

Mechanism, Timing and Prevention of Stroke

Jian Ye, MD, FRCSC

Clinical Professor of Surgery

**St. Paul's Hospital and Vancouver General Hospital
University of British Columbia, Vancouver, Canada**

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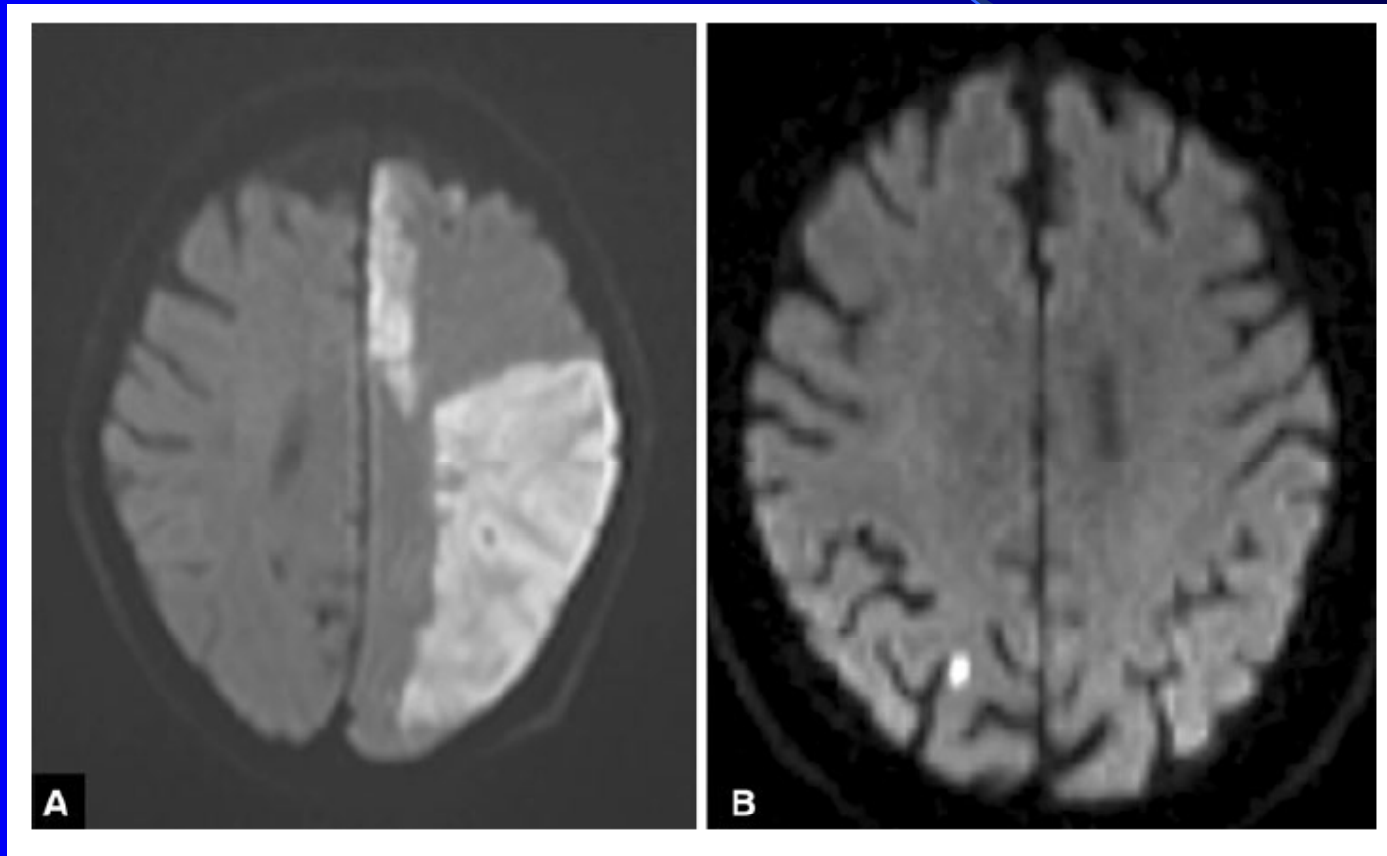


Centre for
Heart Valve Innovation
St. Paul's Hospital, Vancouver



HEART CENTRE
AT ST. PAUL'S HOSPITAL

Incidence of Stroke



PARTNER – Inoperable Patients

Table 2. Clinical Outcomes at 30 Days and 1 Year.*

Outcome	30 Days			1 Year		
	TAVI (N= 179) <i>no. of patients (%)</i>	Standard Therapy (N= 179) <i>no. of patients (%)</i>	P Value [†]	TAVI (N= 179) <i>no. of patients (%)</i>	Standard Therapy (N= 179) <i>no. of patients (%)</i>	P Value [†]
Death						
From any cause	9 (5.0)	5 (2.8)	0.41	55 (30.7)	89 (49.7)	<0.001
From cardiovascular cause [‡]	8 (4.5)	3 (1.7)	0.22	35 (19.6)	75 (41.9)	<0.001
Repeat hospitalization [§]	10 (5.6)	18 (10.1)	0.17	40 (22.3)	79 (44.1)	<0.001
Death from any cause or repeat hospitalization [§]	19 (10.6)	22 (12.3)	0.74	76 (42.5)	126 (70.4)	<0.001
Stroke or TIA						
All	12 (6.7)	3 (1.7)	0.03	19 (10.6)	8 (4.5)	0.04
TIA	0	0	—	1 (0.6)	0	1.00
Stroke						
Minor	3 (1.7)	1 (0.6)	0.62	4 (2.2)	1 (0.6)	0.37
Major	9 (5.0)	2 (1.1)	0.06	14 (7.8)	7 (3.9)	0.18
Death from any cause or major stroke	15 (8.4)	7 (3.9)	0.12	59 (33.0)	90 (50.3)	0.001
Mycardial infarction						

PARTNER – High Risk Patients

Table 2. Clinical Outcomes at 30 Days and 1 Year in the Intention-to-Treat Population.*

Outcome	30 Days			1 Year		
	Transcatheter Replacement (N=348) <i>no. of patients (%)</i>	Surgical Replacement (N=351) <i>no. of patients (%)</i>	P Value	Transcatheter Replacement (N=348) <i>no. of patients (%)</i>	Surgical Replacement (N=351) <i>no. of patients (%)</i>	P Value
Death						
From any cause	12 (3.4)	22 (6.5)	0.07	84 (24.2)	89 (26.8)	0.44
From cardiac causes	11 (3.2)	10 (3.0)	0.90	47 (14.3)	40 (13.0)	0.63
Repeat hospitalization	15 (4.4)	12 (3.7)	0.64	58 (18.2)	45 (15.5)	0.38
Death or repeat hospitalization	25 (7.2)	33 (9.7)	0.24	120 (34.6)	119 (35.9)	0.73
Stroke or transient ischemic attack						
Either	19 (5.5)	8 (2.4)	0.04	27 (8.3)	13 (4.3)	0.04
Transient ischemic attack	3 (0.9)	1 (0.3)	0.33	7 (2.3)	4 (1.5)	0.47
Stroke						
Minor	3 (0.9)	1 (0.3)	0.34	3 (0.9)	2 (0.7)	0.84
Major	13 (3.8)	7 (2.1)	0.20	17 (5.1)	8 (2.4)	0.07
Death from any cause or major stroke	24 (6.9)	28 (8.2)	0.52	92 (26.5)	93 (28.0)	0.68

Incidences of Stroke

Table 1 Overview of selected, referenced studies

	<i>n</i>	TF/TA (%)	ES/MCV (%)	Procedural major stroke (%)	30-Day major stroke (%)	1-Year major stroke (%)
Randomized controlled clinical trials						
Leon [3]/Makkar [14]	179	100/0	100/0	1.7	5.0	7.8
Smith [4]/Kodali [13]/Miller [23]	348	70/30	100/0	n.g.	3.8	5.1
Multicenter registries						
Gilard [17]	3,195	74.6/17.8	66.9/33.1	n.g.	1.9	2.2
Nombela-Franco [27]	1,061	68.4/30.3	64/36	1.6 (within 24 h)	2.8	4.9 %
Tamburino [29]	663	90.3/0	0/100	n.g. stroke: 1.2	n.g. stroke: n.g.	n.g. stroke: 2.5 %
Single-center registries						
Tay [24]	253	66/34	98/2	n.g. CeV: 4.3 (within 24 h)	n.g. CeV rate: 6.7	n.g. CeV rate: 8.7
Stortecky [25]	389	79/20	42/58	2.1 (within 24 h)	3.1	n.g.
Nuis [26]	214	97/0	0/100	1.9 (within 24 h)	2.8	n.g.
Amat-Santos [40]	138	27.5/72.5	100/0	n.g.	3.6	no additional major stroke
Meta-analyses						
Eggebrecht [15]*	10,037	66.5 ± 29.9 30.8 ± 40.0	57.2 ± 42.4 41.6 ± 42.8	1.4 ± 1.5	2.9 ± 1.8	5.2 ± 3.4

n number, *TF* transfemoral, *TA* transapical, *ES* Edwards SAPIEN, *MVC* Medtronic CoreValve, *n.g.* not given, *CeV* cerebrovascular events

* A table overviewing all 53 studies included in this meta-analysis can be found in the original publication

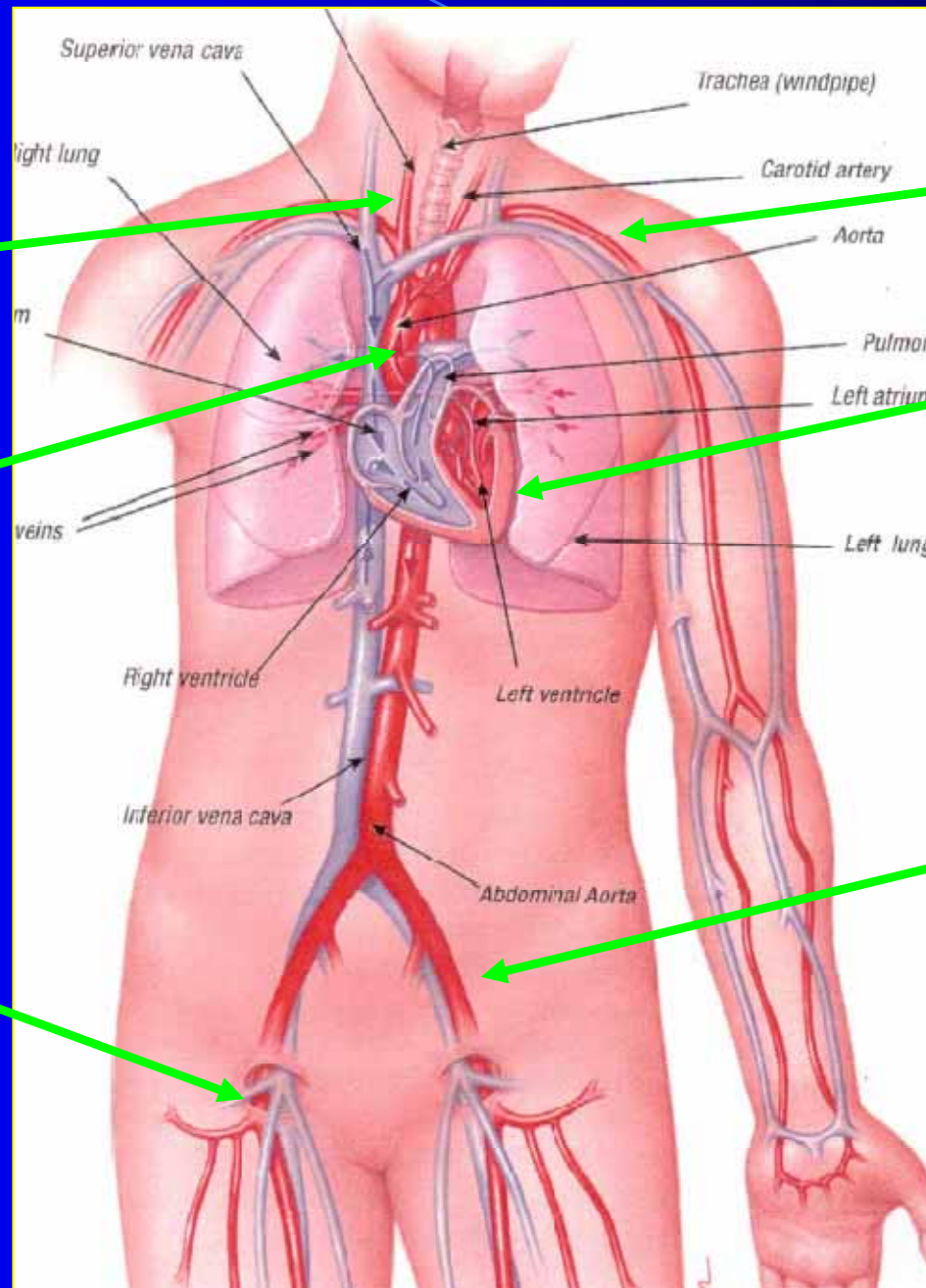
Positive Imaging Findings

Table 2 Overview of current neuroimaging studies with TAVI

	<i>n</i>	Access	Valve type	Number of new lesions on DW-MRI	Incidence of new DW-MRI lesions	Stroke rate	Neurological impairment (including stroke)	Neurological assessment and stroke definition
Kahlert et al. [5]	32	TF	ES (<i>n</i> = 22) MCV (<i>n</i> = 10)	ES: 89 lesions in 22 pts. MCV: 26 lesions in 10 pts. Overall: 115 lesions in 32 pts	ES: 86 % MCV: 80 % Overall: 84 %	ES: 0 % MCV: 0 % Overall: 0 %	none	NIHSS, MMSE, mRS stroke: a neurological deficit lasting >24 h
Ghanem et al. [6]	22	TF	MCV	75 lesions in 16 pts.	73 %	NA	Transient: 2 pts. persistent: 1 pt.	NIHSS stroke: not defined
Fairbairn et al. [10]	31	TF	MCV	131 lesions in 24 pts.	77 %	6.0 %	Transient: 0 pts. persistent: 2 pts.	NIHSS stroke: a neurological deficit lasting >24 h
Arnold et al. [7]	25	TA	ES	Number of new lesions not given	68 %	4.0 %	Transient: 4 pts. persistent: 1 pt.	Clinical assessment stroke: not defined
Rodés-Cabau et al. [8]	60	TF (<i>n</i> = 29) TA (<i>n</i> = 31)	ES	TF: 83 lesions in 19 pts. TA: 168 lesions in 22 pts. Overall: 251 lesions in 41 pts	TF: 66 % TA: 71 % Overall: 68 %	TF: 3.4 % TA: 3.2 % Overall: 3.3 %	TF/TA transient: 0/0 pts. persistent: 1/1 pt.	NIHSS, MMSE stroke: not defined
Astarcı et al. [9]	35	TF (<i>n</i> = 21) TA (<i>n</i> = 14)	ES	TF: 114 lesions in 19 pts. TA: 86 lesions in 13 pts. Overall: 200 lesions in 32 pts	TF: 90 % TA: 93 % Overall: 91 %	TF: 0 % TA: 0 % Overall: 0 %	None	NIHSS stroke: not defined

n number, *DW-MRI* diffusion-weighted magnetic resonance imaging, *TF* transfemoral, *TA* transapical, *ES* Edwards SAPIEN, *MVC* Medtronic CoreValve, *NIHSS* National Institute of Health Stroke Scale, *MMSE* mini-mental state examination, *mRS* modified Rankin scale, *NA* not applicable

Approaches for TAVI



Carotid A.

Aorta

Subclavian A.

Apex or heart

Femoral A.

Iliac A.

Risk of stroke after transcatheter aortic valve implantation (TAVI): a meta-analysis of 10,037 published patients

Holger Eggebrecht¹, MD, FESC; Axel Schmermund¹, MD, FESC; Thomas Voigtländer¹, MD, FESC; Philipp Kahlert², MD; Raimund Erbel², MD, FESC, FACC, FAHA; Rajendra H. Mehta³, MD, MS

n			Log. EuroScore	Stroke / TIA 30-days
3236	TF	MCV	22 %	3.1 ±2.2 %
1733	TF	ES	26 %	4.2 ±2.2 %
2482	TA	ES	29 %	2.7 ±1.4 %

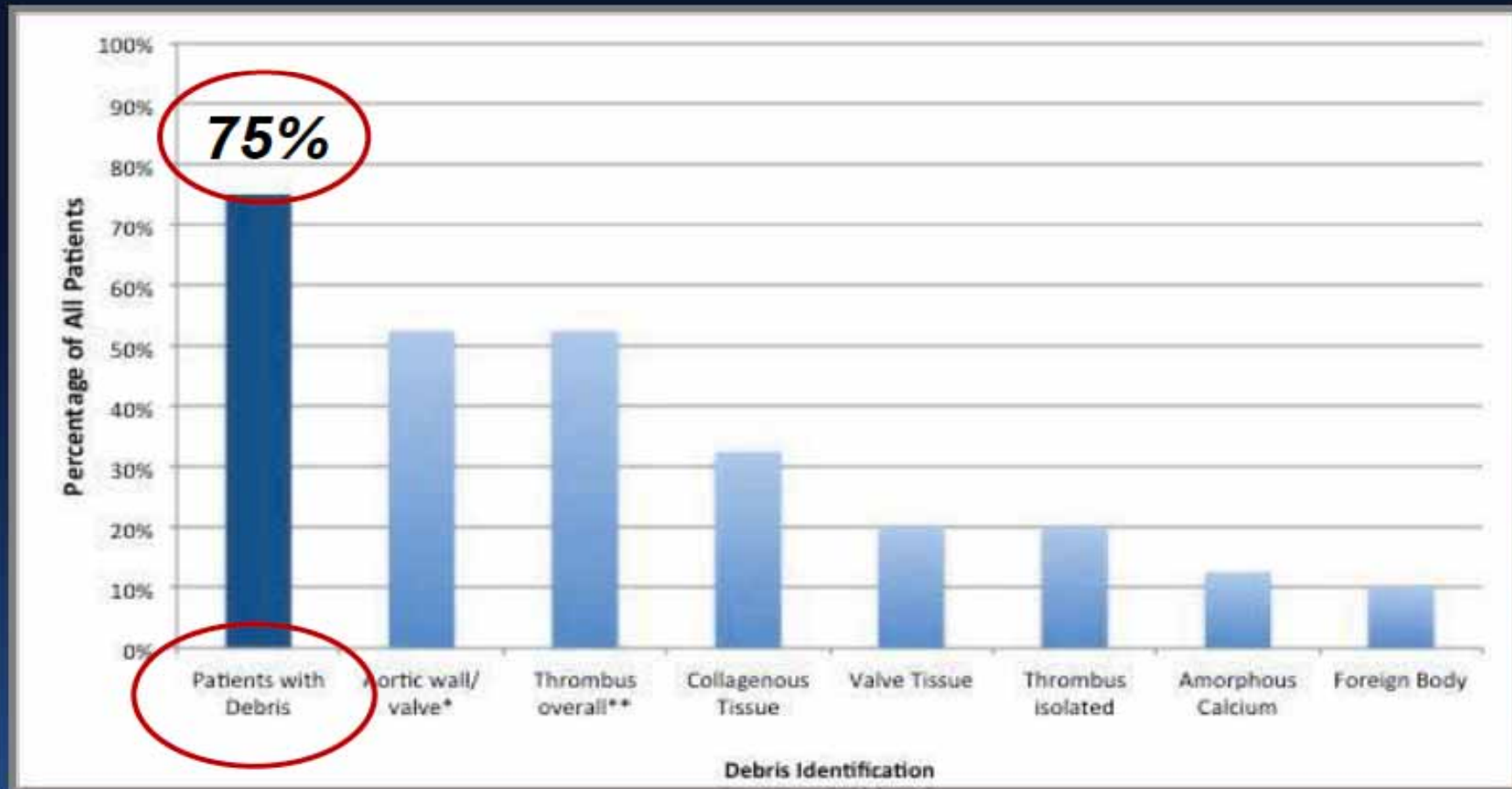
Eurointervention 2012;8:129-38

Mechanism of Stroke

Potential Causes of Stroke

Embolization	Hemorrhage	Hypoperfusion
Calcific AV	Severe hypertension	Prolonged hypotension
- BAV	Anticoagulation	Critical carotid stenosis
- Multiple positioning of THV	Cerebrovascular abnormalities	
- Valve deployment		
- Redilation		
- Valve embolization		
Diseased aorta		
- Instrumentation in ascending aorta/arch		
- Valve embolized into aorta		
Clots		
- A. fib.		
- THV		
- Guide wires and delivery system		
Air emboli		

Embololic Debris Evidence



Van Mieghem, Circulation May 2013 ISSN 1524-4539

Adapted from Eberhard Grube, TVT 2013

Timing of Stroke

The background is a dark blue gradient. A thin, light blue curved line starts from the top left and arcs towards the right. A larger, semi-transparent blue wedge shape is positioned on the right side, pointing towards the center of the slide.

A High-Risk Period for Cerebrovascular Events Exists After Transcatheter Aortic Valve Implantation

Edgar L. W. Tay, MD, Ronen Gurvitch, MD, Namal Wijesinghe, MD, Fabian Nielispach, MD, David Wood, MD, Anson Cheung, MD, Jian Ye, MD, Samuel V. Lichtenstein, MD, Ronald Carere, MD, Christopher Thompson, MD, John G. Webb, MD

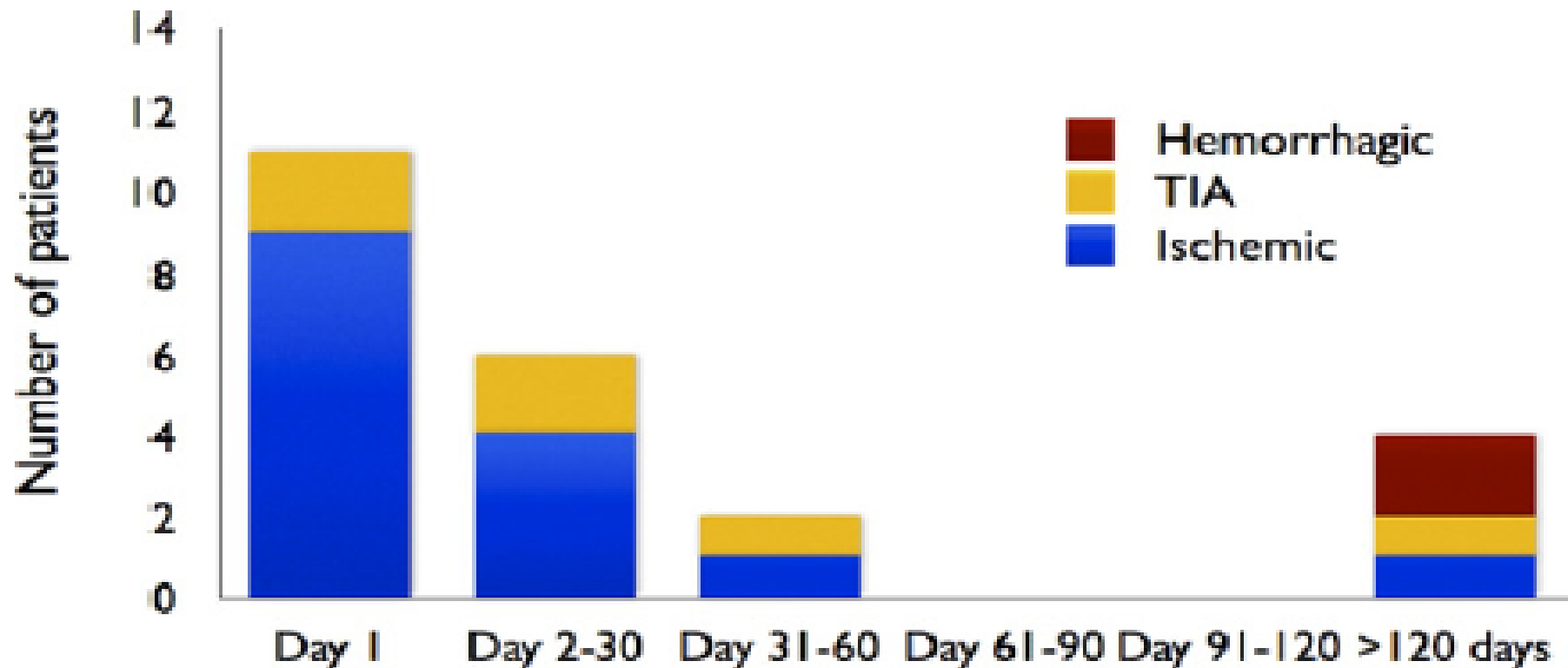
British Columbia, Vancouver, Canada

Results A total of 253 patients were assessed. Median age was 85 years. The median Society of Thoracic Surgeons score was 8.1% (interquartile range [IQR]: 5.5% to 12.0%). Risk factors included smoking (47%), hypertension (70%), dyslipidemia (66%), and diabetes mellitus (25%). Twenty-three percent had known cerebrovascular disease and 39% had atrial fibrillation. Median follow-up was 455 days (IQR: 160 to 912 days) at which time 23 patients experienced a CeV event. The incidence was highest in the first 24 h but remained high for 2 months. In-hospital mortality rate after a CeV event was 21%. A prior history of CeV disease was an independent predictor of an event (hazard ratio: 4.23, 95% CI: 1.60 to 11.11, $p = 0.004$).

Conclusions The incidence of CeV events is highest within 24 h of TAVI, but this risk may remain elevated for up to 2 months. A prior history of cerebrovascular disease is an independent predictor. This may have implications for patient selection and antithrombotic strategies. (J Am Coll Cardiol Intv 2011;4:1290–7) © 2011 by the American College of Cardiology Foundation

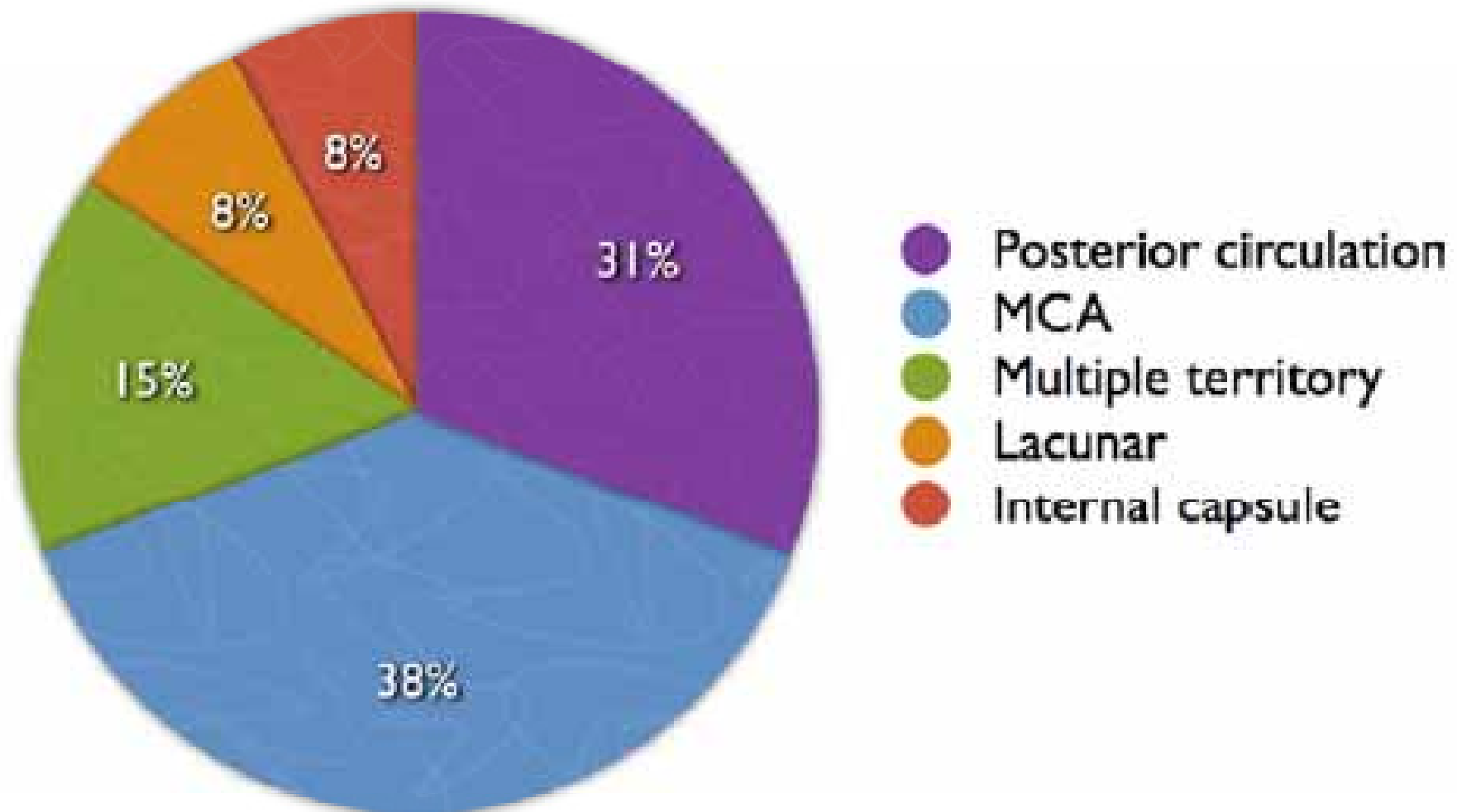
1/2005-11/2009

Timing of CVA after TAVI



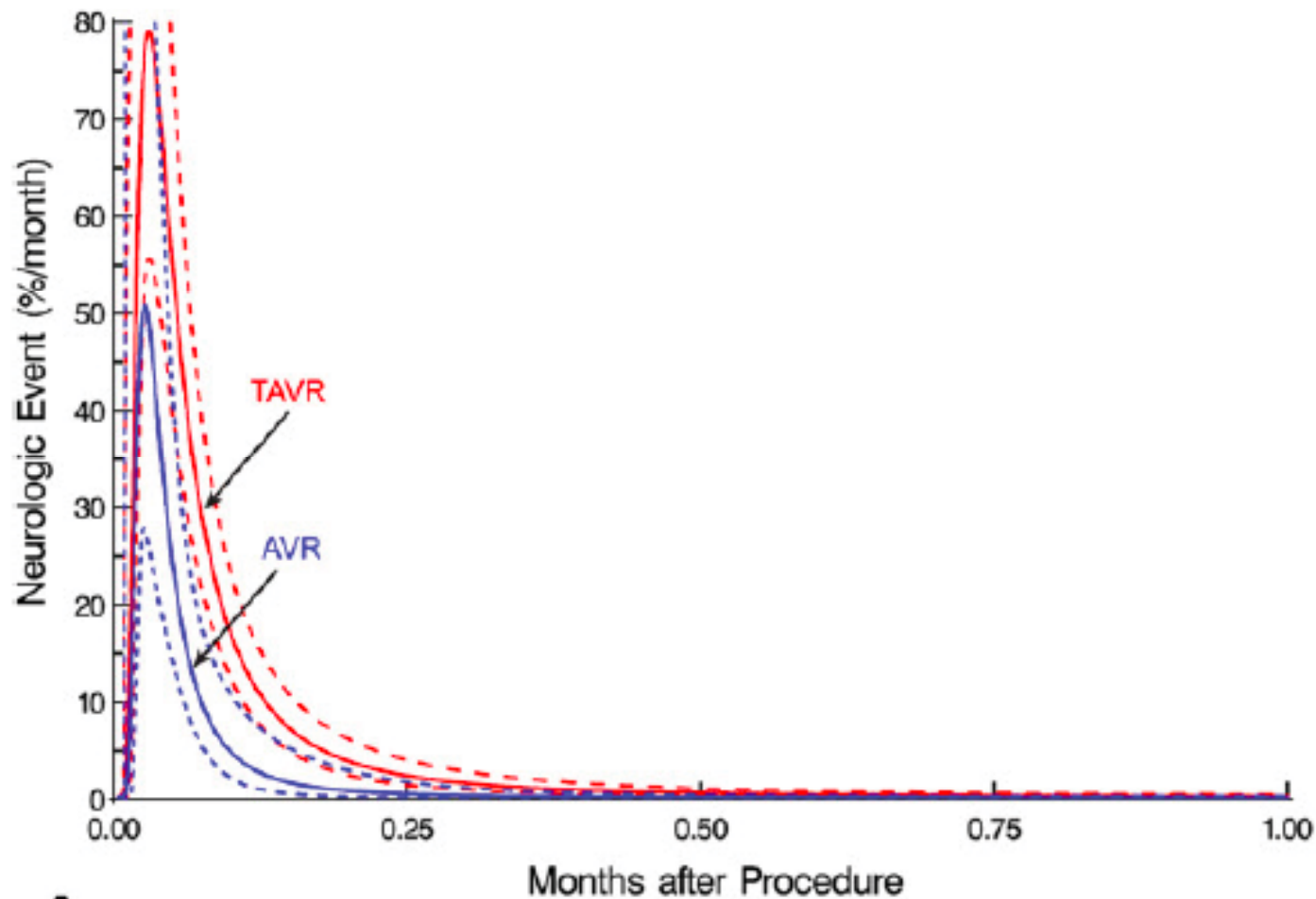
	Day 1	Day 2-30	Day 31-60	Day 61-90	Day 91-120	>120 days
Lost to follow-up	0	0	4	4	5	10
Dead	6	23	28	32	36	45
Alive	247	230	221	217	212	198

Distribution of CVA



Transcatheter (TAVR) versus surgical (AVR) aortic valve replacement: Occurrence, hazard, risk factors, and consequences of neurologic events in the PARTNER trial

Conclusions: After either treatment, there were 2 distinct hazard phases for neurologic events that were driven by different risk factors. Neurologic complications occurred more frequently after TAVR than AVR early, but thereafter the risk was influenced by patient- and disease-related factors. (J Thorac Cardiovasc Surg 2012;143:832-43)

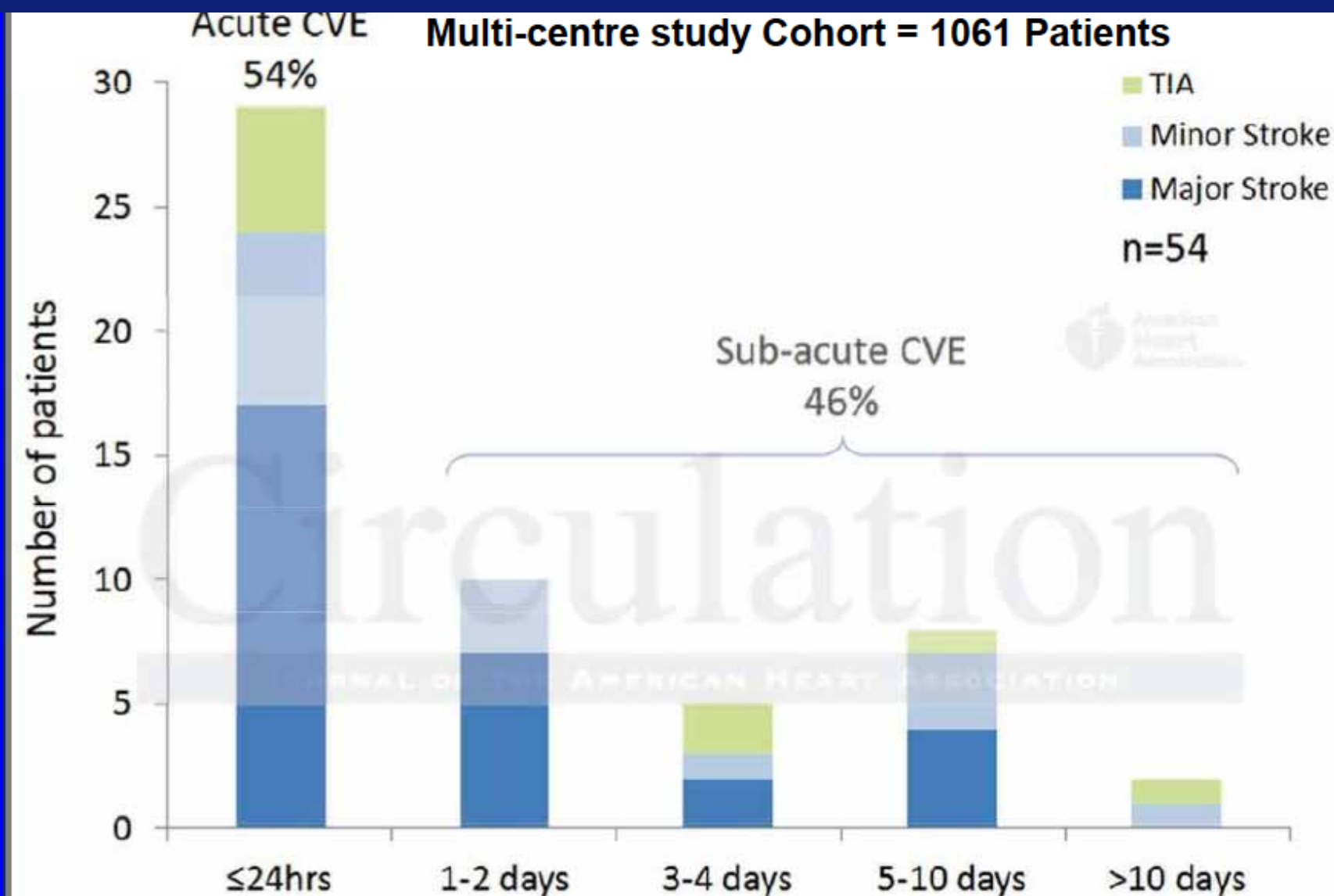


A

Timing, Predictive Factors and Prognostic Value of Cerebrovascular Events in a Large Cohort of Patients Undergoing Transcatheter Aortic Valve Implantation

Luis Nombela-Franco, John G. Webb, Peter de Jaegere, Stefan Toggweiler, Rutger-Jan Nuis, Antonio E. Dager, Ignacio J. Amat-Santos, Anson Cheung, Jian Ye, Ronald K. Binder, Robert M. van der Boon, Nicolas Van Mieghem, Luis M. Benitez, Sergio Pérez, Javier Lopez, José A. San Roman, Daniel Doyle, Robert DeLarochelière, Marina Urena, Jonathon Leipsic, Eric Dumont and Josep Rodés-Cabau

Circulation. published online November 13, 2012;



Timing of Stroke

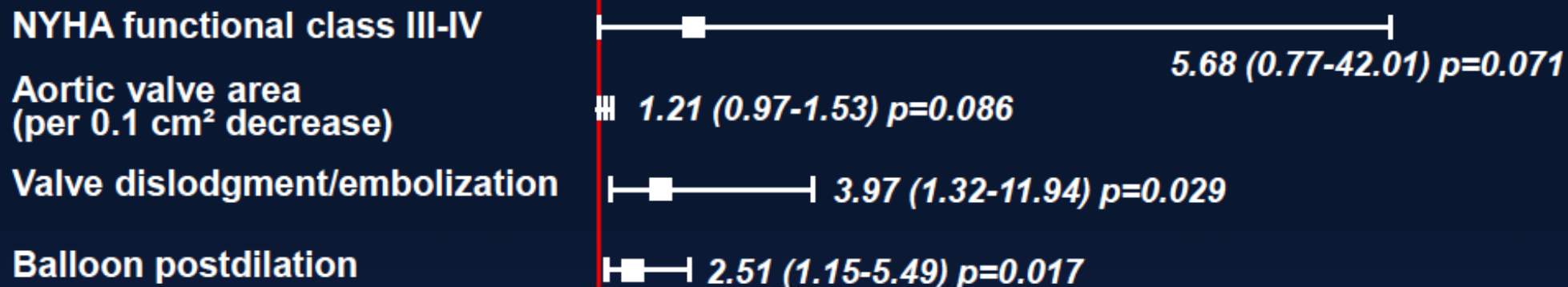
	24-48 hours/30day	30 days/1year
PARTNER inoperable patients	45% (30 days)	65% (1 year)
PARTNER high risk patients	67% (30 days)	75% (1 year)
Vancouver (Tay et al)	58% (60 days)	87% (2 month) (455days)
Stortecky et al	74% (30 days)	
Nuis et al	42% (30 days)	68% (13 months)
Nombela-Franco	54% (30 days)	

The image features a solid blue background with a subtle gradient. A thin, light blue curved line starts from the top left and arcs towards the right. On the right side, there is a wedge-shaped cutout that tapers towards the top right corner, revealing a black background underneath. The word "Predictors" is centered in the blue area.

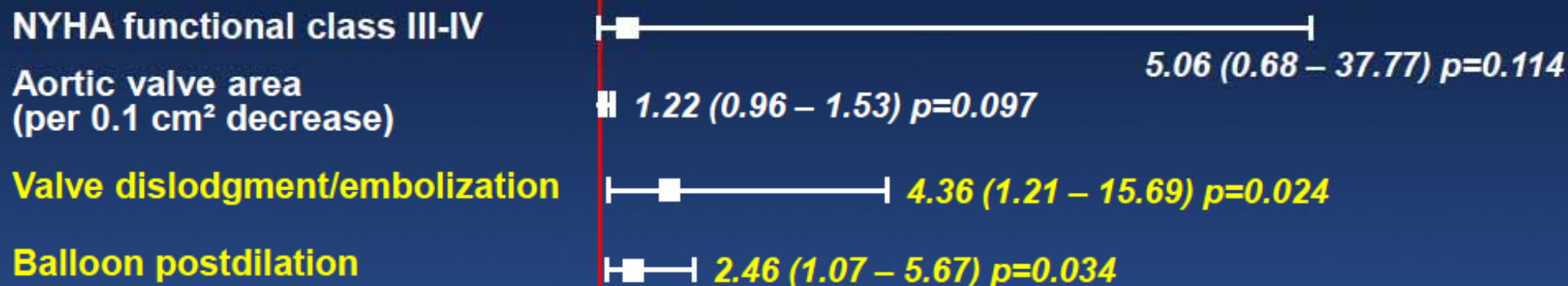
Predictors

Predictors of Acute Cerebrovascular Events (≤24hrs)

UNIVARIATE



MULTIVARIATE



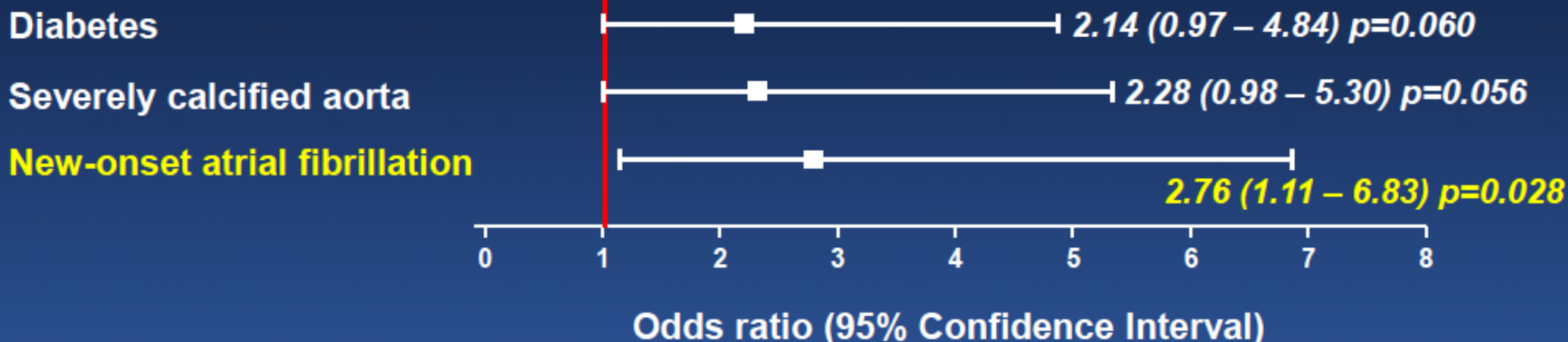
Odds ratio (95% Confidence Interval)

Predictors of Acute Cerebrovascular Events (1-30 days)

UNIVARIATE



MULTIVARIATE

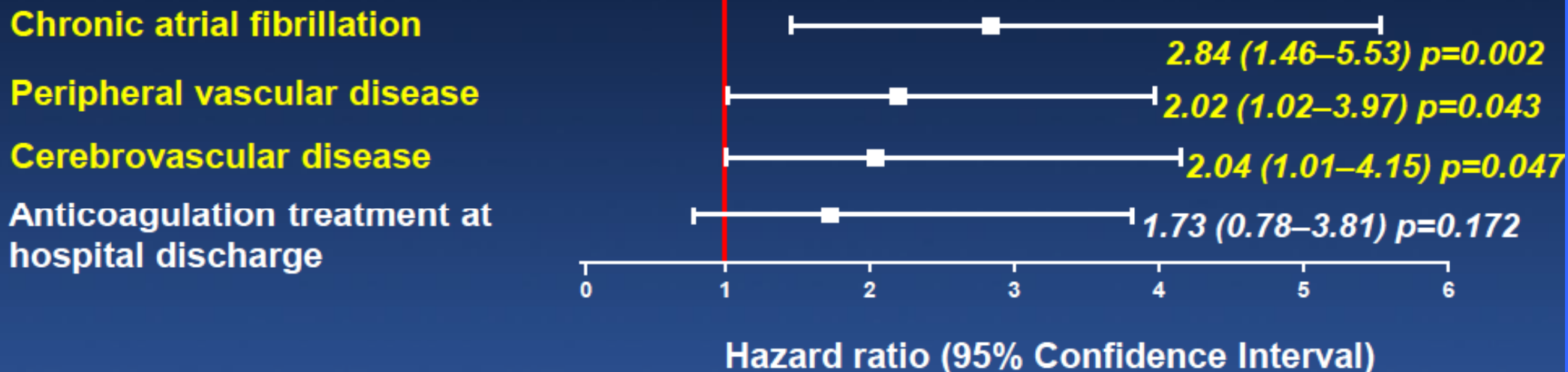


Predictors of late Cerebrovascular Events (>30 days)

UNIVARIATE



MULTIVARIATE



Predictors of Stroke

Early stroke (within 30 days)	Late stroke (after 30 days)
Smaller AVA	Unsuitability for TF
Higher NYHA class	Chronic A. Fib.
History of stroke	PVD
Carotid artery stenosis?	Prior cerebrovascular disease
Severe AI at baseline	
New-onset A. fib.	
COPD	
BMI <25kg/m	
Multiple device implantation attempts	
Dislodgement/redilation	
Aortic arch atheroma burden	
Etiology – cerebral embolization	Etiology - thromboembolization

Prevention of Stroke

Early stroke	Late stroke
New devices with less traumatic properties	Timely detecting new A. Fib.
Avoiding or minimizing aortic arch instrumentation	Anticoagulation
Omission of BAV	
Avoiding multiple positioning of THV	
Minimizing redilation	
No carotid artery compression	
Cerebral protection devices	

Cerebral Embolic Protection

Embrella™ Deflector	TriGuard™ Cerebral Deflector	Claret Montage 2™ Filter	EMBO-X Intra- aortic Filter
Deflection	Deflection	Capture	Capture
2-3 arch vessel coverage	3 arch vessel coverage	2 arch vessel coverage	Aortic arch coverage
Radial artery	Radial artery	Femoral artery	Ascending aorta
6Fr sheath	9Fr sheath	6Fr sheath	14Fr sheath

