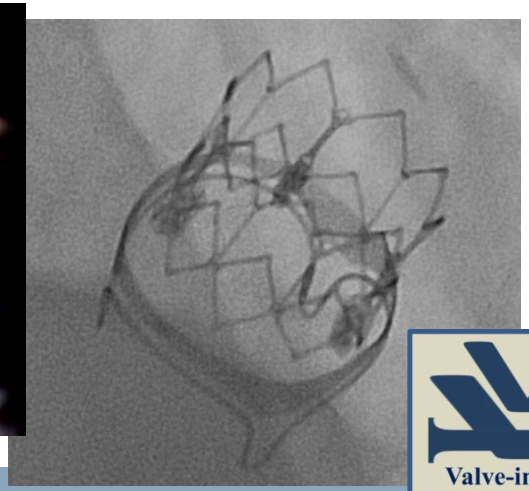








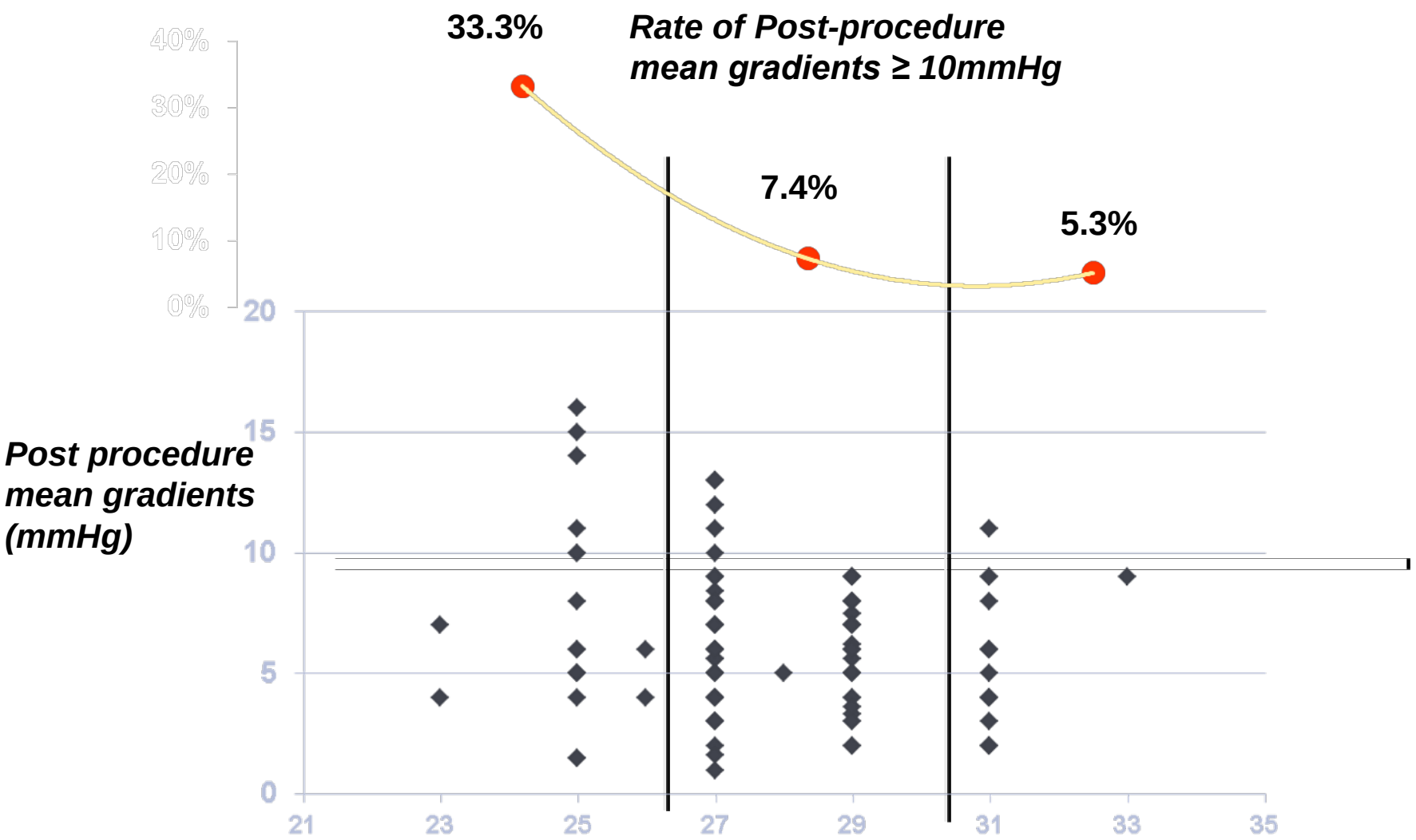




Cleveland Clinic

Valve-in-Valve International Data VIVID

Analysis of gradients after mitral VIV



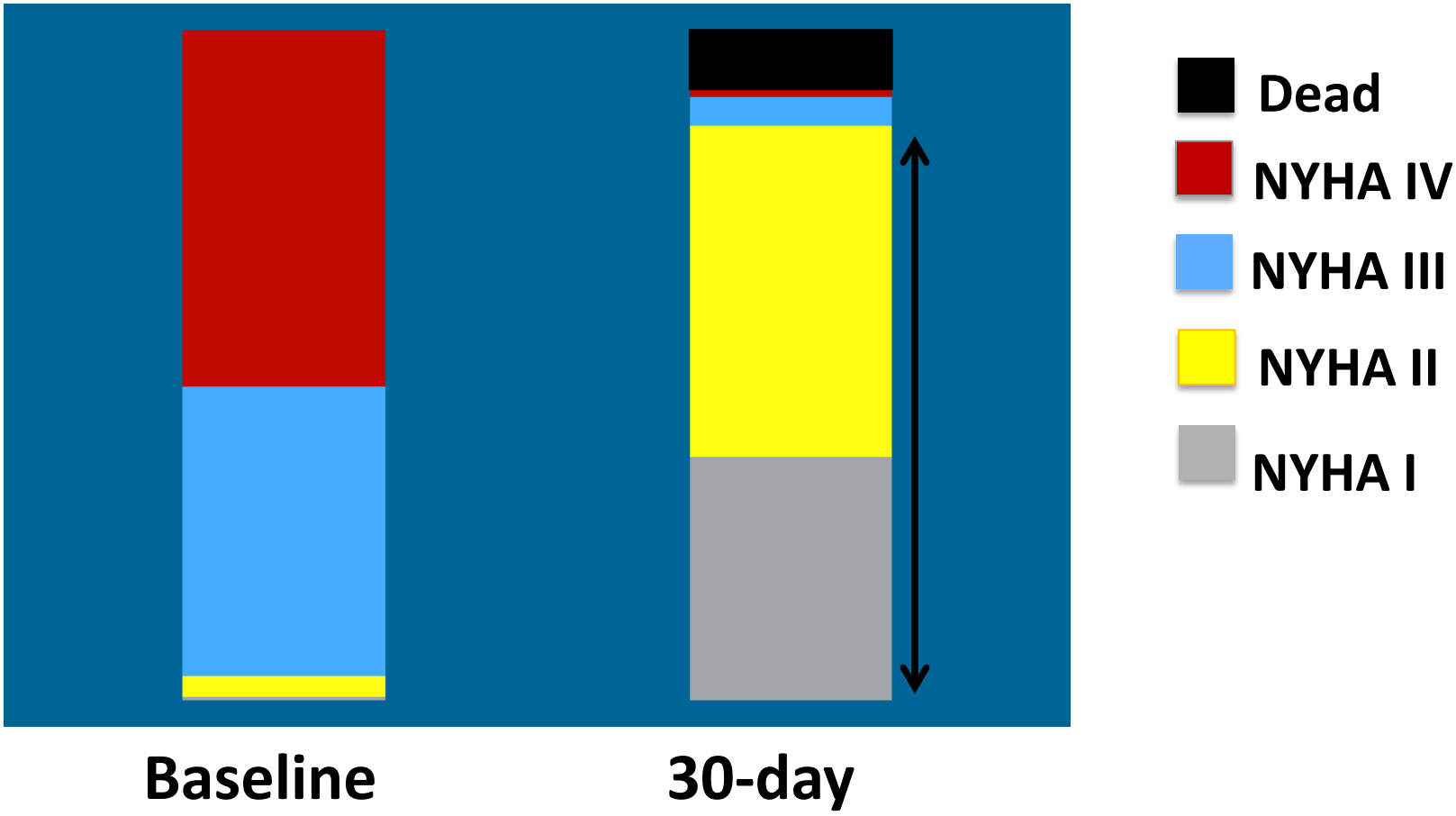
30-day Outcomes

Valve-in-Valve International Data VIVID

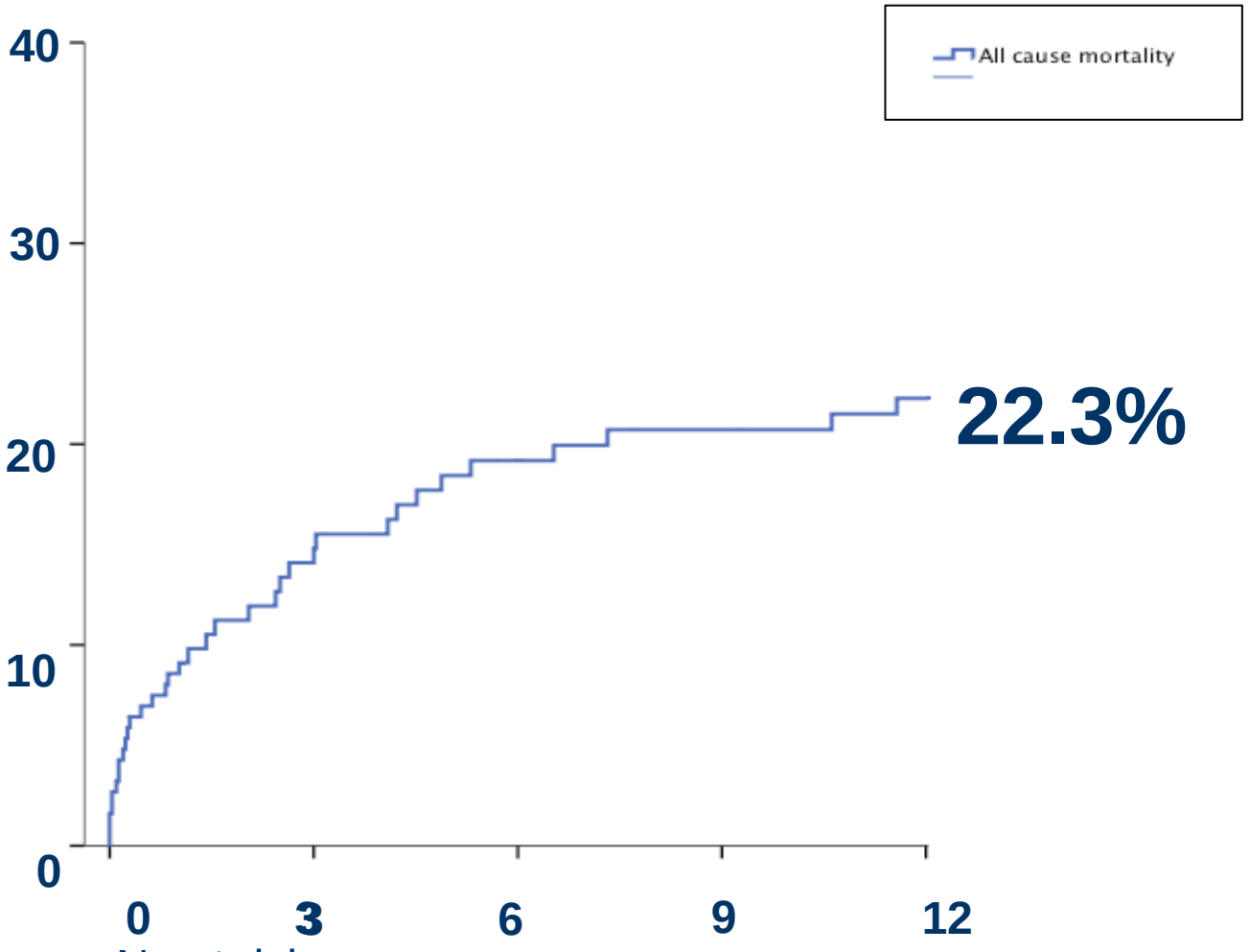
Mitral VIV / VIR Procedures (n=190)	
All-cause death	8.9%
Cardiovascular death	6.8%
Major stroke	2.2%
Major vascular complication	4.2%
Major/ life-threatening bleeding	13.2%
Acute kidney injury (≥type II)	18.6%
Median hospital stay (days)	8
Median ICU stay (days)	2

30-day Outcomes

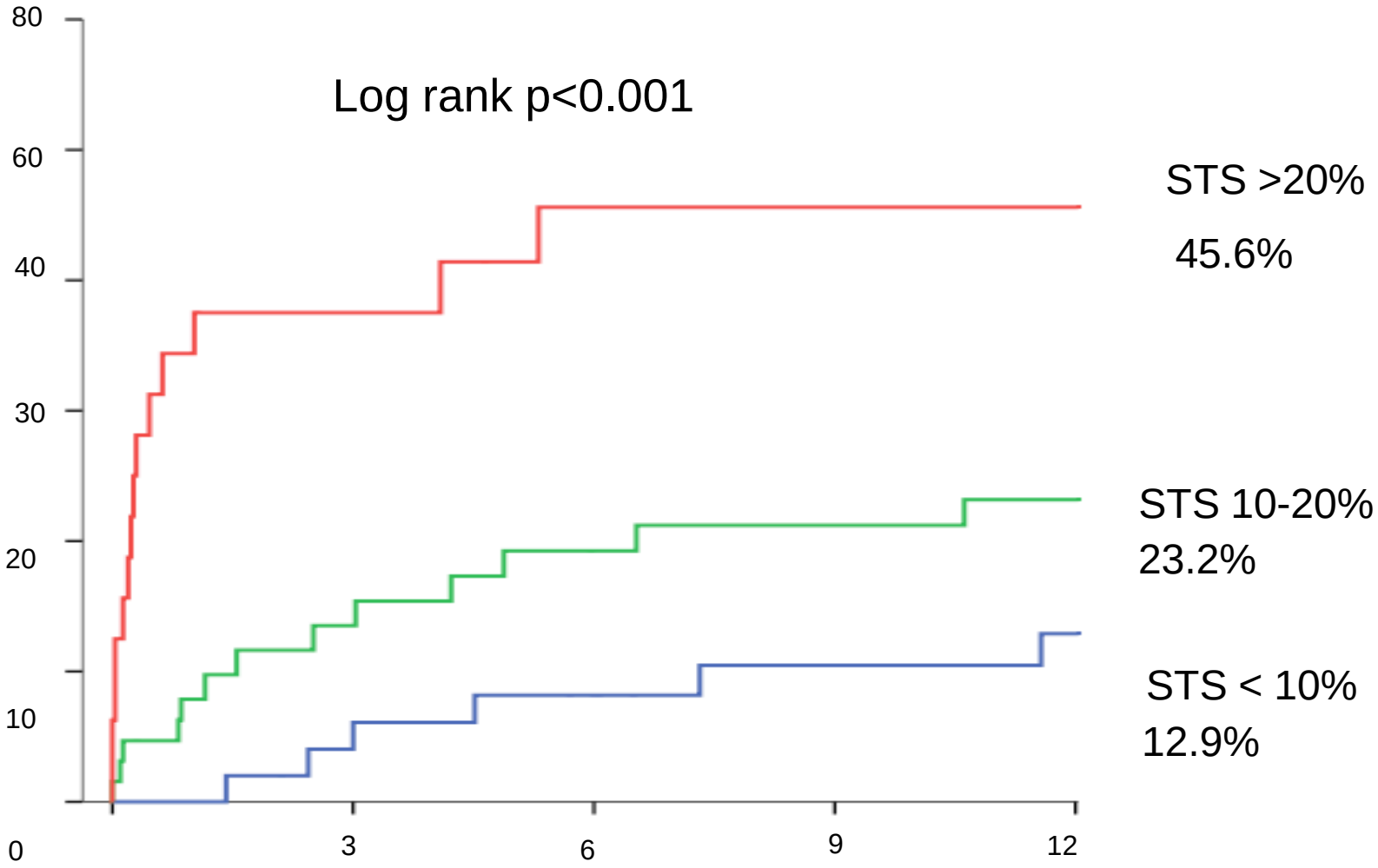
In the total group of patients: 85.8% had NYHA I/II post procedure



Mitral Valve-in-Valve / Valve-in-Ring: Kaplan-Meier Mortality Curve



Mitral Valve-in-Valve / Valve-in-Ring: Kaplan-Meier Mortality Curve



Predictors for 1-Year Mortality Post Mitral VIV/VIR

Variables	Hazard Ratio	95% Confidence Interval	P value
STS Score	1.04	1.02-1.06	<0.001
Renal Failure	2.37	1.06-5.28	0.035

Included in the analysis and found non-significant:
Patient age during VIV procedure, gender, mechanism of failure, label size, LVEF, pulmonary systolic pressure, baseline renal failure, access used and device used during VIV procedure.

Conclusions

- Mitral VIV / VIR procedures were performed in very high-risk patients, using various access and occasionally combined with another structural procedure.

- Most of these procedures were clinically effective; 1-year results are comparable to native aortic valve transcatheter implantation.

- Safety and efficacy concerns include relatively high in-hospital mortality, device malposition, sporadic cases with elevated LVOT gradient and elevated post procedural gradients in small surgical valves.