

EuroValve
April 26-27, 2018



TAVI deterioration : mechanisms, treatment, prevention

J. Kefer, MD, PhD, FESC

Interventional Cardiology

Head of the cardiac catheterization laboratory

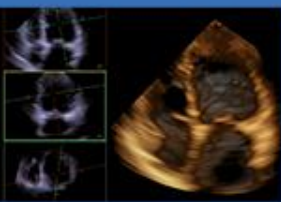
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Faculty disclosure

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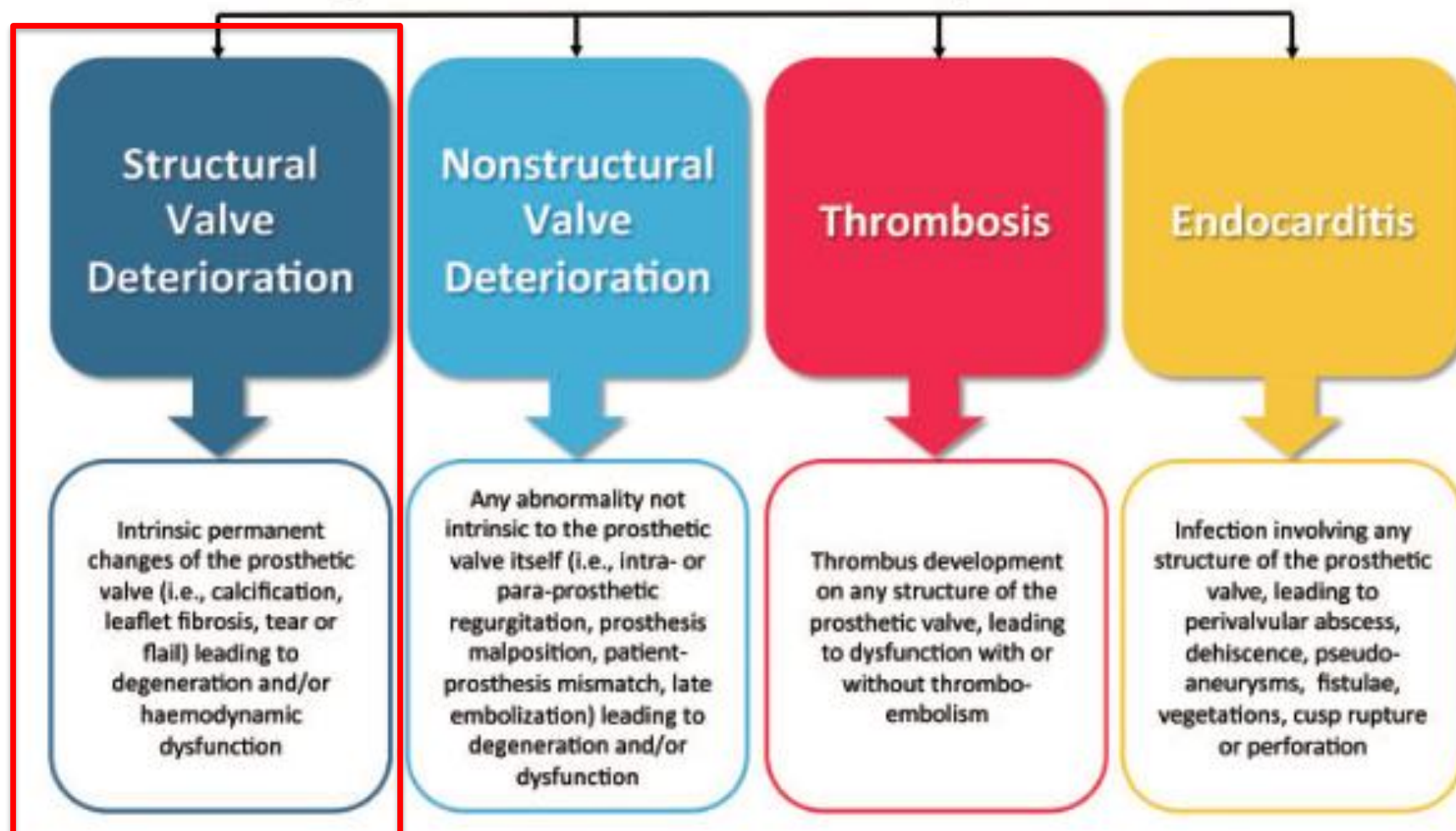
European Heart Journal (2017) **38**, 3382–3390

doi:10.1093/eurheartj/ehx303

SPECIAL ARTICLE

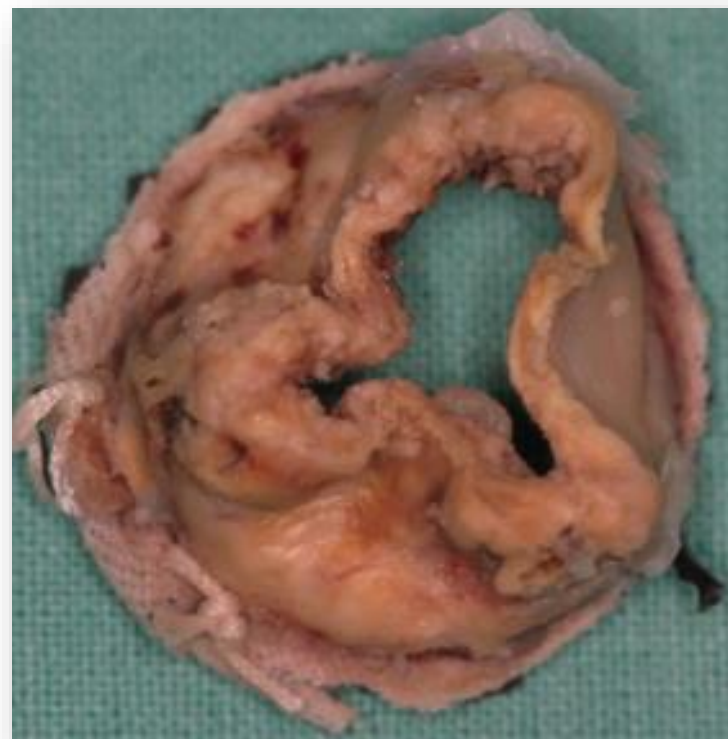
Valvular heart disease

Bioprosthetic Valve Dysfunction



Structural surgical valve deterioration

- ✓ Leaflet tear
- ✓ Calcifications
- ✓ Pannus
- ✓ Flail
- ✓ Fibrosis



Degenerated surgical bioprosthesis :
1-5% @5 yrs; 5-10% @ 10 yrs; 15-50% @ 20 yrs

BVD : TAVI vs SAVR

- ✓ Remaining native valve calcifications
- ✓ Mechanical stress of the stent frame
- ✓ Crimping of the valve tissue before implantation
- ✓ Valve leaflet geometry
- ✓ Balloon expansion for deployment or post-dilatation

Structural TAV deterioration

- ✓ Leaflet reduced mobility
 - ✓ Thickening
 - ✓ Thrombus
 - ✓ Calcifications
- ✓ Stent frame fracture
- ➡ Increase of gradient and/or regurgitation

Degenerated TAVI prosthesis: what we know

- @ 5 yrs :
0/53 patients alive on PARTNER IA
1.4% CV Italian registry
- @ > 5 yrs :
2.4% Vancouver registry



Structural valve deterioration after transcatheter aortic valve implantation.

Foroutan F^{1,2}, Guyatt GH¹, Otto CM³, Siemieniuk RA^{1,4}, Schandelmaier S¹, Agoritsas T^{1,5}, Vandvik PO^{6,7}, Bhagra S², Baqur R^{8,9}.

Author information

Abstract

BACKGROUND: Transcatheter aortic valve implantation (TAVI), widely used to treat high-risk patients with severe symptomatic aortic stenosis, has recently been extended to younger patients at lower operative risk in whom long-term durability of TAVI devices is an important concern. Therefore, we conducted a systematic review and meta-analysis of observational studies addressing the frequency of structural valve deterioration (SVD) after TAVI.

METHODS: We searched Medline, Embase, Cochrane Database of Systematic Reviews, and Cochrane CENTRAL from 2002 to September 2016. We included observational studies following patients with TAVI for at least 2 years. Independently and in duplicate, we evaluated study eligibility, extracted data, and assessed risk of bias for SVD post-TAVI. Our review used the GRADE system to assess quality of evidence. We pooled incidence rates using a random effects model.

RESULTS: Thirteen studies including 8914 patients, with a median follow-up between 1.6 and 5 years, reported an incidence of SVD post-TAVI between 0 to 1.34 per 100 patient years. The pooled incidence of SVD was 28.08 per 10 000 patients/year (95% CI 2.46 to 73.44 per 100 patient years). Of those who developed SVD, 12% underwent valve re-intervention. Confidence in the evidence was moderate due to inconsistency among studies.

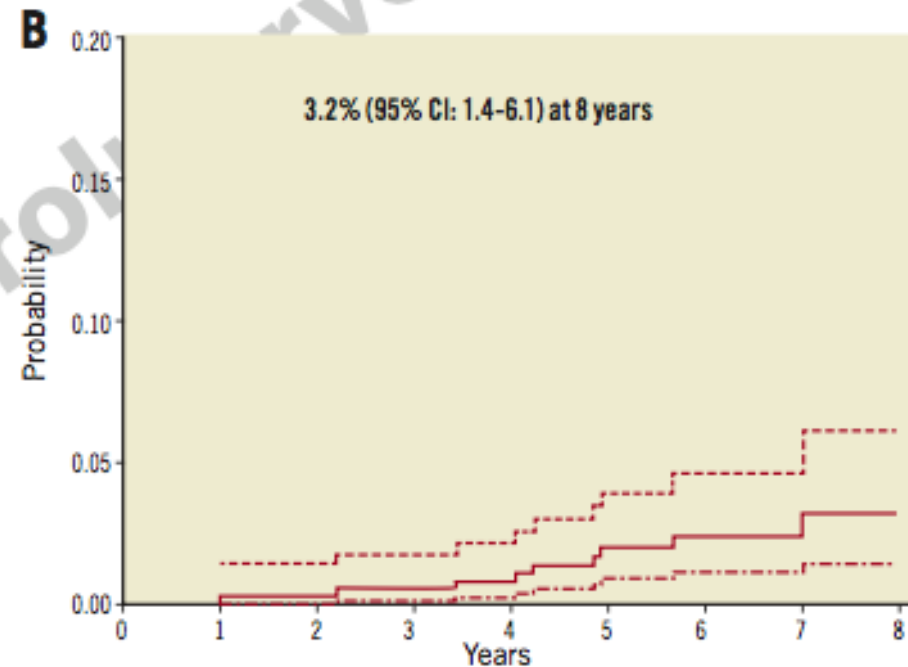
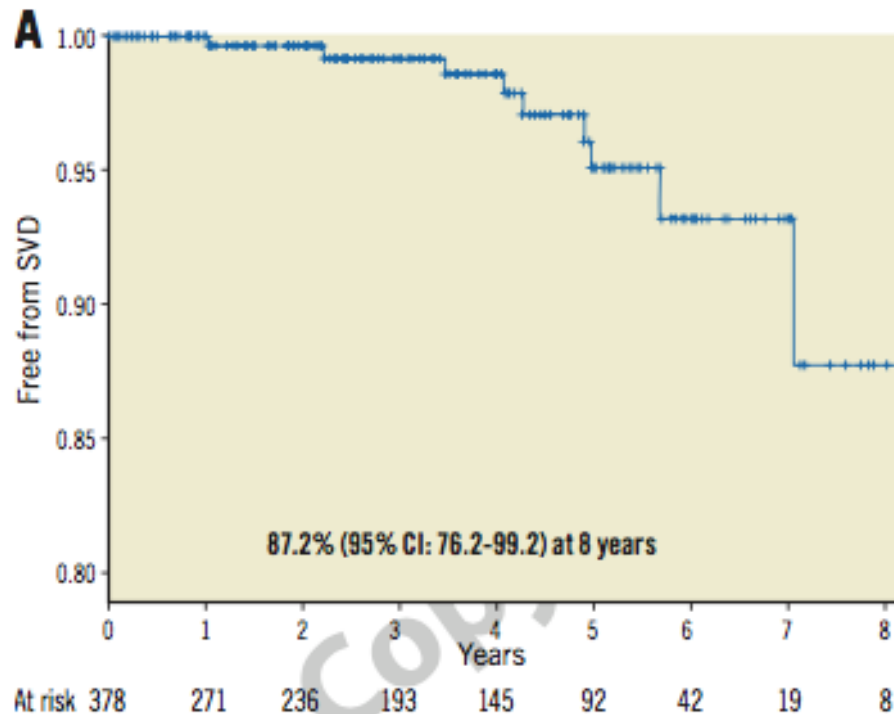
CONCLUSION: Structural valve deterioration is probably an infrequent event within the first 5 years after TAVI. Ascertaining the impact of SVD and the need for valve-related re-interventions to inform recommendations for patients with a longer life-expectancy will require studies including a large number of patients with longer follow-up (>10 years).

Assessment of structural valve deterioration of transcatheter aortic bioprosthetic balloon-expandable valves using the new European consensus definition



Hélène Eltchaninoff^{1,2*}, MD; Eric Durand^{1,2}, MD, PhD; Guillaume Avinée^{1,2}, MD; Christophe Tron¹, MD; Pierre-Yves Litzler^{2,3}, MD; Fabrice Bauer^{1,2}, MD; Jean-Nicolas Dacher^{2,4}, MD; Camille Werhlin¹, MD; Najime Bouhzam¹, MD; Nicolas Bettinger¹, MD; Pascal Candolfi⁵, PhD; Alain Cribier¹, MD

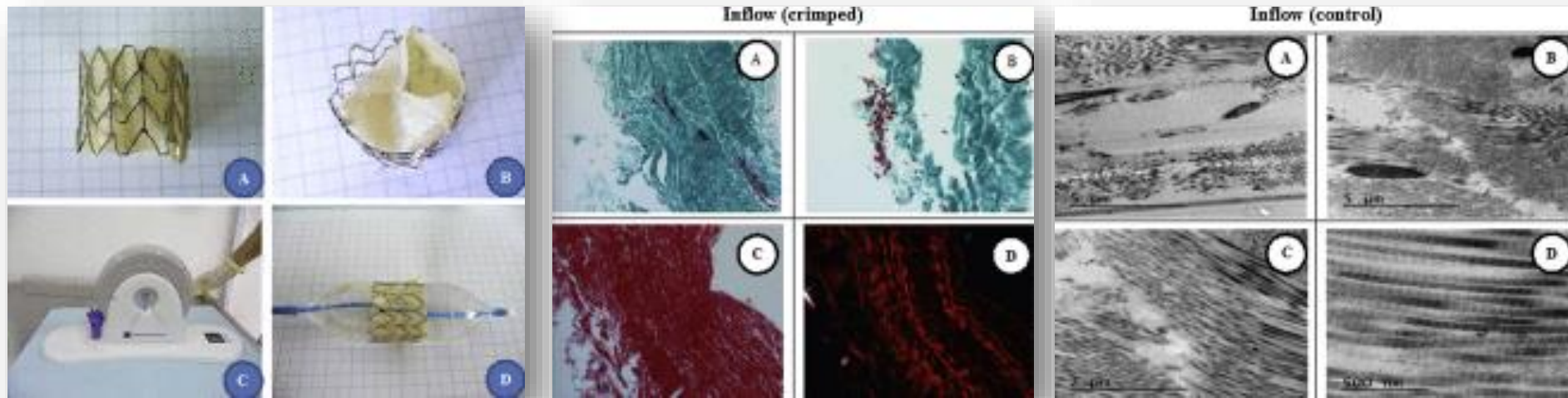
Eurointervention 2018;Mar 30



Structural TAV deterioration : mechanisms?

Structural changes and acute thrombogenicity in transcatheter pericardium valves after crimping and balloon deployment

Bourguet et al. Morphologie 2017;101:19-32

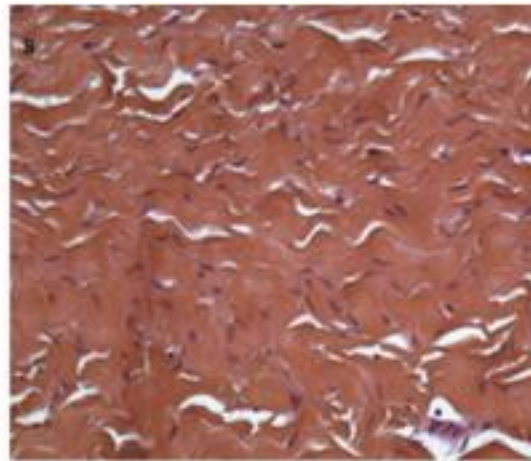


After crimping and ballooning, the structure of the pericardium was severely injured, eventually with delaminations and ruptures. The blood cell uptake was considerably increased compared to the control.

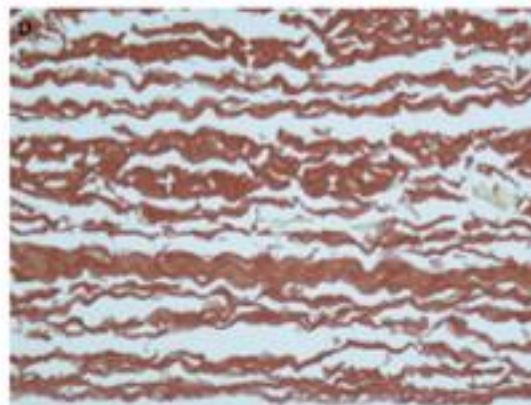
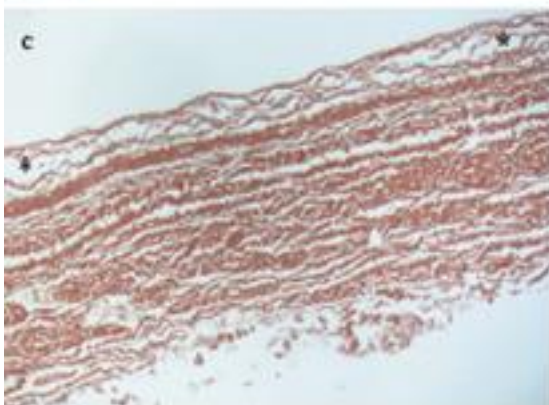
Case report

Evidence of leaflet injury during percutaneous aortic valve deploymentRachid Zegdi^{a,b,*}, Patrick Bruneval^{a,c}, Didier Blanchard^d, Jean-Noël Fabiani^{a,b}

Microscopic analysis of 4 Sapien Edwards valves : pericardial leaflet injury after crimping



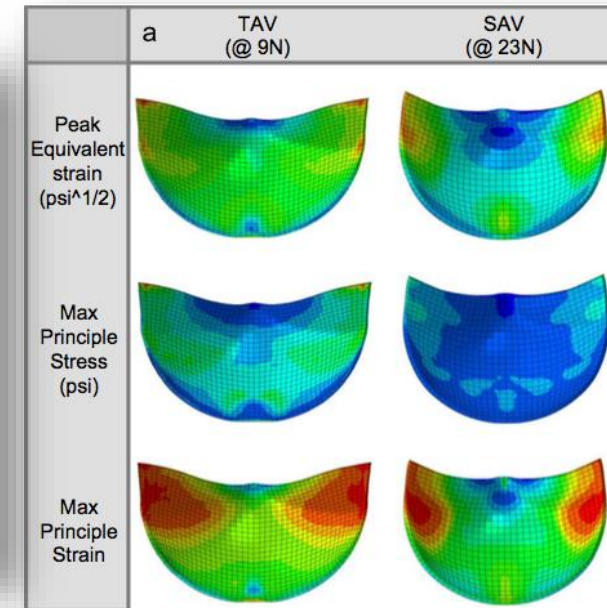
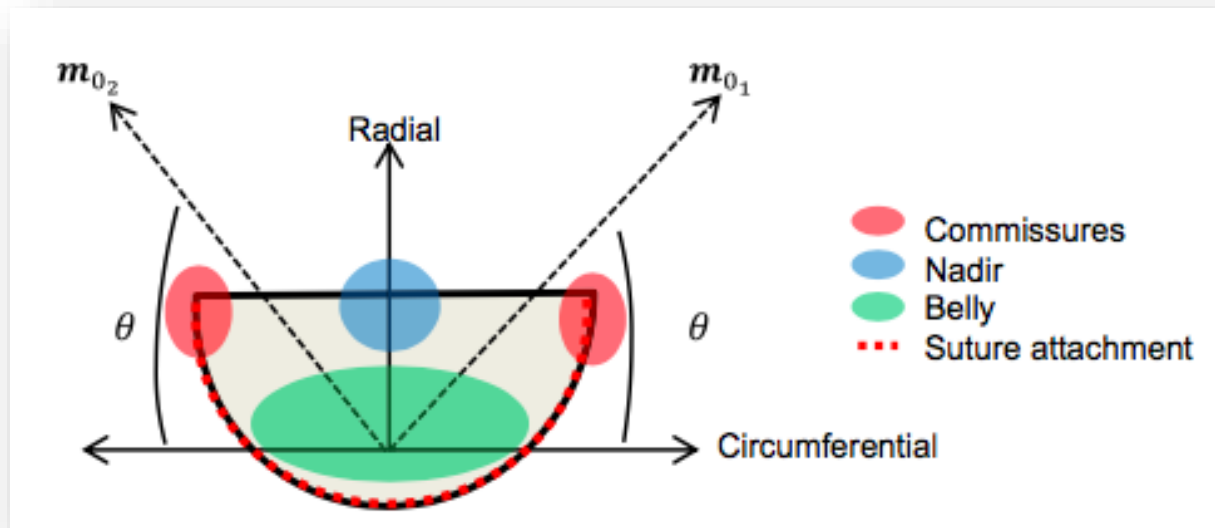
Control : bovine pericardium

Sapien :
disruption of the collagen fibers

Comparison of transcatheter aortic valve and surgical bioprosthetic valve durability: A fatigue simulation study

Martin C, Sun W. *J Biomech* 2015;48:3026-3034

TAV and SAV leaflet fatigue due to cyclic loading was investigated by implementing a computational soft tissue fatigue damage model to describe the behavior of the pericardial leaflets.



Under identical loading conditions and with identical leaflet tissue properties, the TAV leaflets sustained higher stresses, strains, and fatigue damage compared to the SAV leaflets.

The expected durability of TAVs is about 7.8 years.

Structural TAV deterioration : Impact of stent geometry

Simulated elliptical bioprosthetic valve deformation: Implications for asymmetric transcatheter valve deployment

Sun et al. J Biomech 2010

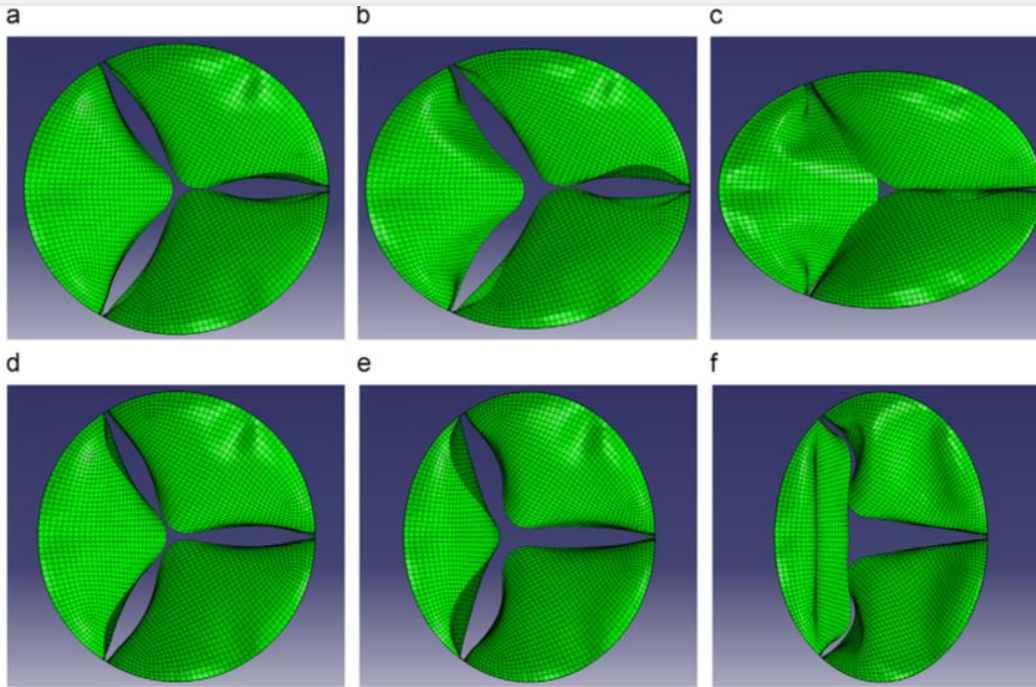


Fig. 2. Six elliptical models of asymmetric TAV. The first row is Scenario 1 with eccentricity of (a) 0.3, (b) 0.5, and (c) 0.68. The second row is Scenario 2 with eccentricity of (d) 0.3, (e) 0.5, and (f) 0.68.

- ✓ Abnormal coaptation
- ✓ Increase leaflets curvature
- ✓ Stress, strain

On a computational model of elliptical TAV, for a distorted TAV with an elliptical eccentricity of 0.68, the peak stress increased significantly by 143% compared with the nominal circular TAV.

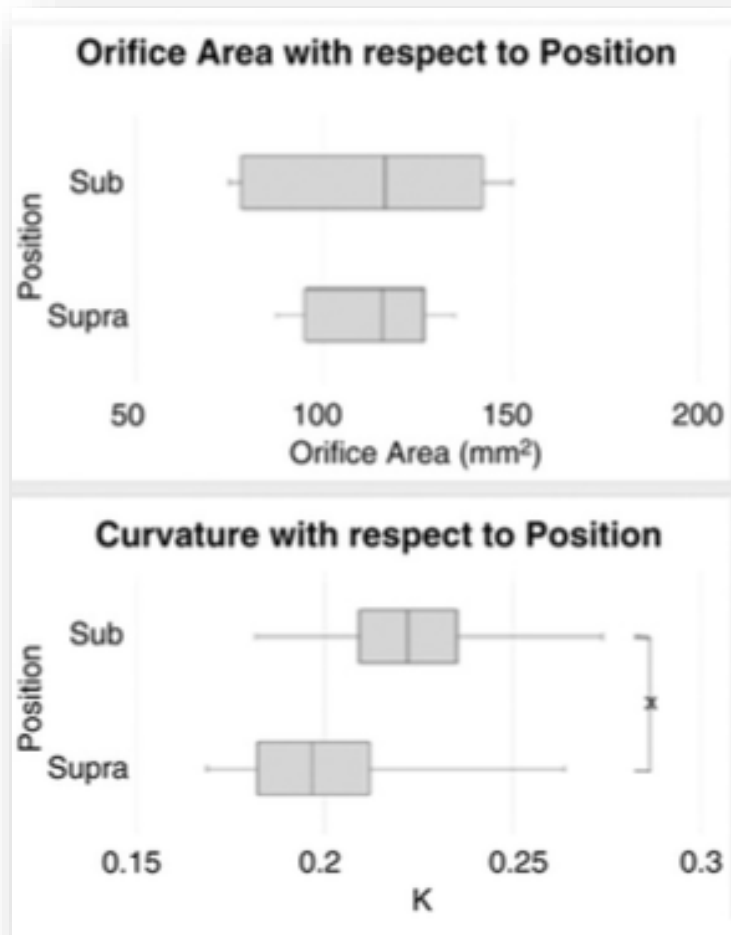
When the eccentricity of an elliptical TAV was larger than 0.5, a central backflow leakage was likely to occur

Structural TAV deterioration : Impact of height of implant

Letter to the Editor

Transcatheter aortic valve implantation can potentially impact short-term and long-term functionality: An in vitro study☆

Stearns et al. Int J cardiol 2014



Subannular position reduces

- orifice area and
- leaflet curvature
- Reduction leaflet curvature induces a leaflet fatigue, reducing long term durability

9 patients with structural TAV deterioration in Rouen

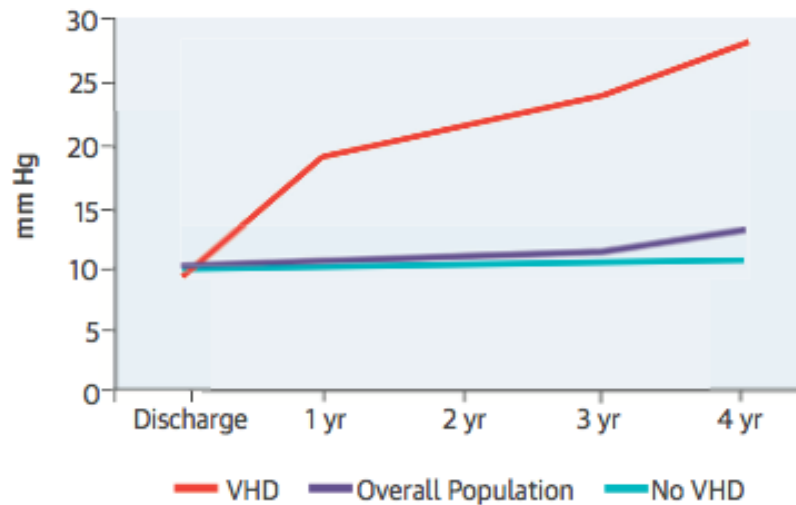
Table 4. Detailed echocardiographic analysis and outcomes of patients with SVD.

Patient	Age	ATR	Baseline		1-year		2-year		3-year		4-year		5-year		6-year		7-year		Outcomes
			MG	AR	MG	AR	MG	AR	MG	AR	MG	AR	MG	AR	MG	AR	MG	AR	
#01	73	Aspirin	7	0	7	0	11	0	9	0	17	0	24	0	29	3			Redo TAVI SAPIEN XT in SAPIEN at 6 years
#02	86	Aspirin	10	0	12	0	11	2	9	2	9	2	9	2	15	2	17	2	Died at 7.8 years after procedure at 93 years old
#03	88	Aspirin	14	0	22	2	31	2											Died at 4.4 years after procedure at 92 years old
#04	87	Aspirin	16	0	8	0							24	2	20	1	28	1	No valve-related symptoms 7 years after procedure
#05	89	Aspirin	10	0	11	0	13	0	13	2	18	2	27	2					No valve-related symptoms 6 years after procedure
#06	85	VKA	15	0	20	0	16	0	12	0	28	2	36	1					No valve-related symptoms 5 years after procedure
#07	79	Aspirin	16	0	13	0	18	0	30	2	20	2							No valve-related symptoms 4 years after procedure
#08	73	Aspirin	10	0	17	0	31	2	36	0	40	0							Redo TAVI CoreValve in SAPIEN at 4 years
#09	84	VKA	11	0	10	0	11	2	15	2	24	2							No valve-related symptoms 4 years after procedure

AR: aortic regurgitation severity (1 to 4); ATR: antithrombotic regimen; MG: mean aortic gradient (mmHg); SVD: structural valve deterioration; VKA: vitamin K antagonist

Structural TAV deterioration - mechanism : thrombus?

Progression of Transvalvular Mean Gradients Following TAVR



- ✓ Multicenter study
- ✓ 1500 pts
- ✓ Fup : 20 months

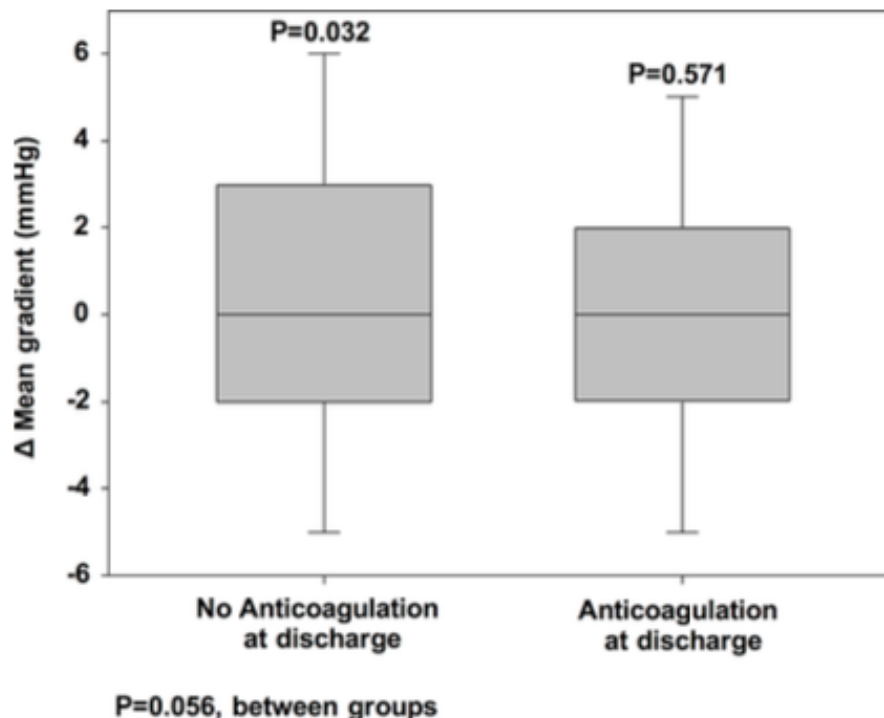
VHD : 4.5% @ 20 months

Predictors of Transcatheter Valve Hemodynamic Deterioration Post-TAVR

- Absence of Anticoagulation Therapy at Discharge
- Valve-in-Valve Procedure (TAVR in a Surgical Valve)
- ≤ 23 mm Transcatheter Heart Valve
- Greater Body Mass Index

No VKA : HR : 3.17

Impact of anticoagulation therapy on valve haemodynamic deterioration following transcatheter aortic valve replacement



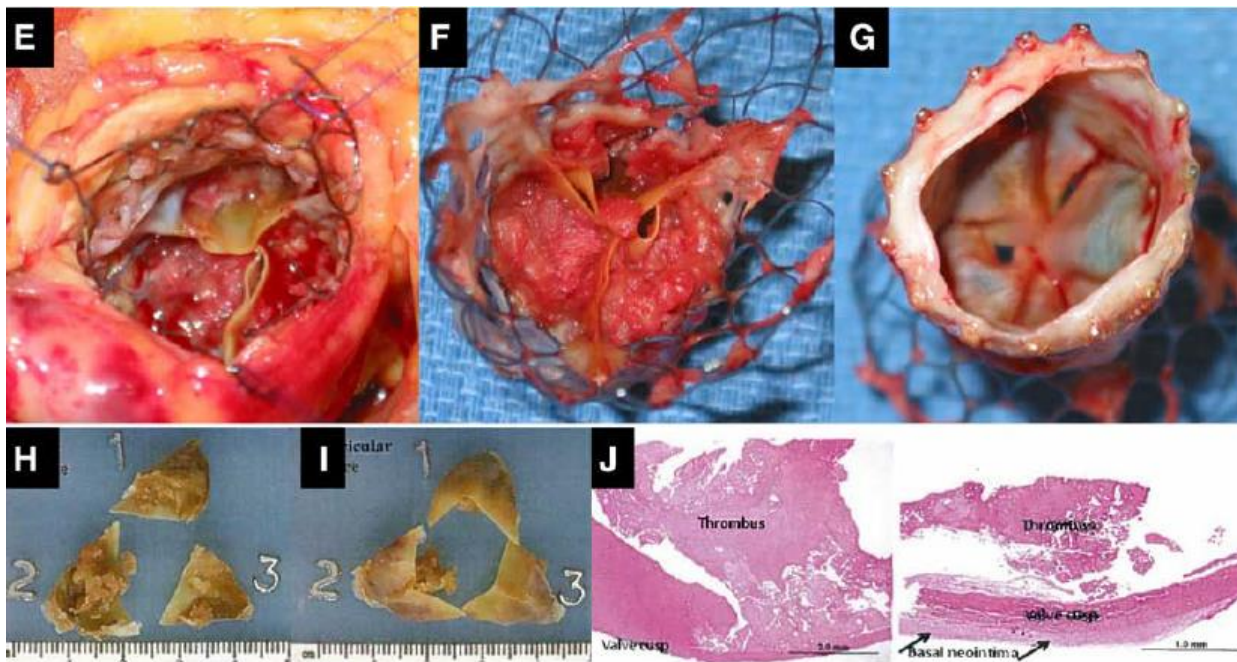
VHD : 0.6 vs 3.9%, $p<0.001$

No adverse event in patients VHD

Figure 1 Absolute changes in mean transvalvular gradient between discharge and 1-year follow-up in the propensity-matched population according to the presence of anticoagulation therapy at hospital discharge (analyses conducted on log-transformed data).

Treatment and Clinical Outcomes of Transcatheter Heart Valve Thrombosis

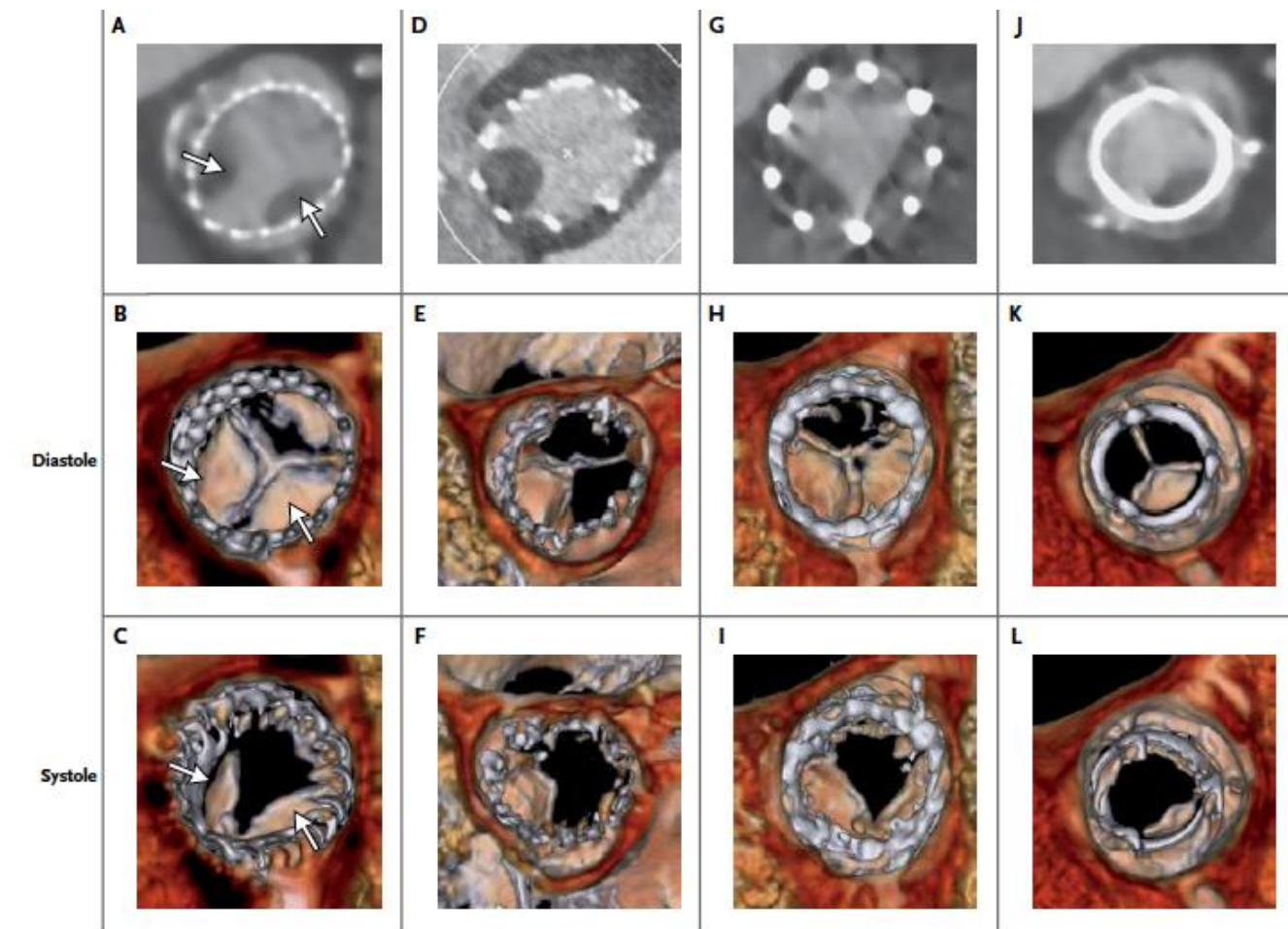
Azeem Latib, MD*; Toru Naganuma, MD*; Mohamed Abdel-Wahab, MD; Haim Danenberg, MD;
Linda Cota, MD; Marco Barbanti, MD; Helmut Baumgartner, MD; Ariel Finkelstein, MD;
Victor Legrand, MD; José Suárez de Lezo, MD; Joelle Kefer, MD;
David Messika-Zeitoun, MD; Gert Richardt, MD; Eugenio Stabile, MD; Gerrit Kaleschke, MD;
Alec Vahanian, MD; Jean-Claude Laborde, MD; Martin B. Leon, MD; John G. Webb, MD;
Vasileios F. Panoulas, MD; Francesco Maisano, MD; Ottavio Alfieri, MD; Antonio Colombo, MD



Circ Cardiovasc Interv. 2015 Apr;8(4)

- ✓ 26 cases on 4266 TAVI in 12 centres : 0.6% @ a median time of 181 days after TAVI
- ✓ Echo : increased gradient, thickened leaflets, thrombus
- ✓ Restoration of normal THV function within 2 months of ACO

Possible Subclinical Leaflet Thrombosis in Bioprosthetic Aortic Valves



Anticoagulation after TAVI

IIB

B-NR

See Online Data Supplement 6.

Anticoagulation with a VKA to achieve an INR of 2.5 may be reasonable for at least 3 months after TAVR in patients at low risk of bleeding (203,210,211).

NEW: Studies have shown that valve thrombosis may develop in patients after TAVR, as assessed by multidetector computerized tomographic scanning. This valve thrombosis occurs in patients who received antiplatelet therapy alone but not in patients who were treated with VKA.

Several studies have demonstrated the occurrence of prosthetic valve thrombosis after TAVR, as assessed by multidetector computerized tomography, which shows reduced leaflet motion and hypo-attenuating opacities. The incidence of this finding has varied from 7% to 40%, depending on whether the patients are from a clinical trial or registry and whether some patients received anticoagulation with VKA (203,210,211). Up to 18% of patients with a thrombus formation developed clinically overt obstructive valve thrombosis (210). A post-TAVR antithrombotic regimen without warfarin seems to predispose patients to the development of valve thrombosis (203,210). The utility of the DOACs in this population is unknown at this time.

IIB

C

Clopidogrel 75 mg daily may be reasonable for the first 6 months after TAVR in addition to life-long aspirin 75 mg to 100 mg daily.

2014 recommendation remains current.

AHA/ACC guidelines 2017

Dual antiplatelet therapy should be considered for the first 3–6 months after TAVI, followed by lifelong single antiplatelet therapy in patients who do not need oral anticoagulation for other reasons.

Ila

C

Single antiplatelet therapy may be considered after TAVI in the case of high bleeding risk.

IIB

C

ESC guidelines 2017

Conclusions

- ✓ In vitro models suggest leaflets damage, when contained within a catheter before deployment or due to the crimping and/or balloon inflation
- ✓ Stent geometry and position according to the native annulus may have an impact on leaflets fatigue
- ✓ Premature structural TAV deterioration is expected, as compared with SAV
- ✓ Clinical data are scarce but reassuring (3.2% @ 8 yrs)
- ✓ Treatment :
 - ✓ Preventive role of anticoagulant @ periprocedural period ?
 - ✓ Medical (high % asymptomatic)
 - ✓ TAV-in-TAV
 - ✓ SAV