2023 PCR imaging valves madrid

Essentials: Episode 1
Aortic valve disease: what you need to know

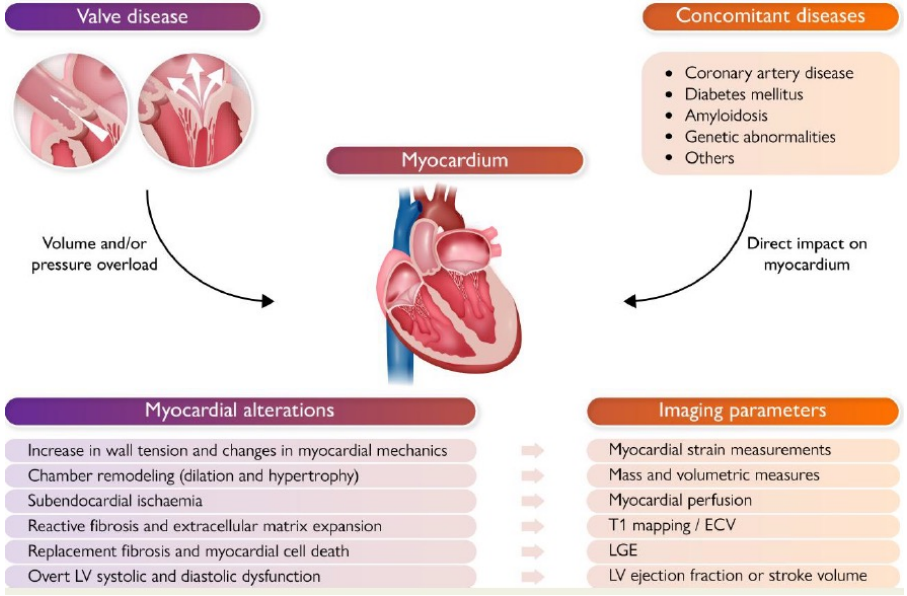
Aortic Stenosis - Focus to the myocardium

ESC European Society of Cardiology
European Heart Journal (2023) **44**, 28–40
https://doi.org/10.1093/eurheartj/ehac504

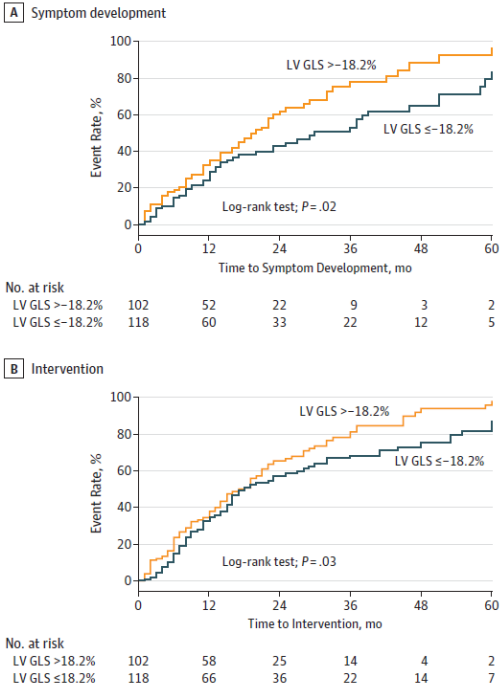
STATE OF THE ART REVIEW
Valvular heart disease

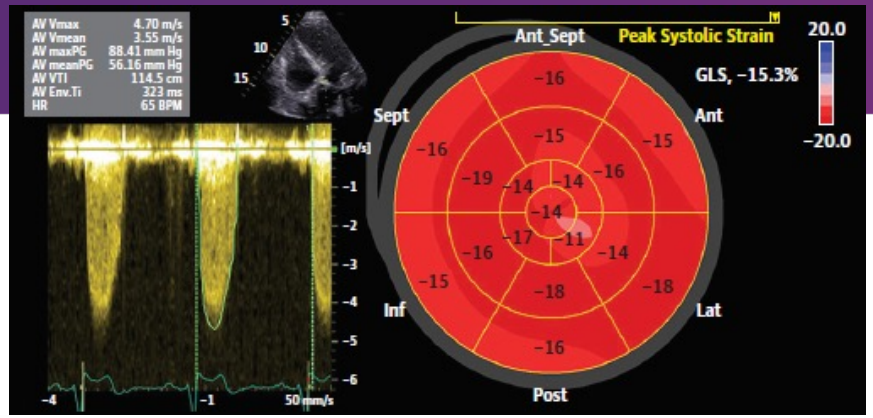
Valvular heart disease: shifting the focus to the myocardium

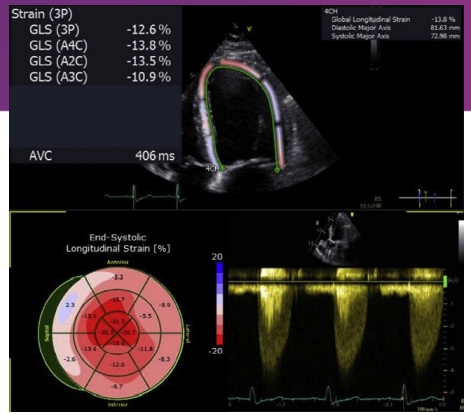
Nina Ajmone Marsan [1], Victoria Delgado [1,2], Dipan J. Shah[3], Patricia Pellikka[4], Jeroen J. Bax[1], Thomas Treibel[5], and João L. Cavalcante[6]

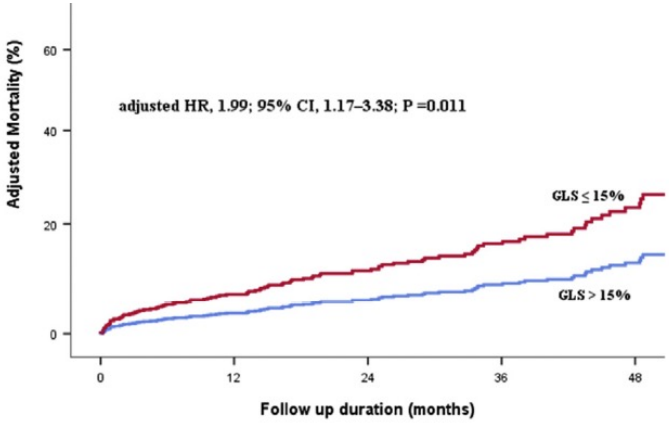


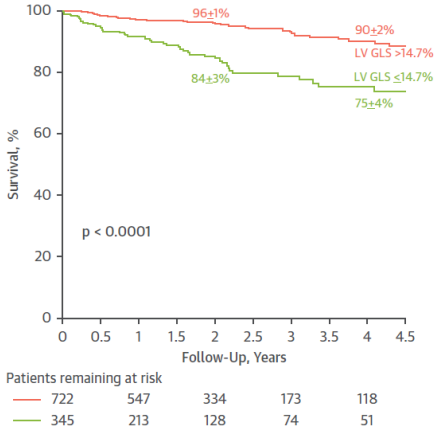
LV GLS in AS









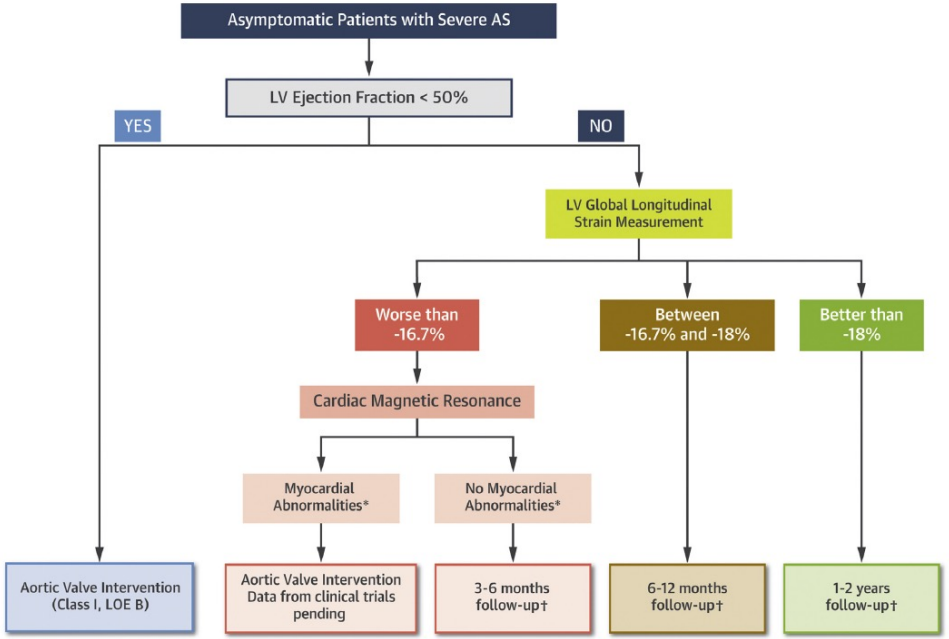


Vollema et al, JAMA Card 2018

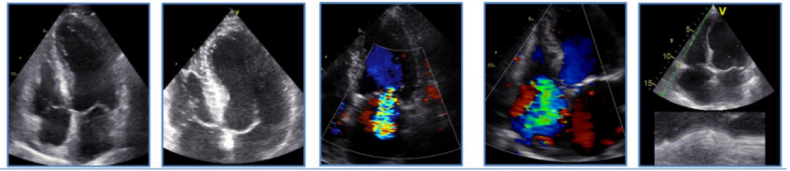
Magne et al, JACC CVI 2019

Thellier et al, JASE 2020

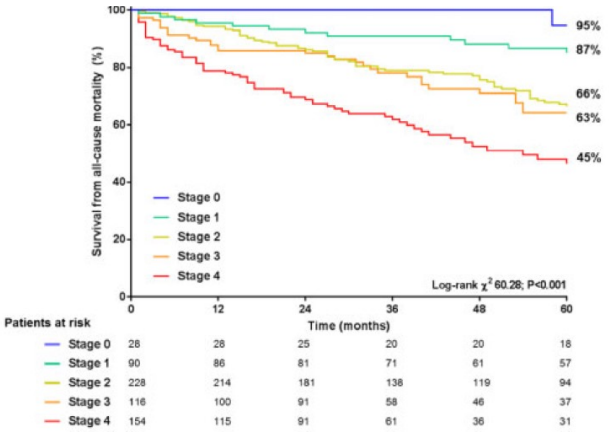
GLS in Asymptomatic Severe AS



Dahl, J.S. et al. J Am Coll Cardiol Img. 2019;12(1):163-71.



	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
	No cardiac damage	Left ventricular damage	Left atrial or mitral damage	Pulmonary vasculature or tricuspid damage	Right ventricular damage
Echocardiographic criteria		LV mass index ♂ >115 g/m² ♀ > 95 g/m² LV ejection fraction <50% E/e' ratio > 14	Left atrial volume index >34 ml/m² Presence of atrial fibrillation Moderate/severe mitral regurgitation	Systolic pulmonary arterial pressure ≥60 mmHg Moderate/severe tricuspid regurgitation	TAPSE <16 mm
LV GLS (%)	>18%	15.8 to 18%	13.2 to 15.8%	10 to 13.2%	<10%



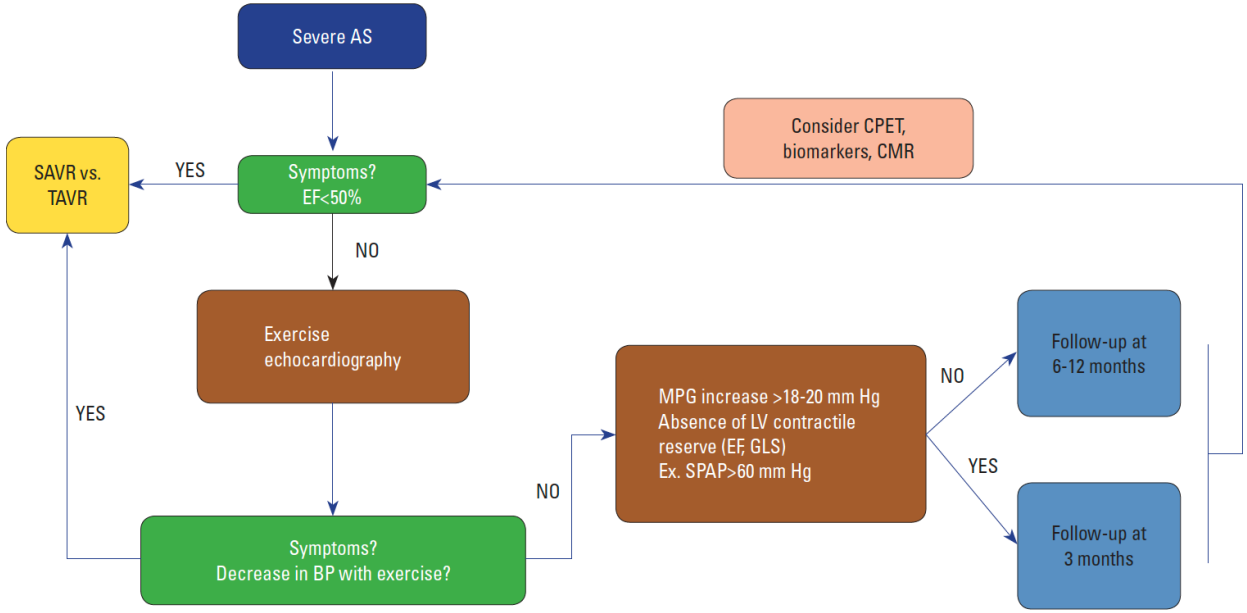
Vollema et al, EHJ CVI 20202

Role of exercise echocardiography (ESE) in AS

Asymptomatic severe AS
Risk stratification, optimal timing

LFLG preserved AS
True severe AS

Symptomatic moderate AS
Cause of symptoms



Postolache Anatol J Cardiol 2020; 23: 312-7

ESE incremental information to optimize follow-up interval according to predicted risk of event

Role of Cardiac CT in AS - Aortic valve calcification

Sex-specific CT-AVC thresholds

Cardiac CT

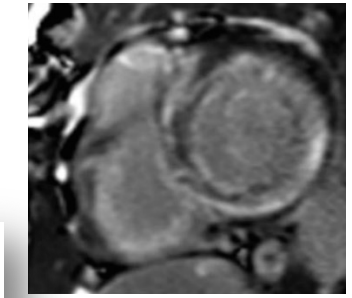
Severe AS very likely

Sex	AUC	Threshold	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
AVC						
Women	0.91	>1600				
	Specific threshold	1,681*	69	95	95	65
Women >1200-1300	Best threshold	1,274*	86	89	93	79
	Sensitive threshold	791*	95	63	81	88
Men	0.90					
	Specific thr	>3000 3,381*	59	95	95	59
Men >2000	Best threshold	2,065*	89	80	88	82
	Sensitive threshold	1,661*	95	70	84	90

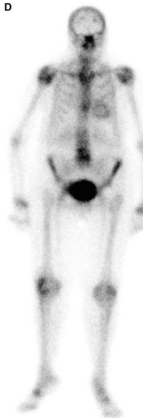
Clavel MA, et al. J Am Coll Cardiol 64:1202–1213
Pawade et al. Circ Cardiovasc Imaging 2018;11:e007146.

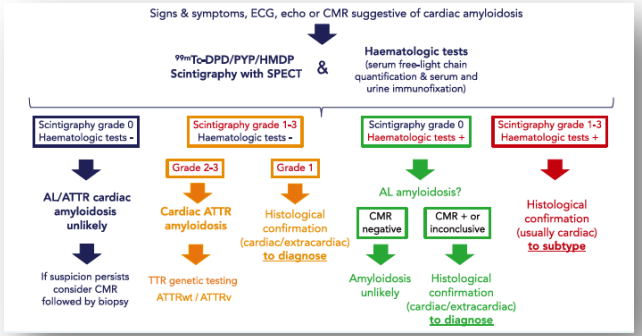
Role of Cardiac MR in AS: Association with cardiac amyloidosis

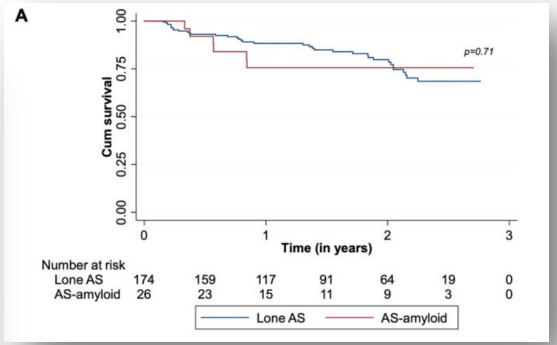
- **Red flags:** LF-LG AS, excessive hypertrophy, low electrocardiographic voltages, or relatively higher levels of biomarkers
- **CMR findings**: typical LGE patterns, high T1 and ECV values



Bone scintigraphy is supported by recent expert consensus recommendations





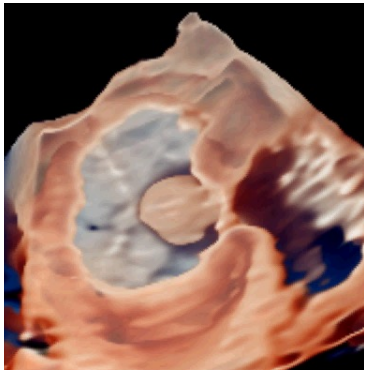


Cavalcante JL, et al. J Cardiovasc Magn Reson 2017;19:98.

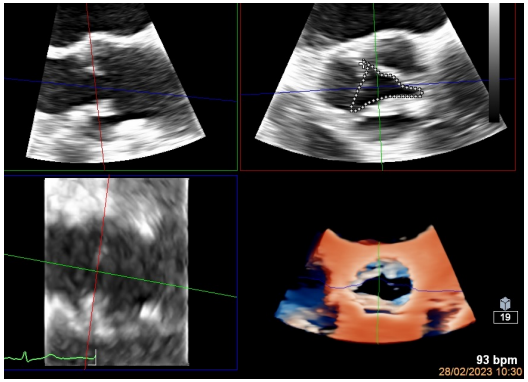
García Pavía. European Journal of Heart Failure (2021) 23, 512–526

Scully PR, et al Eur Heart J. 2020;41:2759–2767.

Aortic Stenosis - Role of 3D echocardiography



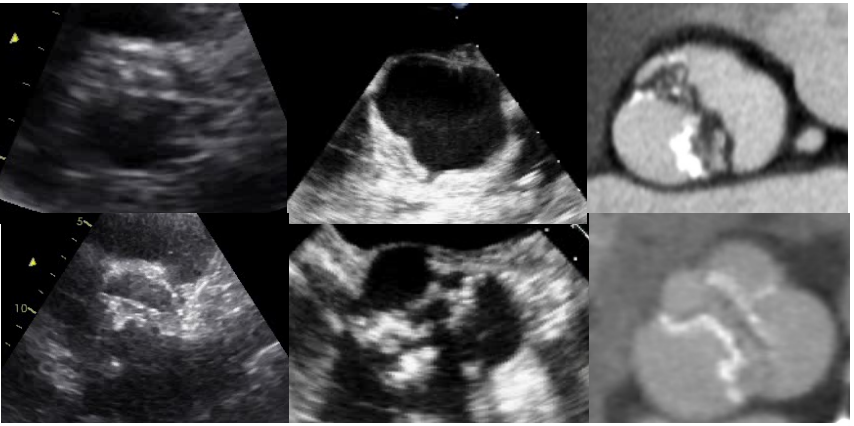
Detailed **anatomy** presentation

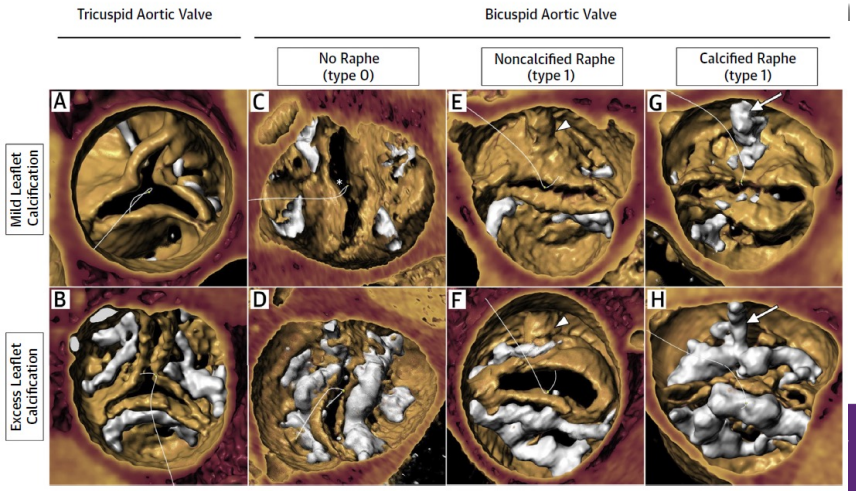


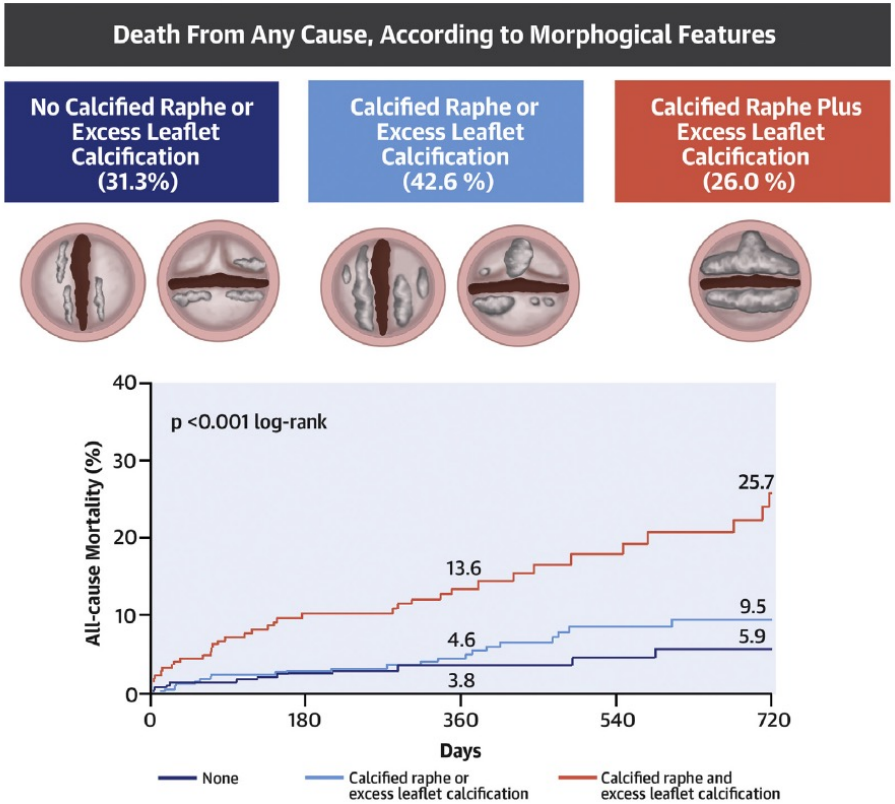
Advances in AVA **quantification**

Cardiac function assessment

Patient selection for TAVI: Mechanism of AS – tricuspid vs bicuspid calcific AS



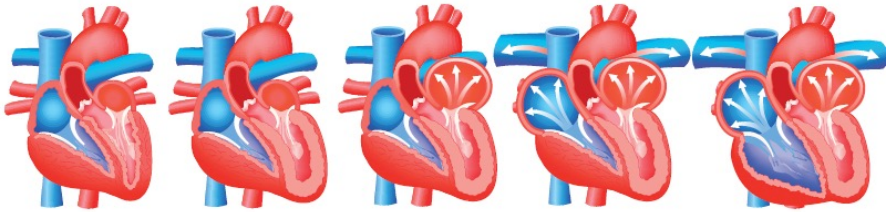




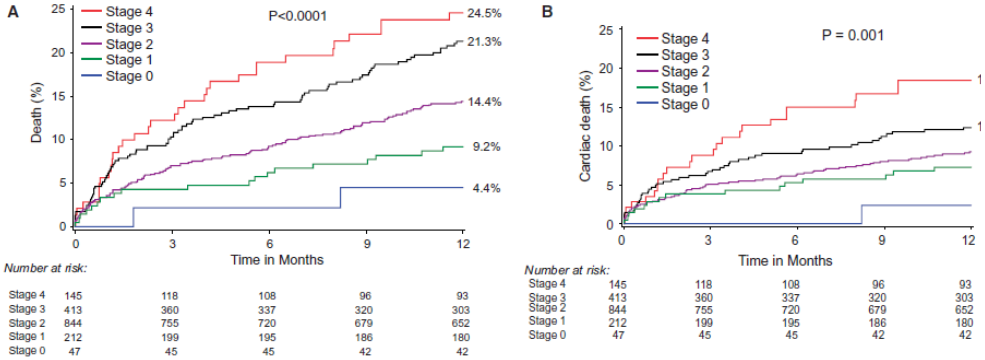
Yoon, S.-H. et al. J Am Coll Cardiol. 2020

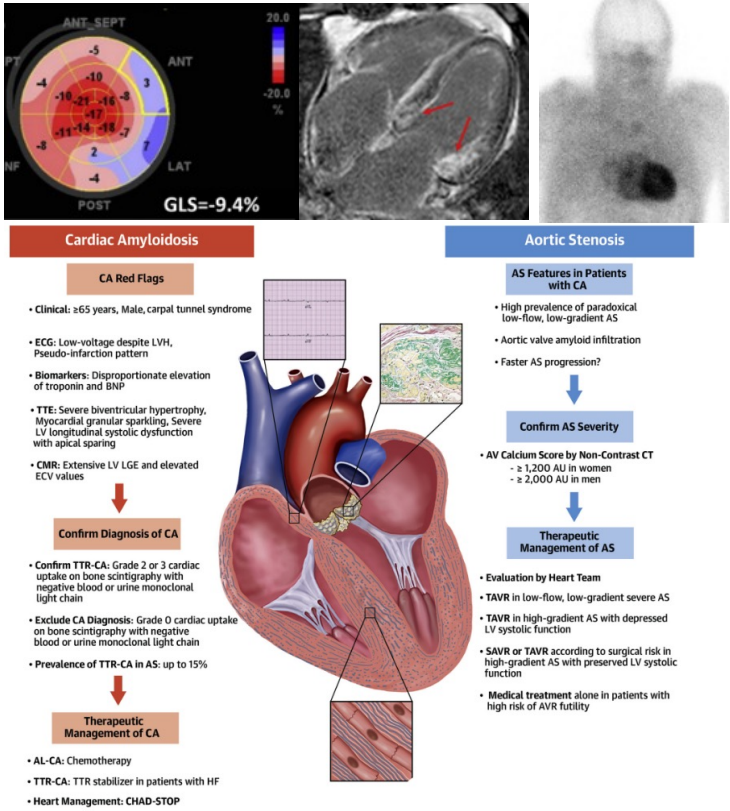
Victoria Delgado

Patient selection for TAVI: Focus on the myocardium



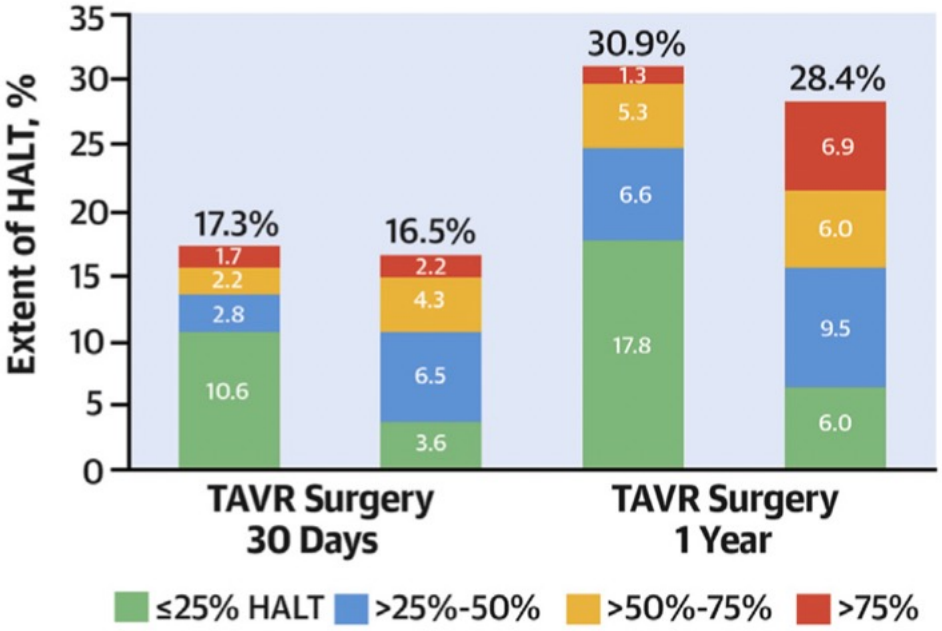
Stages/Criteria	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
	No Cardiac Damage	LV Damage	LA or Mitral Damage	Pulmonary Vasculature or Tricuspid Damage	RV Damage
Echocardiogram		Increased LV Mass Index >115 g/m² (Male) >95 g/m² (Female)	Indexed left atrial volume >34mL/m²	Systolic Pulmonary hypertension ≥60 mmhg	Moderate-Severe right ventricular dysfunction
		E/e' >14	Moderate-Severe mitral regurgitation	Moderate-Severe tricuspid regurgitation	
		LV Ejection Fraction <50%	Atrial Fibrillation		

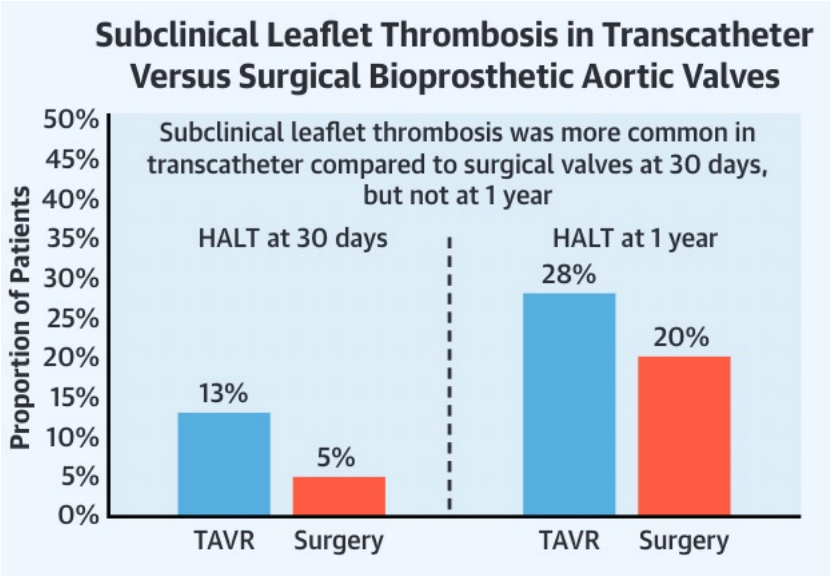




Genereux et al. Eur Heart J 2017 Ternacle et al JACC 2019

Bioprosthetic Valve Thrombosis - Both TAVR and SAVR are Equally Susceptible



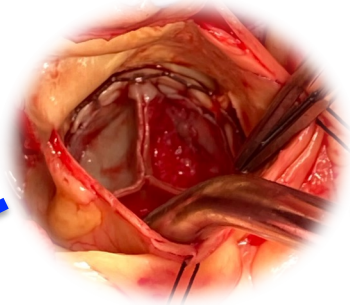


- **At the end of 1 year BPVT incidence is similar in TAVR and SVR**

Blanke, P. et al. J Am Coll Cardiol. 2020;75:2430

Makkar, R.R. et al. J Am Coll Cardiol. 2020;75:3003

Bioprosthetic Valve Thrombosis - Risk Factors



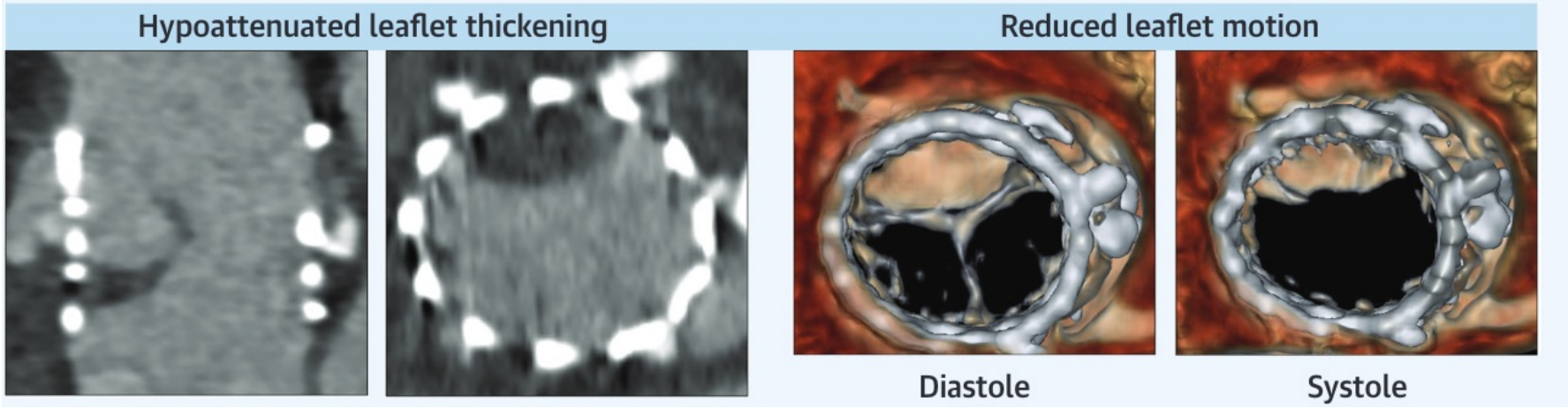
Patient related Factors

CKD(GFR<30)
Afib
BMI>30
Hypercoagulability

Valve/procedural Factors

Balloon expandable TAVR
Valve in valve
Suboptimal postimplant geometry
LFLG AS
Severe PPM
Large BPV size (>28mm)
Sutureless valves

Jose J JACC Intrv 2017;10:686–97
Shahinian J Progress in Cardiovasc Dis 2022;72:15



HALT is very reproducible given the **excellent spatial resolution of CT.**

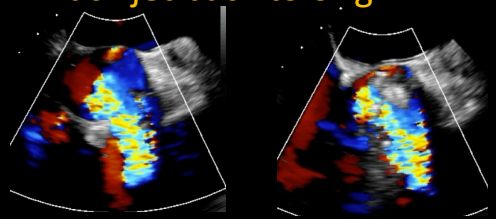
However, because of the **modest temporal resolution** of CT,

- **RLM** should be evaluated only in the context of HALT to avoid overdiagnosis

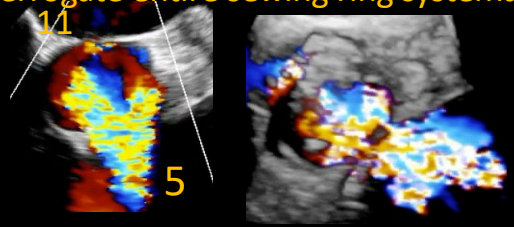
Paravalvular leak evaluation

PVL anatomy

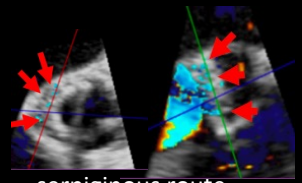
Track jet back to origin



Interrogate entire sewing ring systematically

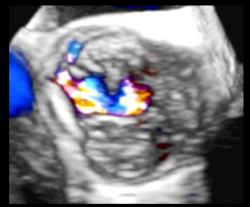


Sieve like defect



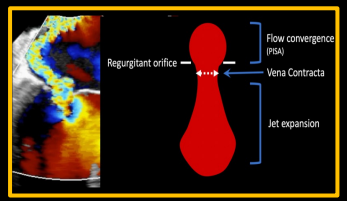
serpiginous route

V Discrete defect



PVL severity

Understand concept of regurgitant jet



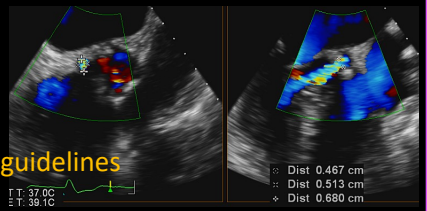
Orifice area

3D vena contracta

Describes the defect size

Quantification similar to standard guidelines

Biplane vena contracta



Jet characteristics

Broad jet origin severe >60% LVOT diameter

Multiple jets

Jet path visible along stent ≥Moderate

Flow convergence visible ≥Moderate

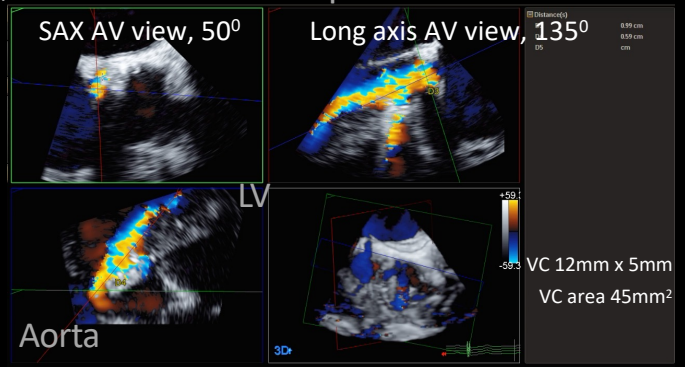
Diastolic flow reversal EDV>20

PHT ≥200

Circumferential extent ≥20%

TOE allows detailed anatomical assessment, TG views essential

3D Multiplane reconstruction



Align to visualize 3 components of regurgitant jet

Locate vena contracta

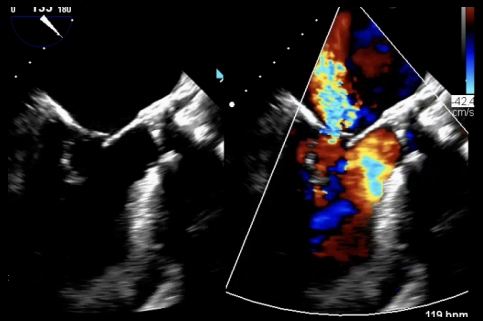
Pibarot JAMA Cardiol. 2017;2(11):1208-1216

Bushra Rana

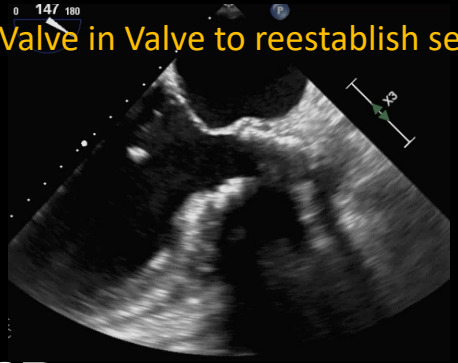
Paravalvular leak management

Suboptimal TAVR position

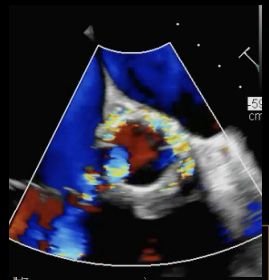
Prosthesis migrated towards aorta



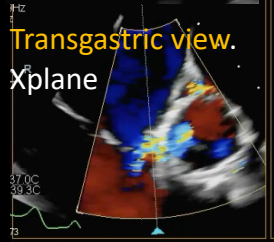
Valve in Valve to reestablish seal



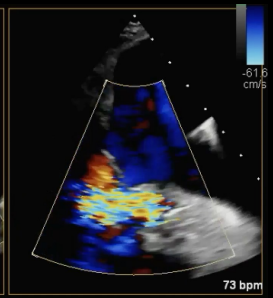
PVL closure



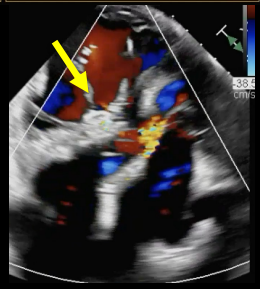
SAX view
Acoustic shadowing



Transgastric view.
Xplane



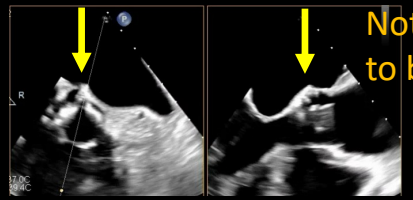
Biplane VC
13x7mm



Leak closure with vascular plug

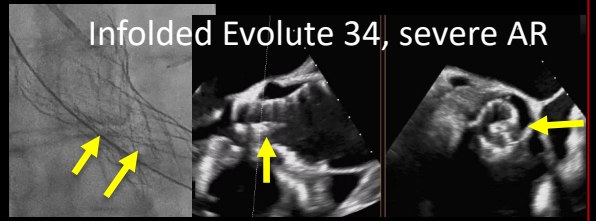
Prosthesis balloon valvuloplasty

High risk of annular rupture

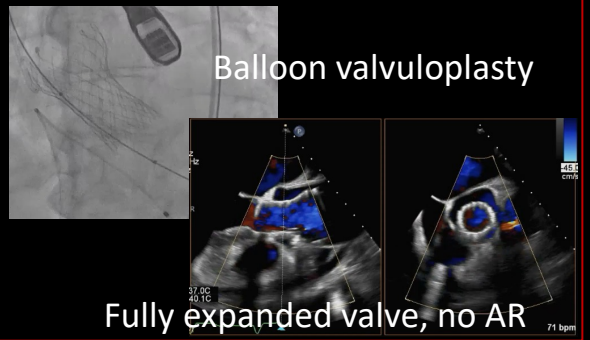


Not attractive to balloon

Infolded Evolute 34, severe AR



Balloon valvuloplasty



Fully expanded valve, no AR

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Bushra Rana

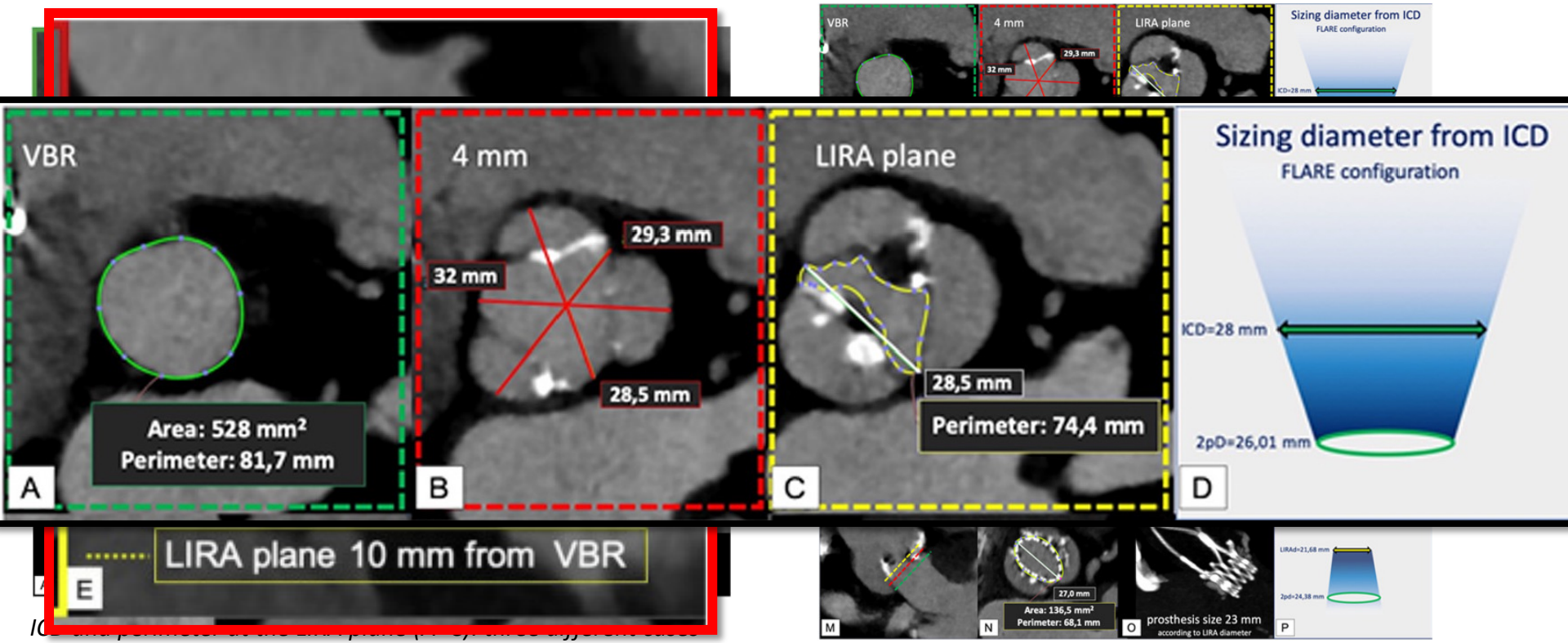
Paravalvular leak evaluation and management

Key messages

Moderate or more PVL after TAVR adversely impacts outcomes
Accurate annulus sizing essential
Ensure no contributing comorbid disease *eg arrhythmia, LV dysynchrony, anaemia*
TOE essential tool in evaluation

Decision on how to treat determined by clinical and anatomical factors
TAVR Malposition, not creating seal ?Valve in Valve
Heavy calcification stent unable to appose ?PVL closure
TAVR distortion (risk during recapture) ? Ballooning valve

Measurement of Aortic annulus in Bicuspid AV using CT (Level of Implantation at the RAphe) plane LIRA method



with similar ICDs values but with different perimeters at the LIRA

sizing according to LIRA plane perimeter and ICD at the LIRA plane

Aortic prosthesis sizing in TAVR and SAVR

Oversizing

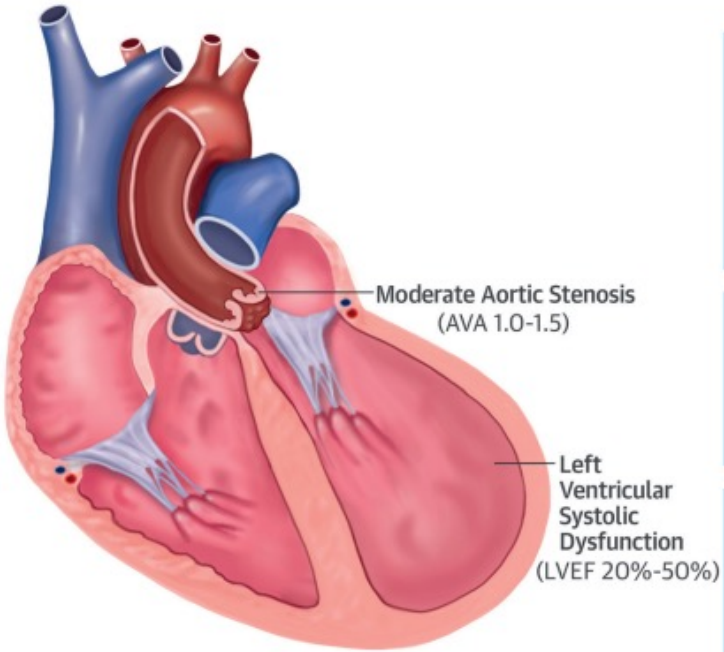
- 10-20% based on annular area for balloon-expandable TAVR prostheses
- 5-10% based on annular diameter for self-expanding TAVR prostheses

Undersizing

- is practiced rarely overall. Mostly in cautious situations to avoid annulus rupture

Symptomatic patient with moderate aortic stenosis. LV systolic and diastolic dysfunction

CENTRAL ILLUSTRATION Moderate Aortic Stenosis and LV Systolic Dysfunction



Prognostic Implications at 4-year follow-up:
- All-cause death or hospitalization for heart failure-48%
- All-cause death-36%
- Aortic valve replacement-24%
- Hospitalization for heart failure-27%

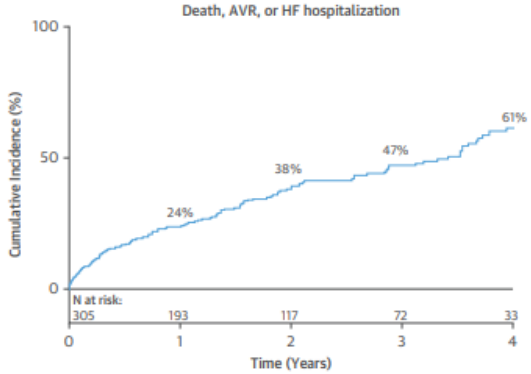
Factors Associated with Worse Prognosis:
- Male sex
- NYHA functional class III or IV
- Higher transaortic velocities

Future Treatment Option:
- Early transcatheter aortic valve replacement; to be investigated in the randomized TAVR-UNLOAD trial.

van Gils, L. et al. J Am Coll Cardiol. 2017;69(19):2383-92.

What are the Prognostic Implications of Moderate Aortic Stenosis in Patients With Left Ventricular Systolic Dysfunction?

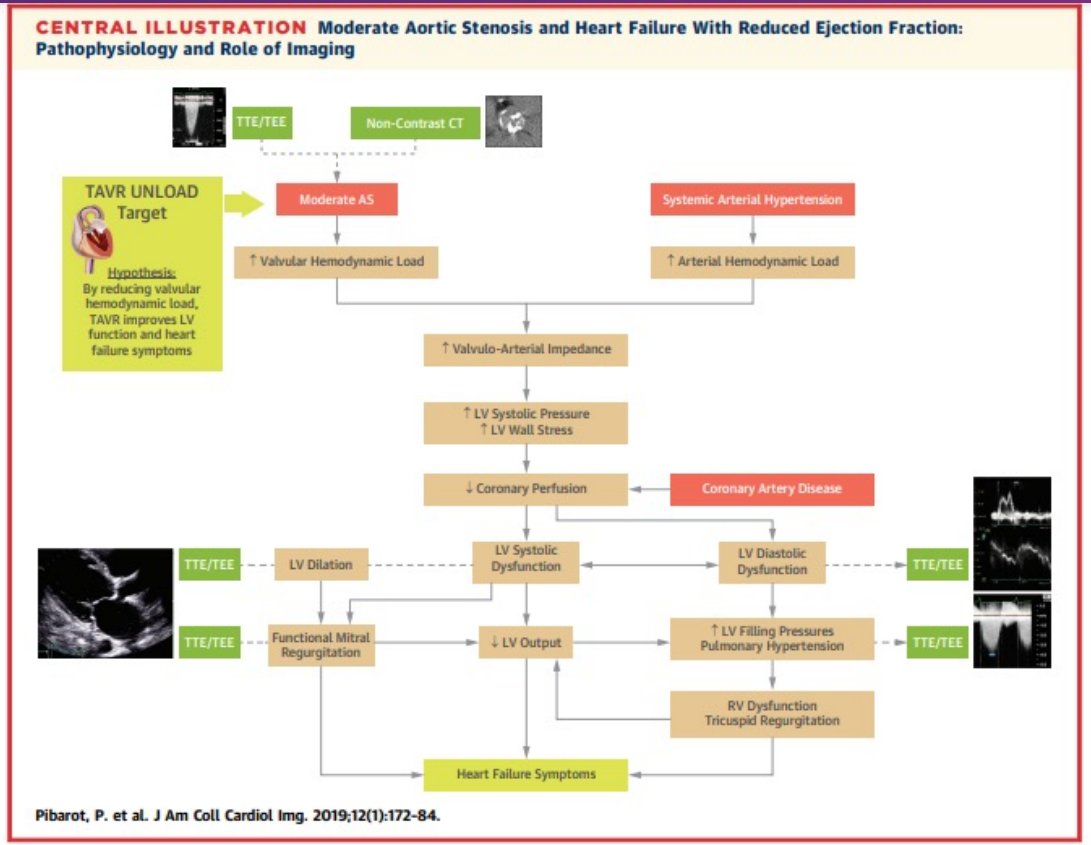
FIGURE 2 Incidence of the Composite Primary Endpoint



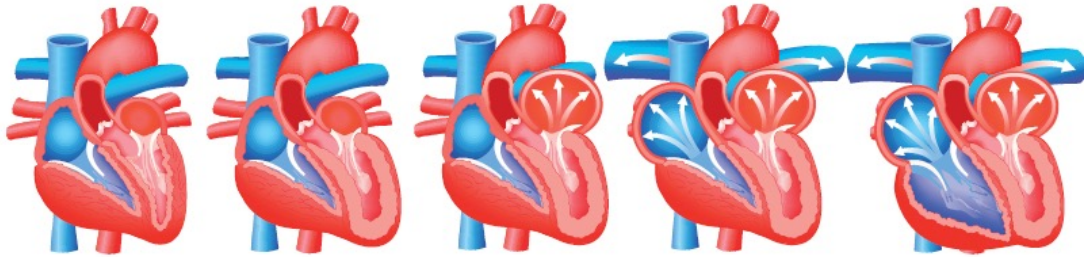
Cumulative incidence increased to 61% at 4-year follow-up, with the steepest increase during the first year following the index echocardiogram. The findings implicated that this population faces a high clinical event rate. Abbreviations as in Figure 1.

J Am Coll Cardiol 2017;69:2383–92

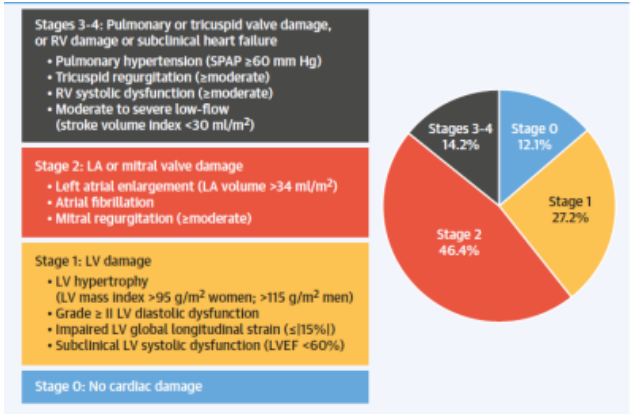
Symptomatic patient with moderate aortic stenosis. LV systolic and diastolic dysfunction



Cardiac Damage Staging

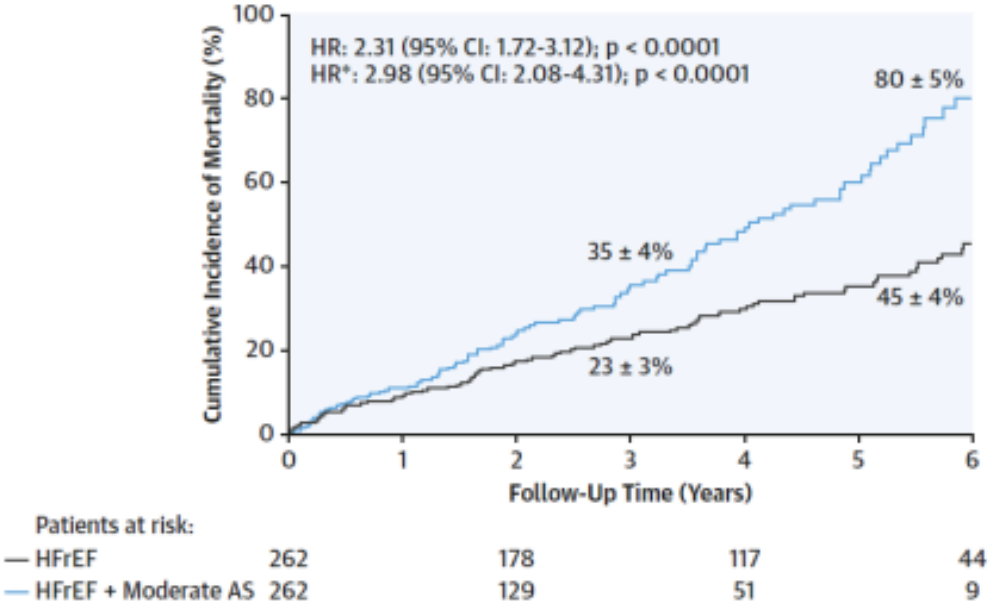


Stages/Criteria	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
	No Cardiac Damage	LV Damage	LA or Mitral Damage	Pulmonary Vasculature or Tricuspid Damage	RV Damage
Echocardiogram		Increased LV Mass Index >115 g/m² (Male) >95 g/m² (Female)	Indexed left atrial volume >34mL/m²	Systolic Pulmonary hypertension ≥60 mmhg	Moderate-Severe right ventricular dysfunction
		E/e' >14	Moderate-Severe mitral regurgitation	Moderate-Severe tricuspid regurgitation	
		LV Ejection Fraction <50%	Atrial Fibrillation		



Excess mortality compared to HFrEF

A



Jean et al. JACC 2021;77(22):2796-803

Why Transfemoral TAVR may be a good option in Moderate AS

- Patients with moderate AS have low gradient at baseline
- Provide large valve EOAs and low gradients: greater potential for significant hemodynamic benefit
- Low rates of paravalvular regurgitation: more impact in HF/LVH patients
- Transfemoral TAVR and under conscious sedation will be feasible in the vast majority of patients with moderate AS and HF
- Who to target and where to stop???

Cardiac Amyloidosis

CA Red Flags

- **Clinical:** ≥65 years, Male, carpal tunnel syndrome
- **ECG:** Low-voltage despite LVH, Pseudo-infarction pattern
- **Biomarkers:** Disproportionate elevation of troponin and BNP
- **TTE:** Severe biventricular hypertrophy, Myocardial granular sparkling, Severe LV longitudinal systolic dysfunction with apical sparing
- **CMR:** Extensive LV LGE and elevated ECV values

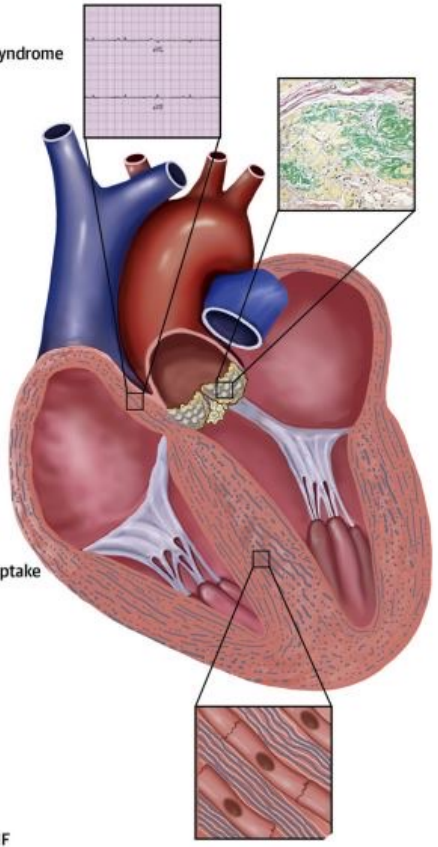
Confirm Diagnosis of CA

- **Confirm TTR-CA:** Grade 2 or 3 cardiac uptake on bone scintigraphy with negative blood or urine monoclonal light chain
- **Exclude CA Diagnosis:** Grade 0 cardiac uptake on bone scintigraphy with negative blood or urine monoclonal light chain
- **Prevalence of TTR-CA in AS:** up to 15%

5-32% ←

Therapeutic Management of CA

- **AL-CA:** Chemotherapy
- **TTR-CA:** TTR stabilizer in patients with HF
- **Heart Management: CHAD-STOP**



Aortic Stenosis

AS Features in Patients with CA

- High prevalence of paradoxical low-flow, low-gradient AS
- Aortic valve amyloid infiltration
- Faster AS progression?

→ **78% HFpEF/paradoxical LF LG AS**

→ **Coexistence of CA not assessed**

Audet et al, Histopathology, 2012

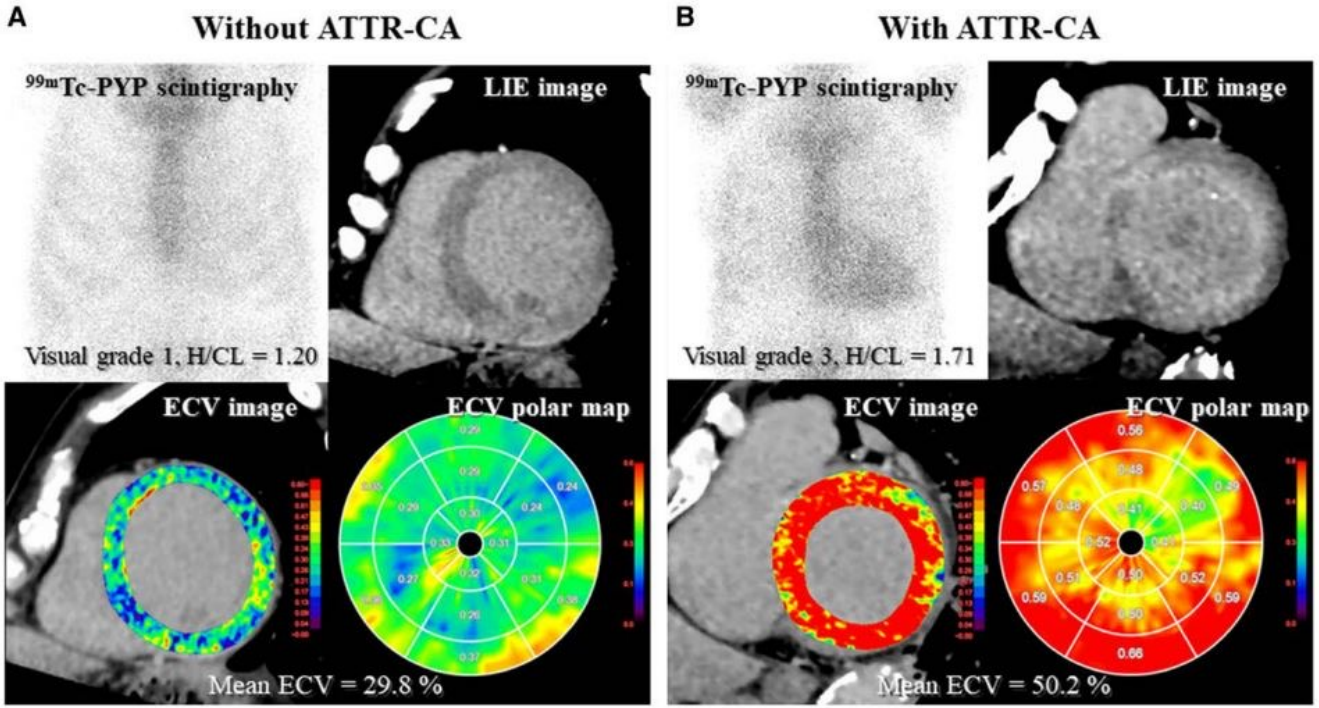
Confirm AS Severity

- **AV Calcium Score by Non-Contrast CT**
  - ≥ 1,200 AU in women
  - ≥ 2,000 AU in men

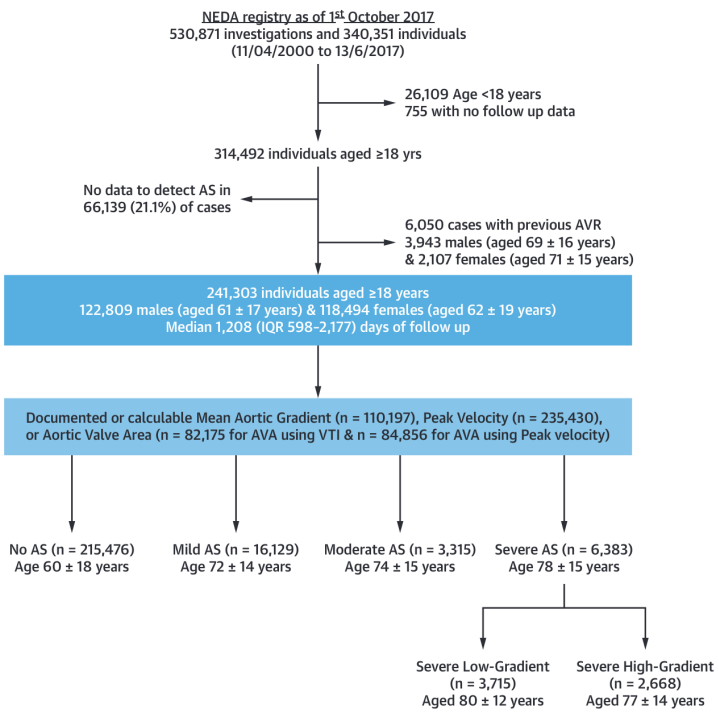
Therapeutic Management of AS

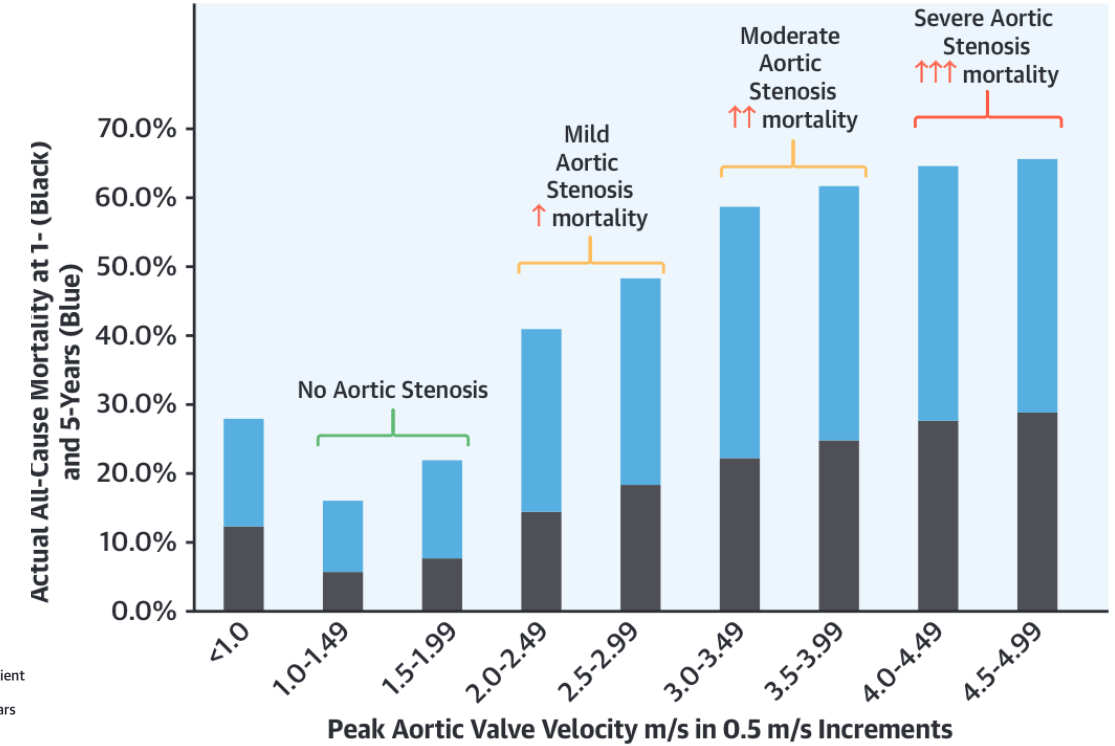
- **Evaluation by Heart Team**
- **TAVR** in low-flow, low-gradient severe AS
- **TAVR** in high-gradient AS with depressed LV systolic function
- **SAVR or TAVR** according to surgical risk in high-gradient AS with preserved LV systolic function
- **Medical treatment** alone in patients with high risk of AVR futility

TAVI CT can be used to detect cardiac amyloidosis



Moderate Native Valvular Aortic Stenosis and Long-Term Survival: 1- and 5-Year Mortality per Increment in Peak Aortic Valve Velocity

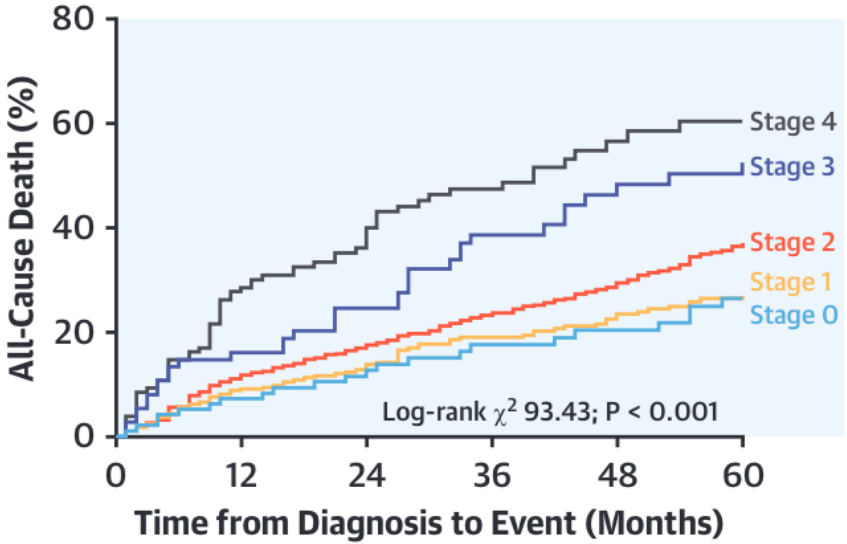


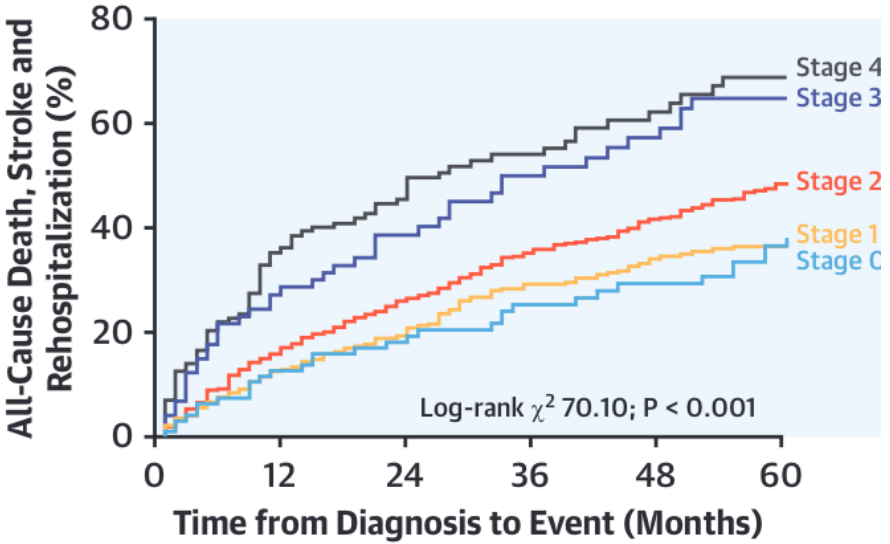


Strange, G. et al. J Am Coll Cardiol. 2019;74(15):1851-63.

Cardiac damage drives outcomes

Outcomes According to Stages of Cardiac Damage





Vollema, E.M. et al. J Am Coll Cardiol. 2019;74(4):538-49.

Combination of the newly **proposed** cardiac damage staging classification and the valvular grading severity ...

Aortic Stenosis Grading and Staging Classification

Grade/Stage	Stage 0 No cardiac damage	Stage 1 LV damage	Stage 2 LA-Mitral damage	Stage 3 PA-Tricuspid damage	Stage 4 RV damage
Grade 0 (V_{max} <2 m/s)					
Grade 1 (V_{max} 2.0-2.9 m/s; MG <20 mm Hg)					
Grade 2 (V_{max} 3.0-3.9 m/s; MG 20-39mm Hg)					
Grade 3 (AVA ≤1.0 cm^2 or AVAi ≤0.6 cm^2/m^2; V_{max}≥4.0 m/s, MG≥40 mm Hg)					

Genereux et al, Eur Heart J, Volume 38, Issue 45, 01 December 2017, Pages 3351–3358

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