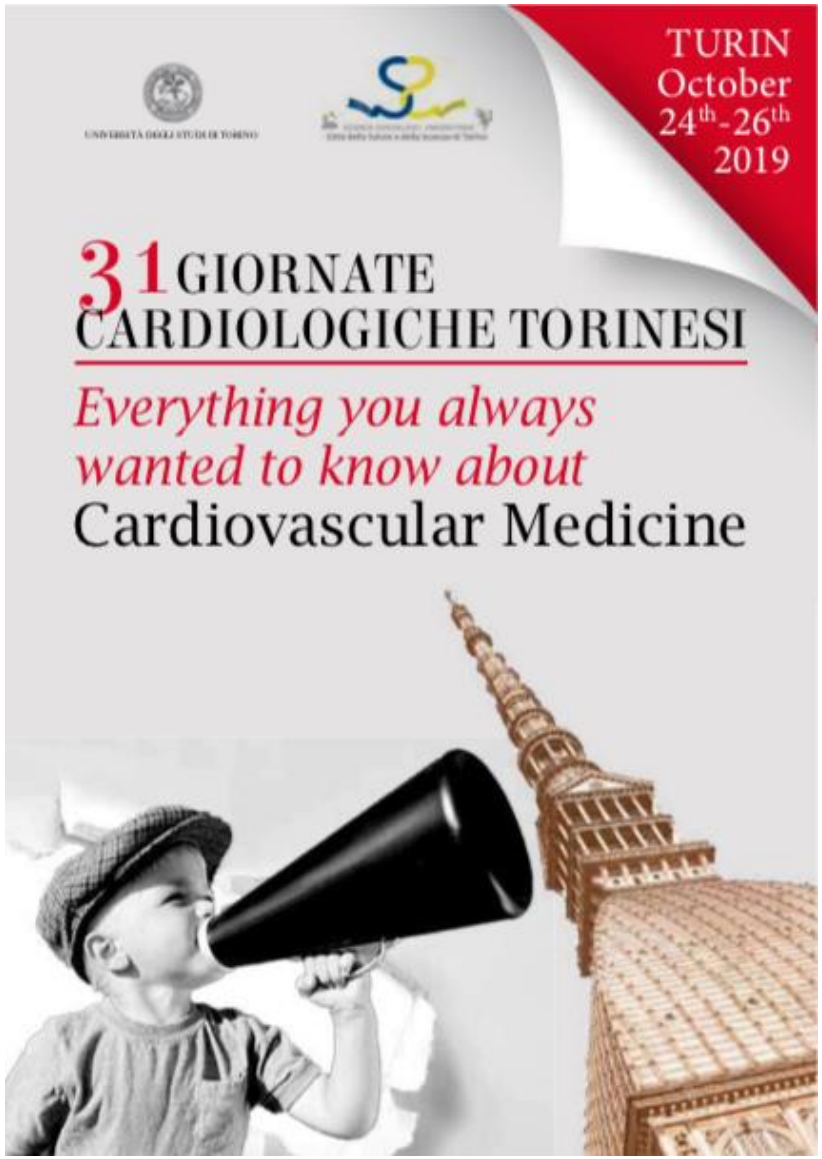


IMAGING IN STRUCTURAL HEART DISEASE

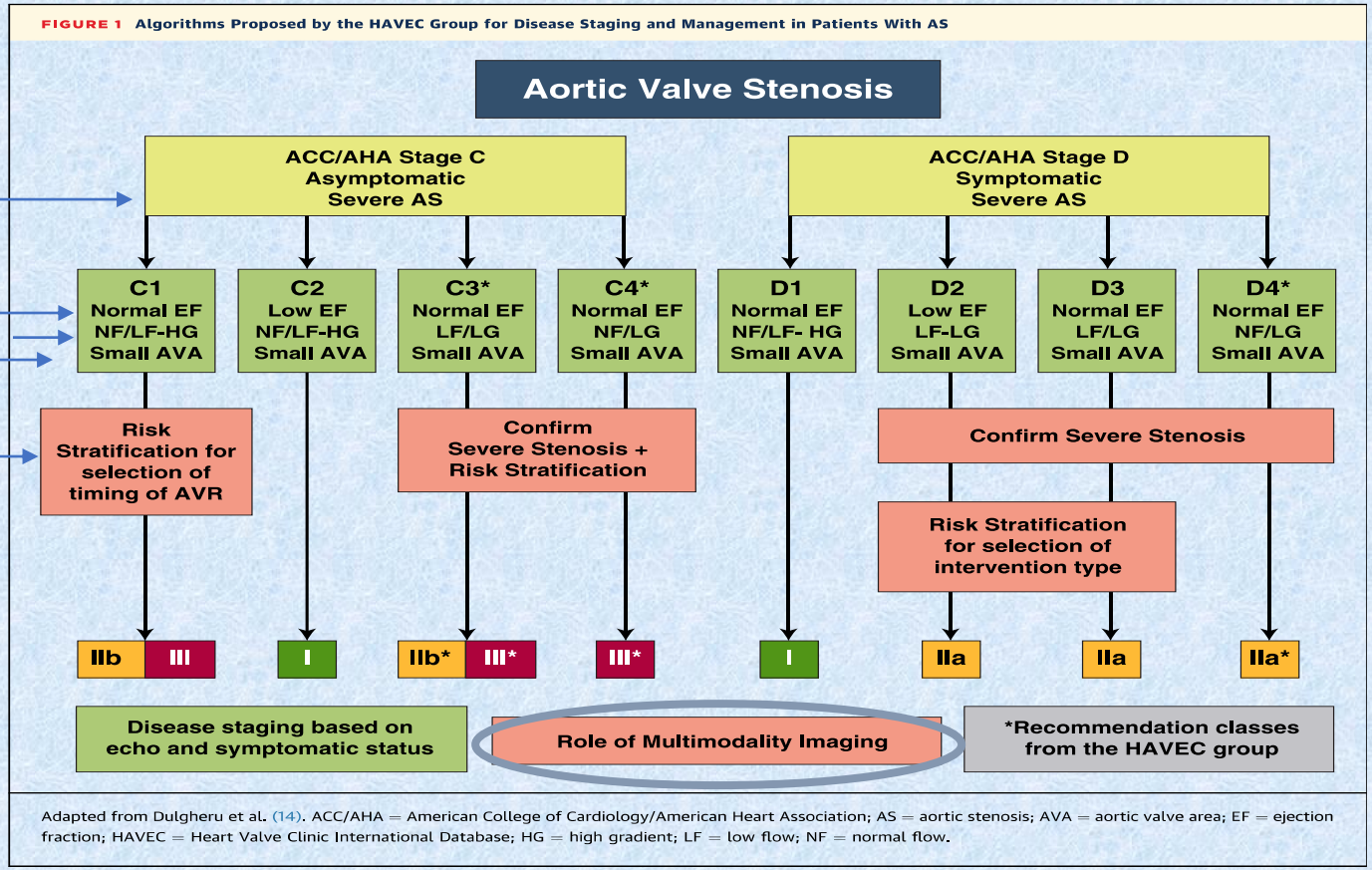
The old and the new: the pivotal role of echocardiography and TC in TAVI

Rodolfo Citro MD PhD FESC

A.O.U. "San Giovanni di Dio e Ruggi d'Aragona"

Dipartimento Cuore, Salerno

Classification of AS



Lancellotti P et al., JACC Cardiovasc Imaging 2016

TAVI timeline for Heart Imagers

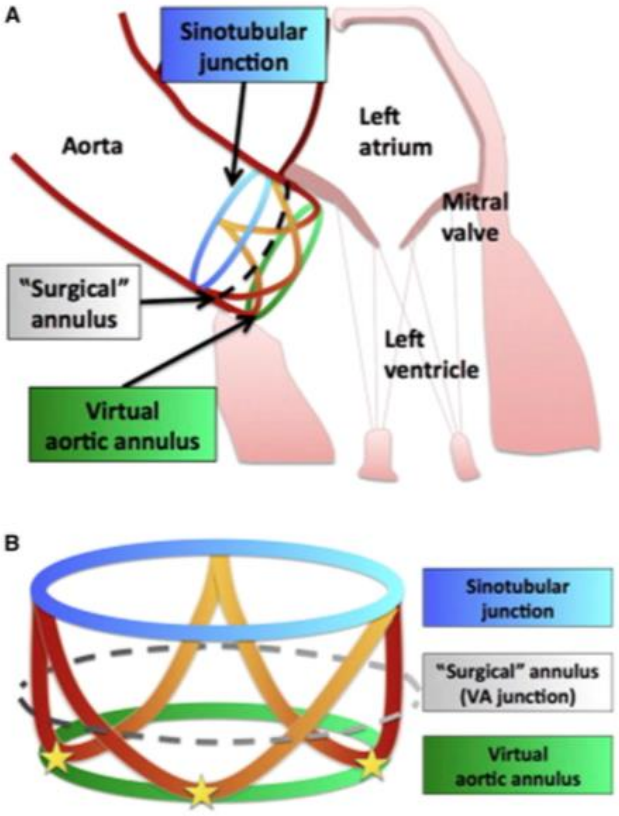
Screening

During procedure

Follow-up

Echo *TC*

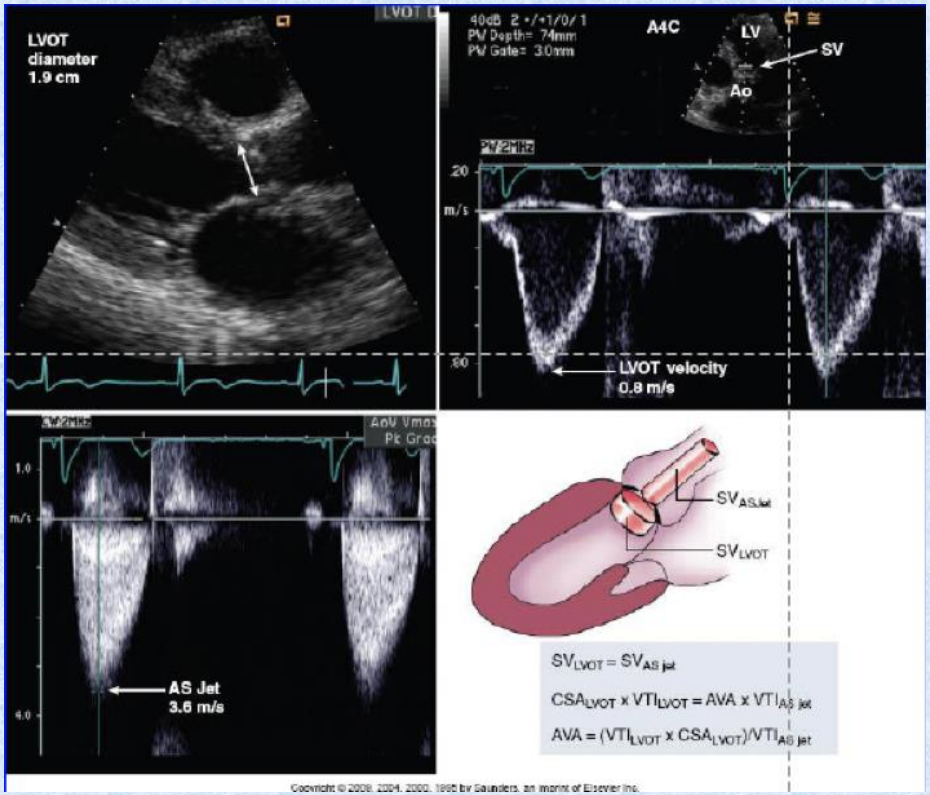
Screening for TAVI



- **Severity of aortic stenosis**
- **Aortic valve complex**

1. Annulus
2. Aortic root
3. Coronary ostia
4. STJ
5. Calcification within

Decision making in AS



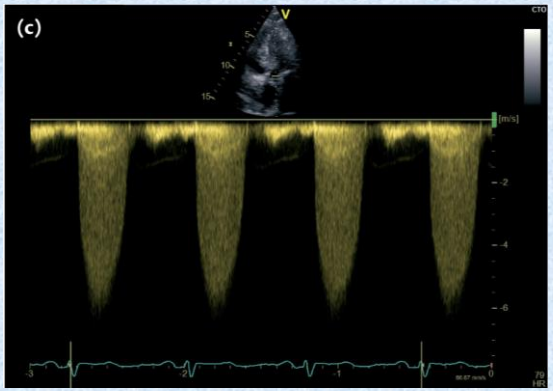
Key measures

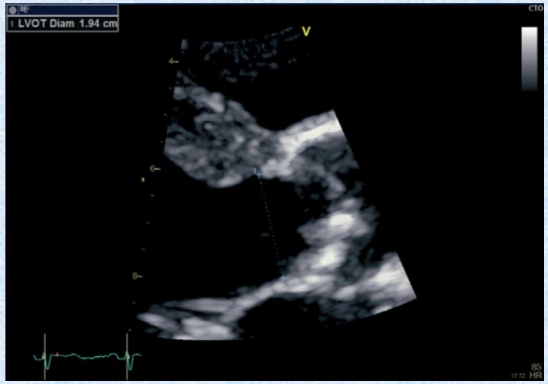
AS-velocity (V_{max} in m/s)
Mean ΔP (mmHg)
Valve Area (AVA in cm^2)

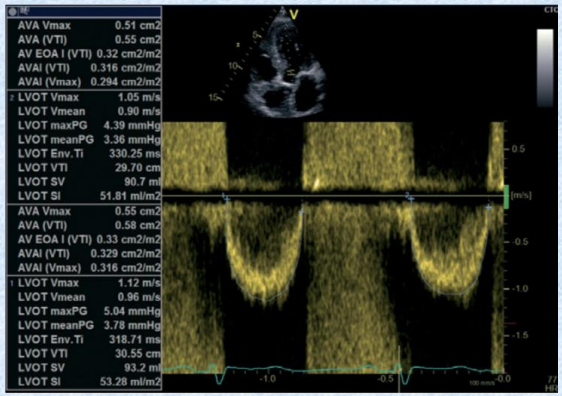
Baumgartner et al, EAE/ASE Guidelines for Valve Stenosis, 2009

Assessment of AS severity

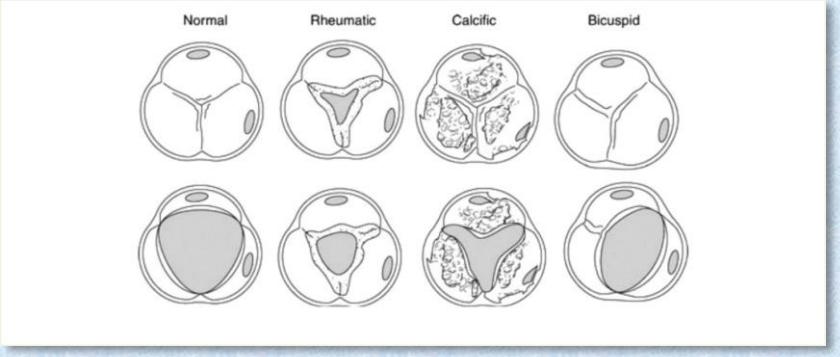
	Aortic sclerosis	Mild AS	Moderate AS	Severe AS
Peak aortic jet velocity (m/s)	≤ 2.5	2.5-2.9	30.3.9	≥4
Mean gradient (mmHg)		<20	20-39	≥40
Aortic valve area (cm^2)		>1.5	1.0-1.5	≤1
Indexed valve area (cm^2/m^2 BSA)				≤0.6 cm^2/m^2

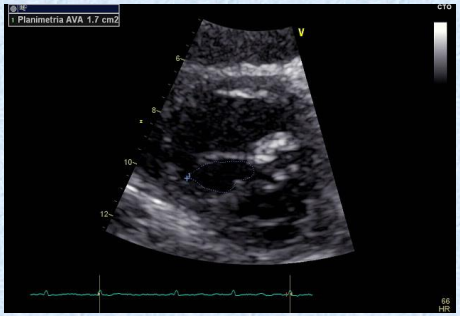




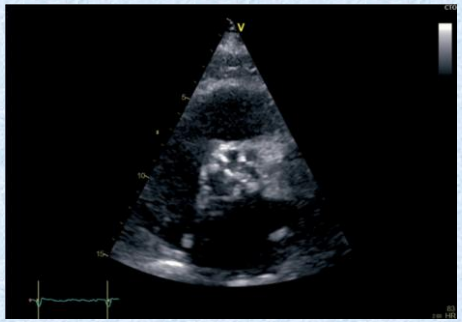


AORTIC STENOSIS - etiology

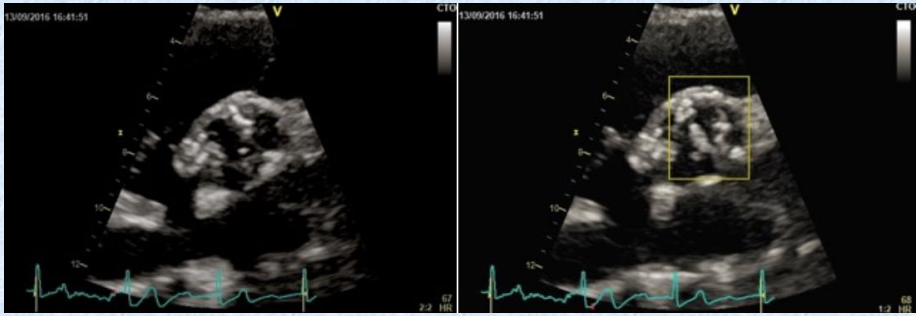




Rheumatic



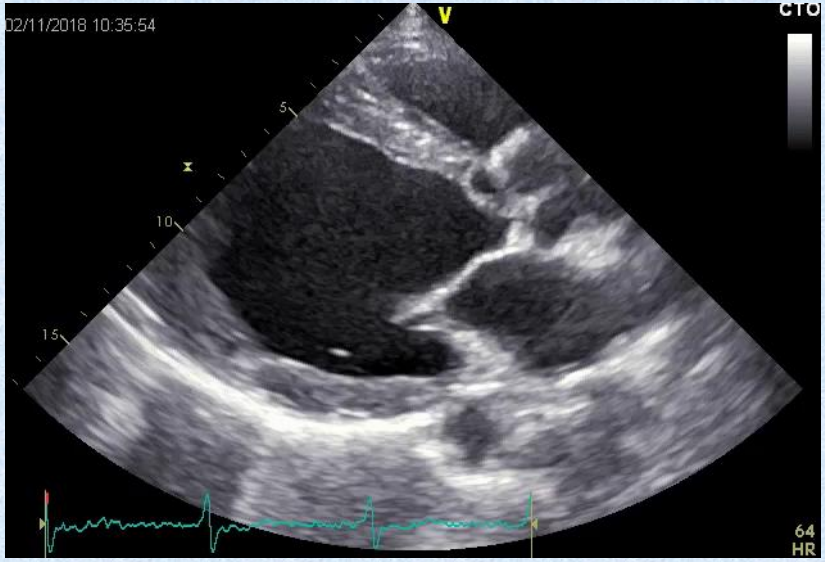
Calcific

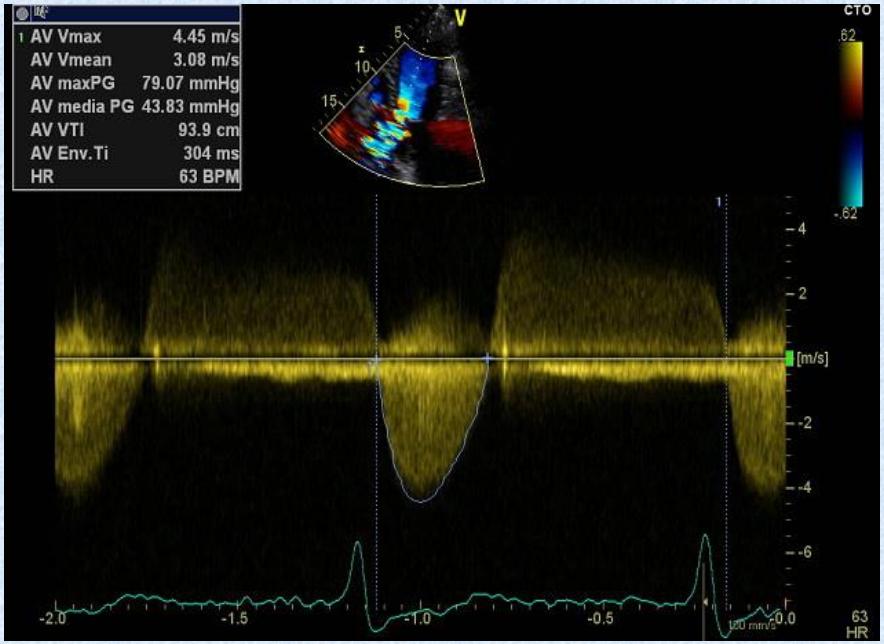


BAV II type

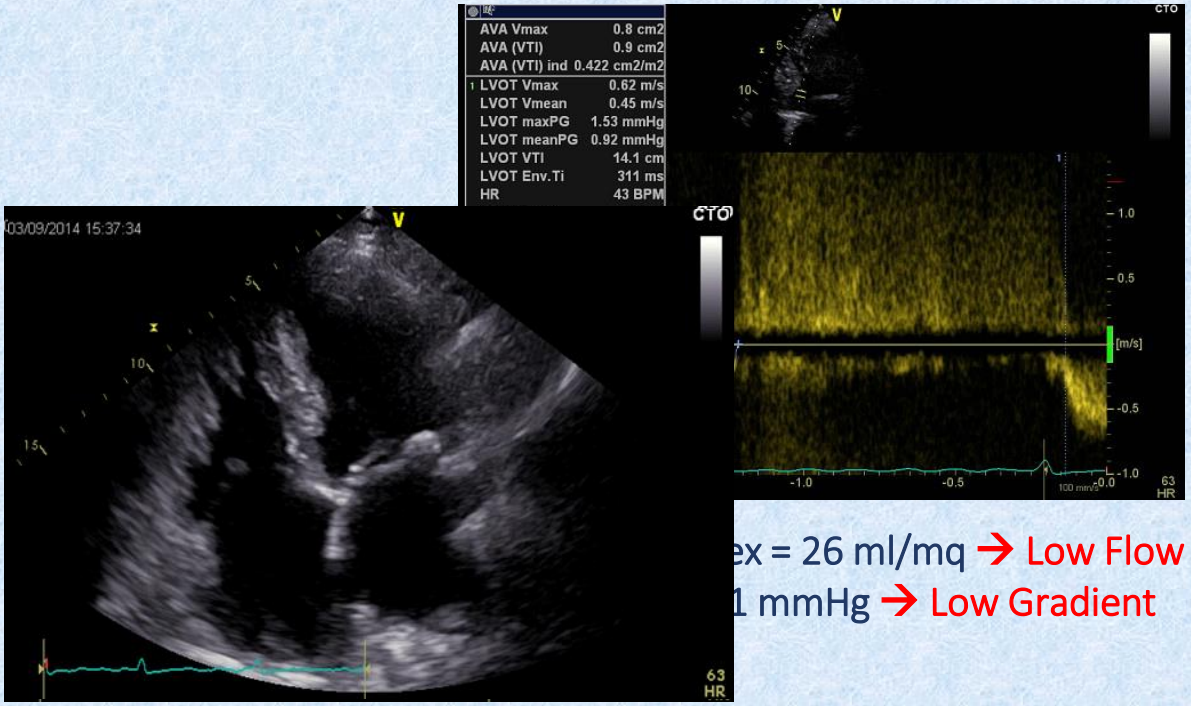
European Heart Journal - Cardiovascular Imaging (2017) 18, 254–275

Sub-valvular AS





Echocardiographic assessment



ex = 26 ml/mq → Low Flow

1 mmHg → Low Gradient

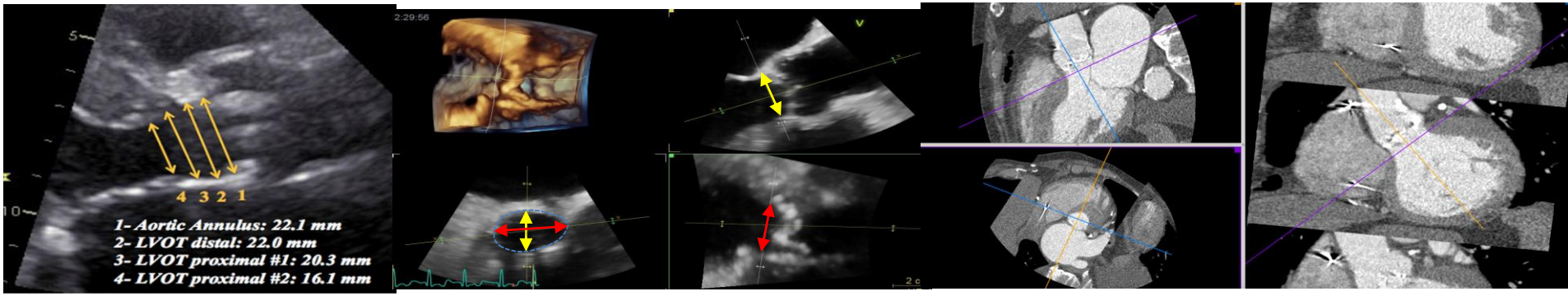
AVAi = 0.42 cm2/m2

FE = 65%

Measurement of LVOT diameter: Implication for AVA and SV measurements

$$\mathbf{AVA} = \frac{CSA_{LVOT} \times VTI_{LVOT}}{VTI_{ao}}$$

2D TT/TE | **3D TE** | **CT**



Only Sagittal Diameter

Understimation of LVOT Diameter

Sagittal and Coronal Diameters

True Area

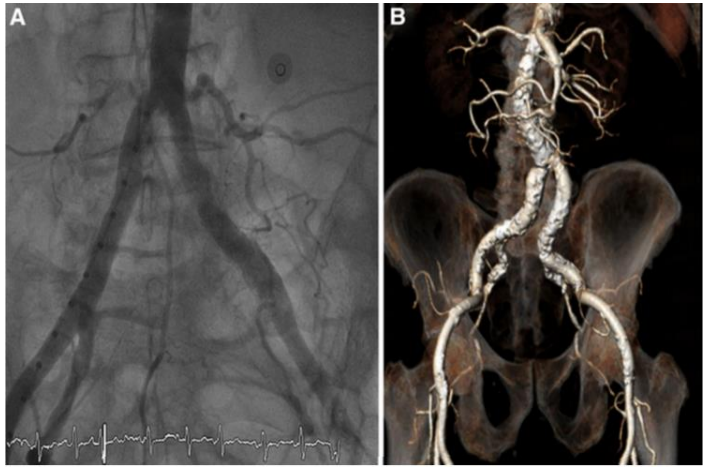
Sagittal and Coronal Diameters

True Area

Screening for TAVI

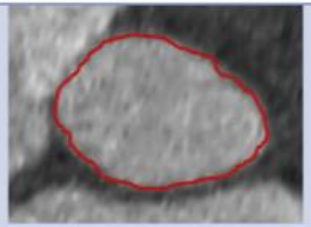
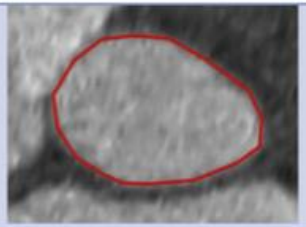
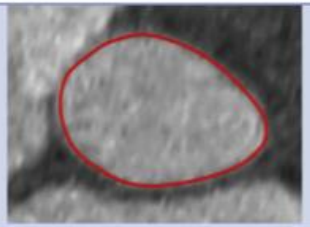
TC assessment:

While computed tomography (CT) was initially used primarily for the assessment of peripheral access, the role of CT has grown substantially and CT is now the gold standard tool for annular sizing, determination of risk of annular injury and coronary occlusion, and to provide co-planar fluoroscopic angle prediction in advance of the procedure.



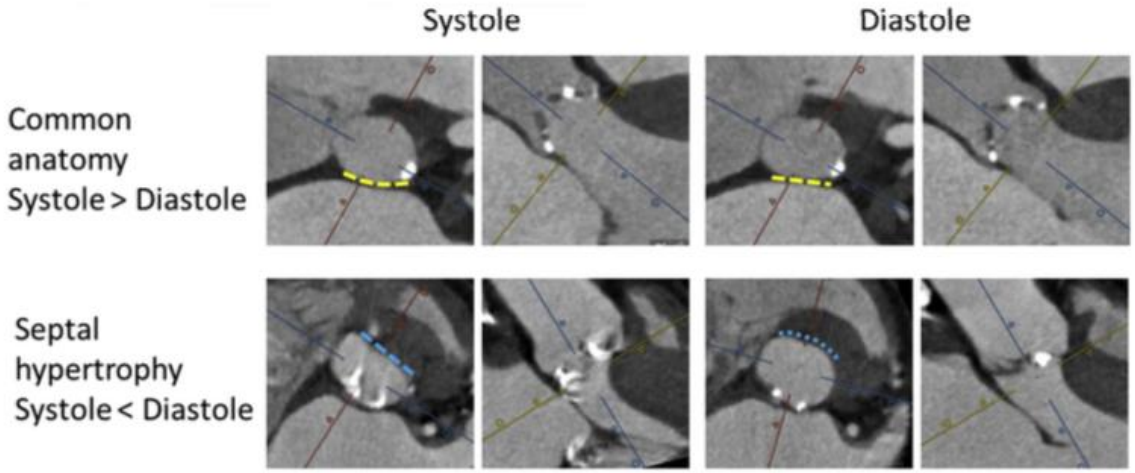
Screening for TAVI

TC assessment

Freehand tool or Hounsfield-based Contour detection	Polygon	Spline
Non-smoothened, irregular line following path of cursor or detected attenuation threshold	Manual placed segmentation points connected by straight line without interpolation	Manual placed segmentation points connected by a cubic spline interpolation – 'elastic ruler'
		
		
Systematic overestimation of perimeter due to non-smoothened contour; Smoothing algorithms, can allow for more realistic perimeter assessment.	Depending on the number of dots, this may yield a closer estimate of perimeter than freehand contouring without smoothing	Accurate quantification of annular perimeter

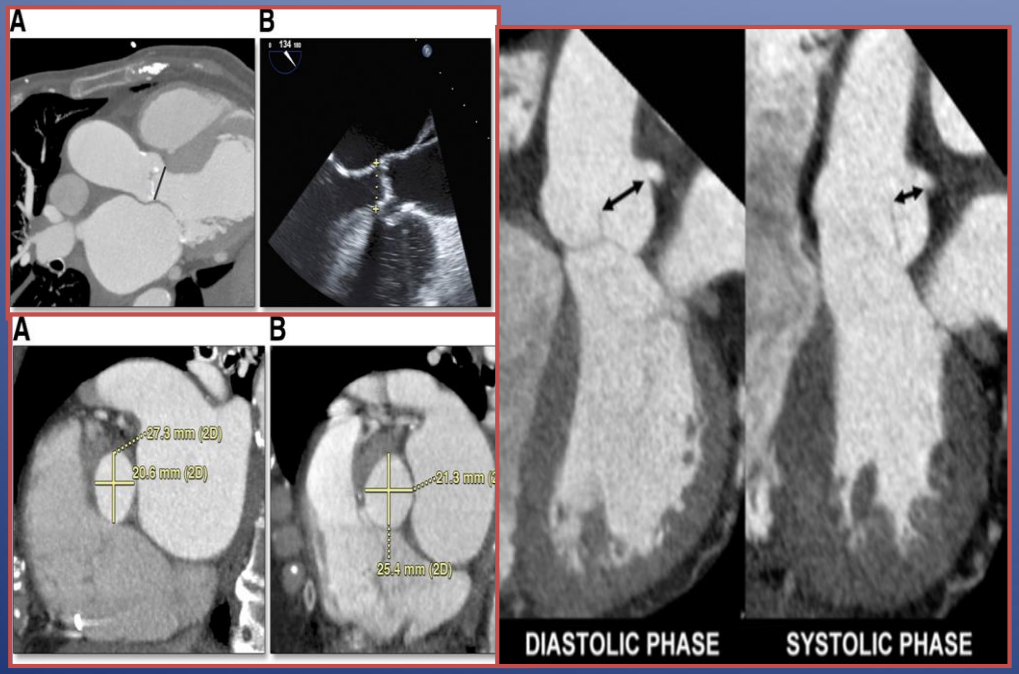
Quantification of annular dimension:

Dynamic Changes of the Aortic Annulus Throughout the Cardiac Cycle



Blanke et al JACC CI 2019

TOMOGRAFIA COMPUTERIZZATA MULTISTRATO



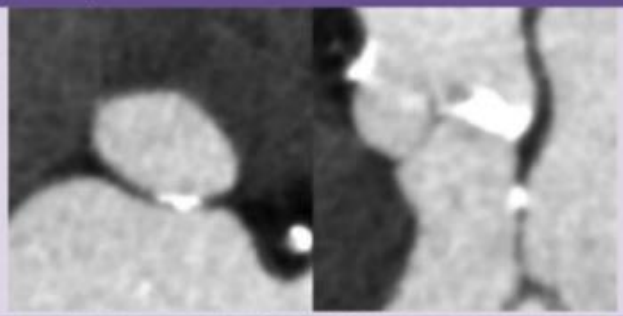
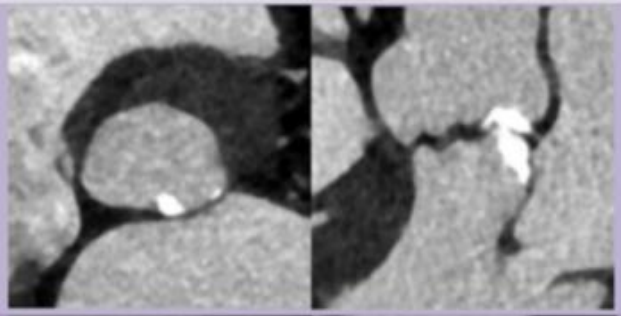
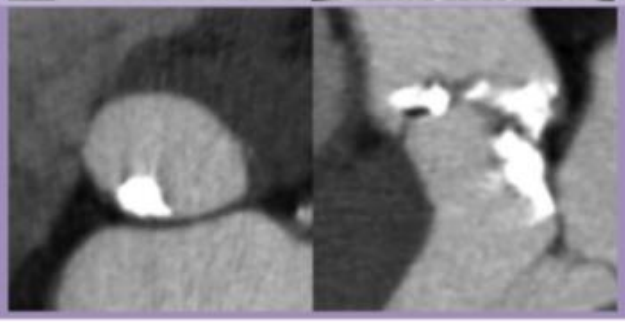
- **Calcolo preciso della distanza tra gli osti coronarici e il punto di intersezione delle cuspidi (diastole e sistole) per determinare il rischio di occlusione coronarica durante TAVI****

** Leipsic et al., JACC: Cardiovascular Imaging, 2011*

*** Tops et al., JACC: Cardiovascular Imaging, 2008*

Screening for TAVI

TC assessment

Grade		Examples
Mild	Single, adherent, non-protruding focus of calcification	
Moderate	Two or more nodules of calcification or a single nodule with limited protrusion into the annular/subannular lumen	
Severe	Single or multiple nodules of calcification, protruding into the annular lumen, and/or extending into the LVOT.	

Qualitative Grading of Annular/Sub-Annular and Left Ventricular Outflow Tract Calcification

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Screening for TAVI

TC assessment

TABLE 5 Summary of Recommendations for the Sizing and Reporting of the Aortic Valve, Annulus and Outflow Tract

Recommendation	Grade of Recommendation*
Annulus assessment and planning	
While facilitated or semi-automated workflows may be used, the interpreter analyzing the imaging must be able to confirm the accuracy of the generated annular plane and perform manual corrections if required.	Strong
Systolic measurements are preferred for measurement and calculation of device sizing	Strong
Area and perimeter measurements are preferred for sizing of the aortic annulus over isolated 2 dimensional measurements and should be provided in the report	Strong
Landing zone calcification	
Annular and subannular calcification should be qualitatively described regarding morphology and extent as well as relation to the aortic valve cusps.	Strong
Valve morphology	
Number of cusps should be stated, and if a bicuspid valve is present, its morphology should be classified.	Strong
The presence of a median raphe and the absence/presence of calcification of this should be mentioned	Strong
The aortic annulus size should be measured and reported in bicuspid aortic valves as for tricuspid aortic valves.	Strong
Aortic root measurement	
Pre-TAVI/TAVR CT assessment should include coronary height, mean SOV diameter, and STJ height and diameter	Strong
Coronary ostial distance from aortic annulus should be measured in a perpendicular fashion from the established annular plane	Strong

*Based on level of consensus.

CT = computed tomography; SOV = sinus of valsalva; STJ = sinotubular junction; TAVI = transcatheter aortic valve implantation; TAVR = transcatheter aortic valve replacement.

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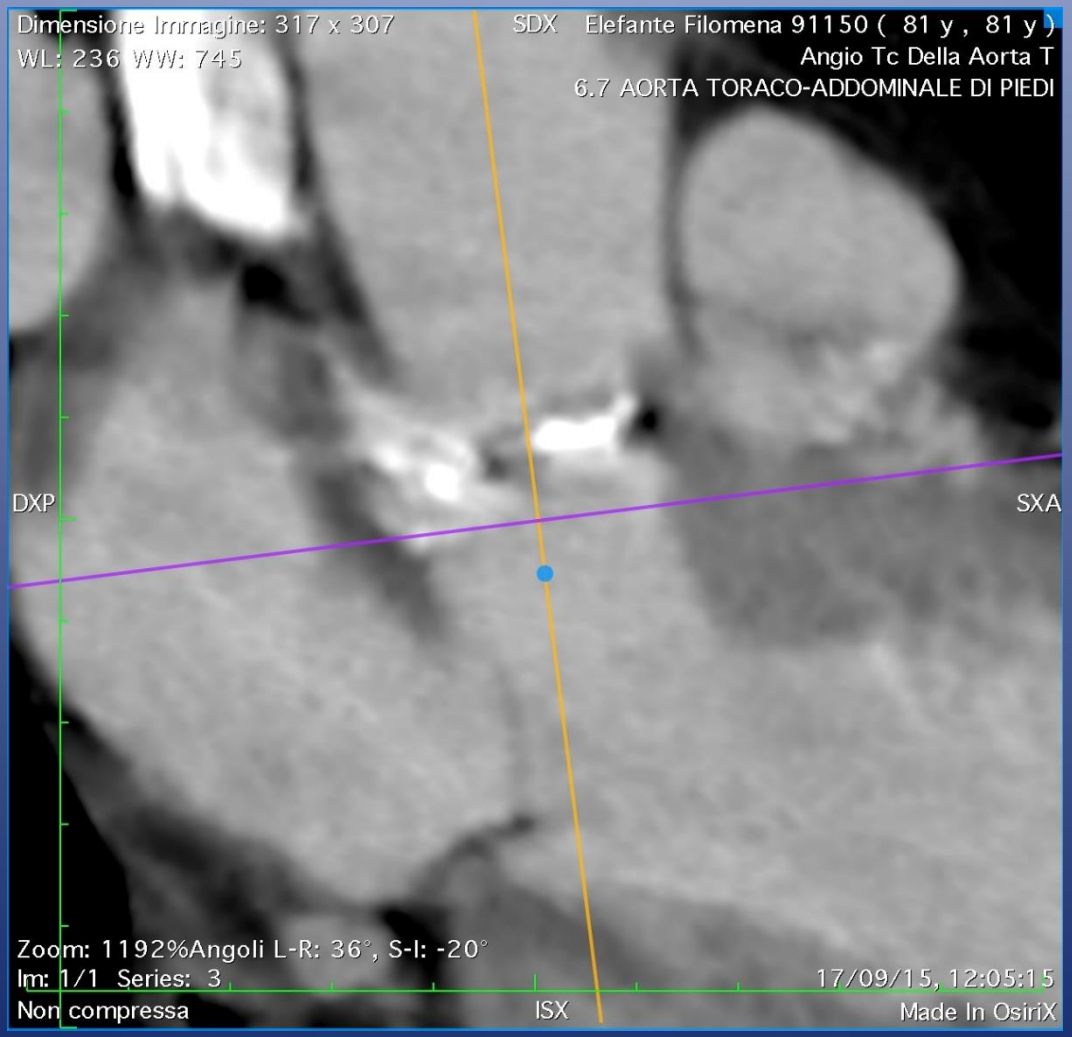
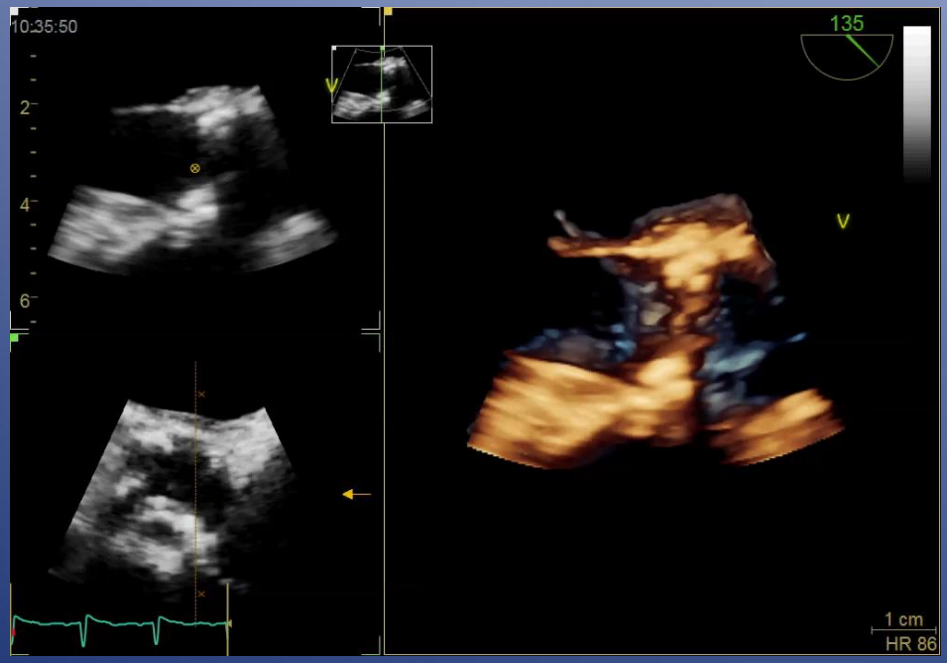
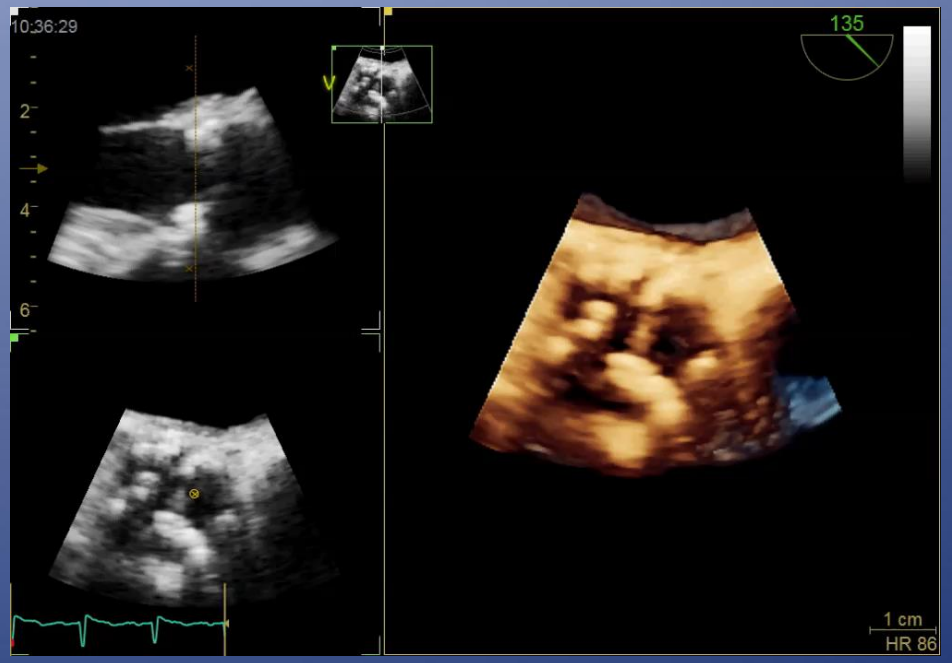
St Ao BPCO IRC
……TAC subottimale

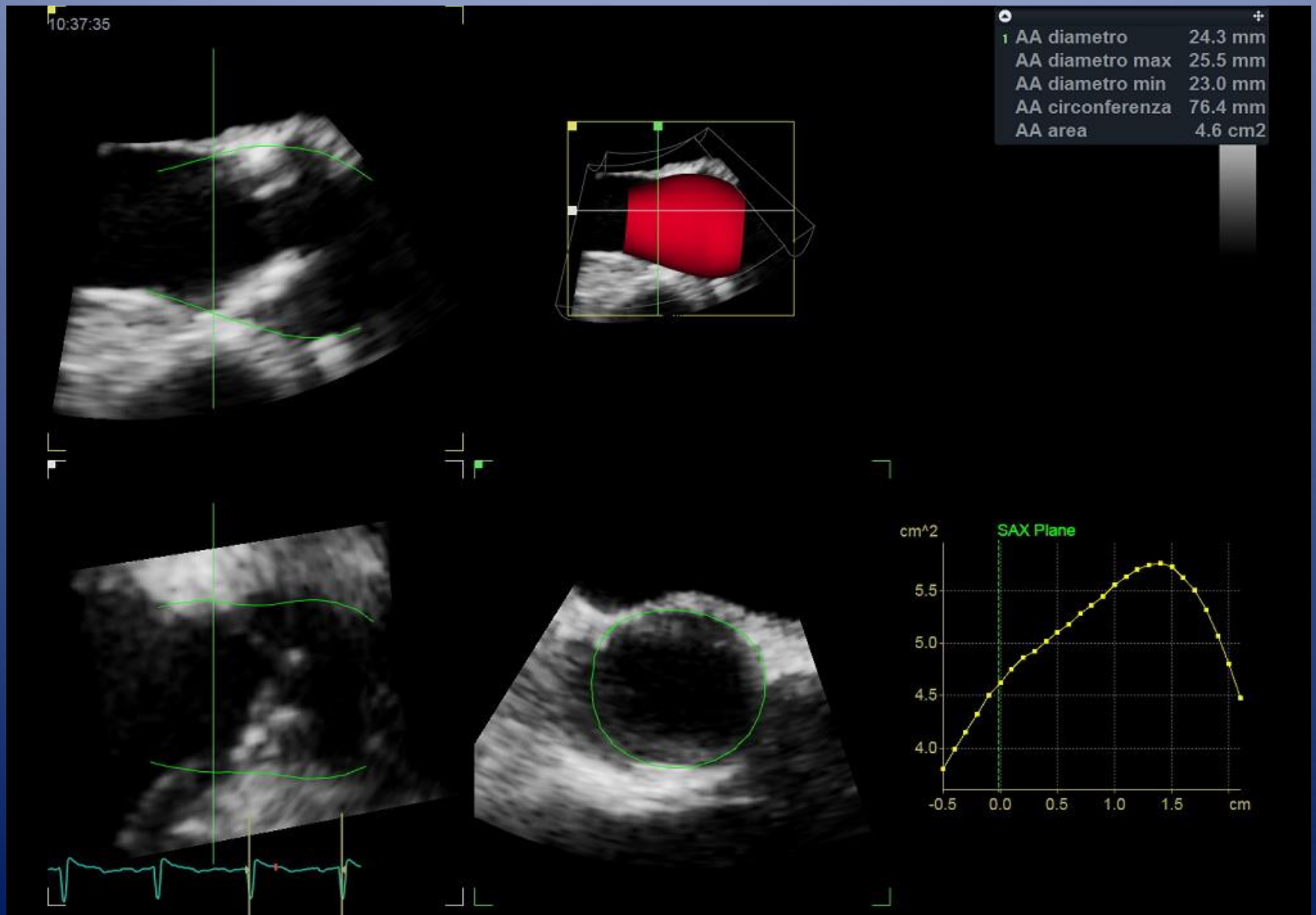


St Ao BPCO IRC
3D-RT TEE





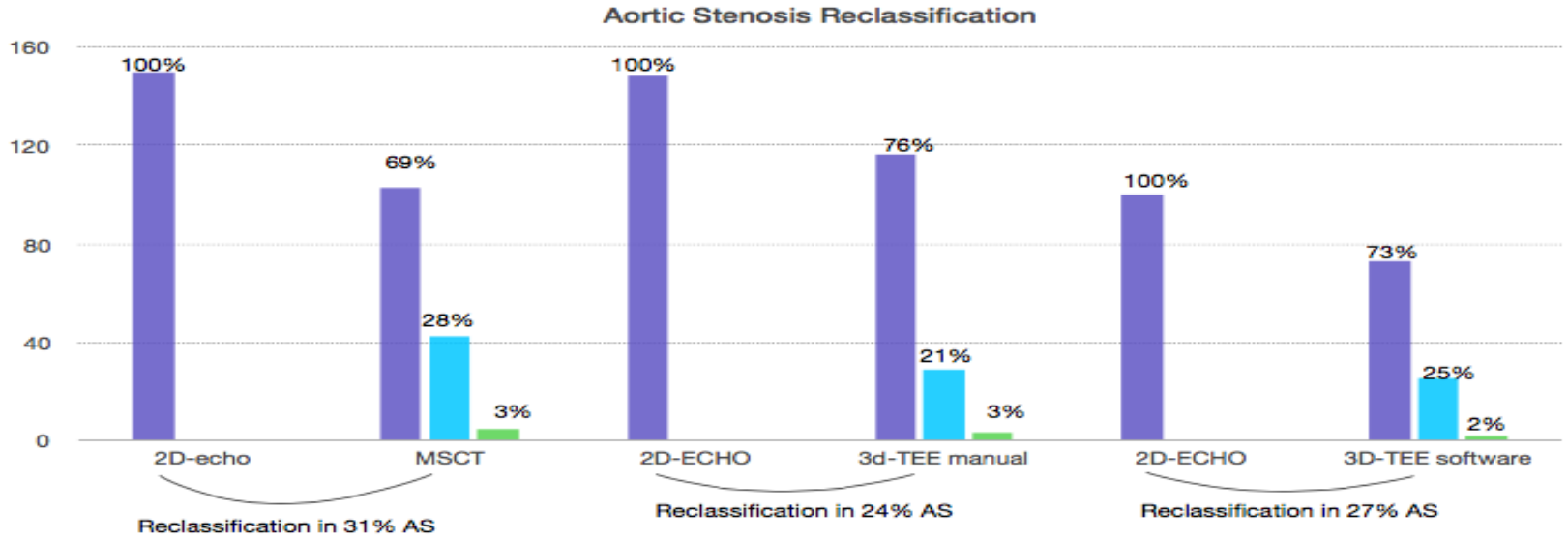
St Ao BPCO IRC
3D-RT TEE



Measurement of LVOT diameter: Implication for AVA and SV measurements

Aortic stenosis reclassification

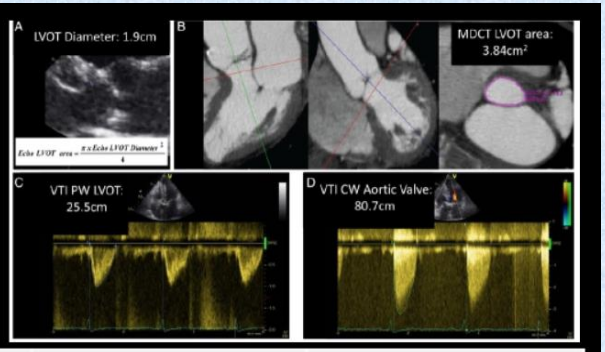
	2D-ECHO	MSCT	2D-ECHO	3D-TEE MANUAL	2D-ECHO	3D-TEE SOFTWARE
Severe AS	150	103	148	116	100	73
Moderate AS	0	42	0	29	0	25
Mild AS	0	5	0	3	0	2



Hybrid AVA:
LVOT area by MDCT and velocities by Doppler

191 patients with symptomatic severe AS undergoing TAVR

If an AVA cut-point of 1.2 cm^2 had been used: 3 % reclassified as non-severe by hybrid CT-echo method



Aortic Stenosis	Normal Flow – High Gradient	Low Flow – High Gradient	Normal Flow – Low Gradient	Low Flow – Low Gradient
Severe, n (%)	72 (100) → 70 (97)	31 (100) → 31 (100)	46 (100) → 22 (48)	42 (100) → 37 (88)
Moderate, n (%)	→ 2 (3)	→ 0 (0)	→ 24 (52)	→ 5 (12)

Kamperidis et al. Eur Heart J 2015

During procedure

Initially, TAVI was performed under **general anesthesia, and TEE guidance**

In recent years, TAVI is being performed **under conscious sedation,** and a large number of hospitals perform **TTE-guided TAVI.**

The French Transcatheter Aortic Valve Implantation (FRANCE TAVI) and FRANCE 2 registry reported that **TEE guidance decreased from 60.7 to 32.3% of all cases.**

These results suggest that TAVI performed **under local anesthesia with TTE guidance is a useful therapeutic approach preferred in clinical settings.**

TEE is justified in case of intra or peri-procedural complications

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Echocardiographic minimal approach

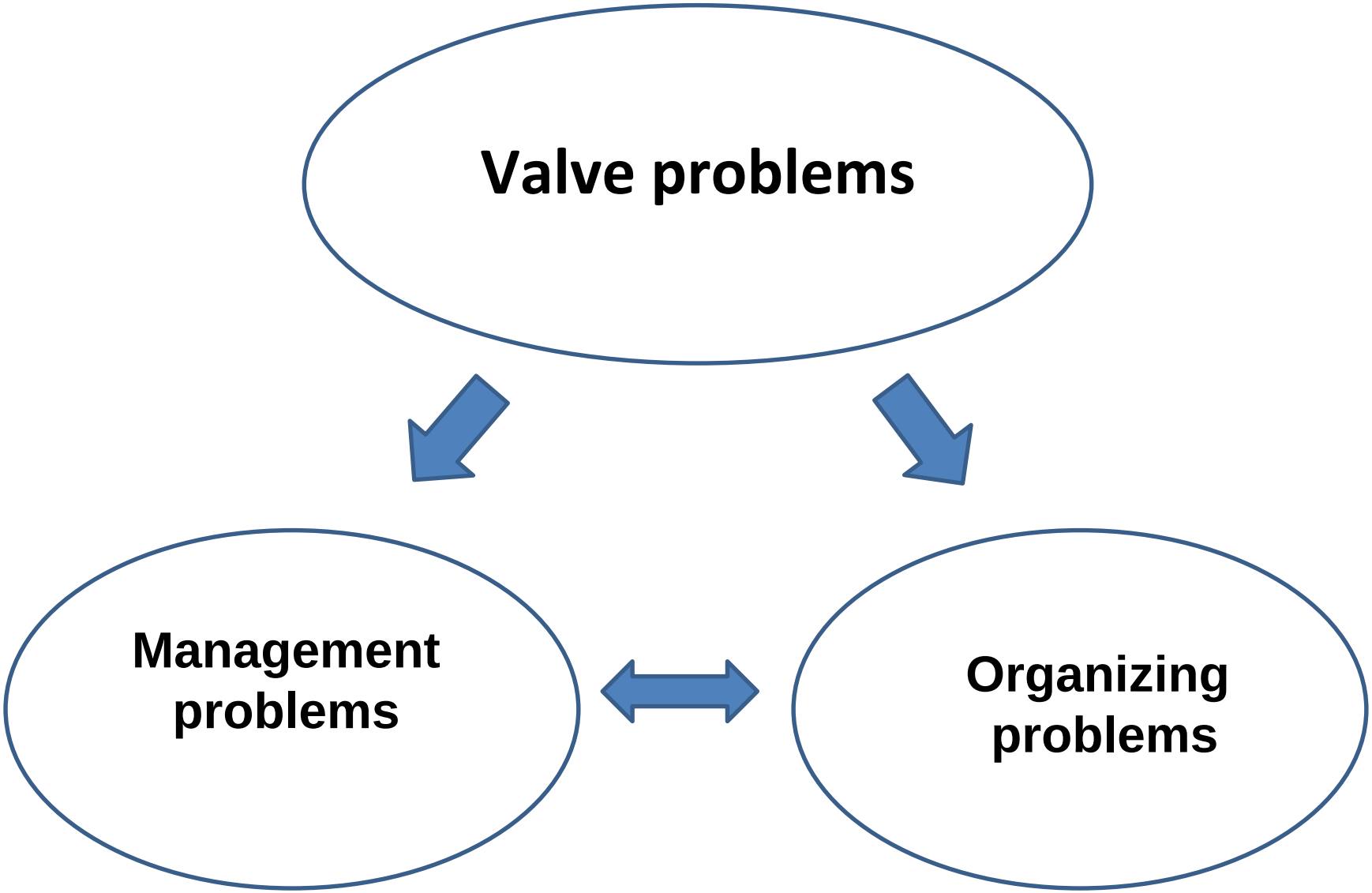
«The main findings of this study are: (i) on-demand TEE approach for TAVR is feasible and not inferior compared with TEE monitoring, allowing prompt detection of complications; (ii) TTE evaluation of PVL is reliable, exhaustive in most of cases and shows good correlation with pre-discharge assessment.»

TEE backup

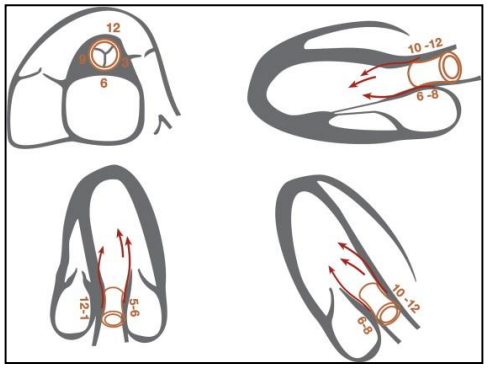
ESC European Society of Cardiology

Stella S et al. EHJ 2019

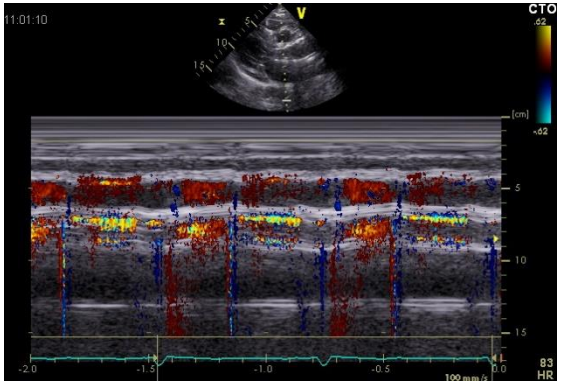
TAVI Follow-up

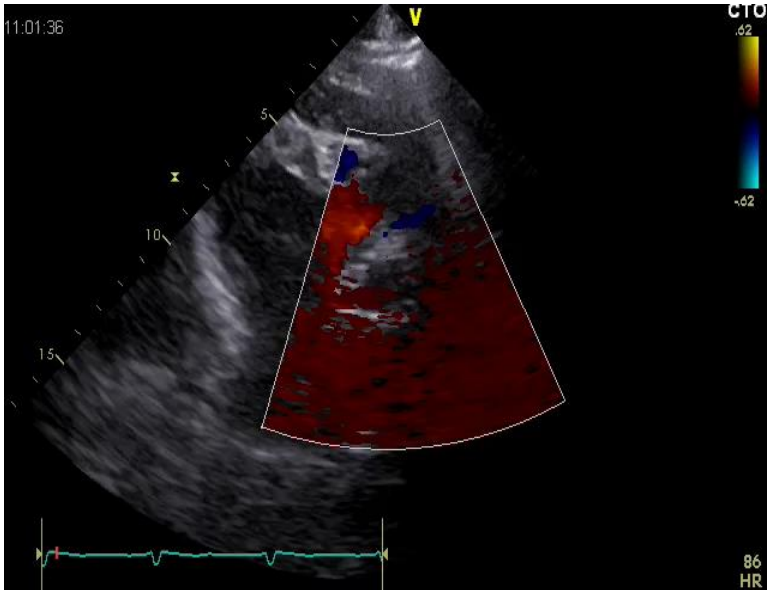


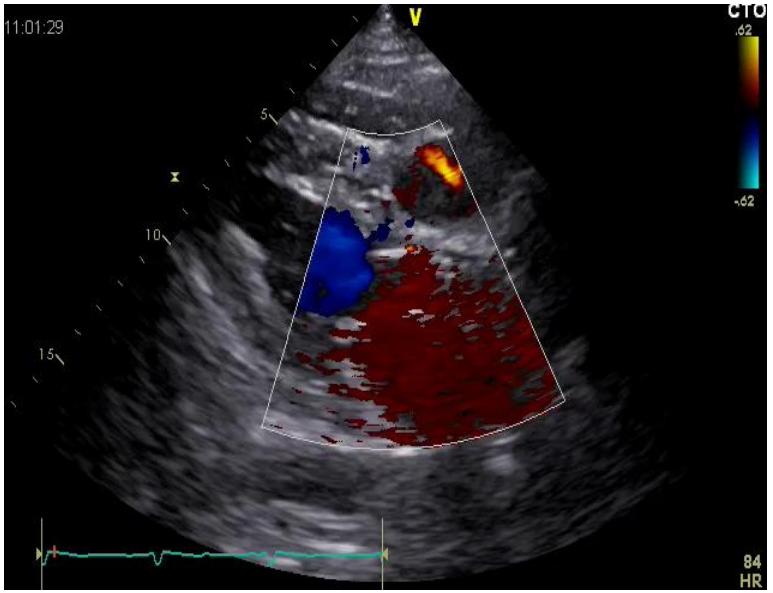
TAVI Valve Problems
Aortic regurgitation



This is **mainly paravalvular (PAR)**, and is one of the most important issues to consider during the FU of TAVI. It represents the **main current limitation** of the TAVI procedure



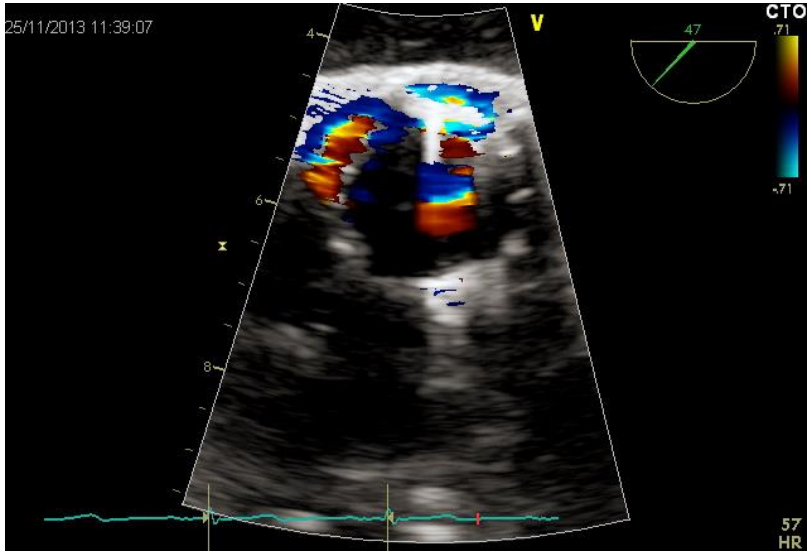




TAVI Valve Problems
Aortic regurgitation, quantification

The **echocardiographic assessment** of AR grade after TAVI is based on the **Valve Academic Research Consortium 2 (VARC2) criteria:**

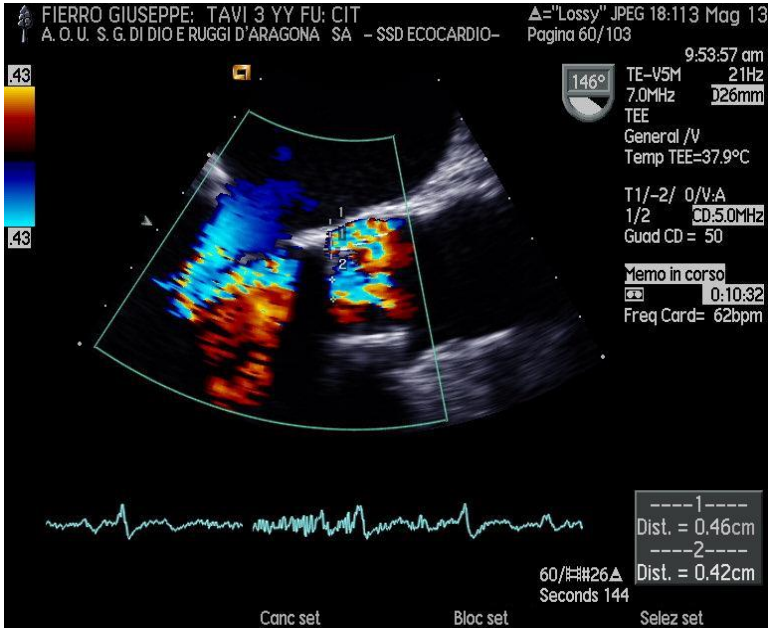
- *For PAR, eccentric or multiple jets: the proportion of the circumference of the prosthesis covered by the AR jet in the short-axis view.* ***Mild, moderate, and severe PAR are defined as <10%, 10-29% and ≥30% extent of the circumference of the prosthesis frame.***



TAVI Valve Problems
Aortic regurgitation, quantification

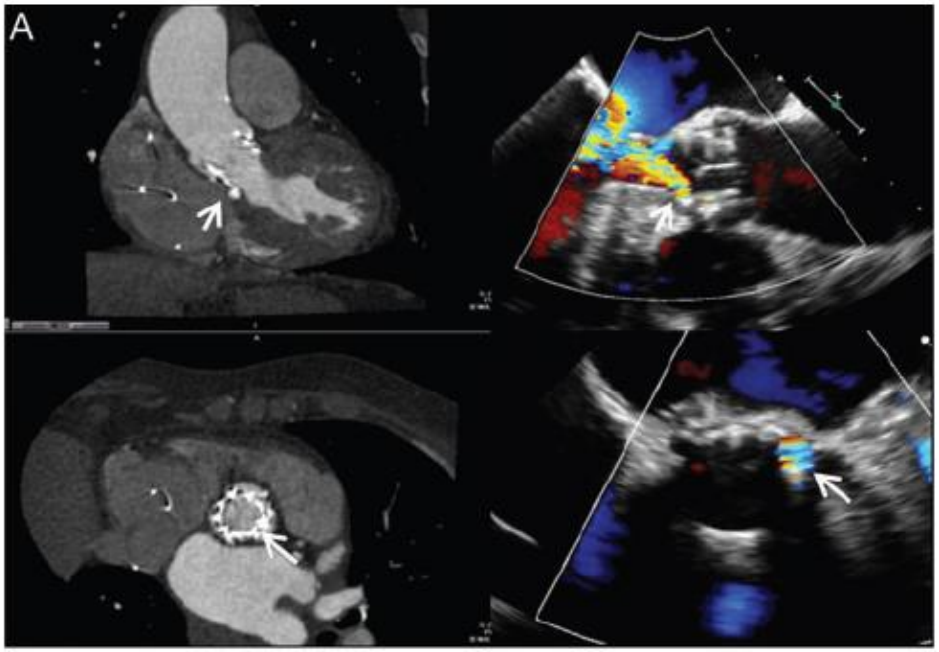
The **echocardiographic assessment** of **AR grade** after TAVI is based on the **Valve Academic Research Consortium 2 (VARC2) criteria:**

- *Regurgitant jet width relative to LV outflow tract diameter (transthoracic echo parasternal long-axis view or transesophageal echo 120°-140° view). This parameter allows a semi-quantitative assessment of transvalvular AR: grading* ***≤25%, 26-64%, ≥65% defines mild, moderate, or severe AR****, respectively.*

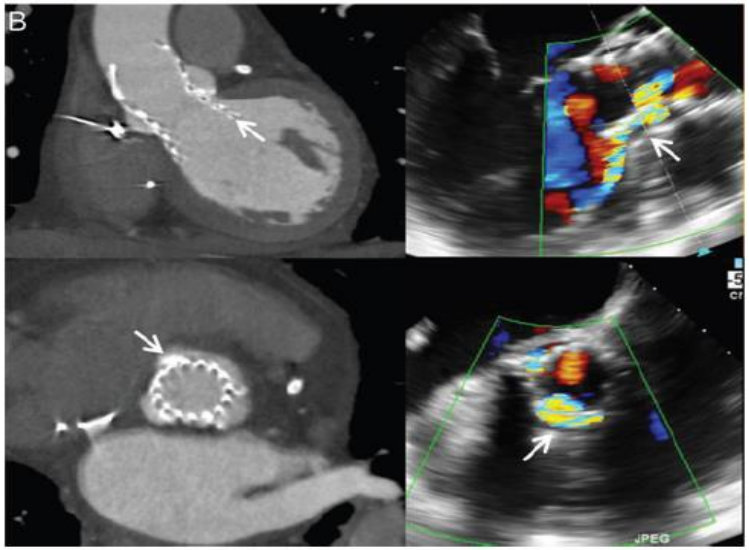


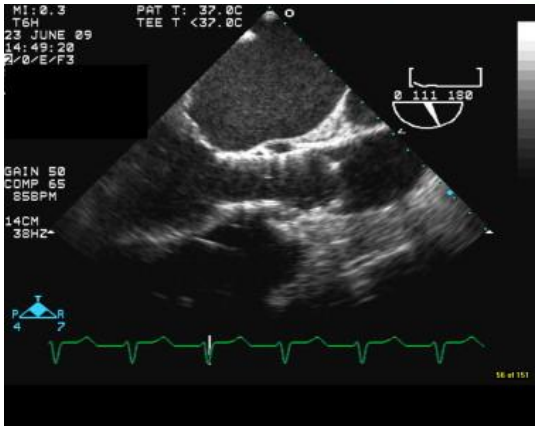
TAVI Valve Problems
Aortic regurgitation, pathophysiological determinants

Bulky calcifications



Deep implantation





TAVI Valve Problems
Aortic regurgitation, incidence

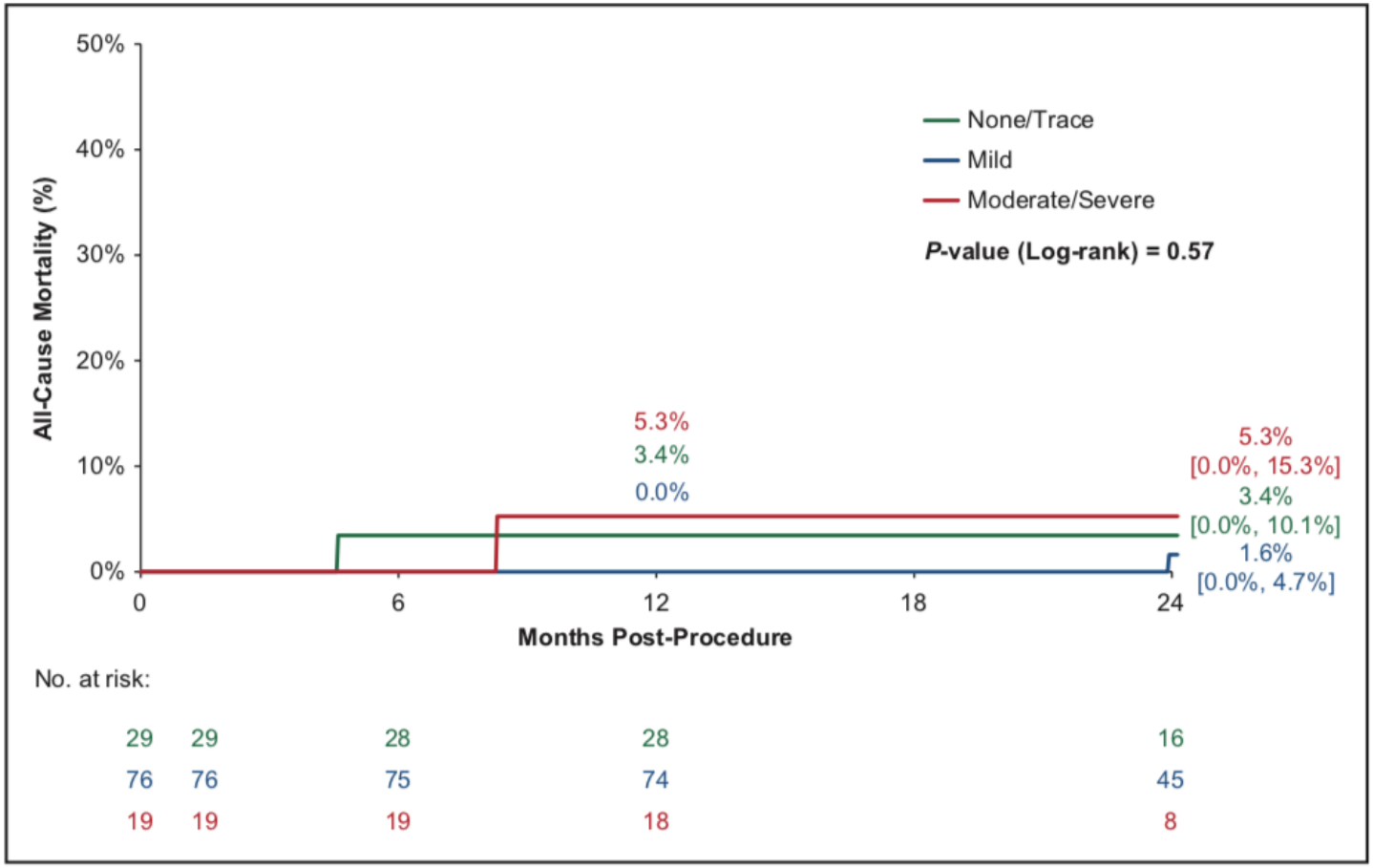
The incidence of moderate to severe AR could reach **11.7%** of patients; it increases the risk of all-cause mortality and morbidity.

The degree of AR may remain stable over time, or may worsen and deteriorate, but it may also decrease at one- and two-year FU.

Table I Incidence of aortic regurgitation after transcatheter aortic valve implantation in major registries and randomized trials

Study	No patients	Type of THV	Access route	Moderate–severe AR (%)	Moderate–severe AR at follow-up (%)	
					1-year	2-year
PARTNER cohort B[22]	179	100% Edwards SAPIEN	100% Transfemoral	13.2	—	4.5
PARTNER cohort A[21]	348	100% Edwards SAPIEN	70% Transfemoral 30% Transapical	10.6	9.2	11
SOURCE Registry[6]	1038	100% Edwards SAPIEN	45% Transfemoral 55% Transapical	1.9	—	—
FRANCE-2[2]	3195	70% Edwards SAPIEN 30% CoreValve	74% Transfemoral 26% Non-transfemoral	16.5	20.2	—
Canadian Registry[23]	339	18% Cribier-Edwards 82% Edwards SAPIEN	48% Transfemoral 52% Transapical	10	10	10
GARY Registry[20]	3876	53% Edwards SAPIEN 42% CoreValve 5% Other[a]	70% Transfemoral 30% Transapical	6.2	—	—
UK-TAVI Registry[3]	870	48% Edwards SAPIEN 52% CoreValve	69% Transfemoral 31% Transapical	13.6	—	—
Italian Registry of transapical TAVI[18]	774	100% Edwards SAPIEN	100% Transapical	8.8	—	—
Italian Registry (self-expandable THV)[24]	663	100% CoreValve	90% Transfemoral 10% Transsubclavian	21	—	—
PRAGMATIC Plus Registry[17]	793	43% Edwards SAPIEN 57% CoreValve	100% Transfemoral	1.9	—	—
TAVI Sentinel Pilot Registry[19]	4571	57% Edwards SAPIEN 43% CoreValve	74% Transfemoral 26% Non-transfemoral	9	—	—
STS/ACC TVT registry[4]	7710	100% Edwards SAPIEN	64% Transfemoral 36% Non-transfemoral	8.5	—	—
ADVANCE study [26]	1015	100% CoreValve	88% Transfemoral 12% Non-transfemoral	15.6	12.5	—
Popma *et al.*[27]	489	100% CoreValve	100% Transarterial	9.7	4.2	—
Adams *et al.*[25]	389	100% CoreValve	100% Transarterial	9.1	7.0	—
CHOICE trial[66]	241	50% Edwards SAPIEN 50% CoreValve	100% Transfemoral	3.7	—	—

TAVI Valve Problems
negative impact of aortic regurgitation on TAVI outcome



Søndergaard L. Circ Cardiovasc Interv 2016

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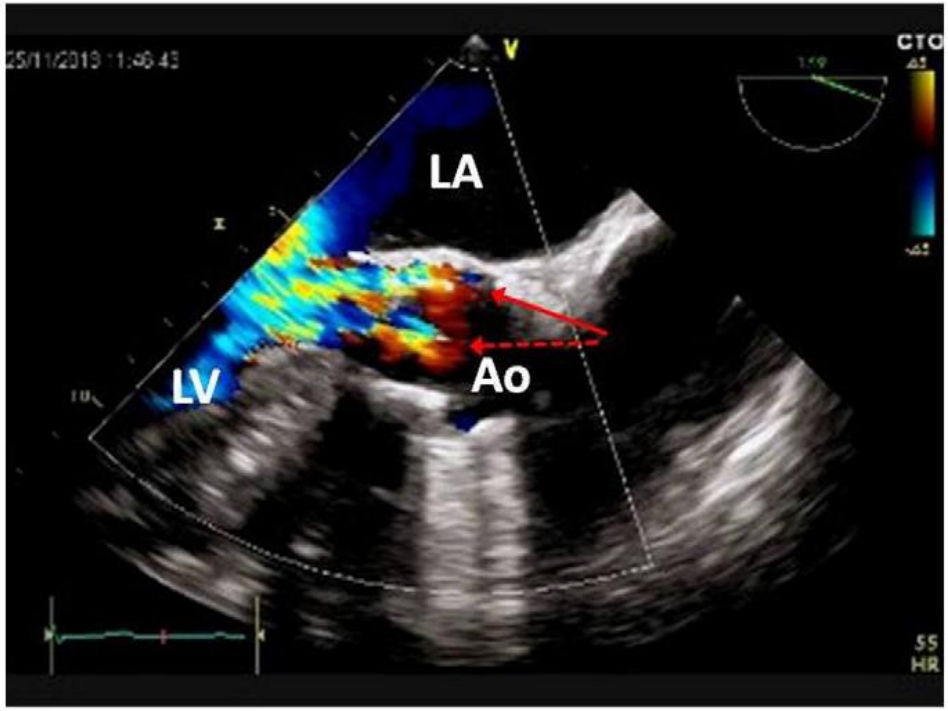
Letter to the Editor

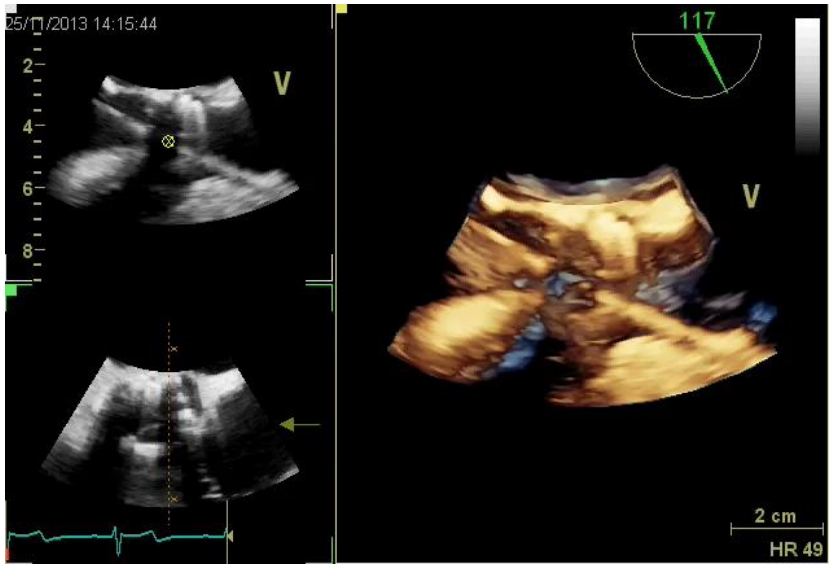
Combined percutaneous closure of paravalvular leaks and intraprosthetic regurgitation after transcatheter aortic valve implantation

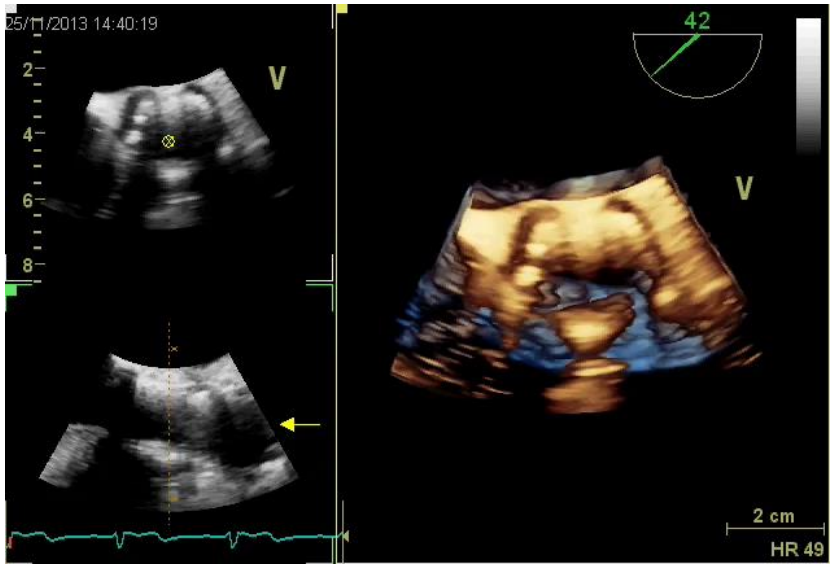
Rodolfo Citro [a,*], Tiziana Attisano [a], Francesco Vigorito [a], Armando Ugo Cavallo [a], Giovanni Vitale [a], Michela Coccia [a], Giuseppe Santoro [b], Pietro Giudice [a]

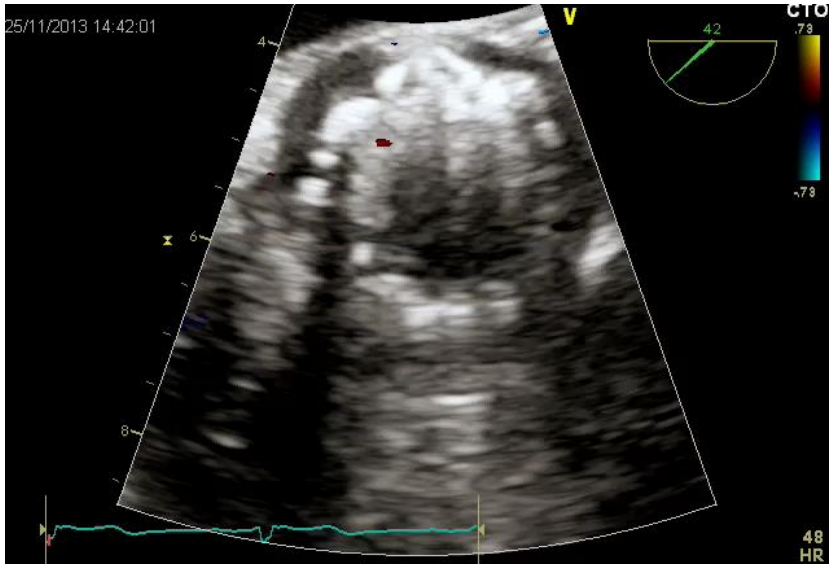


71-year-old man underwent TAVI (23-mm Edwards Sapien) 5 years before

Posterior paravalvular leak with holodiastolic flow reversal and central intraprosthetic regurgitation



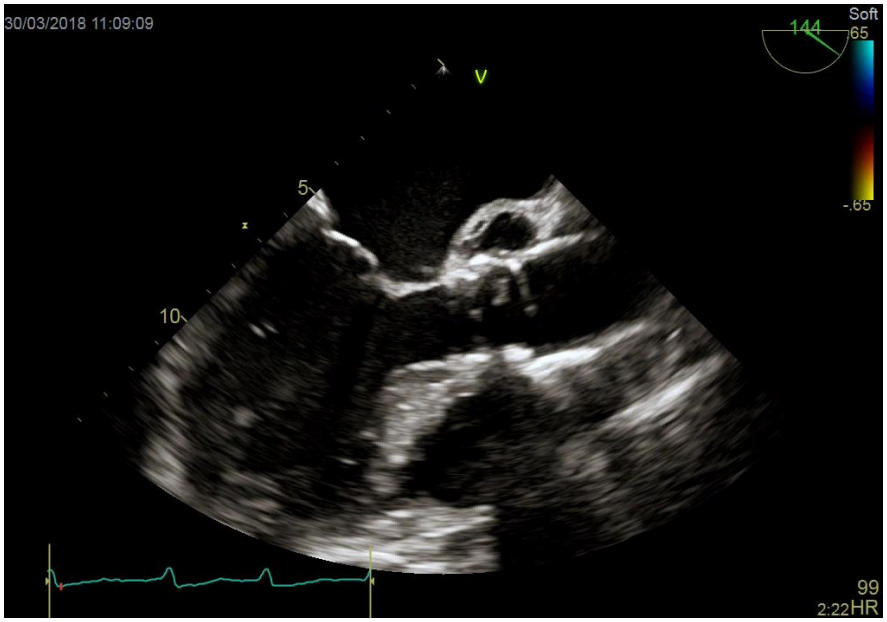


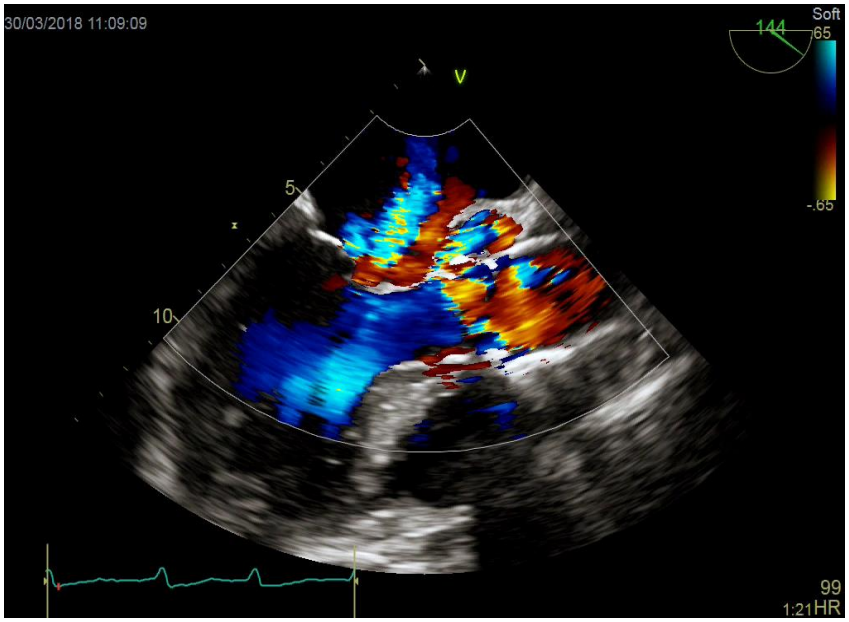


CoreValve bioprosthesis in the aortic root and the two **Amplatzer Vascular Plug** devices filling the paravalvular leak.

Clinical case

An unreported complication of transcatheter aortic valve replacement via transfemoral approach: aortic root – left atrium fistulization





Iesu S. Citro R. et al *in press*

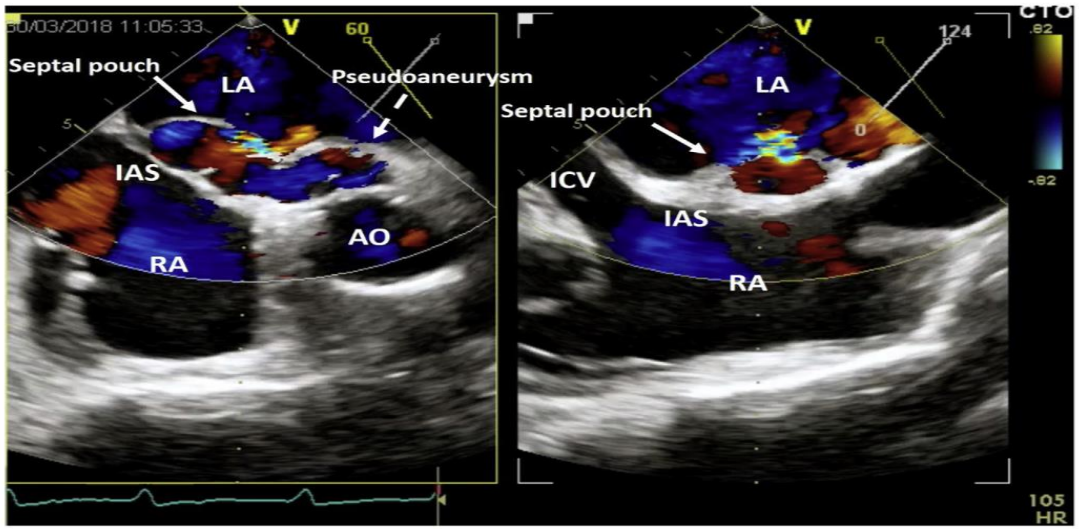
IMAGING VIGNETTE: CLINICAL VIGNETTE

A Rare Complication of Transcatheter Aortic Valve Replacement

Aortic Root–Left Atrium Fistulization

Severino Iesu, MD, Francesco Vigorito, MD, Giuseppe Iuliano, MD, Paolo Masiello, MD, Rodolfo Citro, MD, PhD

FIGURE 1 An Unusual Acquired Intracardiac Aseptic Shunt



JACC: CASE REPORTS

IMAGING VIGNETTE: CLINICAL VIGNETTE

A Rare Complication of Transcatheter Aortic Valve Replacement

Aortic Root–Left Atrium Fistulization

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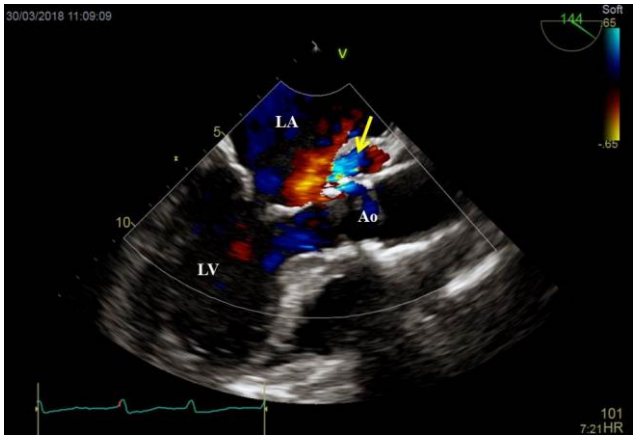
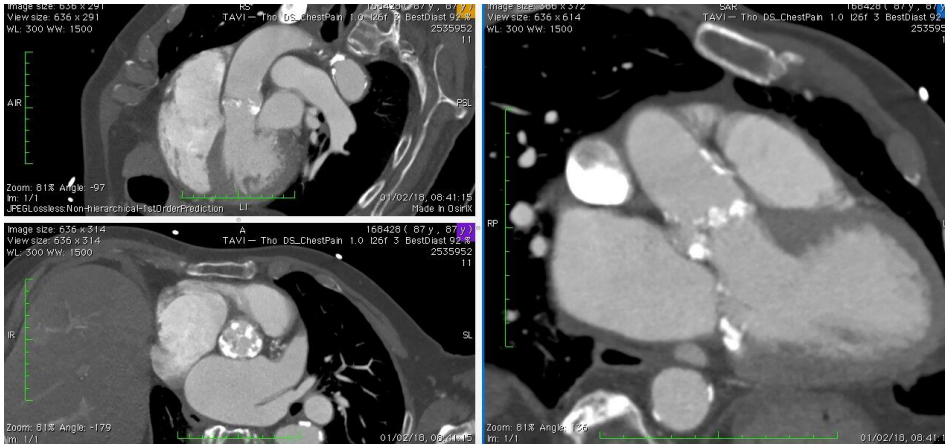
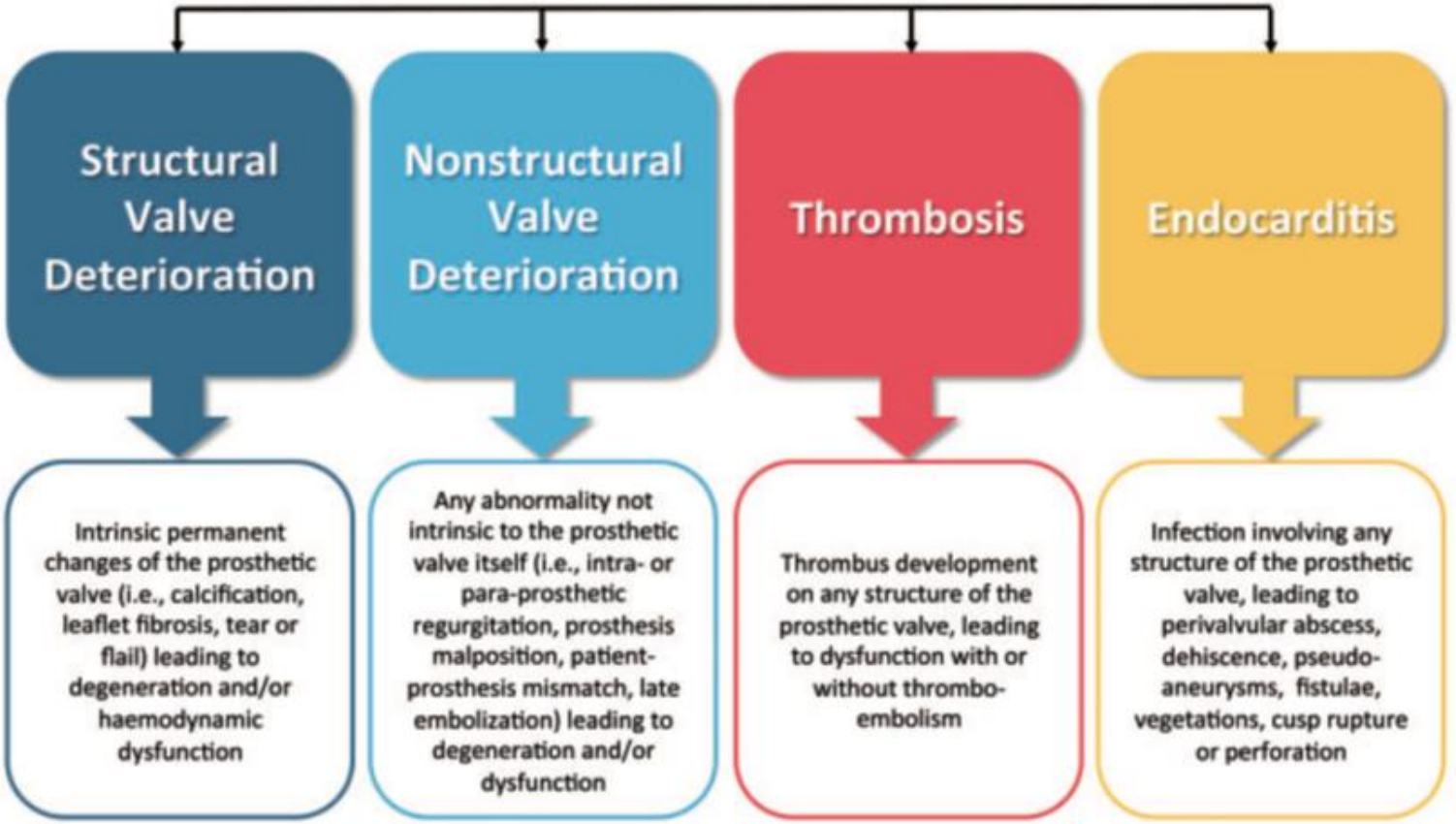




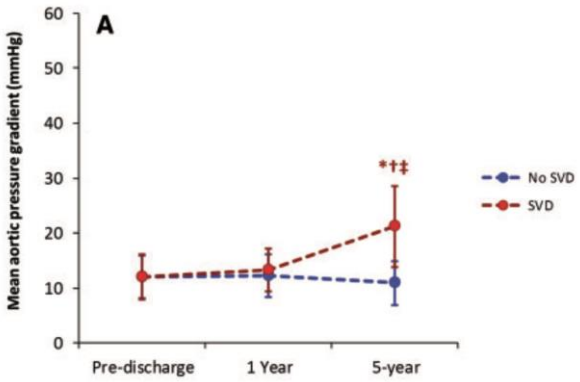
Iesu S. Citro R. et al *in press*

Bioprosthetic Valve Dysfunction

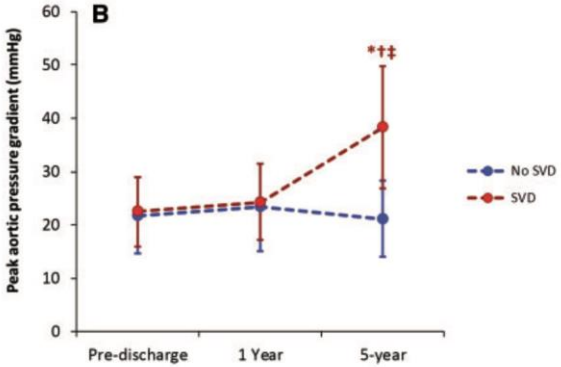


Capodanno D. et al EHJ 2017

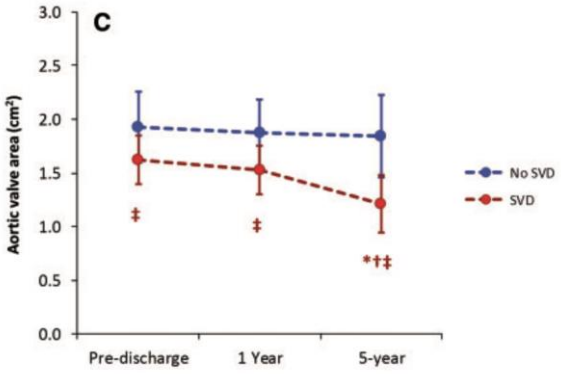
Echocardiographic evaluation of valve performance during 5 years TAVI follow-up



Δ Mean aortic pressure gradient (mmHg)



Δ Peak aortic pressure gradient (mmHg)



Δ Aortic valve area (cm2)

Muratori M. EHJ-Cardiovasc Imag 2018

TAVI structural valve deterioration

Table 3 Structural valve deterioration

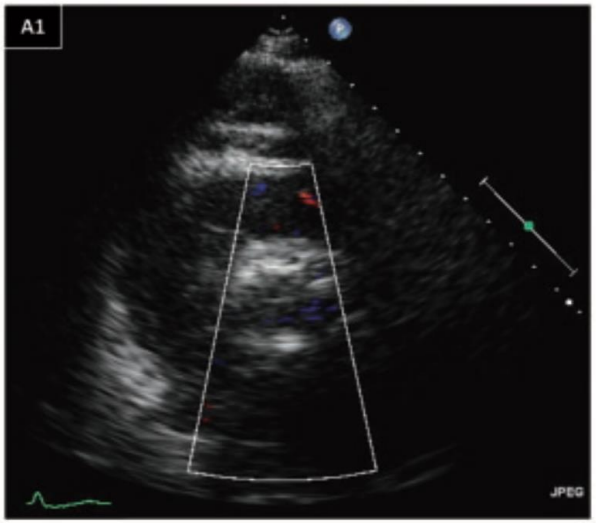
Moderate haemodynamic SVD (any of the following)
Mean transprosthetic gradient ≥20 mmHg and <40 mmHg
Mean transprosthetic gradient ≥10 and <20 mmHg change from baseline
Moderate intra-prosthetic aortic regurgitation, new or worsening (>1+/4+) from baseline
Severe haemodynamic SVD (any of the following)
Mean transprosthetic gradient ≥40 mmHg
Mean transprosthetic gradient ≥20 mmHg change from baseline
Severe intra-prosthetic aortic regurgitation, new or worsening (>2+/4+) from baseline
Morphological SVD (any of the following)
Leaflet integrity abnormality (i.e. torn or flail causing intra-frame regurgitation)
Leaflet structure abnormality (i.e. pathological thickening and/or calcification causing valvular stenosis or central regurgitation)
Leaflet function abnormality (i.e. impaired mobility resulting in stenosis and/or central regurgitation)
Strut/frame abnormality (i.e. fracture)
Haemodynamic and morphological SVD

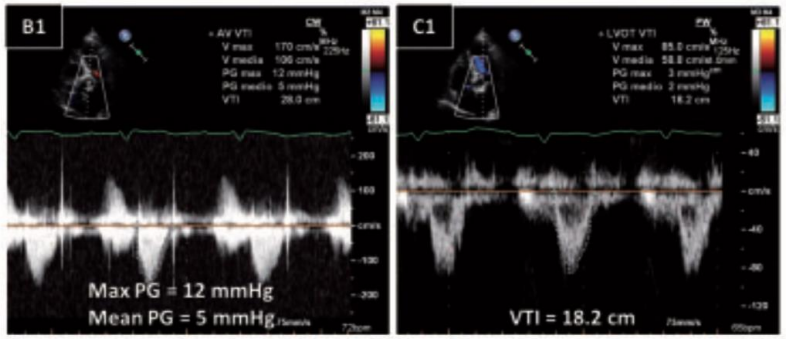
SVD, structural valve deterioration.

Capodanno D. et al EHJ 2017

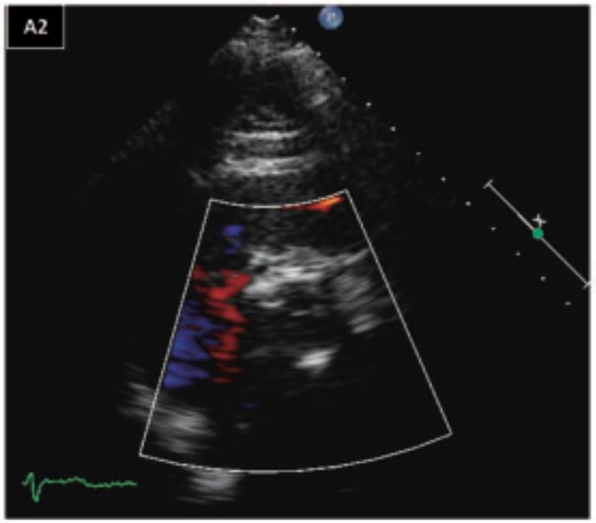
No SVD

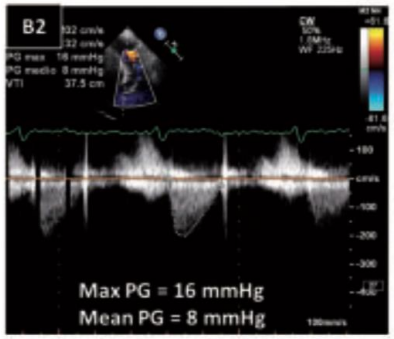
Pre-discharge

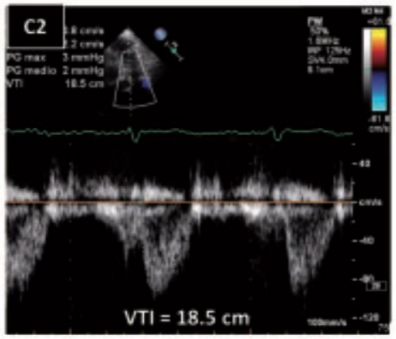




5-year FU







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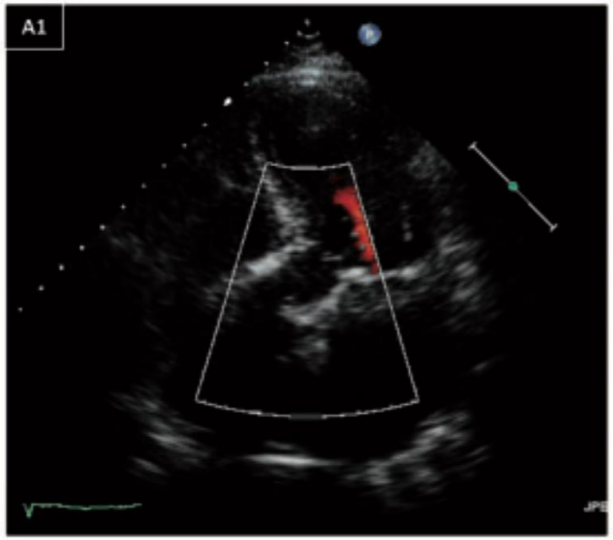
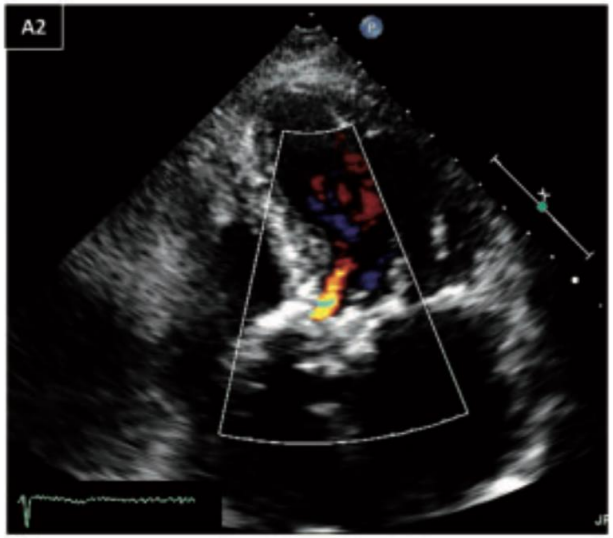
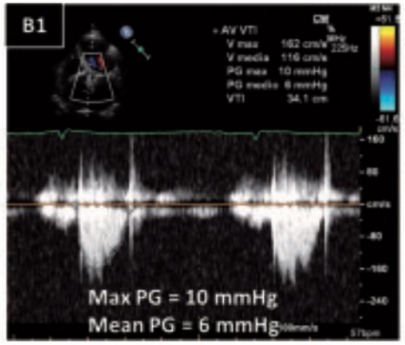
SVD

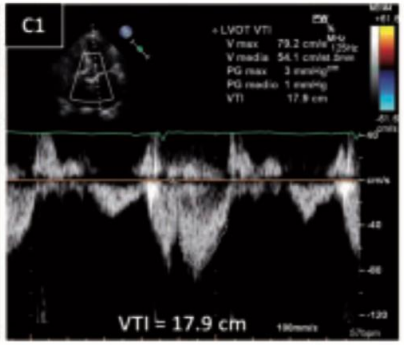
Pre-discharge

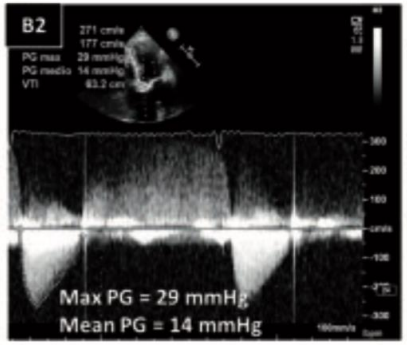
5-year FU

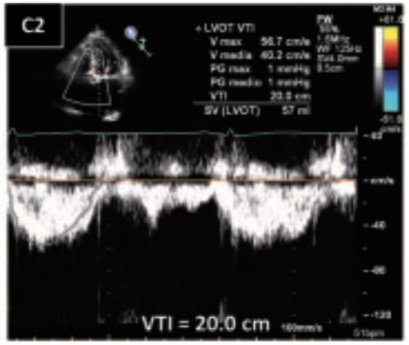












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Echocardiographic evaluation during 5 years TAVI follow-up

Table 4 Comparison of echocardiographic parameters at discharge, 1-year and 5-year follow-up after TAVI between patients without and with SVD

	No SVD ($n = 67$)				SVD ($n = 29$)				
Variables	**Pre-discharge**	**1-year**	**5-year**	**P_1-value**	**Pre-discharge**	**1-Year**	**5-year**	**P_1-value**	**P_2-value**
LVEDV index (mL/m^2)	57 ± 21	57 ± 16	54 ± 22	0.204	56 ± 20	58 ± 18	58±23	0.682	0.416
LVESV index (mL/m^2)	25 ± 16	24 ± 12	23 ± 16	0.215	26 ± 14	23 ± 10	26 ± 17	0.149	0.526
LVEF (%)	57.7 ± 9.7	60.4 ± 9.2[a]	58.5 ± 9.5	0.012	56.1 ± 9.7	61.6 ± 7.2[a]	58.6 ± 11.3	0.001	0.234
LV mass index (g/m^2)	136 ± 41	120 ± 32[a]	126 ± 38	0.001	137 ± 38	124 ± 30	125 ± 41	0.153	0.834
Left atrial volume index (mL/m^2)	57 ± 40	53 ± 35[a]	55 ± 36	0.036	53 ± 24	51 ± 22	55 ± 24	0.365	0.442
AVA (cm^2)	1.93 ± 0.34	1.87 ± 0.31	1.84 ± 0.39	0.081	1.63 ± 0.23[c]	1.53 ± 0.23[c]	1.21 ± 0.27[abc]	<0.001	<0.001
AVA index (cm^2/m^2)	1.12 ± 0.20	1.09 ± 0.20	1.06 ± 0.23	0.087	1.00 ± 0.13[c]	0.94 ± 0.13[ac]	0.75 ± 0.15[abc]	<0.001	<0.001
Mean aortic pressure gradient (mmHg)	12 ± 4	12 ± 4	11 ± 4	0.151	12 ± 4	13 ± 4	21 ± 7[abc]	<0.001	<0.001
Peak aortic pressure gradient (mmHg)	22 ± 7	23 ± 8	21 ± 7	0.098	22 ± 6	24 ± 7	38 ± 11[abc]	<0.001	<0.001
PASP (mmHg)	38 ± 10	35 ± 11[a]	38 ± 12[b]	0.001	40 ± 10	35 ± 10[a]	42 ± 14[b]	<0.001	0.108
Central aortic regurgitation ≥2	1(1%)	1(1%)	1(1%)	1.000	0(0%)	1(3%)	13(45%)[abc]	<0.001	<0.001
Paravalvular regurgitation >2	10(15%)	11(16%)	13(19%)	0.520	1(10%)	4(14%)	5(17%)	0.588	0.074

AVA pre discharge was the only indipendent predictor of SVD at multivariate analysis

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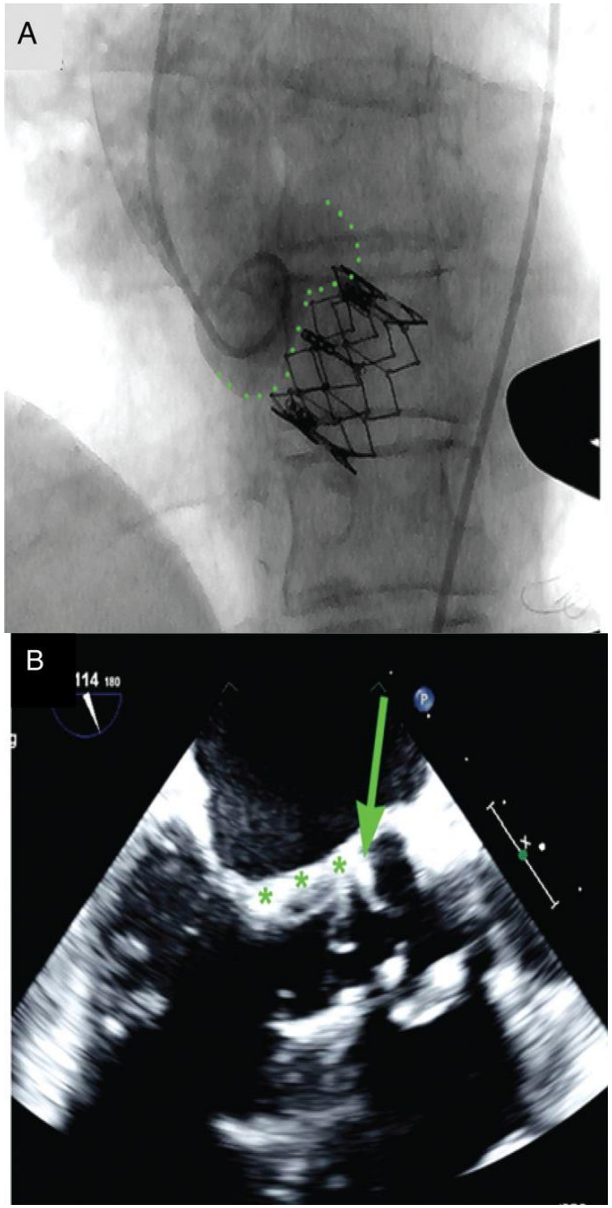
Non Structural valve disfunction
Late prosthesis embolization

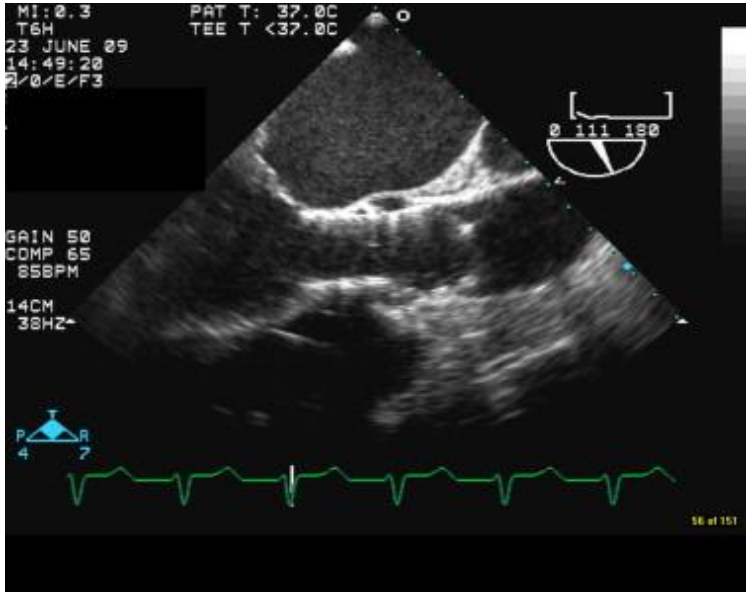
Risk factors for LPE are:

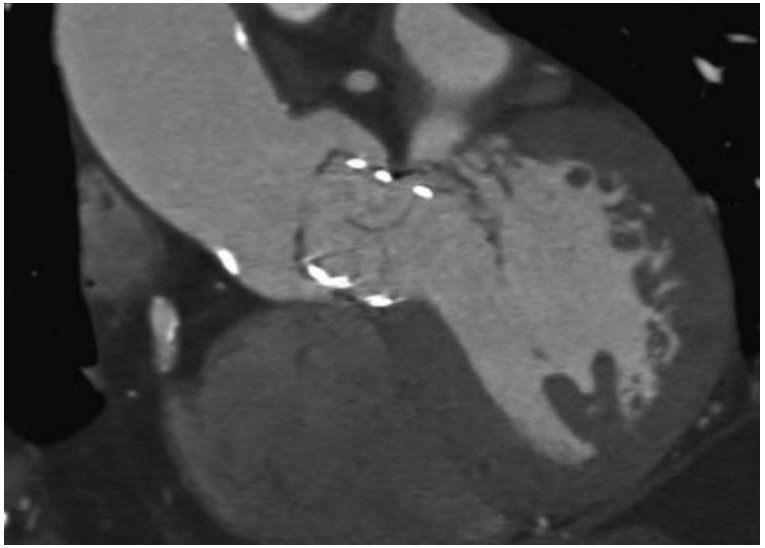
- *prosthesis undersizing,*
- *underexpansion mainly due to aortic root calcification,*
- *low implant into the LV efflux tract,*
- *bicuspid valve, large annular calcification with insufficient prosthesis anchoring,*
- *asymmetric aortic root calcification,*
- *mitral prosthetic valve,*
- *unstable prosthetic positioning,*
- *basal septal bulging*

The treatment of choice is emergent surgery.

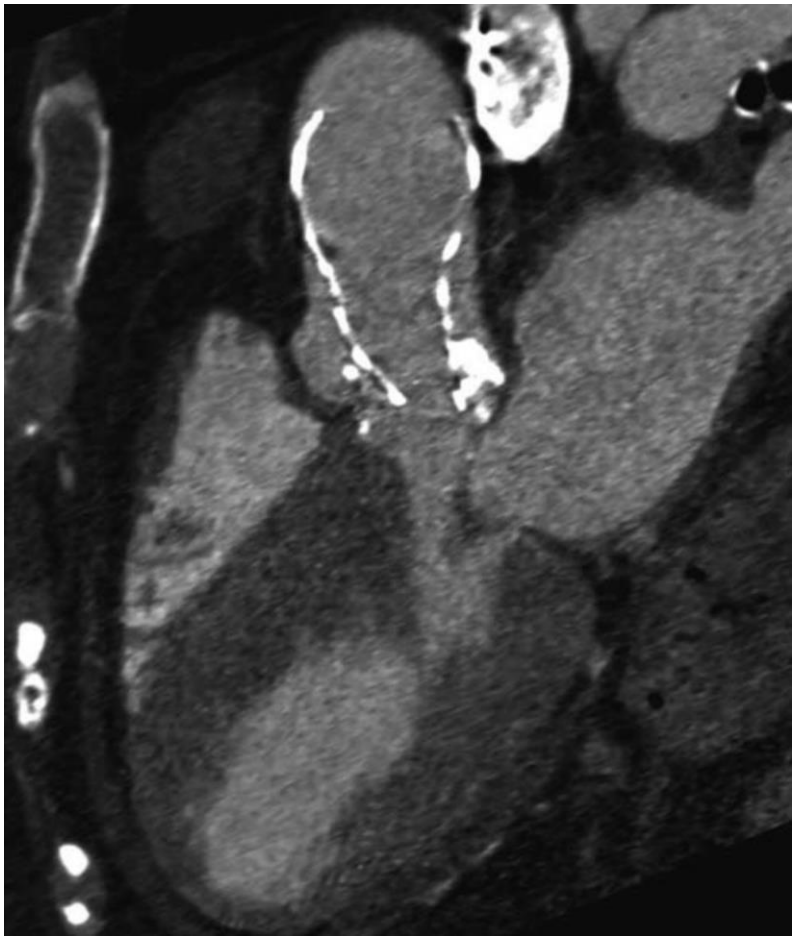


Not correct position of TAVI at MDCT





Too low



Too high

Non Structural valve disfunction
Patient prosthesis mismatch

This occurs when the effective orifice area of the prosthetic valve is too small in relation to the patient's body size and is associated with worse outcome.

This will hopefully be a **very unusual occurrence** since current TAVI prosthesis sizing relies upon **multimodality imaging.**

Severity of PPM:

- nonexistent PPM (indexed EOA > 0.85 cm_2/m_2),
-
- **moderate PPM (indexed EOA 0.65 cm_2/m_2–0.85 cm_2/m_2),**
- **severe PPM (indexed EOA < 0.65 cm_2/m_2)**

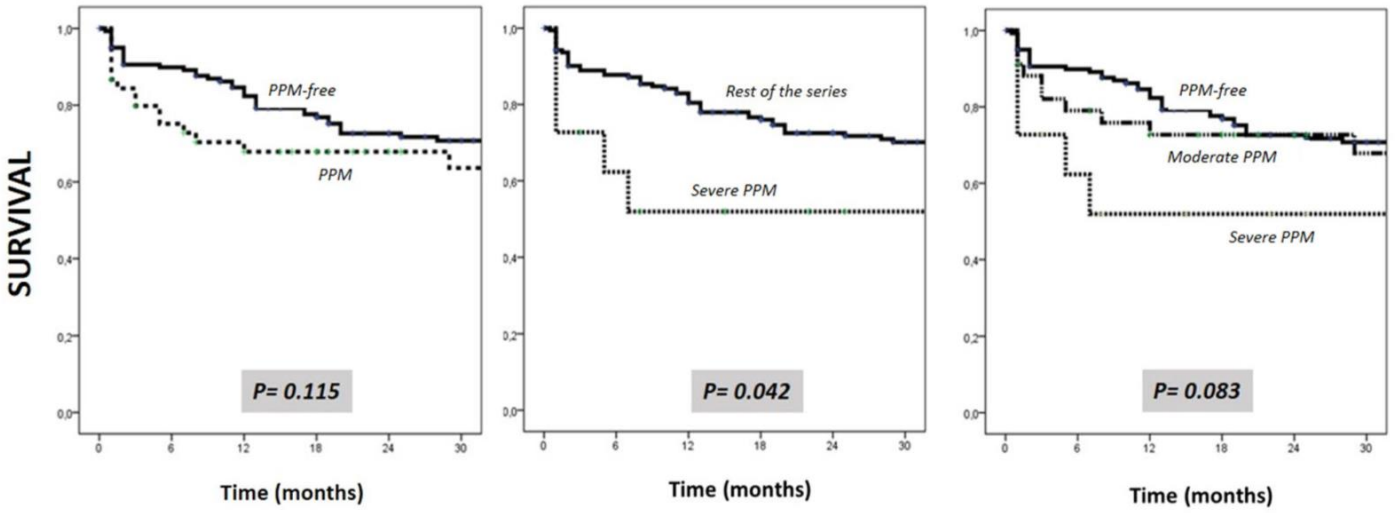
NonStructural valve disfunction
Patient prosthesis mismatch

PPM predictors

Table 3 Multivariate analysis of prosthesis-patient mismatch (PPM) associated factors

Variable	OR	95% CI	P
Associated with PPM			
Logistic EuroSCORE	1.06	1.01–1.12	***0.03***
BSA > 1.72 m^2	3.58	1.30–9.87	***0.01***
Aortic annulus	0.73	0.55–0.96	***0.03***
Associated with severe PPM			
23 mm prosthesis	17.79	1.87–169.78	***0.012***
BSA > 1.72 m^2	8.62	1.03–72.05	***0.047***

PPM and outcome



León del Pino et al. IJC 2019

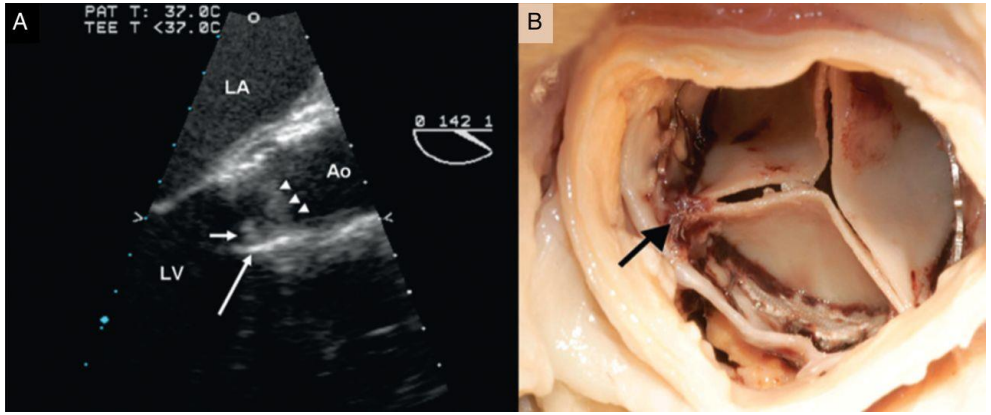
TAVI Valve Problems
Thrombosis

Thrombosis of a TAVI prosthesis is very rare (up to 0.8%) and occurs, mainly in Edwards SAPIEN prostheses, at a mean time of 9±7 months (1-24 months) after the implant

Echocardiographic findings are:

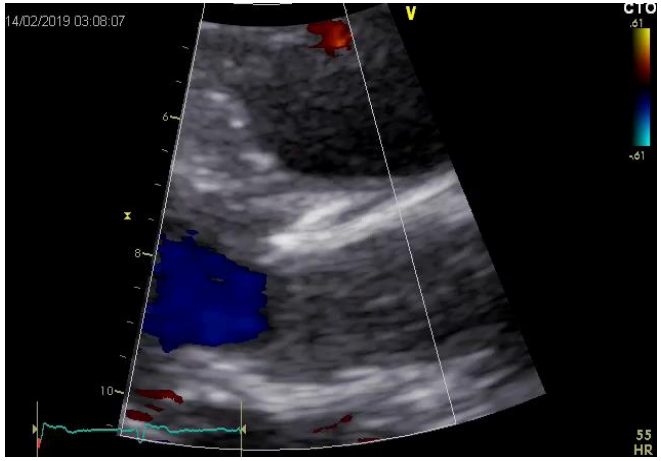
- *increased transvalvular gradients,*
- *leaflet thickening*
- *direct visualization of thrombotic formations*

The **treatment** of choice is intensive **oral anticoagulation** which can, in a relatively short time, lead to the normalization of gradients and leaflet mobility.

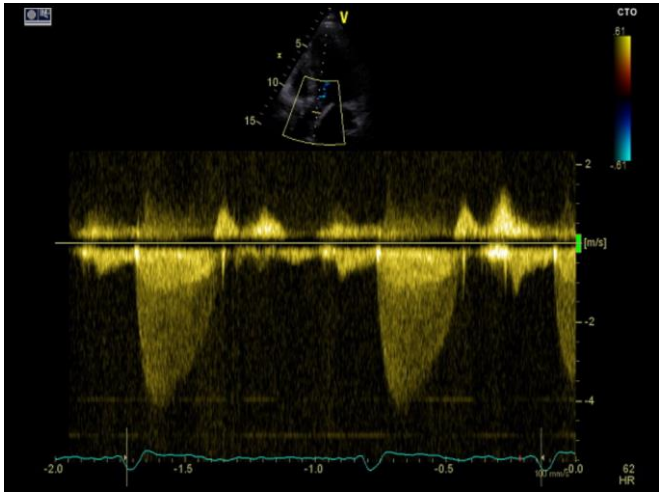


Darren Mylotte et al. Eur Heart J 2015;36:1306-1327

TAVI Valve Problems
Thrombosis

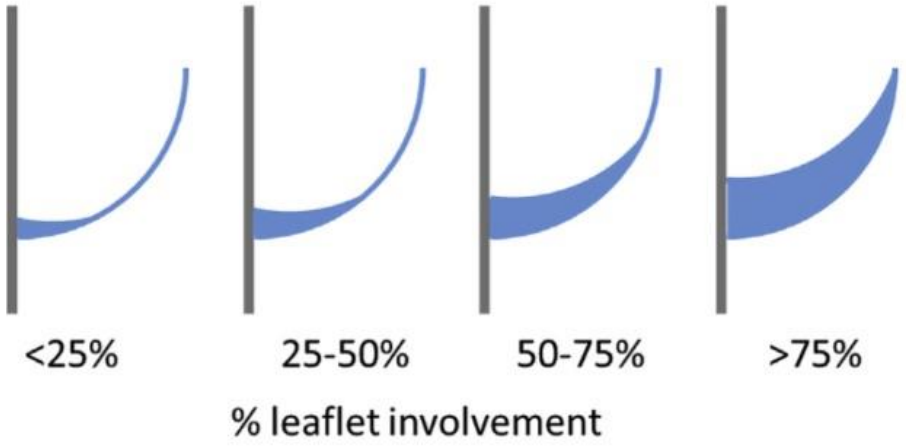


Thrombosis of anterior right cusp

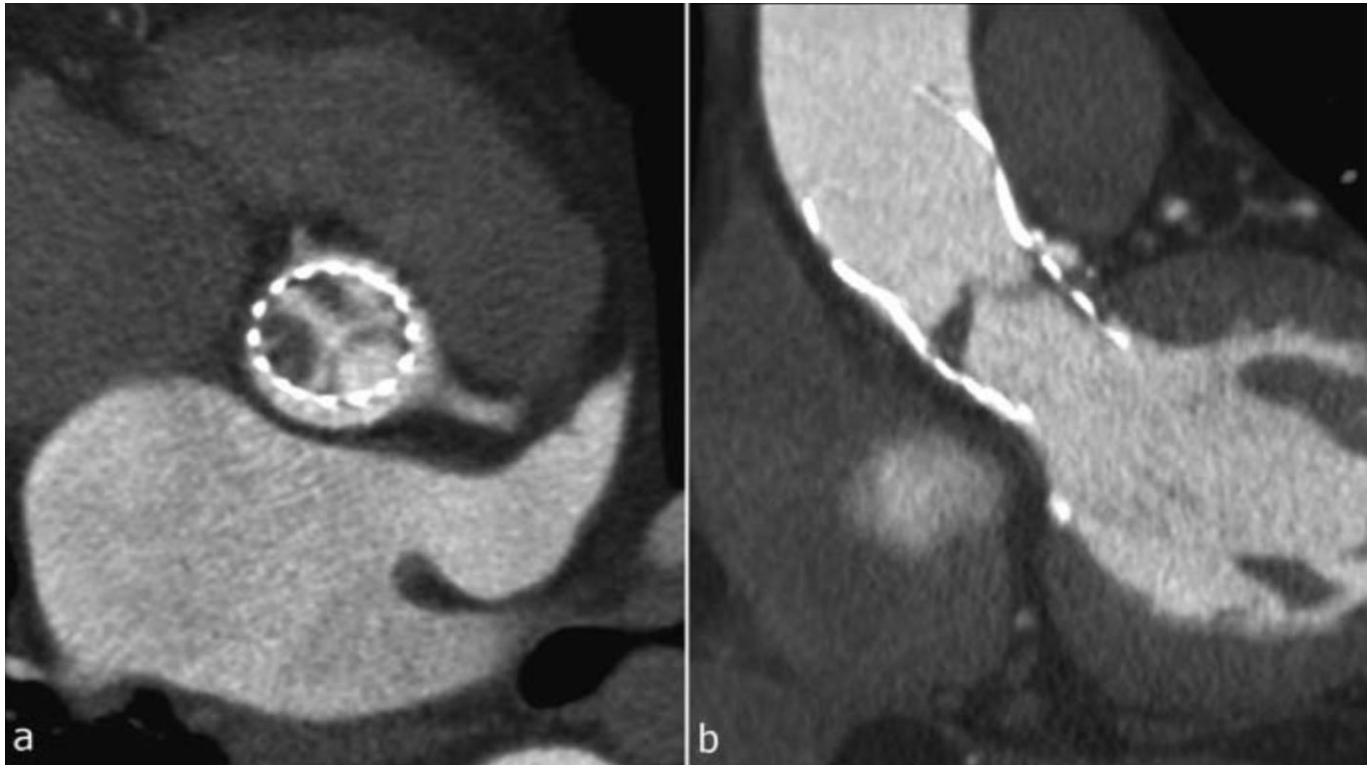


TAVI Valve Problems
Thrombosis

Hypoattenuated leaflet thickening (**HALT**) and restricted leaflet motion (also referred to as **HAM** [hypoattenuation affecting motion]) determined by CT often indicate leaflet thrombus formation

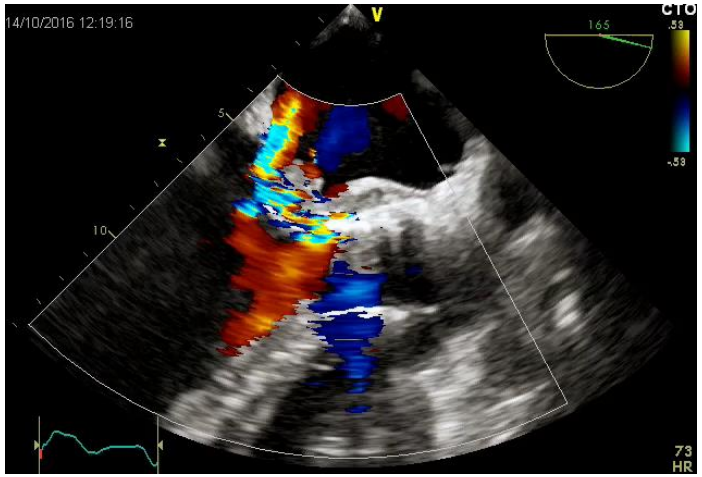


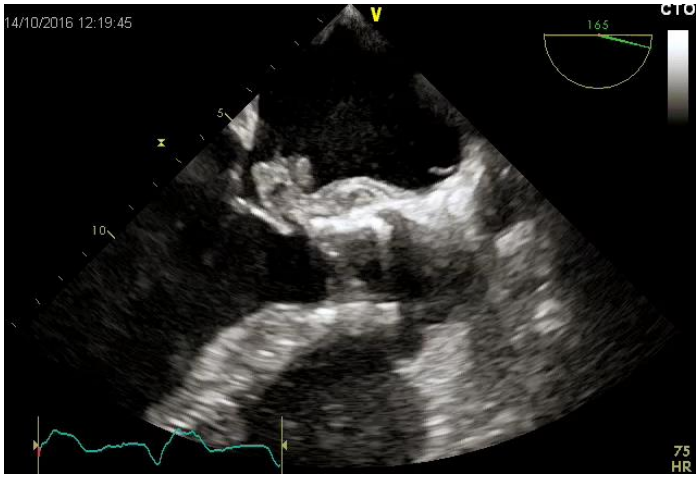
MDTC in TAVI thrombosis

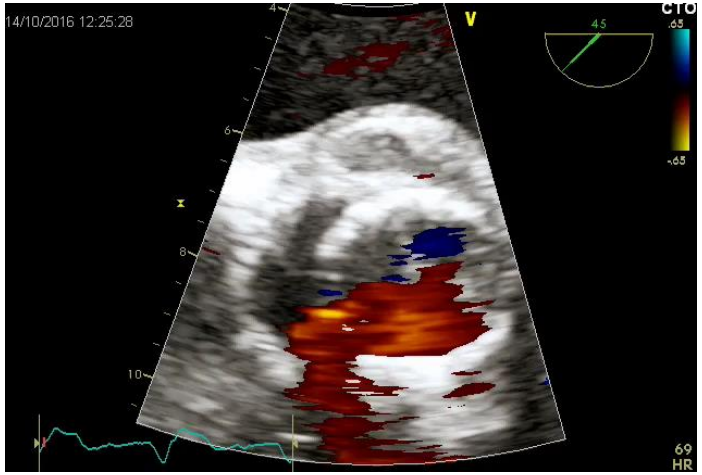


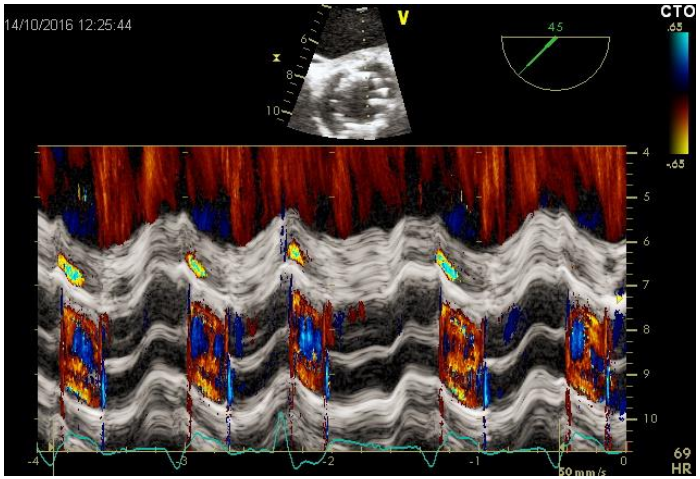
Severe leaflet thrombosis of a CoreValve-prosthesis

TAVI Valve Problems
Infective endocarditis









TAVI Valve Problems
Infective endocarditis

The incidence of TAVI IE is about 1.1%, 18% of cases occur early (<60 days), 62% in an intermediate time (60 days-1 year) and 20% during late FU (>1 year). **Specific risk factors** for TAVI prostheses are:

- *a non-sterile environment of cathlabs*
- *suboptimal valve positioning and injury to the anterior mitral leaflet*
- *failure to administer antibiotic prophylaxis before TAVI*
- *dental procedures*

Meta-Analysis Comparing the Incidence of Infective Endocarditis Following Transcatheter Aortic Valve Implantation Versus Surgical Aortic Valve Replacement

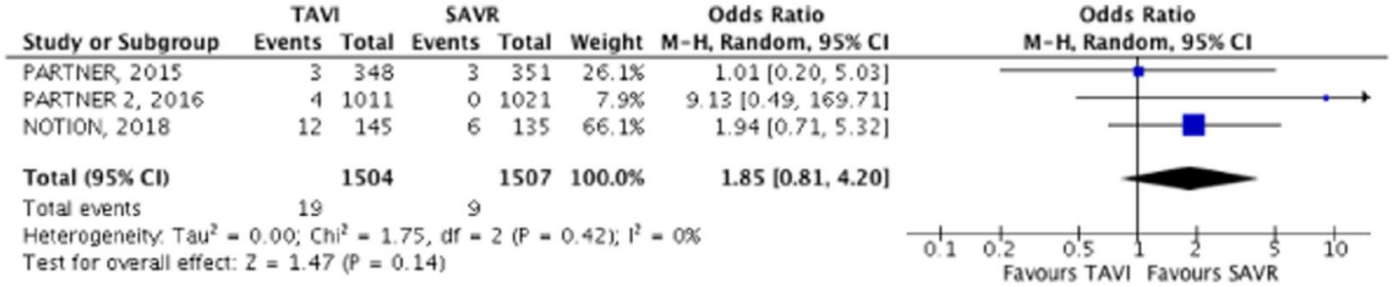


Figure 3. Forest plot of late endocarditis TAVI versus SAVR.
SAVR = surgical aortic valve replacement; TAVI = transcatheter aortic valve implantation.

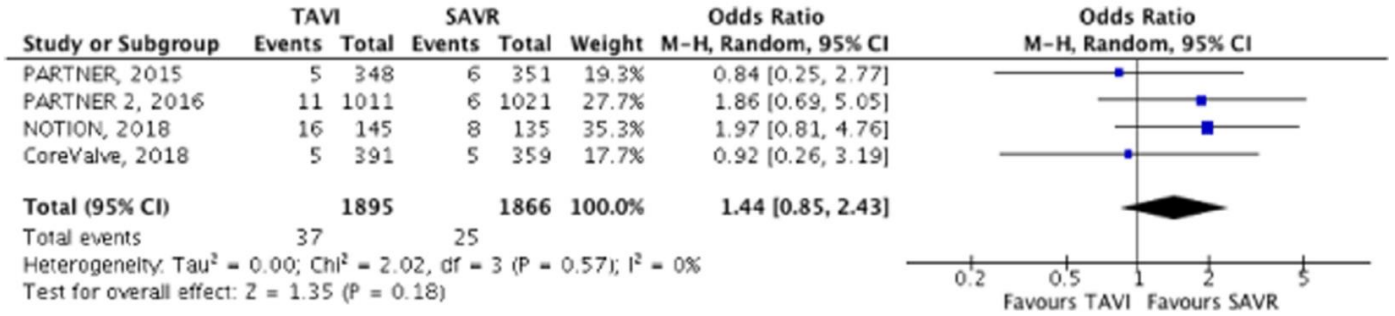


Figure 4. Forest plot of overall endocarditis TAVI versus SAVR.
SAVR = surgical aortic valve replacement; TAVI = transcatheter aortic valve implantation.

In this meta- analysis, we did ***not find an increased risk*** *of IE in TAVI compared with SAVR.*

Contents lists available at SciVerse ScienceDirect

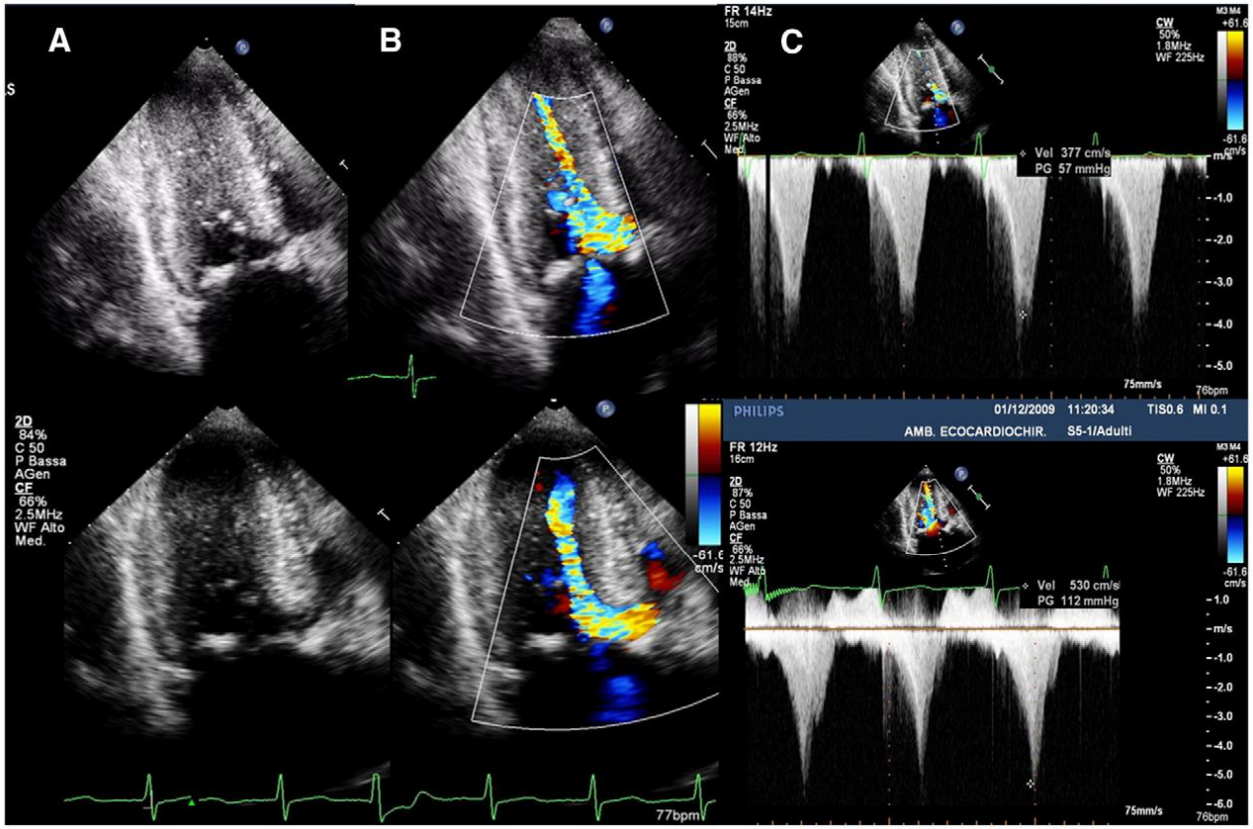
International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Letter to the Editor

Concomitant dynamic obstruction and endocarditis after "valve in valve" TAVI implantation

Rodolfo Citro [a,*], Marco Mirra [a], Cesare Baldi [a], Costantina Prota [a], Basilio Palumbo [a], Federico Piscione [a], Giovanni La Canna [b]



72 years old woman underwent "valve-in-valve" TAVI implantation

Five months later: persistent fever

TTE showed new paraprosthetic aortic regurgitation due to anterior leak with concomitant dynamic obstruction

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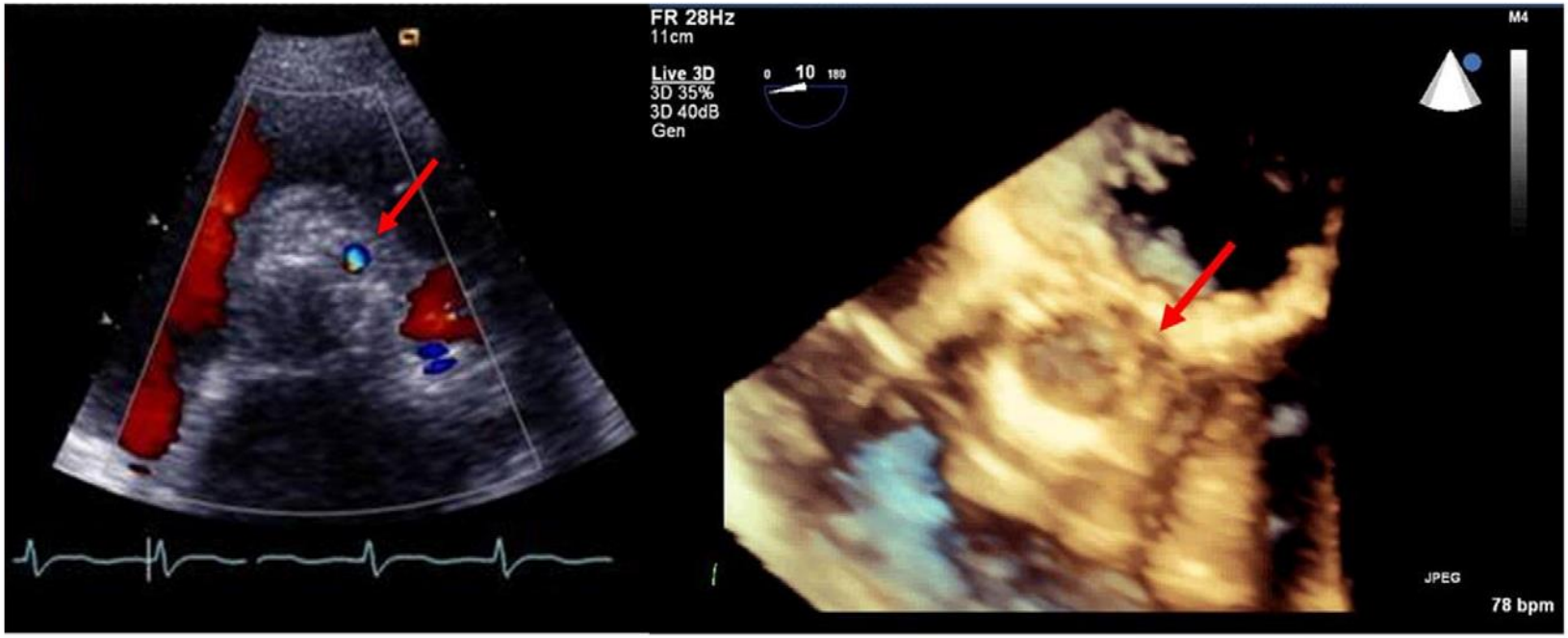


Echodense abscess with a mitro-aortic intervalvular fibrosa fistula into the LV

Recommendations for TC post-TAVI

TABLE 8 Summary of Recommendations for the Reporting of Post TAVI/TAVR and Pre-VIV Scans

Recommendation	Grade of Recommendation*
Post TAVR	
At present, routine CT imaging following TAVI/TAVR is not recommended	Strong
CT should be considered in the setting of clinical concern for valve thrombosis, infective endocarditis, or structural valve degeneration	Strong
Leaflet thickening should be described based on location, extent in length and overall thickness	Strong
Restricted motion should be reported as present or absent	Strong
Valve-in-valve	
When available the size of the surgical valve in situ should be obtained from the patient records. When this is not possible, internal diameter may be measured and used for calculating the valve to be inserted	Strong
The relationship of the uppermost aspect of the surgical valve struts to the STJ and to the coronaries should be described	Strong
When the surgical valve struts end below the level of the coronary ostia, virtual transcatheter valve to coronary ostia distances do not need to be measured.	Strong
Stentless surgical valve in valve procedures should be interpreted and reported as for native TAVI/TAVR cases regarding risk of coronary occlusion	Strong

*Based on level of consensus.

CT = computed tomography; SOV = sinus of valsalva; STJ = sinotubular junction; TAVI = transcatheter aortic valve implantation; TAVR = transcatheter aortic valve replacement.

Blanke et al JACC CI 2019

Conclusions

- **Tips and tricks for heart imagers better direct all phase of «TAVI timeline»**

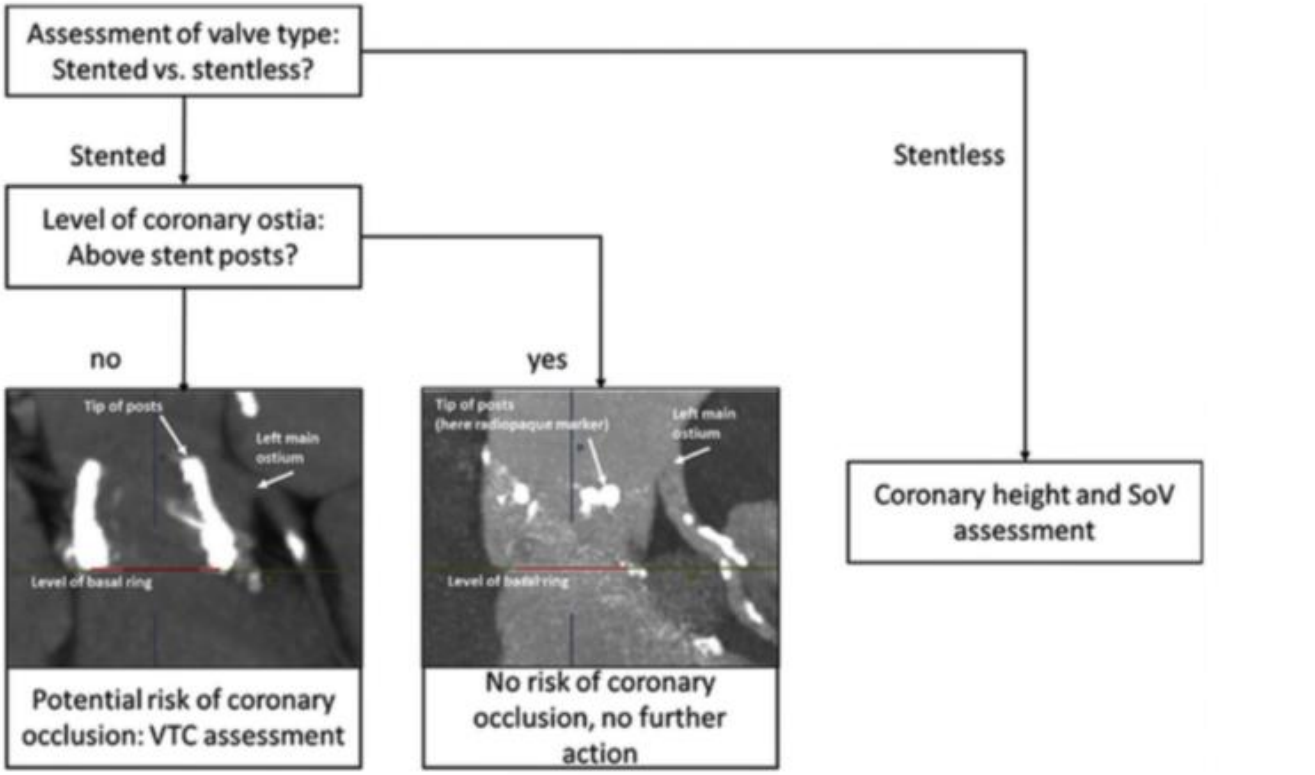
- **The care of TAVI patients does *not end with the TAVI procedure.* An intensive and *well-organized FU should be mandatory***

- ***Overall long-term function of transcatheter aortic heart valves was excellent, with an incidence of SVD of < 0,5 % at a median follow-up of 5,8 years.***

- ***Imaging (integrative value of echo and TC) plays a key role in the whole «TAVI timeline»***

Thank you

Workflow for Assessment of Coronary Obstruction Risk through TC in patients undergoing Valve in Valve Procedure



Virtual THV to coronary (VTC) distance should be assessed in patients with stented valves and coronary artery orifices originating at the level of the prosthetic heart valve.

Blanke et al JACC CI 2019

Stress Echo 2020

SOCIETÀ ITALIANA DI ECOGRAFIA CARDIOVASCOLARE

SIEC

Why Italy works

Marco Fabio Costantino, Rodolfo Citro

Project 5 : Stress echo after TAVI: focus on mitral regurgitation

Acronym:

SETA

TAVI follow-up

1st Scheduled Visit & Echo (≥ 3 months)

Clinical status
ECG
Blood tests
MACCE and other AEs
Adherence to prescriptions
Therapy optimization
± Consult with specialists

Prosthesis performance, LVEF, IM, IA, PVL

↓

± 2nd Visit & Echo (≥ 6 months)

↓

Final TAVI-FU Visit & Echo (12 months after TAVI)

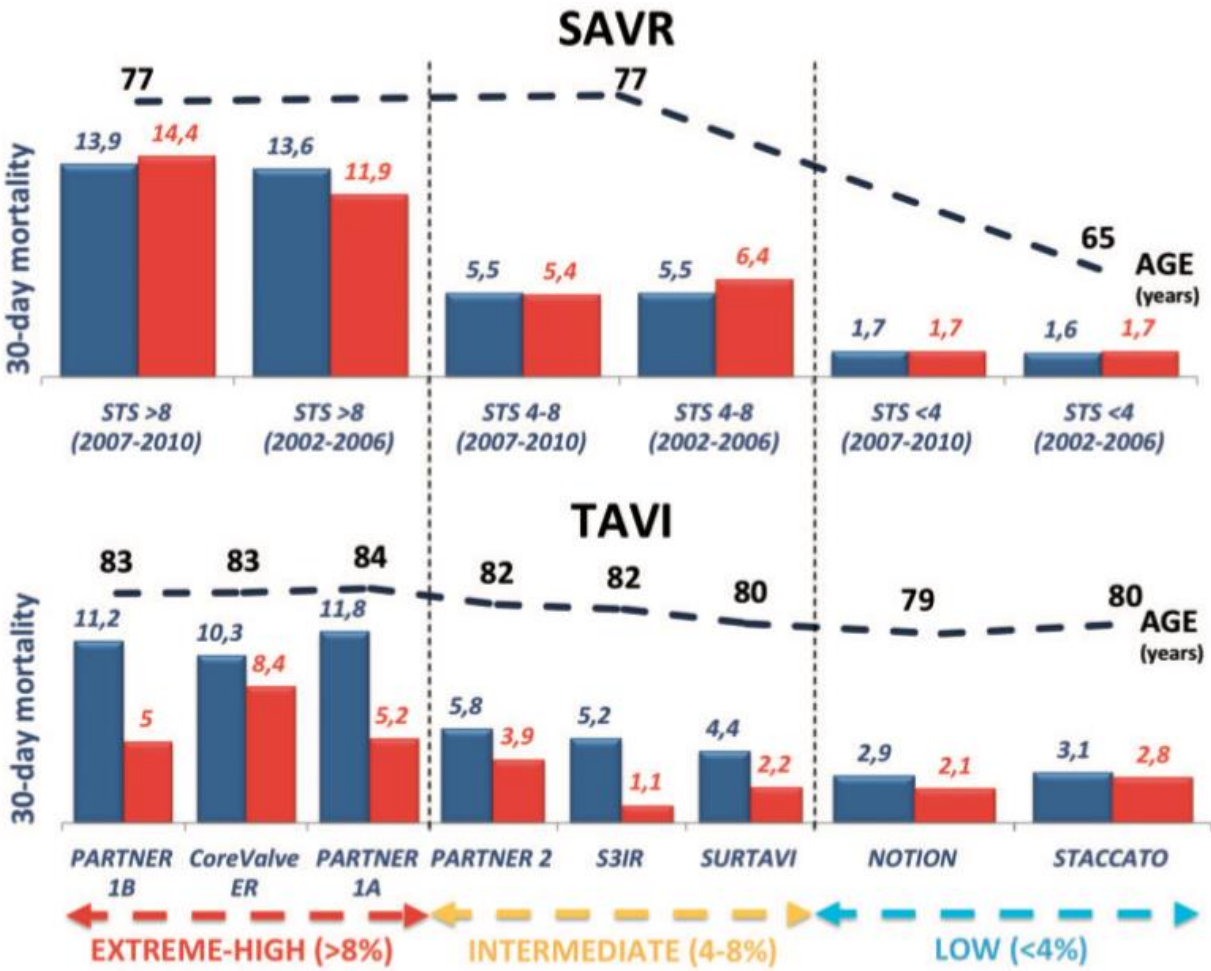
↙ ↘

Clinical & echo follow-up continued at our center (by clinical cardiologists)

Follow-up by local physicians + our periodic phone calls and/or contacts with them

…in the low-risk patient?

«The time is opportune to examine the role of TAVI in low-risk patients, currently the objective of on-going randomized trials.»



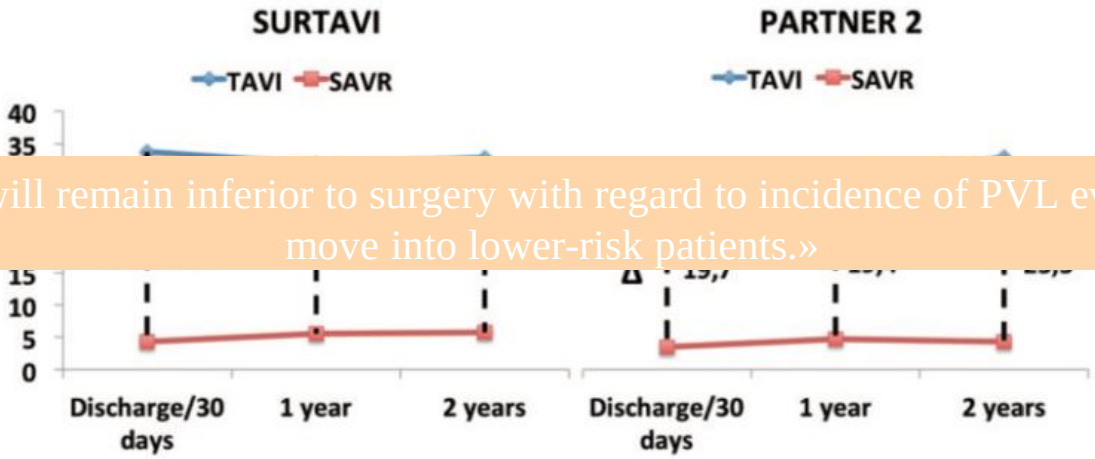
In la mortalità a 30 giorni predetta dall' STS score

In la mortalità a 30 giorni rilevata

G. Tarantini et al. European Heart Journal (2017)

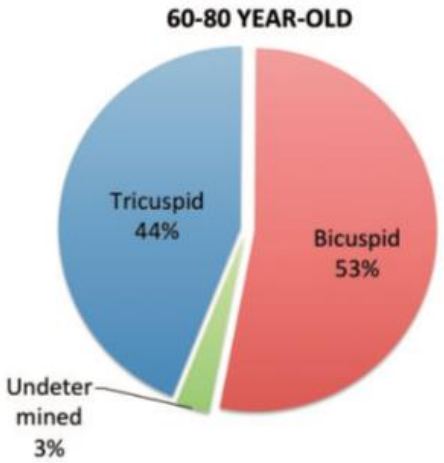
…in the low-risk patient?

Paravalvular leak

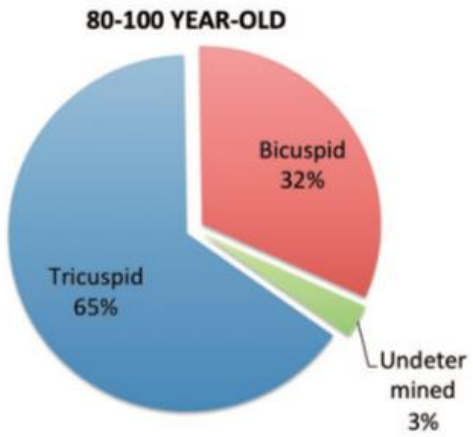


«TAVI will remain inferior to surgery with regard to incidence of PVL even as we move into lower-risk patients.»

Self-expandable



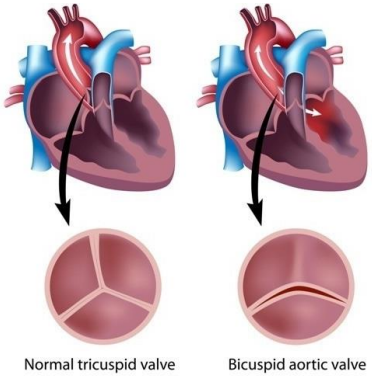
Baloon-expandable



G. Tarantini et al. European Heart Journal (2017)

tAVR e bicuspidia aortica

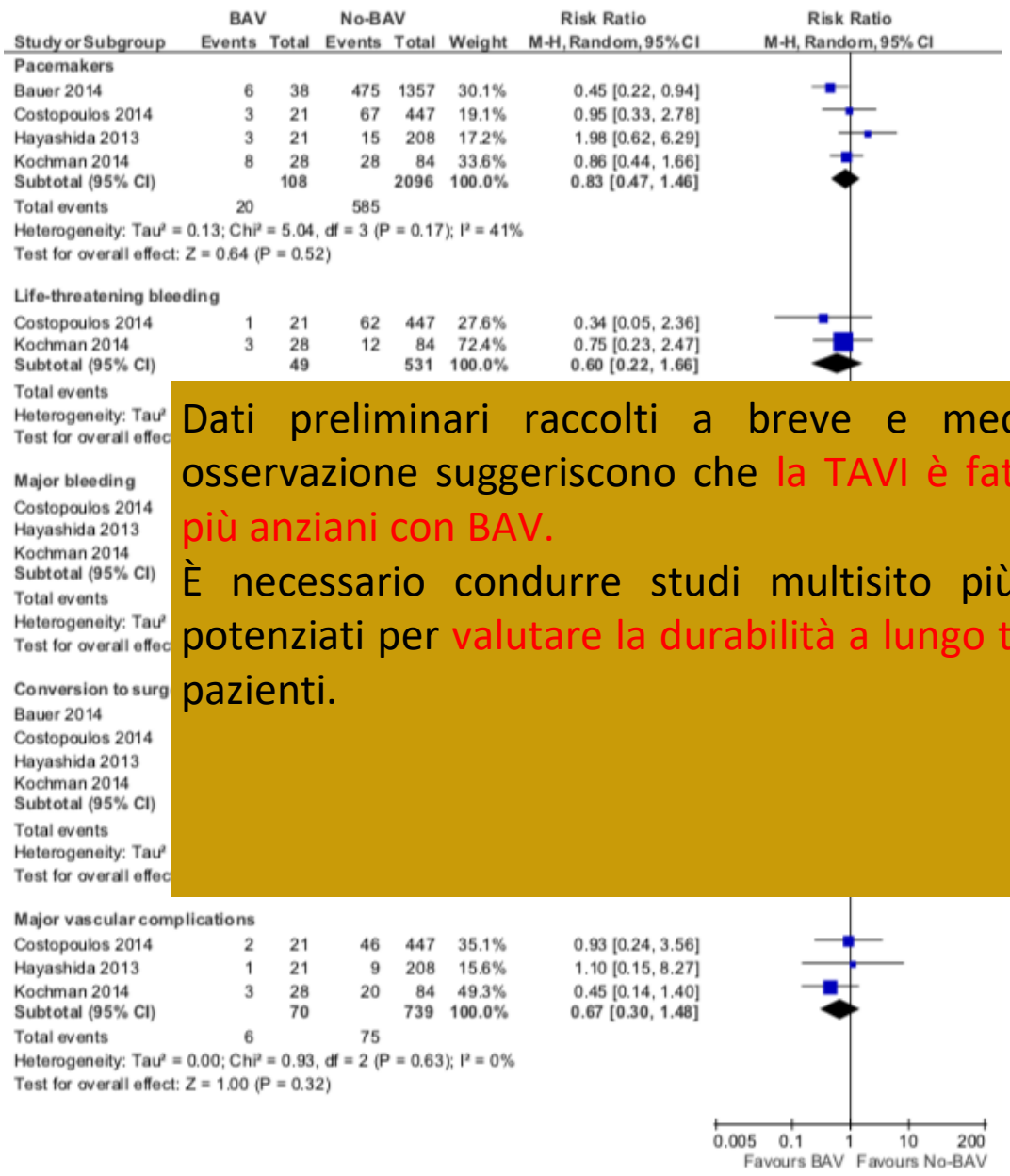
In diversi tAVR trials, la procedura è stata **controindicata nei pazienti con bicuspidia aortica** per via del'anomala geometria valvolare e del conseguente **rischio di malposizionamento o malfunzionamento**



Sono stati analizzati dati derivanti da 6 databases elettronici e 7 articoli. Sono stati inclusi 149 pazienti con BAV e 2096 pazienti non-BAV sottoposti a tAVR

Phan K et al. Heart, Lung and Circulation (2015)

tAVR e bicuspidia aortica



- Gradiente transvalvolare medio post-TAVI (differenza media ponderata, 0,36 mmHg; P = 0,55),

Dati preliminari raccolti a breve e medio termine da studi di osservazione suggeriscono che la TAVI è fattibile e sicura nei pazienti più anziani con BAV.

È necessario condurre studi multisito più ampi e adeguatamente potenziati per valutare la durabilità a lungo termine in questo subset di pazienti.

e

o

P =

i

% vs

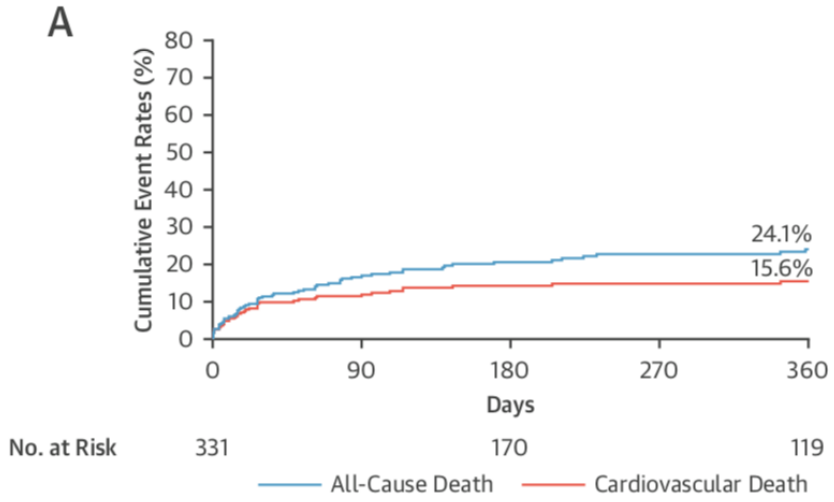
a nella

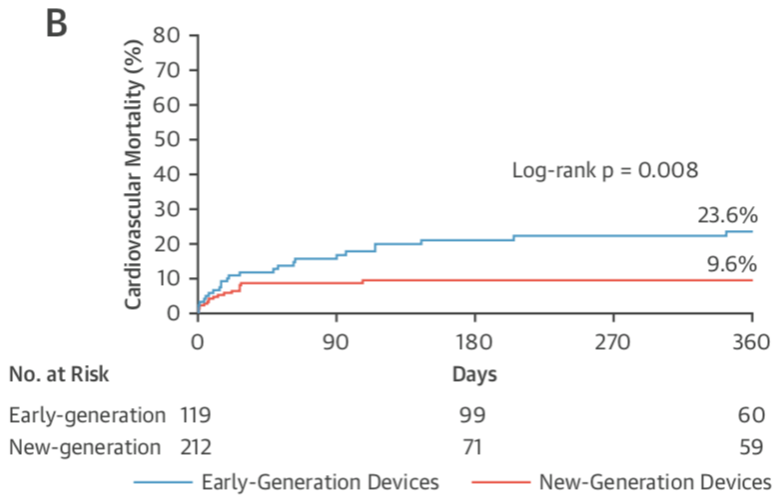
mortalità a 30 giorni (8,3% vs 9,0%; P = 0,68)

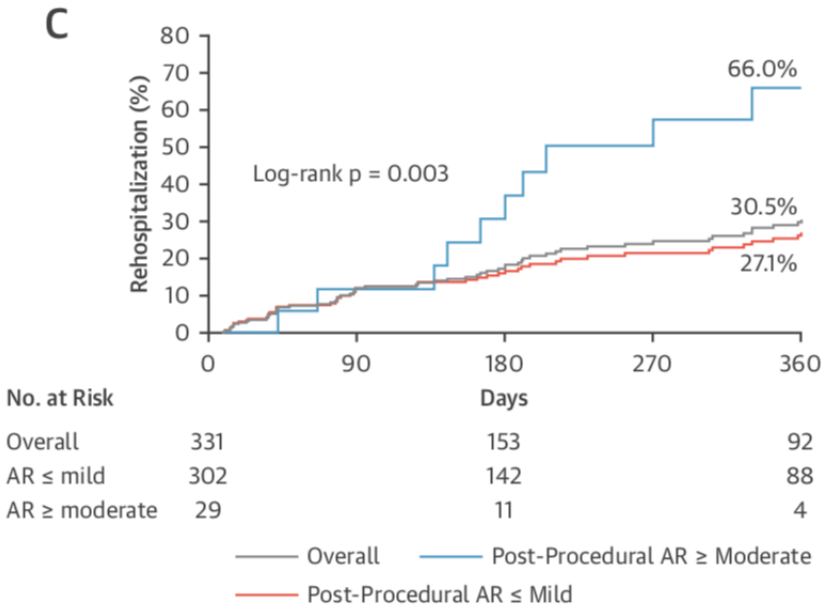
Phan K et al. Heart, Lung and Circulation (2015)

tAVR nei pazienti con insufficienza aortica pura

331 pz.; STS score of 6.7 ± 6.7





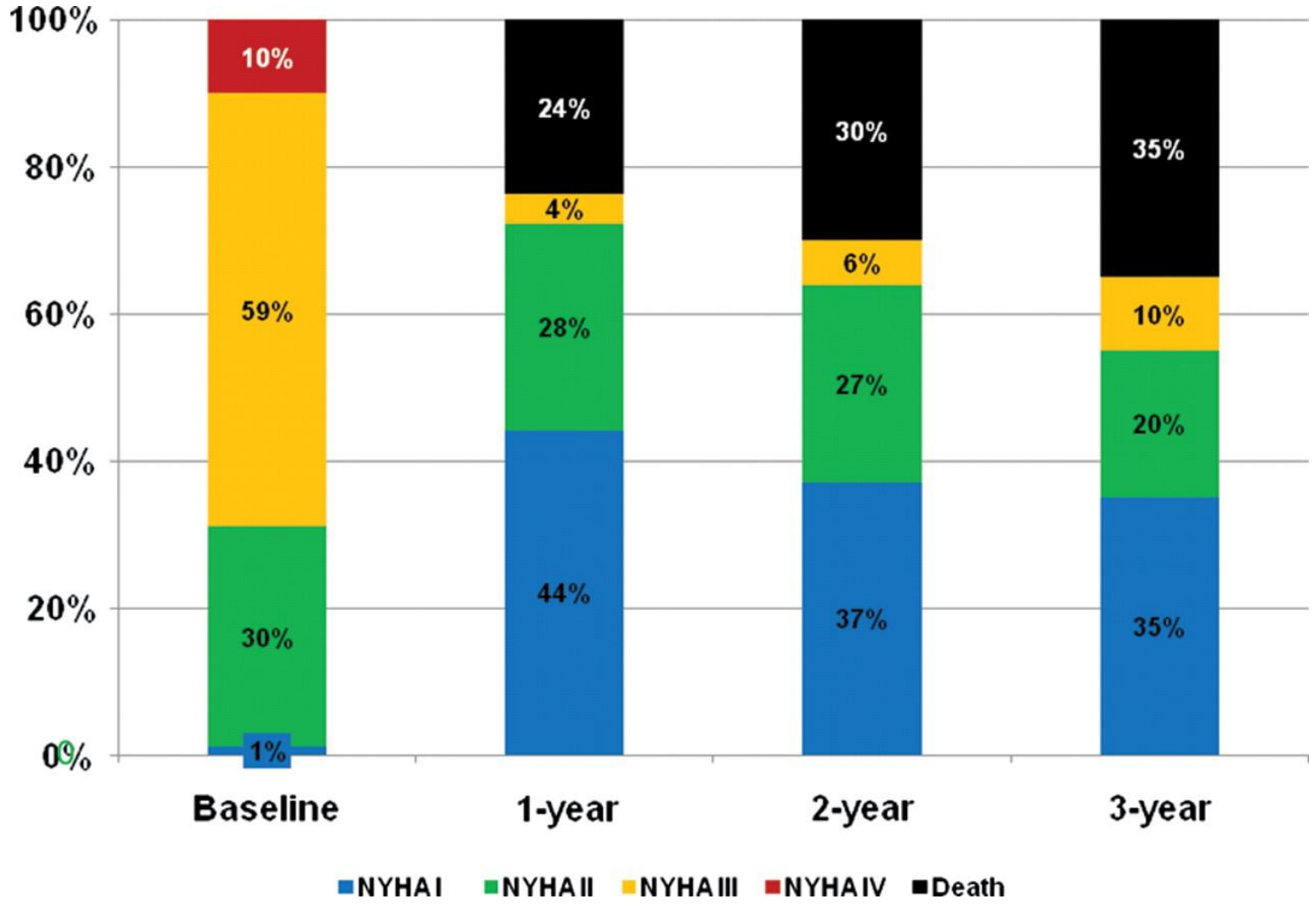


	Univariable Model		Multivariable Model	
	HR (95% CI)	p Value	HR (95% CI)	p Value
Post-procedural aortic regurgitation ≥ moderate	2.72 (1.45-5.10)	0.002	2.85 (1.52-5.35)	0.001

L'insufficienza aortica post-procedurale significativa è stata indipendentemente associata ad un aumento della mortalità.

Yoon S-H et al. JACC 2017

New York Heart Association (NYHA) functional status at baseline and up to 3-year follow-up.



Gian Paolo Ussia et al. Eur Heart J 2012;33:969-976

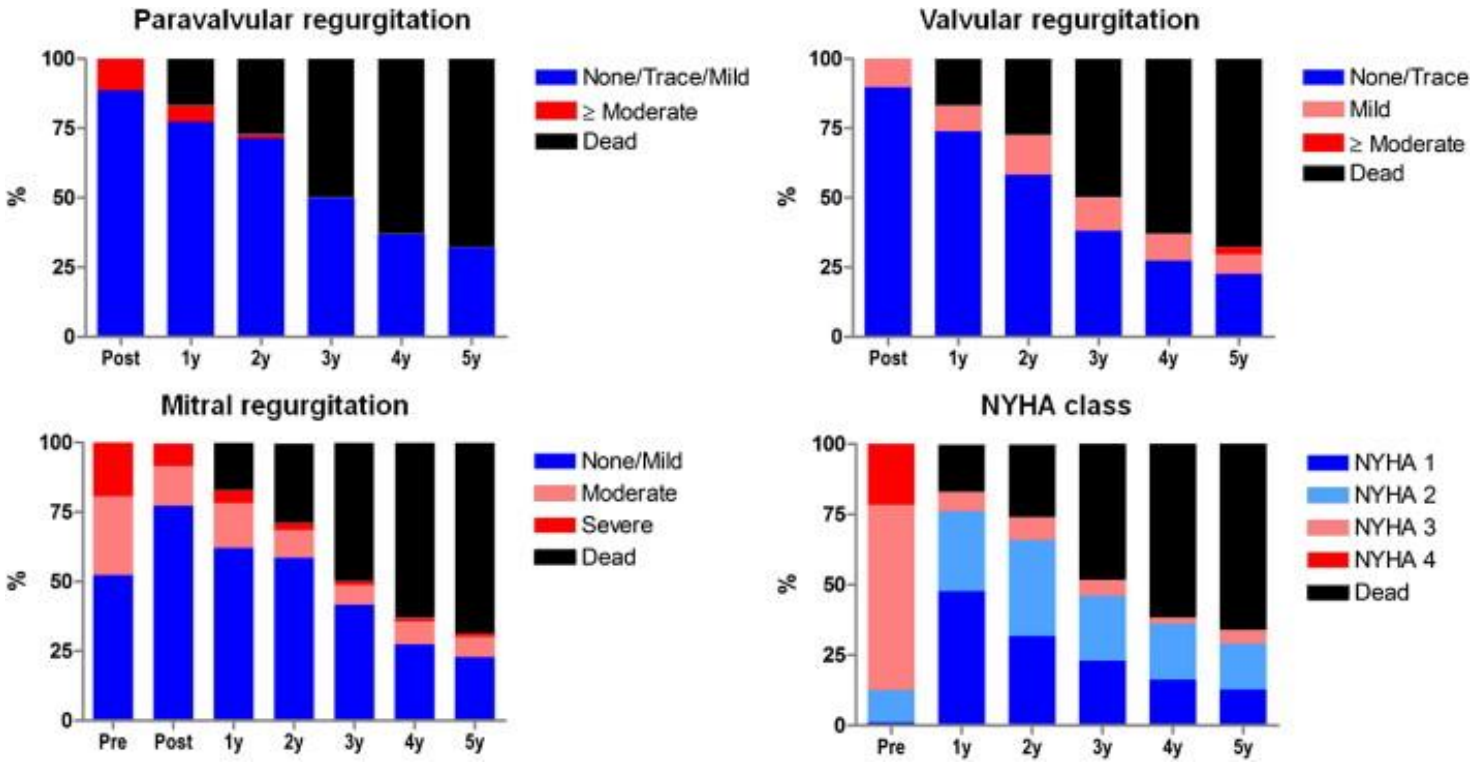


Figure 5. Paravalvular and Valvular Regurgitation, NYHA Class, and Mitral RegurgitationParavalvular aortic regurgitation, valvular aortic regurgitation, mitral regurgitation, and New York Heart Association (NYHA) class are shown over the 5-year observation per...

5-Year Outcome After Transcatheter Aortic Valve Implantation

Stefan Toggweiler, Karin H. Humphries, May Lee, Ronald K. Binder, Robert R. Moss, Melanie Freeman, Jian Ye, Anson Cheung, David A. Wood, John G. Webb

Journal of the American College of Cardiology, Volume 61, Issue 4, 2013, 413–419

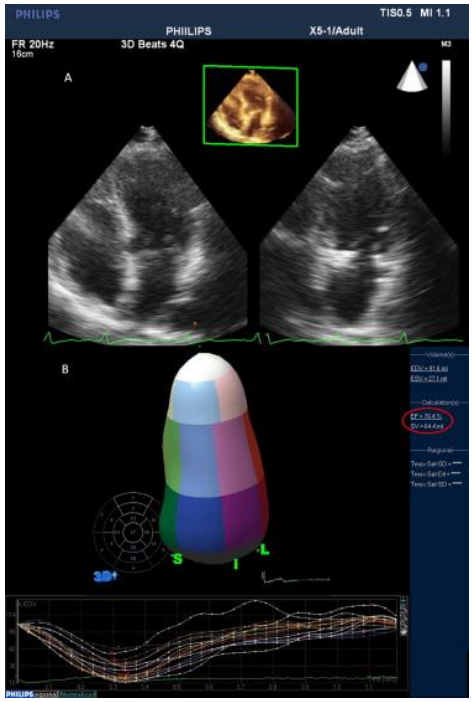


Figure 2. (A) Three-dimensional transthoracic echocardiographic four-heartbeat full-volume acquisition. (B) Left ventricular ejection fraction and stroke volume determination by direct volumetric analysis.

Alexandra Gonçalves, Carlos Almeria, Pedro Marcos-Alberca, Gisela Feltes, Rosana Hernández-Antolín, Enrique Rodríguez, José C. Silva Cardoso, Carlos Macaya, José Luis Zamorano

Three-Dimensional Echocardiography in Paravalvular Aortic Regurgitation Assessment after Transcatheter Aortic Valve Implantation

Journal of the American Society of Echocardiography, Volume 25, Issue 1, 2012, 47–55

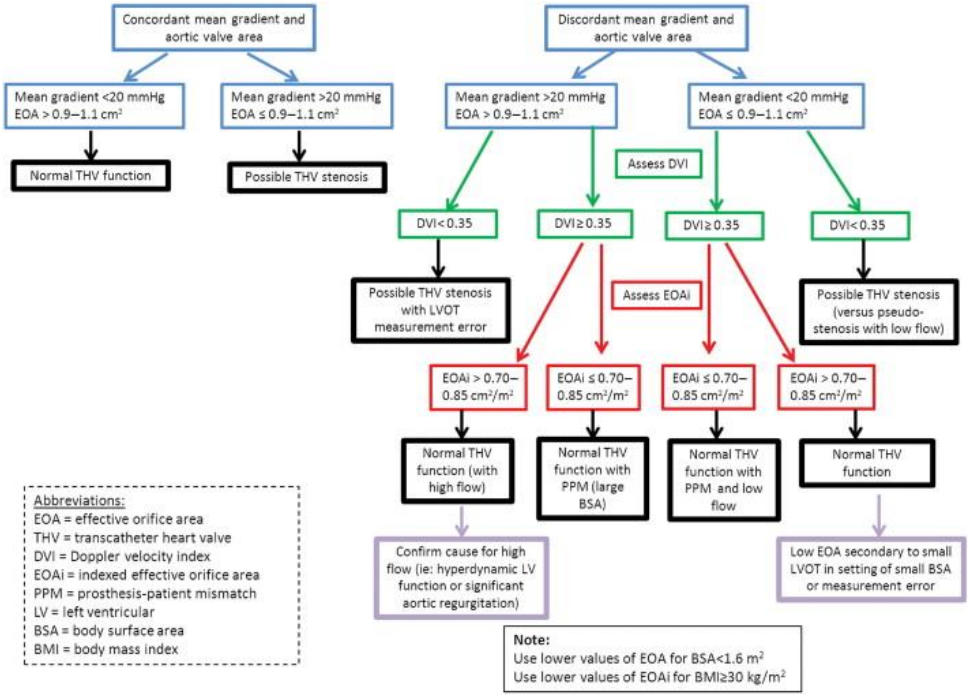


Figure 4. Transcatheter Heart Valve Haemodynamic Evaluation Algorithm

A. Pieter Kappetein, Stuart J. Head, Philippe Généreux, Nicolo Piazza, Nicolas M. van Mieghem, Eugene H. Blackstone, Thomas G. Brott, David J. Cohen, Donald E. Cutlip, Gerrit-Anne van Es, Rebecca T. Hahn, Ajay J. Kirtane, Mitchell W. Krucoff, Susheel Kodali, Michael J. Mack, Roxana Mehran, Josep Rodés-Cabau, Pascal Vranckx, John G. Webb, Stephan Windecker, Patrick W. Serruys, Martin B. Leon

Updated Standardized Endpoint Definitions for Transcatheter Aortic Valve Implantation : The Valve Academic Research Consortium-2 Consensus Document†

Journal of the American College of Cardiology, Volume 60, Issue 15, 2012, 1438–1454

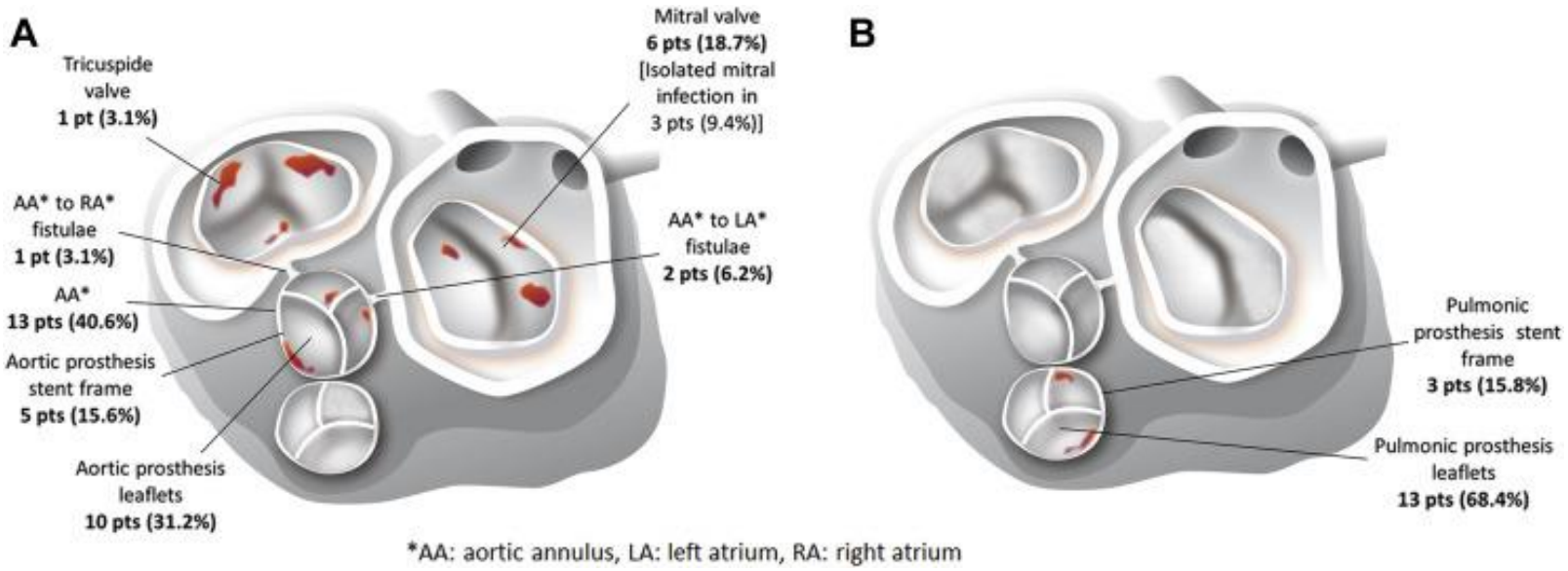


Figure 6. Location of Infective Endocarditis After Transcatheter Valve ReplacementSchematic location of infective endocarditis according to echocardiographic and/or pathological findings. (A) Location of infective endocarditis in patients with previous transca...

Prosthetic Valve Endocarditis After Transcatheter Valve Replacement : A Systematic Review

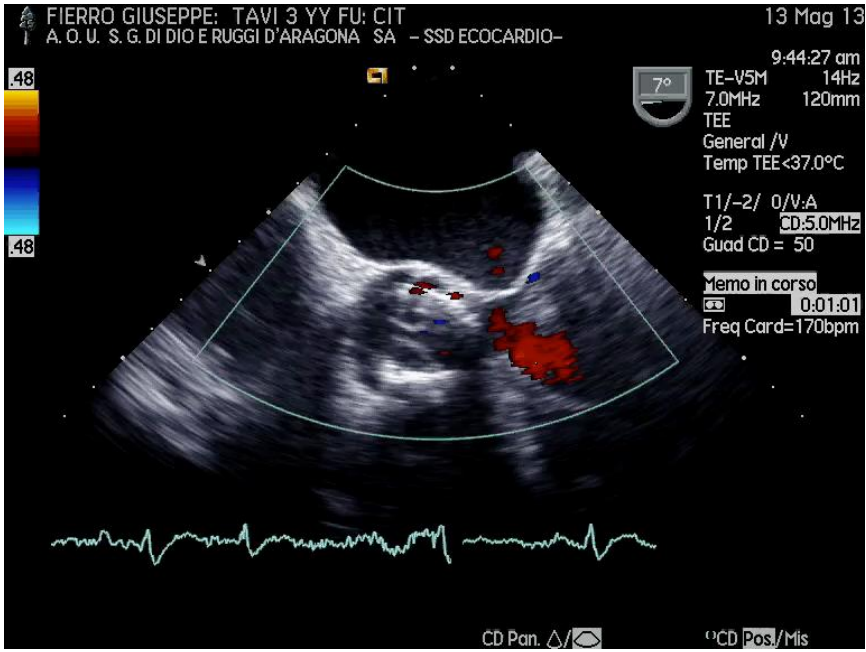
Ignacio J. Amat-Santos, Henrique B. Ribeiro, Marina Urena, Ricardo Allende, Christine Houde, Elisabeth Bédard, Jean Perron, Robert DeLarochellière, Jean-Michel Paradis, Eric Dumont, Daniel Doyle, Siamak Mohammadi, Mélanie Côté, José Alberto San Roman, Josep Rodés-Cabau

JACC: Cardiovascular Interventions, Volume 8, Issue 2, 2015, 334–346

1. Tavi specific issues – Aortic regurgitation: incidence

The incidence of moderate to severe AR could reach **11.7% of patients;** it increases the risk of all-cause mortality and morbidity.

The degree of AR may remain stable over time, or may worsen and deteriorate, but it may also decrease at one- and two-year FU.



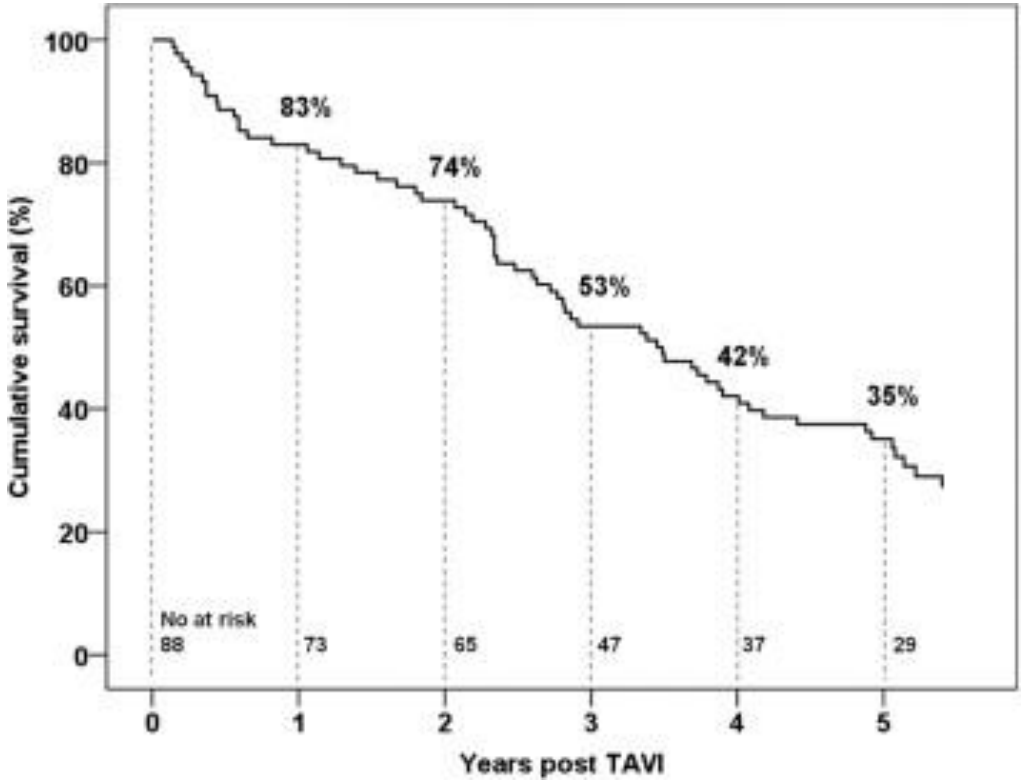


Figure 2. Long-Term Survival After Transcatheter Aortic Valve ImplantationThis represents first in human transarterial and transapical experience in nonoperative patients.

5-Year Outcome After Transcatheter Aortic Valve Implantation

Stefan Toggweiler, Karin H. Humphries, May Lee, Ronald K. Binder, Robert R. Moss, Melanie Freeman, Jian Ye, Anson Cheung, David A. Wood, John G. Webb

Journal of the American College of Cardiology, Volume 61, Issue 4, 2013, 413–419

Valve problems

Any FU program for TAVI patients should include imaging, **particularly echocardiography**, as a main step. As in the pre-TAVI evaluation, ejection fraction (EF), regional kinesis, pulmonary artery pressure (PAP) and left ventricle (LV) hypertrophy should be assessed, and other valve dysfunction should also be detected and followed up.

Focus on:

1.TAVI specific issue

2. Prosthetic problems