XIII CONGRESO INTERNACIONAL DE CARDIOLOGIA
CARDIOLOGIA INTERVENCIONISTA - LII JORNADA ACCI-SOLACI
DE LA PREVENCIÓN A LA INTERVENCIÓN

Estenosis aortica de bajo flujo y bajo gradiente con FE preservada ¿cuál es pronostico real y cuando intervenir?

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CARDIOLOGÍA Área Sanitaria de Vigo

Declaración de Interés

Ningún conflicto de interés en relación al tema de esta presentación

Agenda

1. Conceptos
2. Aspectos diagnósticos
3. Consideraciones terapéuticas
4. Guías Clínicas
5. Mensajes finales

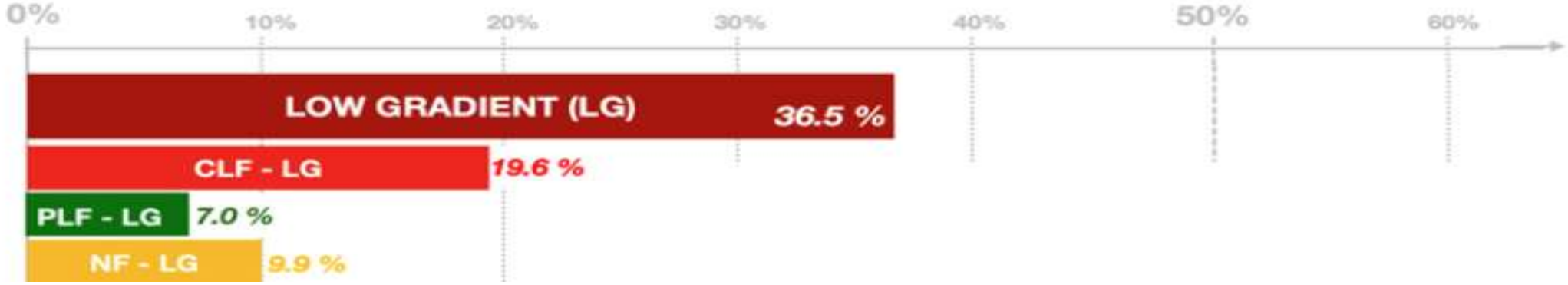
Agenda

1 Conceptos

Magnitud del problema

- La estenosis aórtica (EA) es la valvulopatía más prevalente en adultos de >65 años.

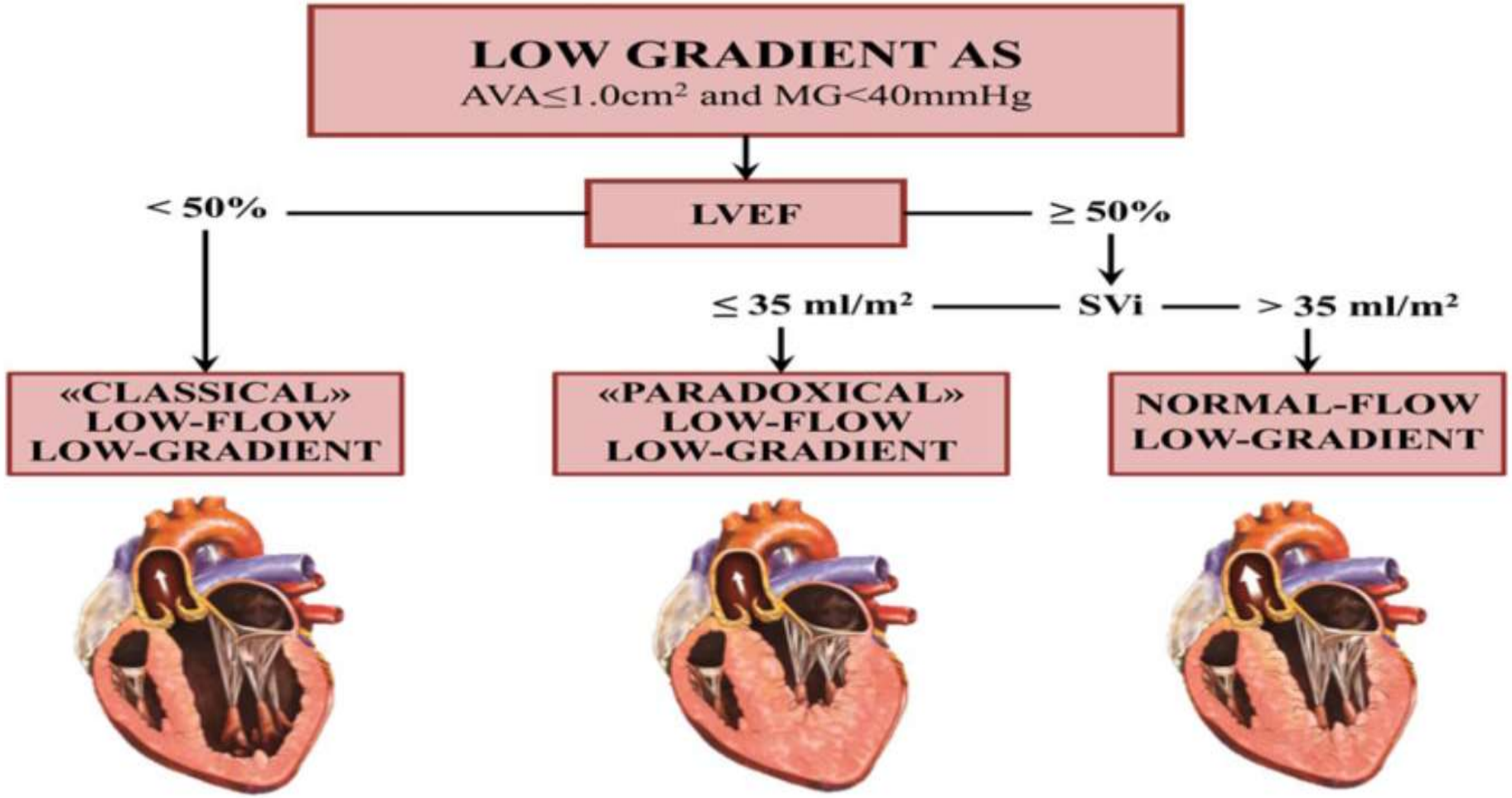
- El subtipo EA BG representa entre el 10–35% de los pacientes con EA severa sintomática.



- Mayor prevalencia en mujeres, hipertensos e hipertrofia ventricular izquierda.

Circ Cardiovasc Interv. 2020 Jul;13(7):e008792.

El problema


LOW GRADIENT AS
AVA≤1.0cm² and MG<40mmHg
LVEF
< 50%
≥ 50%
SVi
≤ 35 ml/m²
> 35 ml/m²
«CLASSICAL» LOW-FLOW LOW-GRADIENT
«PARADOXICAL» LOW-FLOW LOW-GRADIENT
NORMAL-FLOW LOW-GRADIENT

Tipología de ESTENOSIS AÓRTICA

	63.5%	36.5%		
		9.9%	7%	19.6%
	EAo: *Flujo Normal Elevado Gradiente* (Clásica)	EAo: Flujo Normal Bajo Gradiente (FN-BG)	EAo: Bajo Flujo Bajo Gradiente (BF-BG "Paradójica")	EAo: Bajo Flujo Bajo Gradiente (BF-BG "Clásica")
AVAo	<1 cm^2	<1 cm^2	<1 cm^2	<1 cm^2
Índice AVAo	<0.6 cm/m^2	<0.6 cm/m^2	<0.6 cm/m^2	<0.6 cm/m^2
Gradiente Presión Vi-Ao	≥40 mmHg	<40 mmHg	<40 mmHg	<40 mmHg
FEVI	> o < 50%	> 50%	≥ 50%	< 40%
Índice de VSi	> 35 ml/m^2	>35 ml/m^2	≤ 35 ml/m^2	≤ 35 ml/m^2
Índice Cardíaco	>3 $l/min/m^2$	>3 $l/min/m^2$	≤ 3 $l/min/m^2$	≤ 3 $l/min/m^2$

American Journal of Medicine, Vol 130, No 3, March 2017: 253-263

Fisiopatología EAo BF-BG

Mecanismos implicados:

- Disfunción diastólica ventricular reducción del volumen sistólico
  - ✓Hipertrofia concéntrica → menor volumen de llenado
  - ✓Fibrosis miocárdica → menor reserva contráctil
- Disfunción sistólica ventricular con reducción vol. Sistólico
- Aumento de post-carga y de impedancia valvulo-arterial → desacoplamiento ventrículo–válvula–arteria

Agenda

2 Aspectos diagnósticos

Aspectos a destacar en el Diagnóstico Diferencial

Key Points

1. Low flow, low gradient AS with preserved ejection fraction is defined as (i) AVA <1 cm^2, (ii) peak velocity <4 m/s, (iii) mean pressure gradient <40 mmHg, and (iv) normal LVEF (≥50%).
2. When considering low flow, low gradient AS with preserved ejection fraction, important to exclude:
   - Measurement errors (most importantly, underestimation of LVOT area and thus flow).
   - Severe hypertension during examination.
   - Inconsistency between AVA and velocity/gradient cut-offs in the range of AVAs between 0.8 and 1.0 cm^2.
   - Clinically moderate AS (despite an AVA < 1.0 cm^2) in a patient with small body size.

Helmut Baumgartner et al.

ttp://dx.doi.org/10.1016/j.echo.2017.02.009 EACVI/ASE CLINICAL RECOMMENDATIONS

Diagnóstico EAo BF-BG: "Errores en la valoración de severidad"

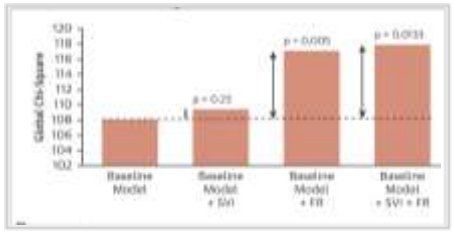
Related to patient	• Body habitus and anatomy • General status: postoperative, acute illness, chest disorders, COPD, etc. • Physiology: rate, rhythm

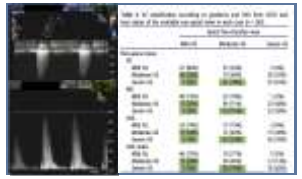
Related to image acquisition	• Operator skill and experience
	• Mistaking mitral regurgitation for AS
	• Pitfalls: max velocity and mean gradient
	  – Highest velocity missed due to lack of use of all windows (non-parallel intercept angle)
	  – Over- or underestimation if spectral Doppler not traced appropriately
	• Pitfalls: AVA by continuity equation acquisition
	  – Underestimation of AVA if highest VTI or velocity not recorded
	  – Difficulty measuring LVOT diameter, e.g., heavy calcification, shape of LVOT
	  – Inaccurate PW sampling – leading to over- or underestimation
	  – Subaortic obstruction leading to difficulty measuring LVOT or VTI
	  – If patient not in sinus rhythm: 8–10 quality beats needed

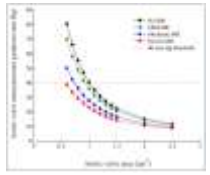
Related to method of assessment	• Most parameters are flow-dependent • DVI is least flow-dependent measure of AS severity • Low-dose dobutamine challenge may be needed to assess contractile reserve
Related to analysis and interpretation	• Inter- and intra-observer error • Learning curve

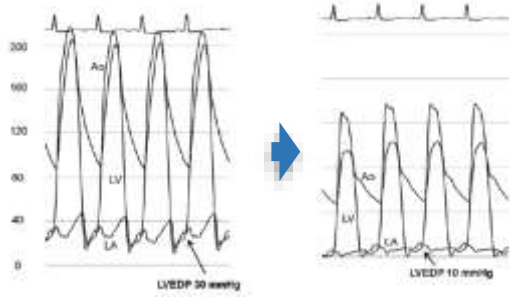
Diagnóstico EAo BF-BG: “Errores Ecocardiográficos”

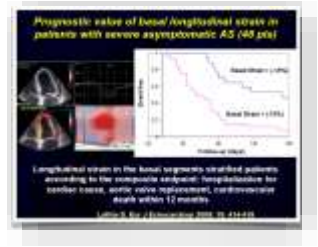
- Concepto de bajo flujo
- Medición anillo
- Medición apropiada gradientes
- Insuficiencia mitral
- Hipertensión arterial
- FEVI 50% es normal en EA
- EA severa si AVA < 1cm2

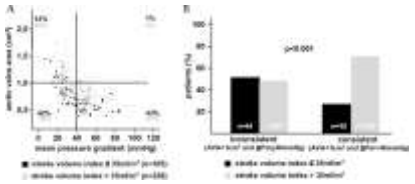






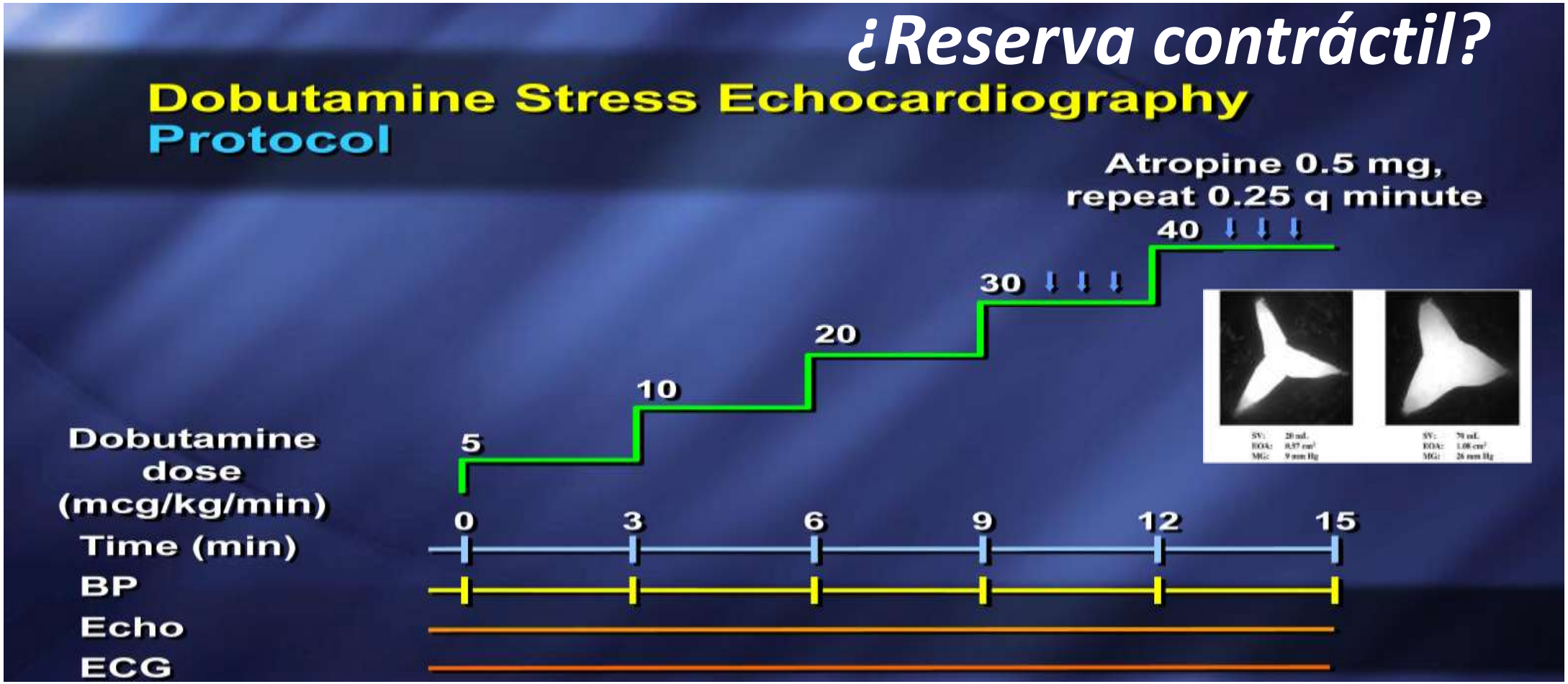






Heart 2010;96:1463e1468

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA



Philippe Pibarot, et al. J Am Coll Cardiol. 2012 Nov 6;60(19):1845-53

De Filippi CR. Am J Cardiol 1995; 75: 191-4

DIAGNÓSTICO DIFERENCIAL: Test Dobutamina

Table 4 Low dose dobutamine protocol

Starting dobutamine dose of 2.5 to 5 mcg/kg/min

⇩ Increase dose 2.5 to 5 mcg/kg/min every 3-5 minutes

Maximum dobutamine dose of 20 mcg/kg/min

Infusion stopped when:

1) Maximum dobutamine dose reached (20 mcg/kg/min)
2) Positive result obtained
3) Heart rate rises 10-20 bpm over baseline or exceeds 100 bpm
4) Symptoms, blood pressure fall, or significant arrhythmias

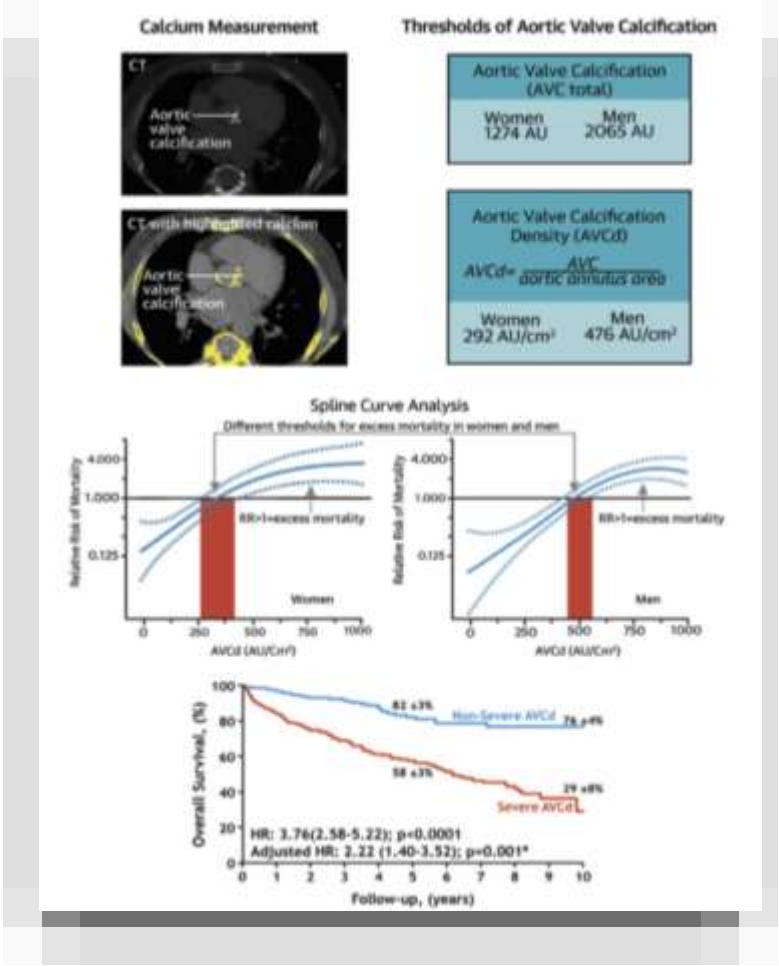
Positive Result:

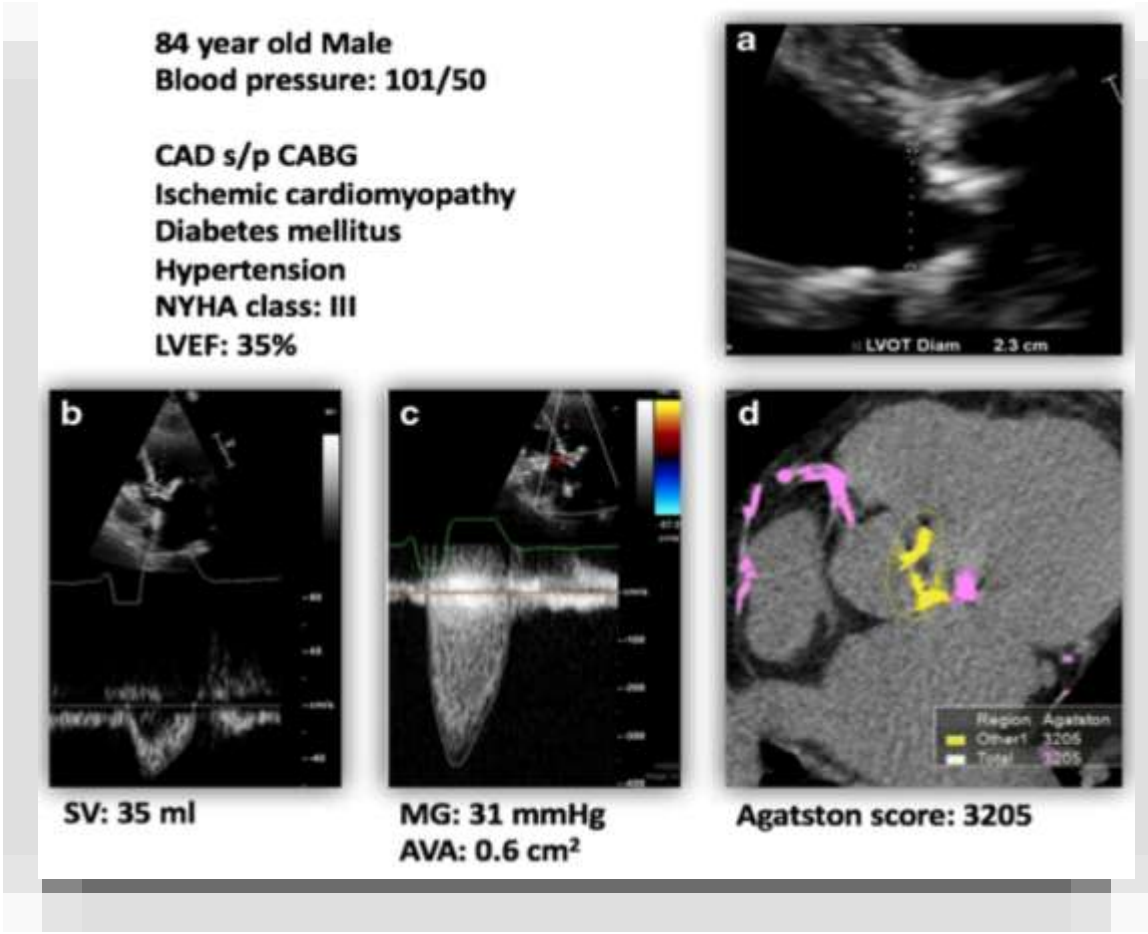
- An increase in effective AVA to a final valve area >1.0 cm2 suggests that stenosis is not severe [47].
- Severe stenosis is suggested by an AS jet velocity ≥4.0 m/s or a mean gradient > 30-40 mmHg provided that valve area does not exceed 1.0 cm^2 at any flow rate [50,51].
- Absence of contractile reserve (failure to increase SV by >20%) is a predictor of a high surgical mortality and poor long-term outcome although valve replacement may improve LV function and outcome even in this subgroup [52].

Helmut Baumgartner et al.

ttp://dx.doi.org/10.1016/j.echo.2017.02.009 EACVI/ASE CLINICAL RECOMMENDATIONS

DIAGNÓSTICO DIFERENCIAL: Papel del CT / Ca++





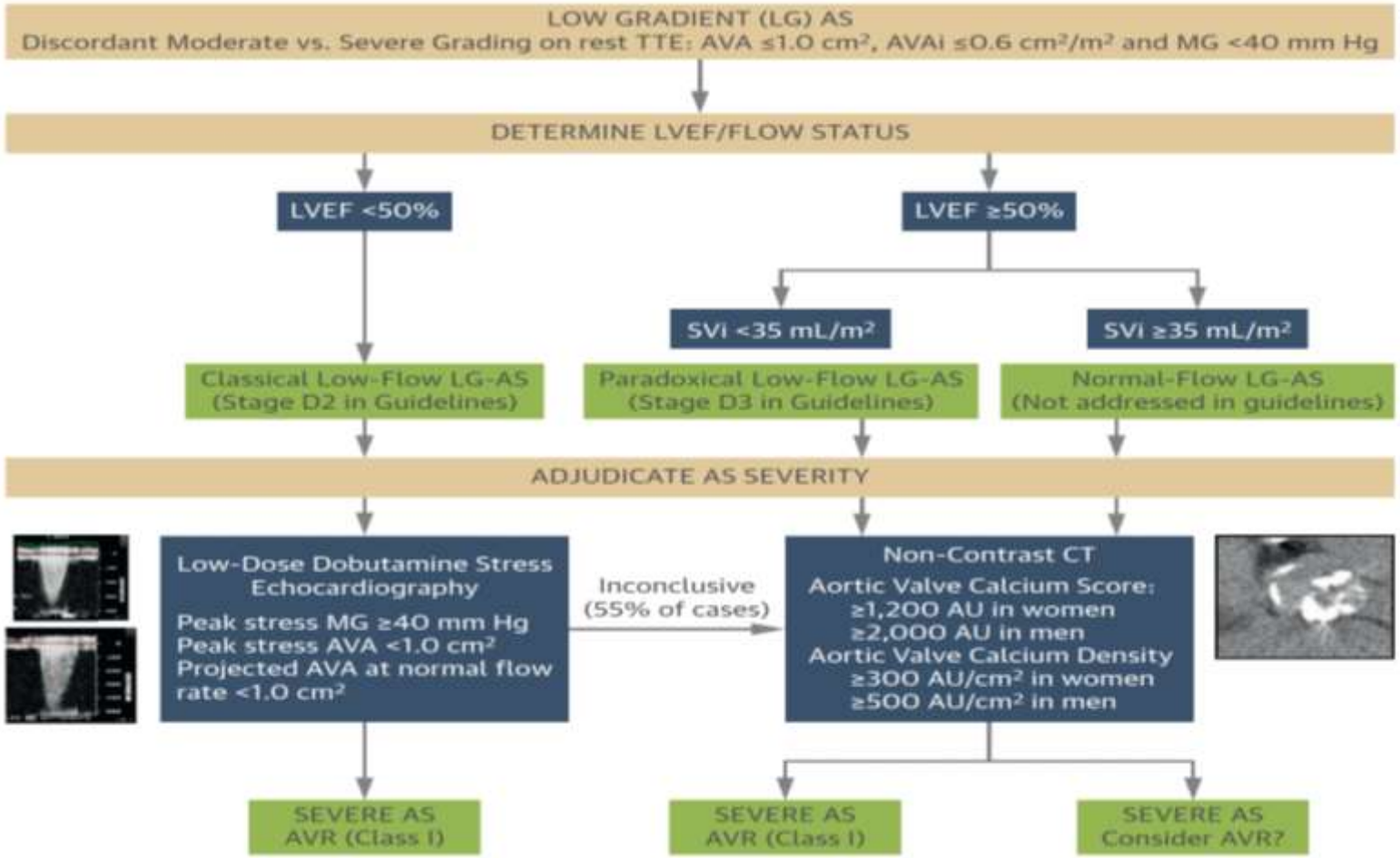
Clavel MA, JACC 2014 / Aksoy, Clin Cardiol 2013 / Pawade, Circulation CVI 2018

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

Adjudication of Low-Flow, Low-Gradient Aortic Stenosis Severity

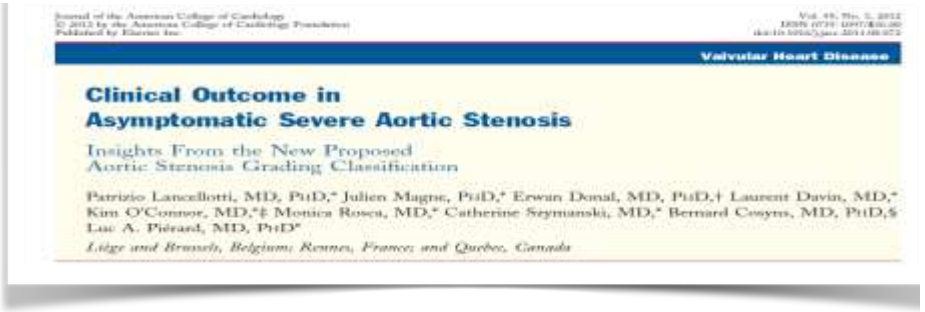
Dobutamine Stress Echocardiography and MSCT Are Complementary, Not Competitive

Marie-Annick Clavel, DVM, PhD, Philippe Pibarot, DVM, PhD



JACC: CARDIOVASCULAR IMAGING 2024: 861–864

El Origen



Valvular Heart Disease

Clinical Outcome in Asymptomatic Severe Aortic Stenosis

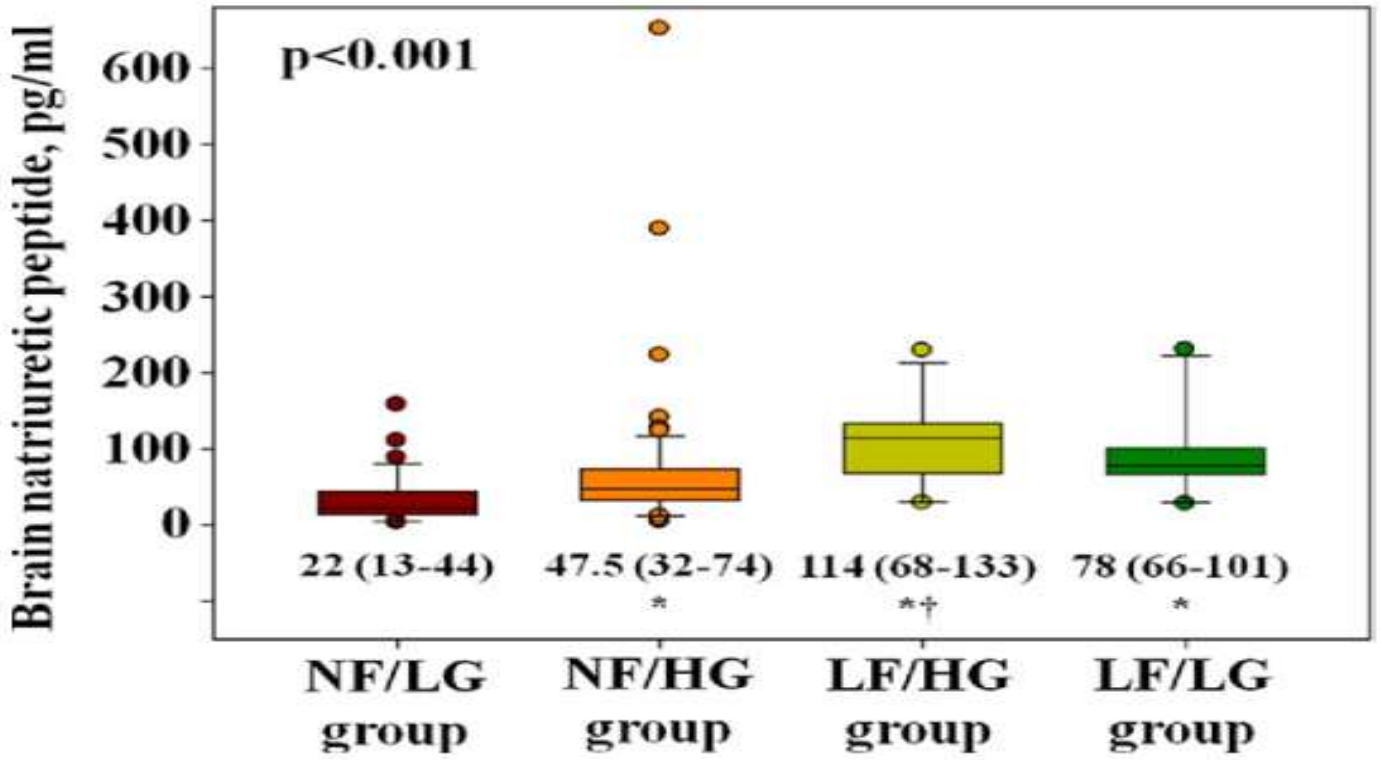
Insights From the New Proposed Aortic Stenosis Grading Classification

Patrizio Lancellotti, MD, PhD,* Julien Magne, PhD,* Erwan Donal, MD, PhD,† Laurent Davin, MD,* Kim O'Connor, MD,*‡ Monica Rosca, MD,* Catherine Szymanski, MD,* Bernard Cosyns, MD, PhD,§ Luc A. Piérard, MD, PhD*

Liège and Brussels, Belgium; Rennes, France; and Québec, Canada

150 P con EA Severa (AVA<1cm2).
Asintomáticos

- Ergometría normal
- FEVI >55%
- IA <2+
- No FA
- No EPOC

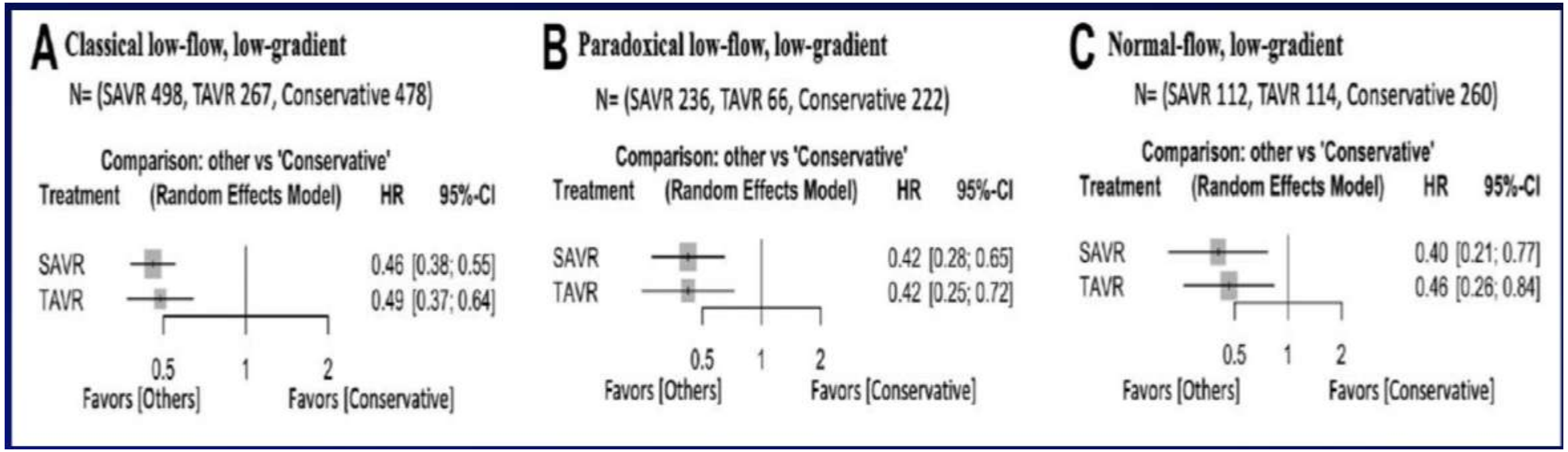


LANCELLOTTI, JACC 2012

Agenda

3 Consideraciones terapéuticas

RESULTADOS TAVI / Cirugía Vs Tto. Conservador



Ueyama *et al.* JACC Cardiovasc Interv. 2021;14(13):1481-1492.

Tratamiento de la EAo Severa: RVAo vs No RVAo

TABLE 3 Studies That Examined the Role of AVR Among Patients With NFLG Severe AS

First Author	Design	Patient Recruitment Years	Follow-Up, mo[a]	HG Severe AS, n	LFLG Severe AS, n	NFLG Severe AS, n	Moderate AS, n	Symptomatic Status	Primary Outcome	Comparisons and Results, HR (95% CI)
Tribouilloy et al[40]	Retrospective	2000-2012	39 (11-69)	247	57	85	420	Both	All-cause mortality	AVR vs no AVR: 0.57 (0.14-2.26)
Eleid et al[41]	Retrospective	2006-2011	28 ± 23	279	28	209	–	Both	All-cause mortality	AVR vs no AVR: 0.86 (0.52-1.41)
Berthelot-Richer et al[11]	Prospective	2000-2012	53 ± 36	537	392	280	–	Both	All-cause mortality	AVR vs no AVR: AVA (0.8-1.0 cm^2): 0.40 (0.18-0.84) AVA (<0.8 cm^2): 0.31 (0.14-0.62)
Melis et al[42]	Retrospective	2007-2010	25 (15-33)	76	23	44	–	Both	All-cause mortality	AVR vs no AVR: 0.15 (0.04-0.54)
Kang et al[51]	Prospective	2000-2011	59 (38-89)	–	–	284	–	Symptomatic	All-cause mortality CV mortality	All-cause mortality: AVR vs no AVR: 1.13 (0.55-2.35) CV mortality: AVR vs no AVR: 1.22 (0.53-2.81)
Shen et al[52]	Retrospective	Not reported	36 ± 19	–	75	97	–	Both	All-cause mortality	AVR vs no AVR: 0.66 (0.29-1.50)
Ozkan et al[53]	Prospective	2006-2011	28 ± 24	–	135	125	–	Symptomatic	All-cause mortality	AVR vs no AVR: 0.40 (0.19-0.84)
Zusman et al[54]	Retrospective	2012-2015	22	–	–	303	–	Symptomatic	All-cause mortality CV mortality	All-cause, AVR vs no AVR: Surgical AVR: 0.55 (0.17-1.78) Transcatheter AVR: 0.49 (0.26-0.92) CV mortality, AVR vs no AVR: Transcatheter AVR: 0.30 (0.10-0.74)
Saeed et al[55]	Retrospective	2010-2017	38 ± 22	–	–	303	–	Symptomatic	All-cause mortality	AVR vs no AVR: 0.26 (0.16-0.42)
Tarantini et al[56]	Retrospective	1985-2008	42 (23-75)	–	26	76	–	Both	All-cause mortality	AVR vs no AVR: 0.32 (0.17-0.58)
Mohty et al[57]	Retrospective	2000-2010	55 ± 36	497	99	172	–	Both	All-cause mortality	AVR vs no AVR: 0.21 (95% CI 0.12-0.38)

JACC Cardiovasc Imaging 2024;17:926–936

RESULTADOS TAVI: Aumento mortalidad LF-LG AS

Endpoint primario: Muerte, rehospitalización por IC, ACV

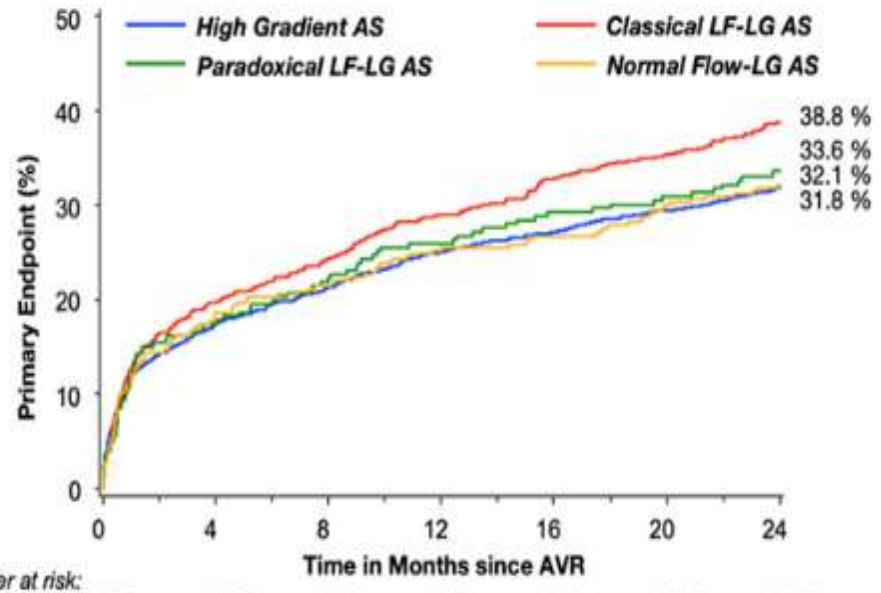
Circulation: Cardiovascular Interventions
Volume 13, Issue 7, July 2020

ORIGINAL ARTICLE

Outcome of Flow-Gradient Patterns of Aortic Stenosis After Aortic Valve Replacement

An Analysis of the PARTNER 2 Trial and Registry

OUTCOMES OF FOW-GRADIENT PATTERNS OF SEVERE AS IN PARTNER 2



Number at risk:							
HG AS	2,229	1,832	1,733	1,633	1,563	1,507	1,198
CLF-LG	689	549	513	480	449	431	352
PLF-LG	247	203	191	182	171	166	127
NF-LG	346	280	268	255	248	236	191

Overall Log-Rank p Value = 0.02

CLF-LG vs HG,
HR: 1.25 (95% CI: 1.09, 1.45), p=0.002

PLF-LG vs HG,
HR: 1.06 (95% CI: 0.85, 1.33), p=0.60

NF-LG vs HG ,
HR: 1.01 (95% CI: 0.83, 1.23), p=0.91

CLF-LG vs PLF-LG,
HR: 1.18 (95% CI: 0.92,1.52), p=0.18

CLF-LG vs NF-LG,
HR: 1.24 (95% CI: 1.00, 1.55), p=0.05

PLF-LG vs NF-LG,
HR: 1.05 (95% CI: 0.79, 1.40), p=0.74

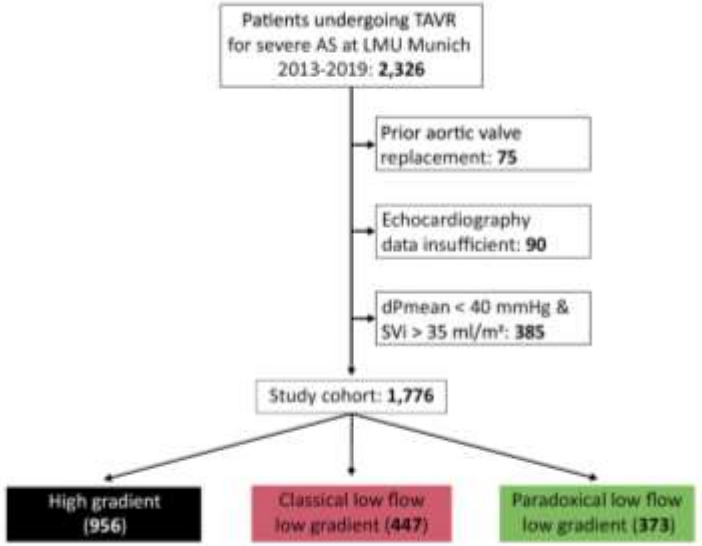
MORTALIDAD total a 2 años
HG AS Vs **LF-LG AS clásica**
16.8% Vs 21.4% p=0.007

Circ Cardiovasc Interv. 2020 Jul;13(7):e008792.

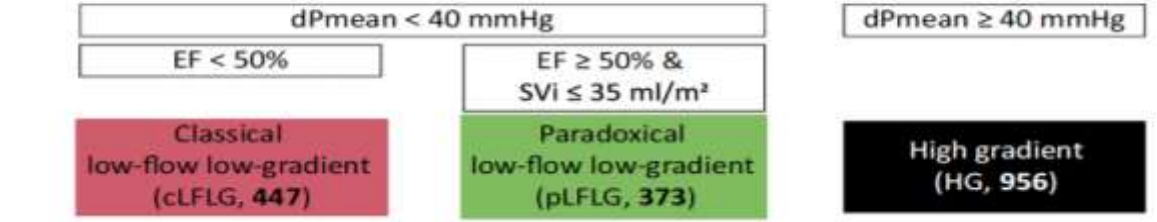
Resultados TAVI

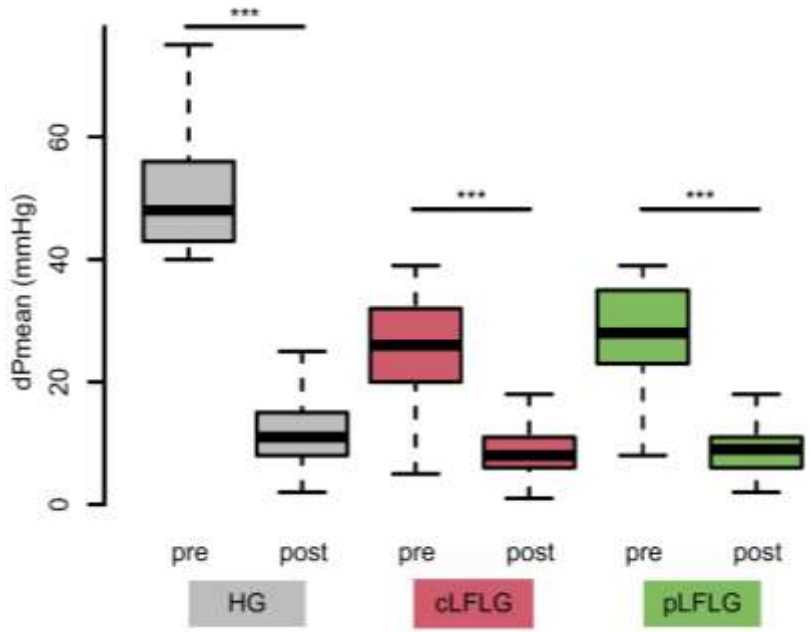
TAVI in patients with low-flow low-gradient aortic stenosis–short-term and long-term outcomes

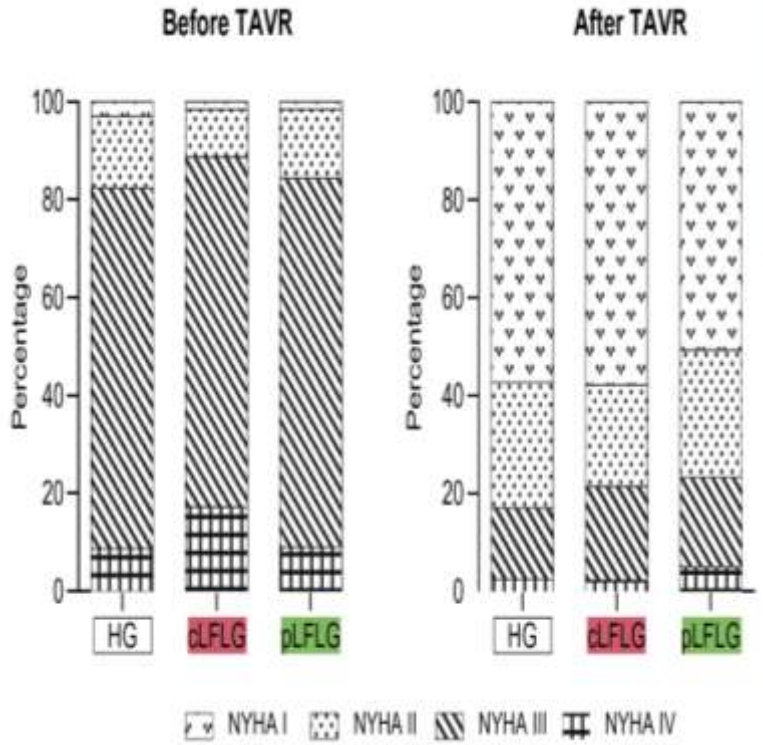
Julius Steffen[1,2] · Nikolas Reißig[1] · David Andreae[1] · Markus Beckmann[1] · Magda Haum[1] · Julius Fischer[1] · Hans Theiss[1] · Daniel Braun[1] · Martin Orban[1] · Konstantinos Rizas[1,2] · Sebastian Sadoni[3] · Michael Näbauer[1] · Sven Peterss[3] · Jörg Hausleiter[1,2] · Steffen Massberg[1,2] · Simon Deseive[1]



Analysis of 1,776 patients with different types of severe AS undergoing TAVR





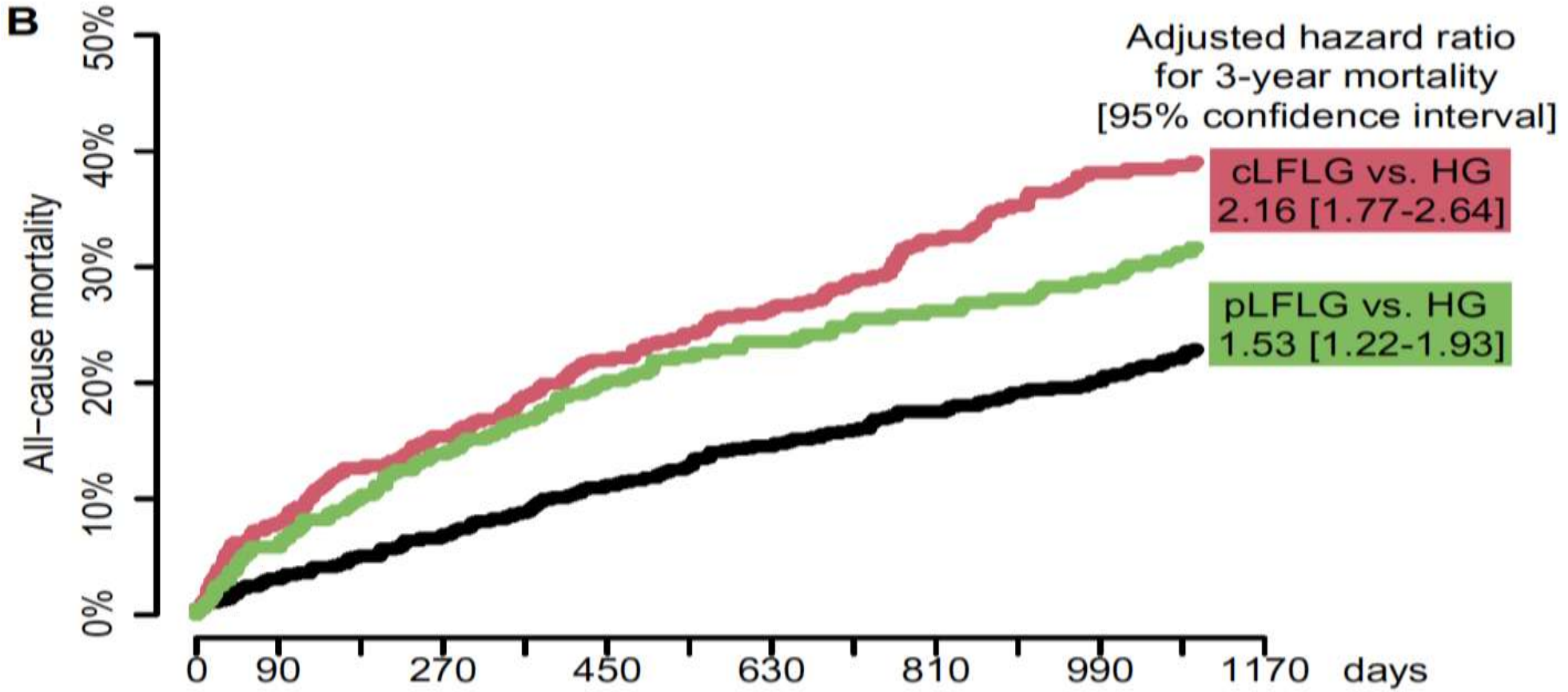


Steffen J, et al. Clinical Research in Cardiology (2022) 111:1325–1335

Resultados TAVI

TAVI in patients with low-flow low-gradient aortic stenosis–short-term and long-term outcomes

Julius Steffen[1,2] · Nikolas Reißig[1] · David Andreae[1] · Markus Beckmann[1] · Magda Haum[1] · Julius Fischer[1] · Hans Theiss[1] · Daniel Braun[1] · Martin Orban[1] · Konstantinos Rizas[1,2] · Sebastian Sadoni[3] · Michael Näbauer[1] · Sven Peterss[3] · Jörg Hausleiter[1,2] · Steffen Massberg[1,2] · Simon Deseive[1]



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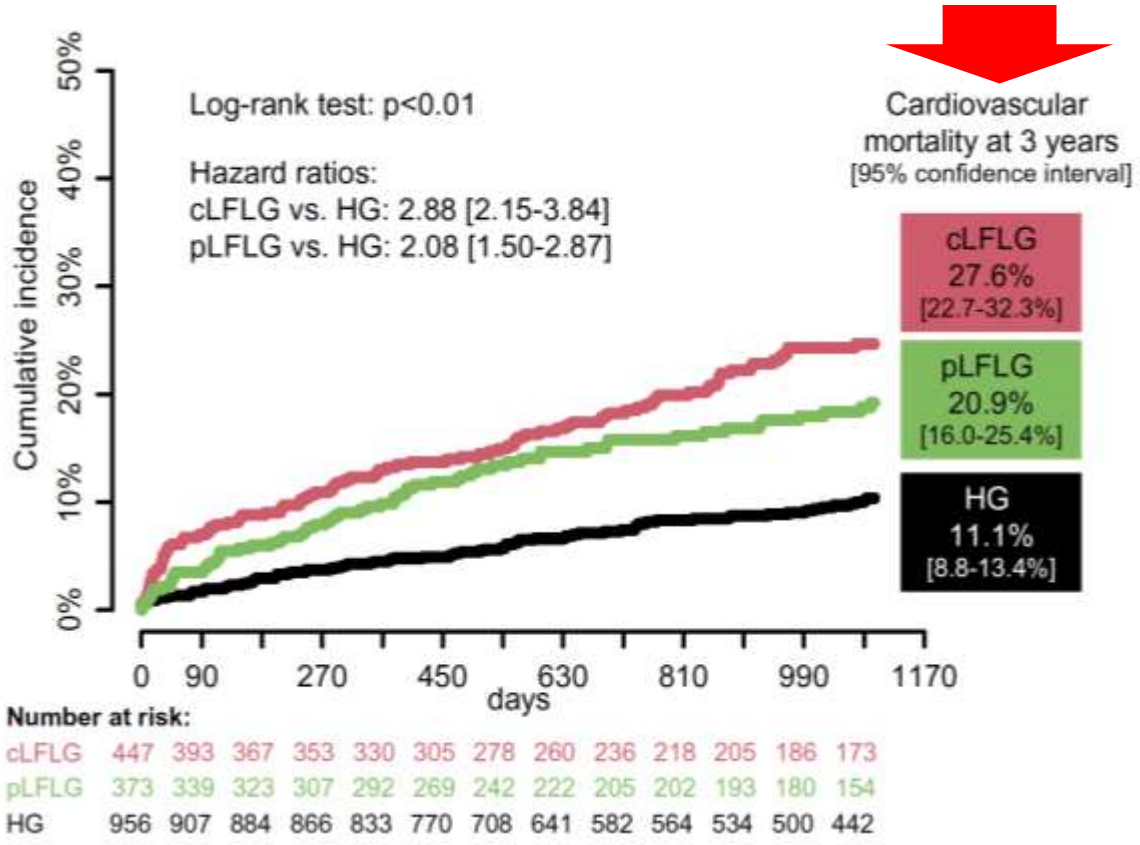
Resultados TAVI



HG patients died from cancer more frequently (3.9 vs. 2.1 vs. 10.5%, p < 0.01).

Steffen J, et al. Clinical Research in Cardiology (2022) 111:1325–1335

Table 1 Patient characteristics

	HG (*N* = 956)	cLFLG (*N* = 447)	pLFLG (*N* = 373)	Total (*N* = 1776)	*p* value
Male sex	440 (46.0%)	311 (69.6%)	166 (44.5%)	917 (51.6%)	**< 0.01**
Age (years)	81.2 [77.3–85.4]	82.0 [77.4–86.3]	82.2 [78.3–85.6]	81.7 [77.5–85.7]	0.19
Body mass index (kg/m²)	25.8 [23.4–29.4]	25.5 [22.7–28.8]	26.0 [23.8–28.7]	25.8 [23.4–29.1]	0.19
Body surface area (m²)	1.8 [1.7–2.0]	1.9 [1.7–2.0]	1.8 [1.7–2.0]	1.8 [1.7–2.0]	**0.02**
STS-score	3.0 [2.0–5.0]	5.0 [3.0–7.3]	3.9 [2.2–6.0]	3.8 [2.1–6.0]	**< 0.01**
Diabetes mellitus type 2	249 (28.3%)	148 (35.3%)	118 (33.8%)	515 (31.2%)	**0.02**
Hypertension	785 (88.7%)	392 (92.9%)	324 (92.8%)	1501 (90.6%)	**0.01**
Smoker (active or past)	174 (19.7%)	103 (24.5%)	54 (15.4%)	331 (20.0%)	**< 0.01**
Hypercholesterolemia	351 (40.3%)	170 (41.3%)	161 (46.4%)	682 (41.8%)	0.14
Positive family history	86 (9.0%)	35 (7.8%)	46 (12.3%)	167 (9.4%)	0.07
Chronic kidney disease	367 (38.4%)	279 (62.4%)	178 (47.7%)	824 (46.4%)	**< 0.01**
Atrial fibrillation	193 (20.2%)	163 (36.5%)	155 (41.6%)	511 (28.8%)	**< 0.01**
Coronary artery disease	500 (56.2%)	314 (73.5%)	222 (63.4%)	1036 (62.2%)	**< 0.01**
Prior MI	107 (11.2%)	119 (26.6%)	50 (13.4%)	276 (15.5%)	**< 0.01**
Prior PCI	258 (29.3%)	195 (46.2%)	113 (32.3%)	566 (34.2%)	**< 0.01**

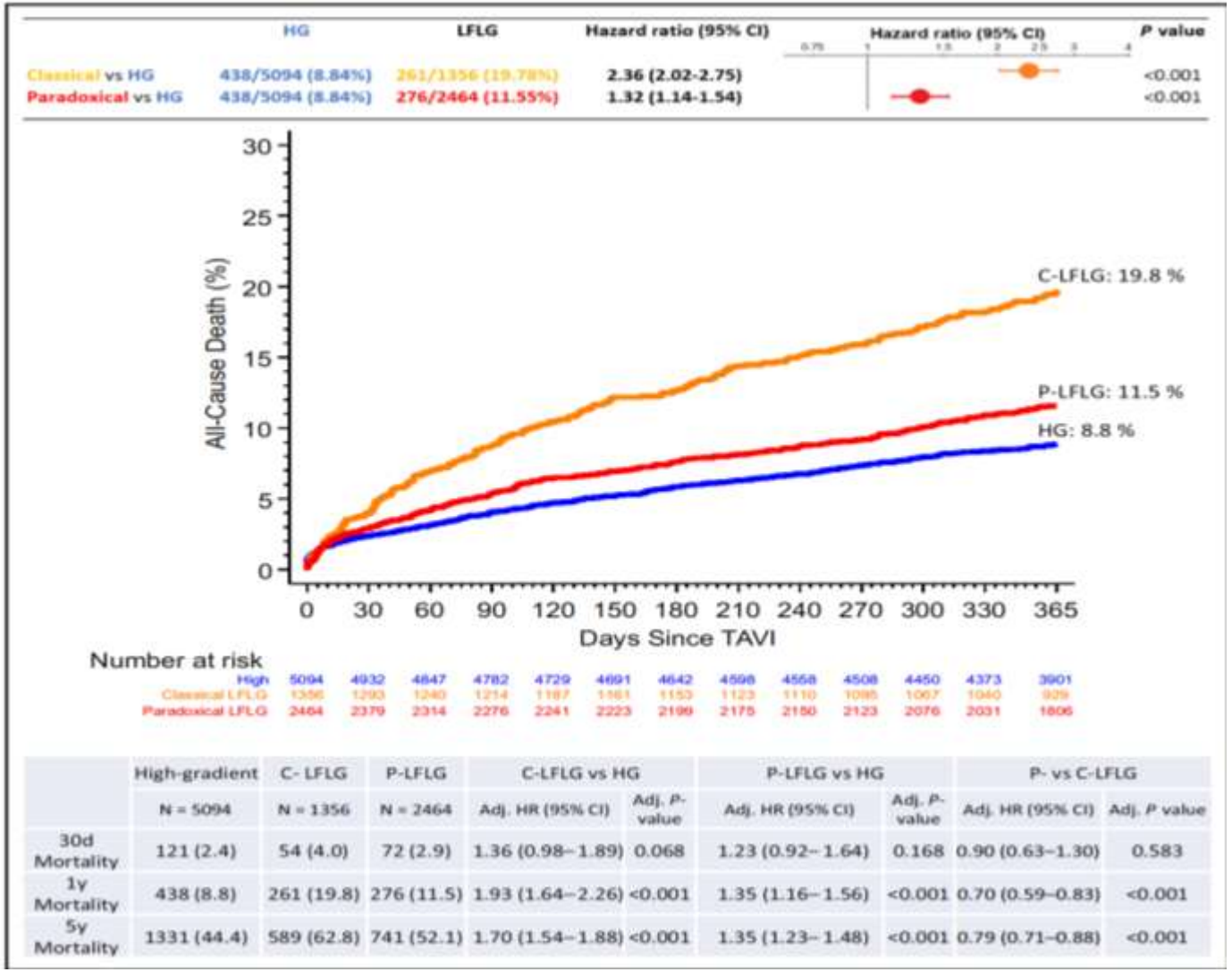
Table 2 Echocardiographic characteristics

	HG (*N* = 956)	cLFLG (*N* = 447)	pLFLG (*N* = 373)	Total (*N* = 1776)	*p* value
AVA (cm²)	0.7 [0.5–0.8]	0.7 [0.6–0.9]	0.7 [0.6–0.8]	0.7 [0.6–0.8]	**< 0.01**
AVAi (cm²/m²)	0.4 [0.3–0.4]	0.4 [0.3–0.5]	0.4 [0.3–0.4]	0.4 [0.3–0.4]	**< 0.01**
Maximum gradient (mmHg)	76.0 [68.0–89.0]	43.0 [33.0–52.0]	48.0 [39.0–56.0]	64.0 [46.0–78.0]	**< 0.01**
Mean gradient (mmHg)	48.0 [43.0–56.0]	26.0 [20.0–32.0]	28.0 [23.0–35.0]	40.0 [28.0–49.0]	**< 0.01**
SV (ml)	68.0 [57.0–83.0]	51.0 [40.0–59.0]	55.0 [46.0–60.0]	59.0 [49.0–72.0]	**< 0.01**
SVi (ml/m²)	37.9 [31.5–44.9]	27.3 [21.8–32.7]	29.5 [26.0–32.4]	32.4 [27.0–39.2]	**< 0.01**
LVEF (%)	55.0 [50.0–58.0]	40.0 [35.0–45.0]	55.0 [53.0–56.0]	55.0 [45.0–55.0]	**< 0.01**
TAPSE (mm)	22.0 [18.0–25.0]	17.0 [14.0–20.0]	20.0 [16.0–23.0]	20.0 [17.0–23.0]	**< 0.01**
AR grade 2	96 (10.0%)	57 (12.8%)	26 (7.0%)	179 (10.1%)	**0.02**
MR 3–4/4	37 (3.9%)	41 (9.2%)	15 (4.0%)	93 (5.3%)	**< 0.01**
TR 2–3/3	82 (9.1%)	80 (19.1%)	74 (20.2%)	236 (14.0%)	**< 0.01**
RV/RA-gradient (mmHg)	34.5 [26.0–45.0]	38.0 [29.0–48.0]	35.0 [27.0–42.0]	36.0 [27.0–45.0]	**< 0.01**
E (cm/s)	119.0 [106.0–136.0]	117.0 [103.0–132.2]	115.0 [108.0–133.0]	118.0 [106.0–135.0]	0.67
A (cm/s)	119.0 [107.0–137.0]	104.5 [81.2–119.8]	113.0 [101.5–128.5]	116.0 [103.8–133.2]	**< 0.01**
Septal E' (cm/s)	5.1 [4.1–6.1]	4.9 [4.2–6.0]	5.9 [4.7–7.4]	5.2 [4.2–6.4]	**< 0.01**
Lateral E' (cm/s)	7.0 [5.4–8.6]	7.3 [5.9–9.9]	8.6 [7.2–10.7]	7.4 [5.8–9.4]	**< 0.01**
LA volume (ml)	79.8 [60.7–98.1]	93.8 [76.1–117.0]	87.9 [60.3–111.8]	84.0 [63.0–107.0]	**< 0.01**
LVIDd (mm)	4.6 [4.1–5.1]	5.2 [4.5–5.7]	4.5 [4.0–5.0]	4.7 [4.2–5.3]	**< 0.01**
IVSd (mm)	1.4 [1.2–1.5]	1.2 [1.1–1.4]	1.3 [1.1–1.5]	1.3 [1.2–1.5]	**< 0.01**
LVPWd (mm)	1.2 [1.1–1.4]	1.1 [1.0–1.3]	1.1 [1.0–1.3]	1.2 [1.0–1.3]	**< 0.01**

RESULTADOS TAVI

Clinical Outcomes in High-Gradient, Classical Low-Flow, Low-Gradient, and Paradoxical Low-Flow, Low-Gradient Aortic Stenosis After Transcatheter Aortic Valve Implantation: A Report From the SwissTAVI Registry

Max Wagener, MD; Oliver Reuthebuch, MD; Dik Heg, PhD; David Tüller, MD; Enrico Ferrari, MD; Jürg Grünenfelder, MD; Christoph Huber, MD; Igal Moarof, MD; Olivier Muller, MD, PhD; Fabian Nietlispach, MD, PhD; Stéphane Noble, MD; Marco Roffi, MD; Maurizio Taramasso, MD; Christian Templin, MD, PhD; Stefan Toggweiler, MD; Peter Wenaweser, MD; Stephan Windecker, MD; Stefan Stortecky, MD, MPH; Raban Jeger, MD



	High-gradient	C- LFLG	P-LFLG	C-LFLG vs HG		P-LFLG vs HG		P- vs C-LFLG	
	N = 5094	N = 1356	N = 2464	Adj. HR (95% CI)	Adj. *P*-value	Adj. HR (95% CI)	Adj. *P*-value	Adj. HR (95% CI)	Adj. *P* value
30d Mortality	121 (2.4)	54 (4.0)	72 (2.9)	1.36 (0.98–1.89)	0.068	1.23 (0.92–1.64)	0.168	0.90 (0.63–1.30)	0.583
1y Mortality	438 (8.8)	261 (19.8)	276 (11.5)	1.93 (1.64–2.26)	<0.001	1.35 (1.16–1.56)	<0.001	0.70 (0.59–0.83)	<0.001
5y Mortality	1331 (44.4)	589 (62.8)	741 (52.1)	1.70 (1.54–1.88)	<0.001	1.35 (1.23–1.48)	<0.001	0.79 (0.71–0.88)	<0.001

J Am Heart Assoc. 2023;12:e029489. DOI: 10.1161/JAHA.123.029489

RESULTADOS TAVI

CURRENT AS Registry-2: Flow Chart

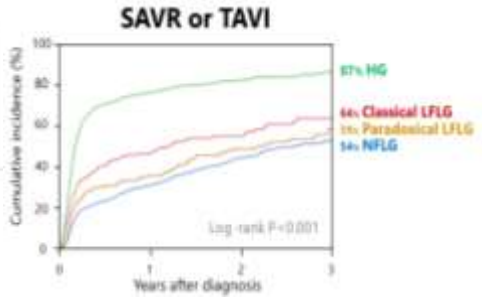
Multi-center, Prospective Registry

3369 consecutive patients with severe AS

(Sep 2018 - Dec 2020, 21 centers in Japan)

Peak aortic jet velocity >4.0 m/s, mean aortic pressure gradient >40 mmHg, or aortic valve area <1.0 cm²

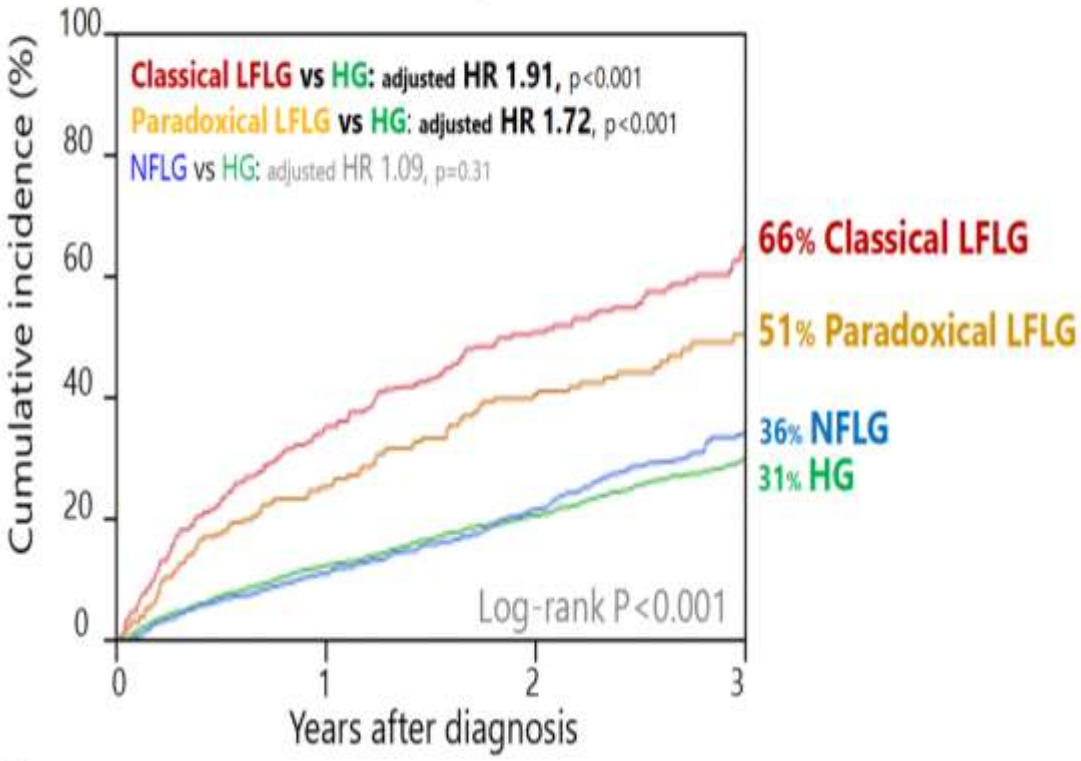
- Classical LFLG AS N=285 (8%)
- Paradoxical LFLG AS N=220 (7%)
- NFLG AS N=872 (26%)
- HG AS N=1986 (59%)



	Classical LFLG	Paradoxical LFLG	NFLG	HG	P value
	285 (8%)	220 (7%)	872 (26%)	1986 (59%)	
Age (years)	82.0±8.9	82.5±8.1	82.1±8.1	81.2±8.4	0.01
Male	160 (56%)	91 (41%)	292 (33%)	786 (40%)	<0.001
Diabetes mellitus	139 (49%)	70 (32%)	261 (30%)	524 (26%)	<0.001
Coronary artery disease	185 (65%)	75 (34%)	314 (36%)	634 (32%)	<0.001
Atrial fibrillation or flutter*	96 (34%)	134 (61%)	172 (20%)	363 (18%)	<0.001
Creatinine level >2 mg/dl	71 (25%)	33 (15%)	105 (12%)	187 (9%)	<0.001
STS score (PROM), %	6.1 (3.9-9.0)	4.3 (2.8-6.8)	4.3 (2.8-6.3)	4.0 (2.6-5.9)	<0.001
Symptoms related to AS	212 (74%)	124 (56%)	326 (37%)	1348 (68%)	<0.001

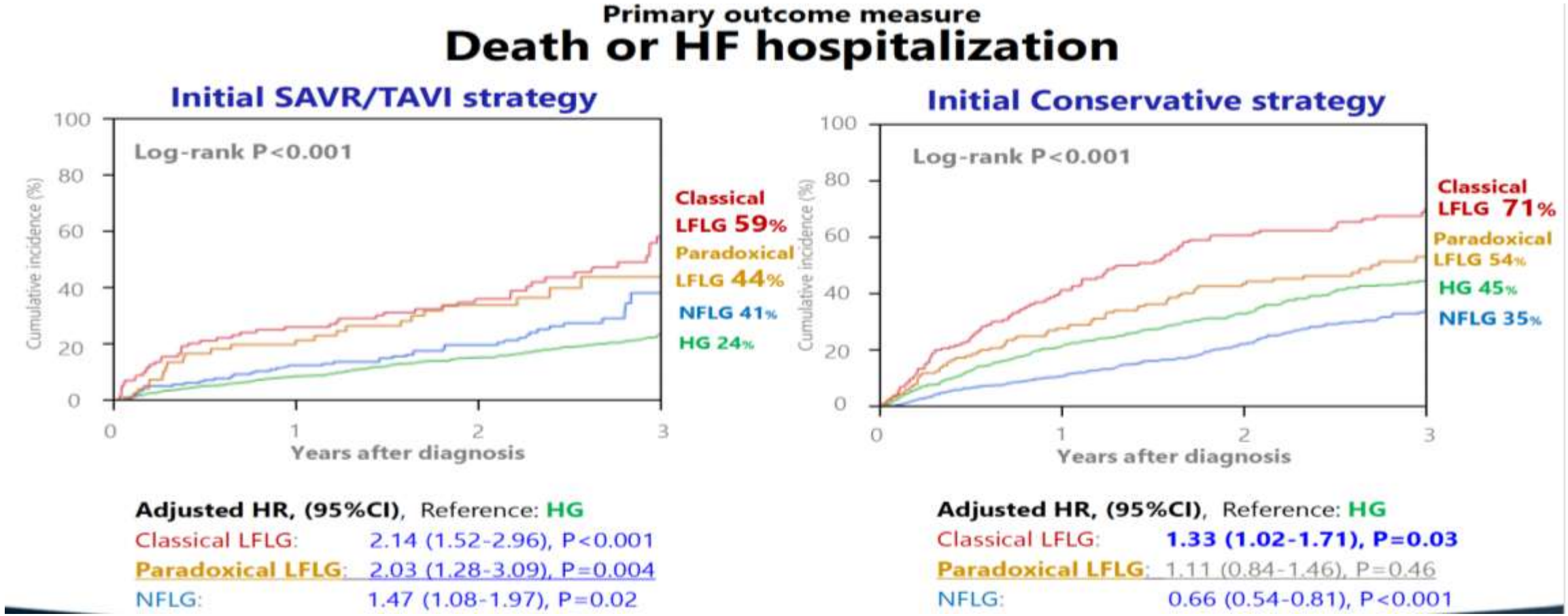
Primary outcome measure

Death or HF hospitalization



Tomohiko Taniguchi, MD

RESULTADOS TAVI



Patients with paradoxical LFLG AS had similarly unfavorable outcomes as those with HG AS under conservative strategy.

Tomohiko Taniguchi, MD

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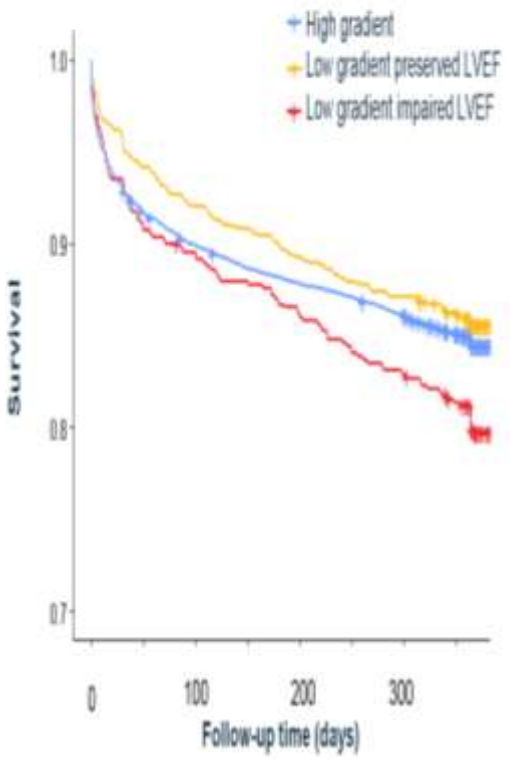
Survival



	HR, 95% CI, p value	
	High gradient vs Low gradient preserved LVEF	High gradient vs Low gradient impaired LVEF
	1.63 (1.19-2.20) P= 0.002	1.03 (0.88-1.19) P = 0.74
	1.11 (0.92-1.33) P = 0.30	0.87 (0.79-0.95) P = 0.003

Kimberley Hemelrijk CRF TCT

Primary Outcome

				HR, 95% CI, p value		
	High gradient n = 17,952	Low gradient preserved LVEF n =1,615	Low gradient impaired LVEF n = 1,116	High gradient vs Low gradient preserved LVEF	High gradient vs Low gradient impaired LVEF	Low gradient preserved LVEF vs Low gradient impaired LVEF
Mortality						
Thirty-day (%)	796 (5.0%)	45 (3.4%)	47 (4.9%)	1.63 (1.19-2.20) P= 0.002	1.03 (0.88-1.19) P = 0.74	0.65 (0.43-0.98) P = 0.04

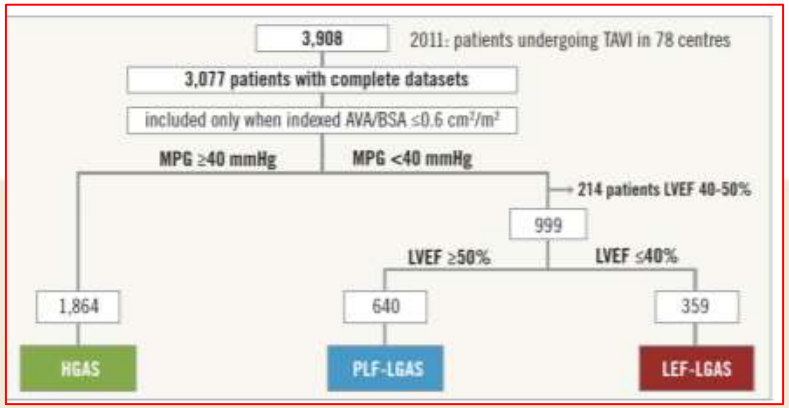
Clinical Outcomes

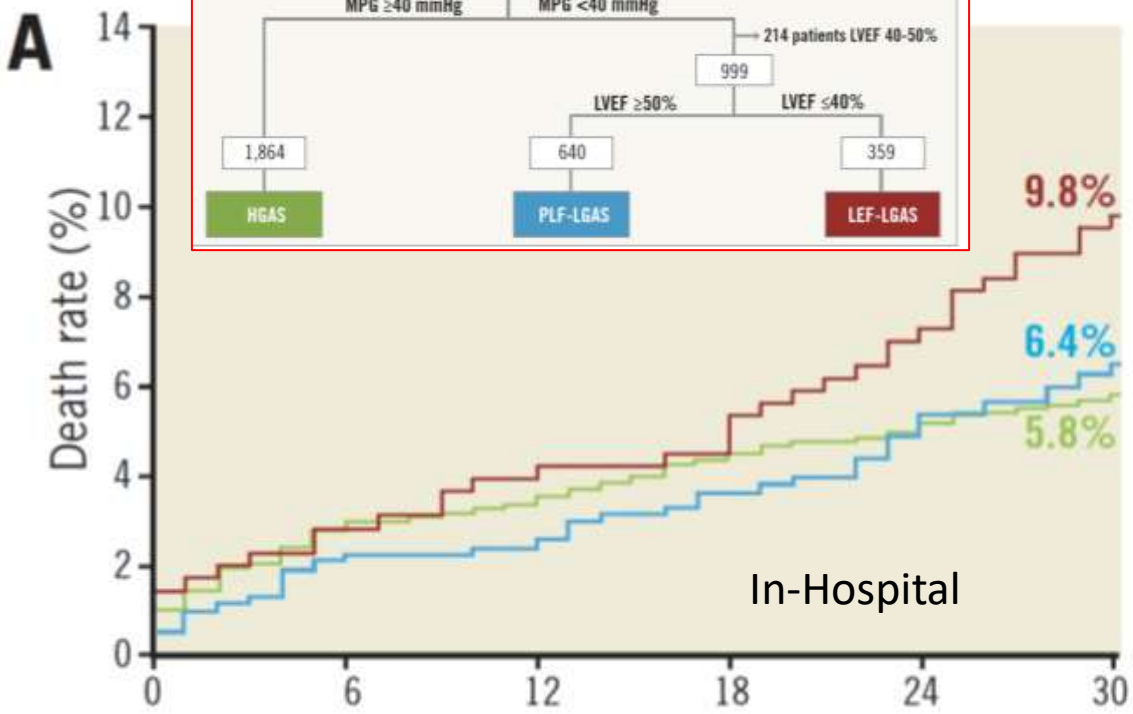
				OR, 95% CI, P value		
	High gradient n = 17,952	LG and preserved LVEF n = 1,615	LG and impaired LVEF n = 1,116	High gradient vs LG and preserved LVEF	High gradient vs LG and impaired LVEF	LG and preserved LVEF vs LG and impaired LVEF
Thirty day						
Myocardial infarction (%)	169 (1.2%)	13 (1.0%)	8 (0.9%)	1.16 (0.66-2.04) P=0.77	1.35 (0.66-3.75) P=0.52	1.17 (0.48-2.83) P=0.83
Stroke (%)	411 (2.3%)	38 (2.4%)	19 (1.7%)	0.972 (0.70-1.40) P=0.87	1.35 (0.85-2.15) P=0.25	1.391 (0.80-2.42) P=0.15
Major bleeding (%)	1218 (7.0%)	87 (5.4%)	45 (4.0%)	1.32 (1.06-1.65) P=0.02	1.79 (1.32-2.43) P <0.001	1.36 (0.94-1.97) P=0.10

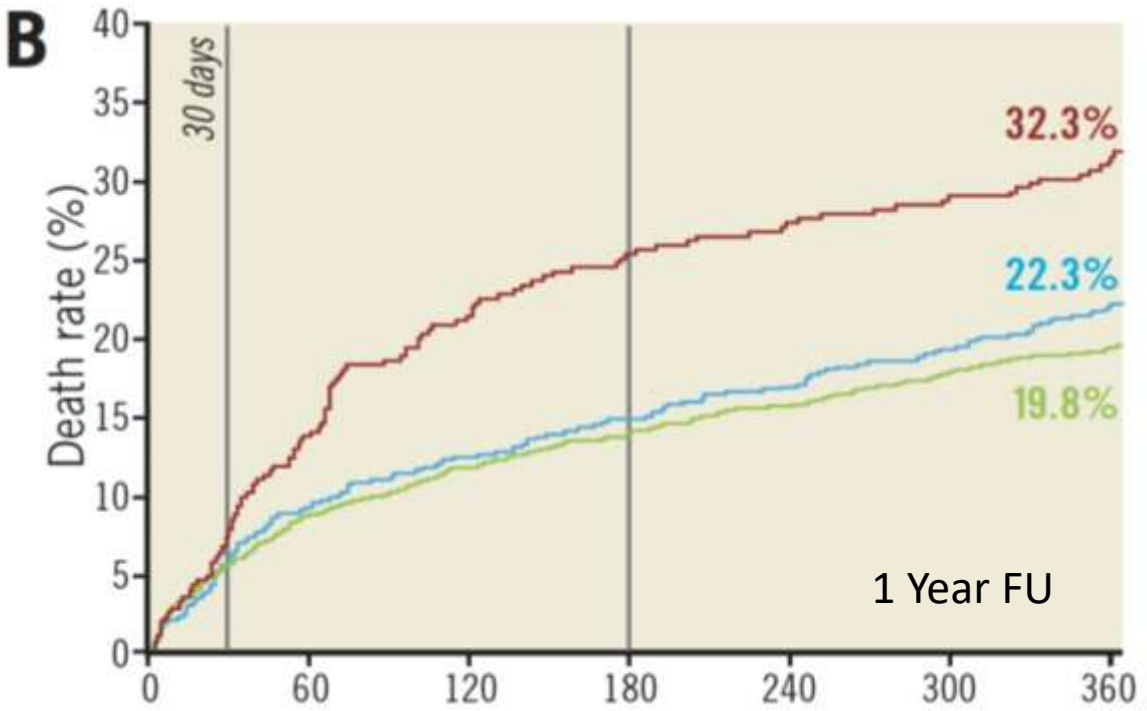
RESULTADOS TAVI

TAVI for low-flow, low-gradient severe aortic stenosis with preserved or reduced ejection fraction: a subgroup analysis from the German Aortic Valve Registry (GARY)

Alexander Lauten[1]*, MD; Hans R. Figulla[2], MD; Helge Möllmann[2], MD; David Holzhey[3], MD; Joachim Kötting[4], MSc; Andreas Beckmann[5], MD; Christof Veit[4], MD; Jochen Cremer[6], MD; Karl-Heinz Kuck[7], MD; Rüdiger Lange[8], MD; Ralf Zahn[9], MD; Stefan Sack[10], MD; Gerhard Schuler[3], MD; Thomas Walther[11], MD; Friedhelm Beyersdorf[12], MD; Michael Böhm[13], MD; Gerd Heusch[14], MD; Thomas Meinertz[15], MD; Till Neumann[16], MD; Armin Welz[17], MD; Friedrich W. Mohr[1], MD; Christian W. Hamm[1], MD; on behalf of the GARY Executive Board



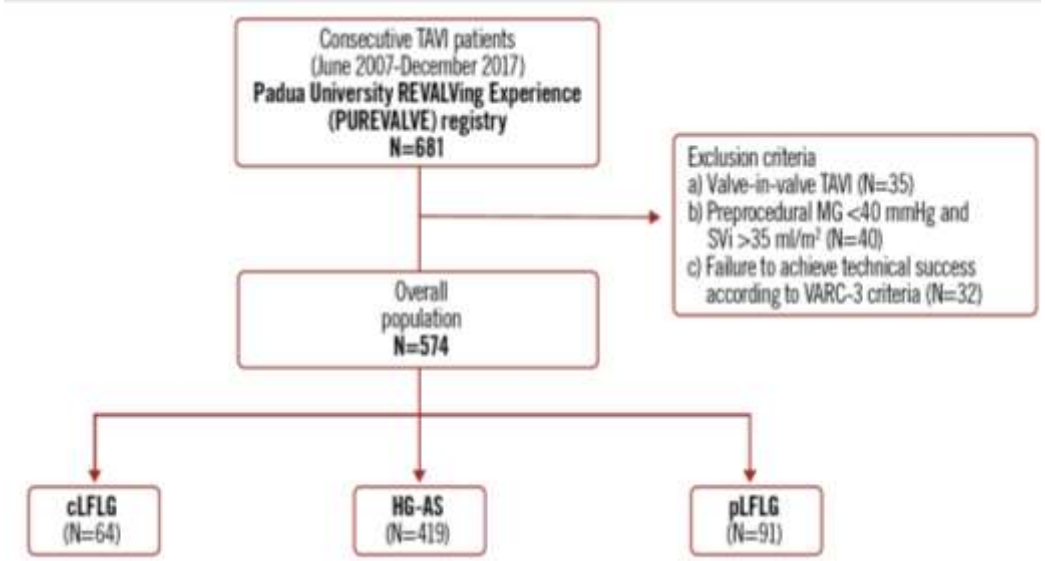




Low-gradient AS — Paradoxical low-gradient AS — High-gradient AS

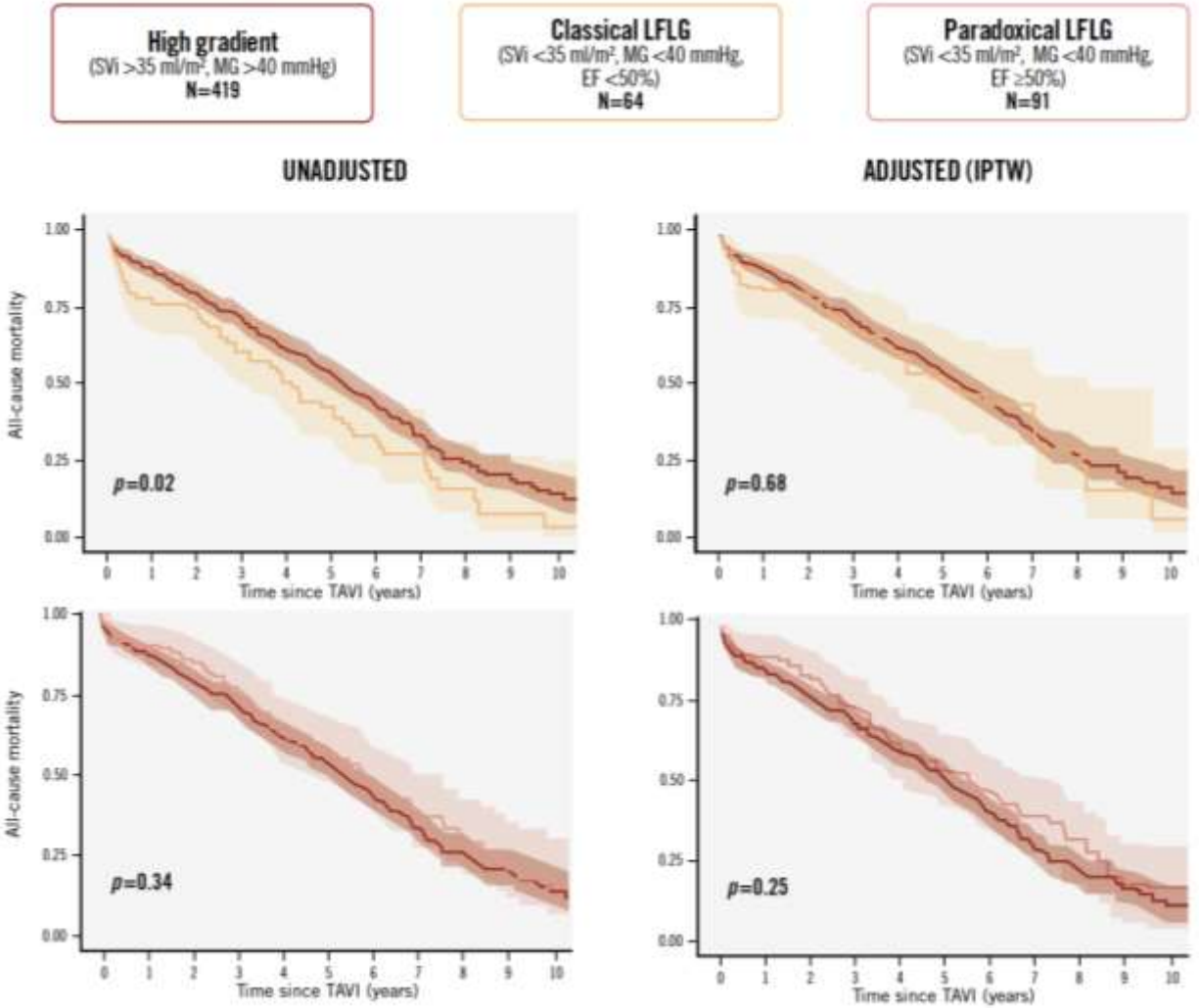
EuroIntervention 2014;10:850-859

RESULTADOS TAVI



Long-term survival after TAVI in low-flow, low-gradient aortic valve stenosis

Francesco Cardaioli[1], MD; Luca Nai Fovino[1], MD, PhD; Tommaso Fabris[1], MD; Giulia Masiero[1], MD; Federico Arturi[1], MD; Andrea Panza[1], MD; Andrea Bertolini[1], MD; Giulio Rodinò[1], MD; Saverio Continisio[1], MD; Massimo Napodano[1], MD, PhD; Giulia Lorenzoni[2], PhD; Dario Gregori[2], PhD; Chiara Fraccaro[1], MD, PhD; Giuseppe Tarantini[1]*, MD, PhD



EuroIntervention 2024;20:1380-1389
DOI: 10.4244/EIJ-D-24-00442

RESULTADOS TAVI

1-Year Survival After TAVR of Patients With Low-Flow, Low-Gradient and High-Gradient Aortic Valve Stenosis in Matched Study Populations

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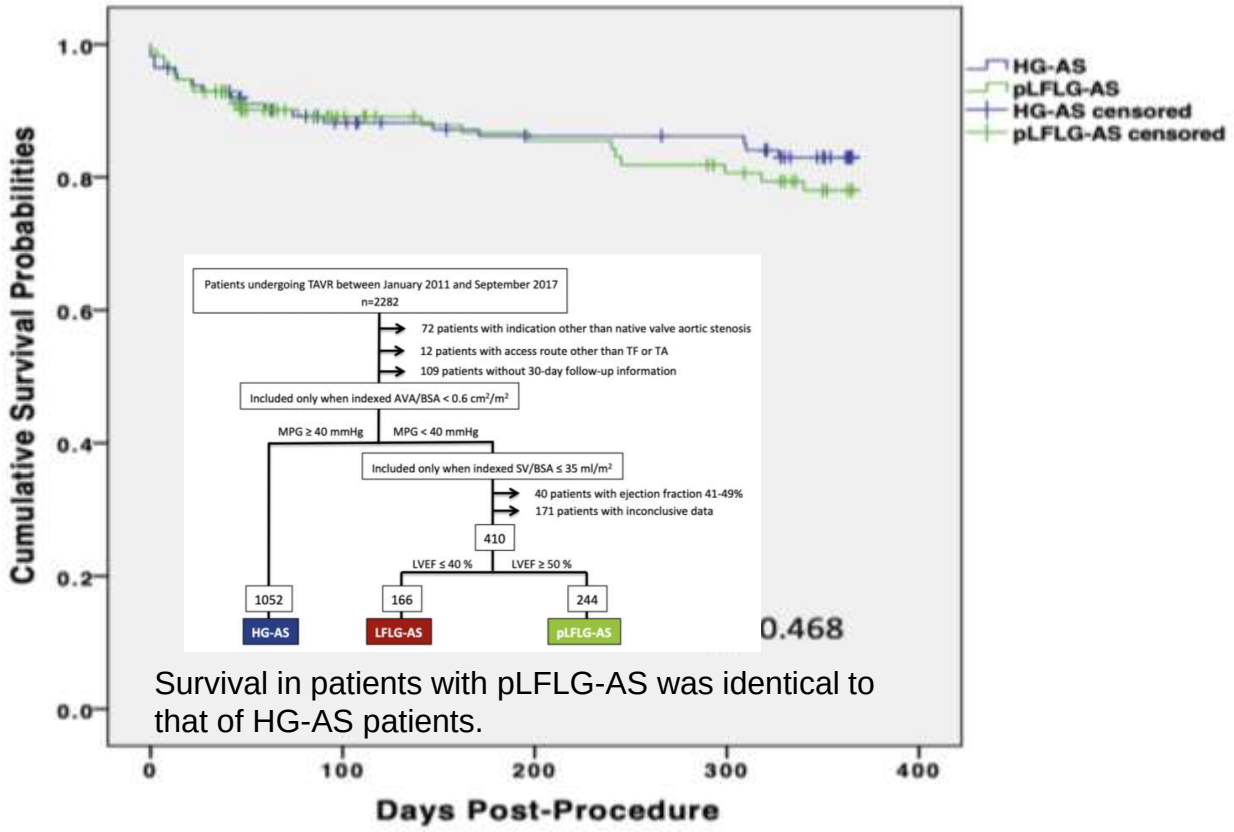
Survival Curves Based on All-Cause Mortality for Patients in the Matched Study Populations HG-AS and pLFLG-AS



Survival in patients with pLFLG-AS was identical to that of HG-AS patients.

TABLE 5 Clinical Outcomes

	HG-AS (n = 68)	LFLG-AS (n = 68)	p Value	HG-AS (n = 113)	pLFLG-AS (n = 113)	p Value
30-day clinical outcomes						
Overall mortality	4 (5.9)	9 (13.2)	0.145	8 (7.1)	8 (7.1)	NS
In-hospital mortality	3 (4.4)	8 (11.8)	0.116	8 (7.1)	6 (5.3)	0.581
Cardiovascular mortality	4 (5.9)	8 (11.8)	0.281	7 (6.2)	5 (4.4)	0.531
Major stroke	1 (1.5)	3 (4.4)	0.310	3 (2.7)	5 (4.4)	0.472
Major vascular complication	4 (5.9)	4 (5.9)	NS	6 (5.3)	9 (8.0)	0.423
New pacemaker implant	11 (16.2)	12 (17.6)	0.819	24 (21.2)	13 (11.5)	0.048
Acute kidney injury						
Stage 1	7 (10.3)	3 (4.4)		11 (9.7)	4 (3.5)	
Stage 2	1 (1.5)	3 (4.4)	0.352	7 (6.2)	3 (2.7)	0.068
Stage 3	2 (2.9)	4 (5.9)		2 (1.8)	6 (5.3)	
Any event according to VARC-2 criteria	26 (38.2)	27 (39.7)	0.860	51 (45.1)	42 (37.2)	0.224
EF unchanged or improved*	40 (100)	26 (78.8)	0.002	41 (65.1)	44 (68.8)	0.660
1-yr clinical outcomes						
Overall mortality	11 (16.2)	21 (30.9)	0.043	18 (15.9)	21 (18.6)	0.597
Cardiovascular mortality	9 (13.2)	16 (23.5)	0.122	14 (12.4)	16 (14.2)	0.864
Major stroke	1 (1.5)	3 (4.4)	0.310	3 (2.7)	8 (7.1)	0.122
New pacemaker implant	12 (17.6)	18 (26.5)	0.215	25 (22.1)	14 (12.4)	0.053
Decompensation after 30-day follow-up	3 (4.4)	5 (7.4)	0.466	2 (1.8)	5 (4.4)	0.249

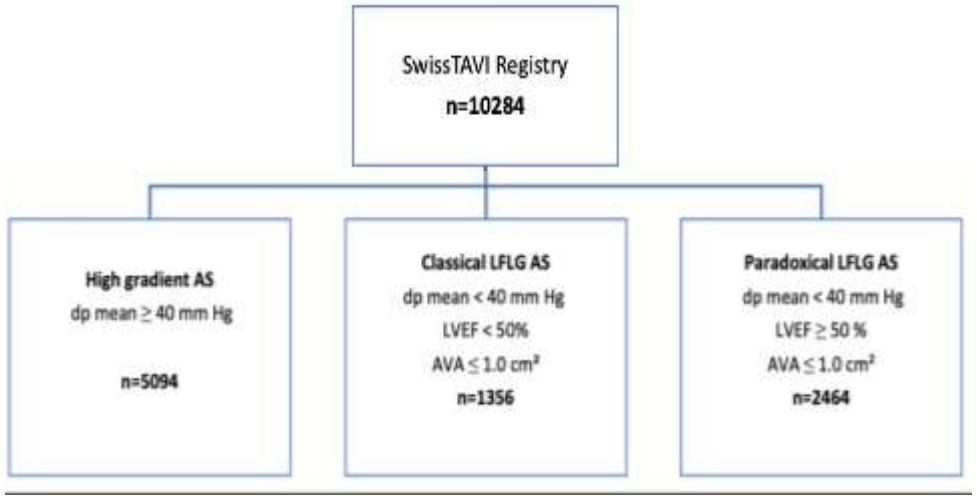
J Am Coll Cardiol Intv 2019;12:752–63

RESULTADOS TAVI: LF-LG AS Vs HG AS

Journal of the American Heart Association

ORIGINAL RESEARCH

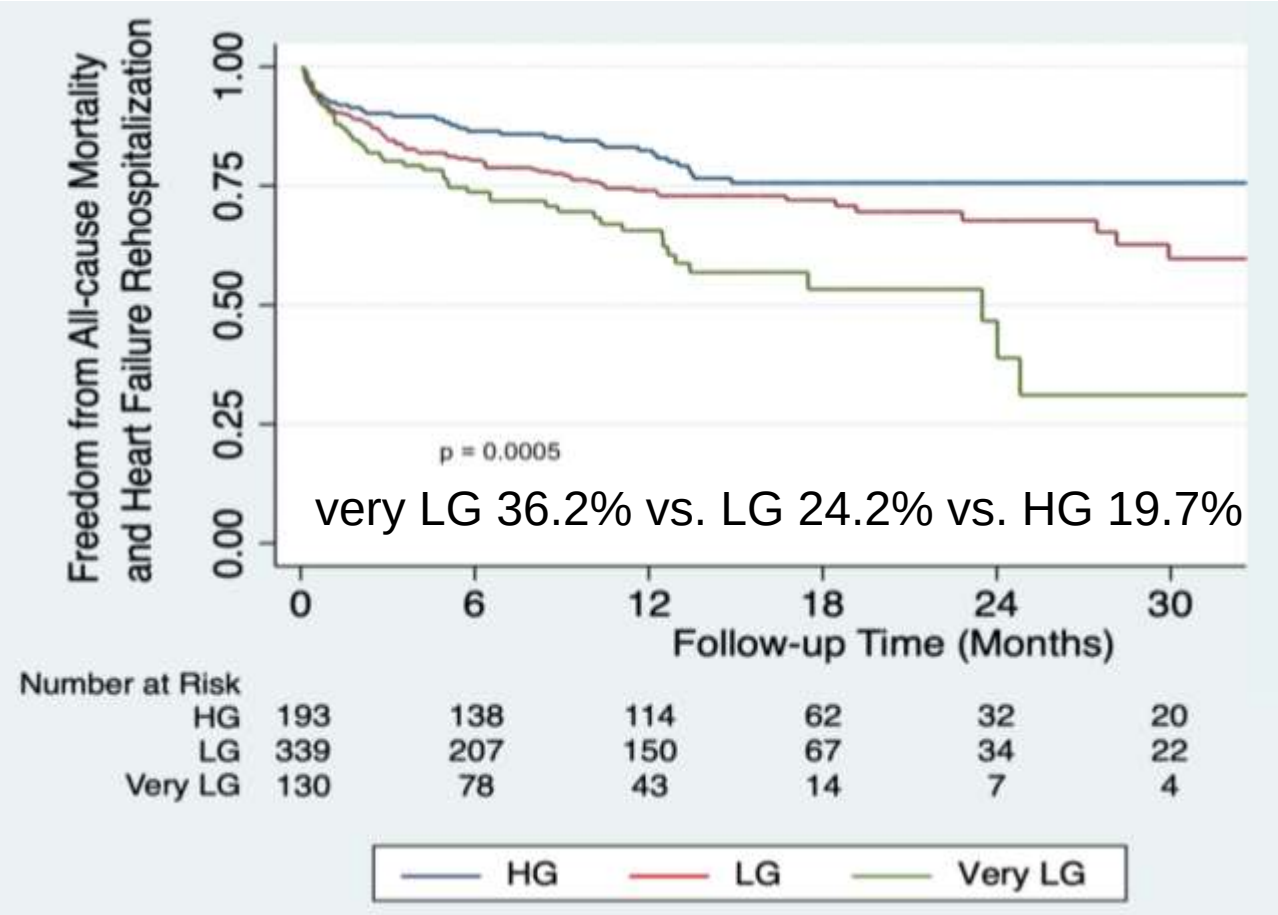
Clinical Outcomes in High-Gradient, Classical Low-Flow, Low-Gradient, and Paradoxical Low-Flow, Low-Gradient Aortic Stenosis After Transcatheter Aortic Valve Implantation: A Report From the SwissTAVI Registry

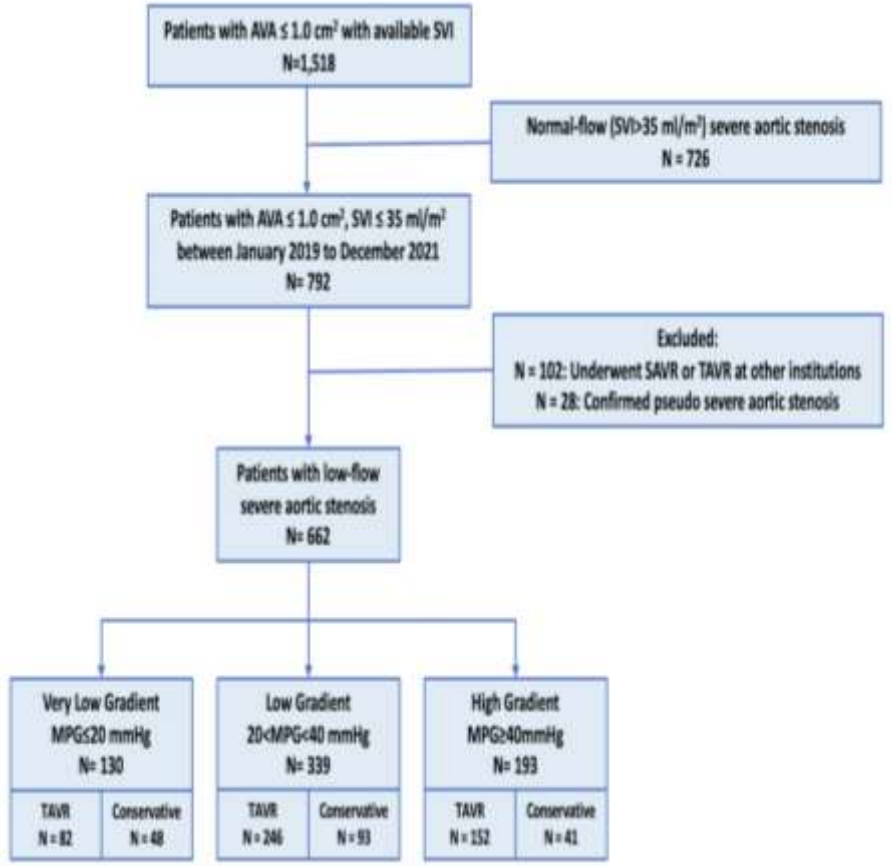


J Am Heart Assoc. 2023 Jun 20;12(12):e029489.

	All groups	High gradient	Classical LFLG	Paradoxical LFLG	*P* value		
	N=8914	N=5094	N=1356	N=2464	Classical LFLG vs HG	Paradoxical LFLG vs HG	Paradoxical vs classical LFLG
Age, y	82.10±6.26	82.09±6.13	81.94±6.90	82.21±6.14	0.411	0.461	0.215
Female sex, n (%)	4471 (50.2)	2625 (51.5)	454 (33.5)	1392 (56.5)	<0.001	<0.001	<0.001
Body mass index, kg/cm²	26.76±5.09	26.87±5.17	26.29±4.80	26.79±5.05	<0.001	0.534	0.003
Diabetes, n (%)	2281 (25.6)	1262 (24.8)	429 (31.6)	590 (23.9)	<0.001	0.441	<0.001
Arterial hypertension, n (%)	7075 (79.5)	3976 (78.2)	1089 (80.4)	2010 (81.7)	0.079	<0.001	0.340
Dyslipidemia, n (%)	4826 (54.2)	2643 (52.0)	802 (59.2)	1381 (56.1)	<0.001	0.001	0.065
COPD, n (%)	987 (11.1)	491 (9.7)	206 (15.2)	290 (11.8)	<0.001	0.005	0.003
History of cerebrovascular accident, n (%)	1042 (11.7)	542 (10.6)	187 (13.8)	313 (12.7)	0.001	0.008	0.341
Atrial fibrillation, n (%)	2141 (32.4)	964 (26.2)	439 (44.5)	738 (38.1)	<0.001	<0.001	0.001
Previous pacemaker implantation, n (%)	78[illegible] (8.8)	337 (6.6)	207 (15.3)	239 (9.7)	<0.001	<0.001	<0.001
Previous defibrillator implantation, n (%)	65 (0.7)	19 (0.4)	34 (2.5)	12 (0.5)	<0.001	0.460	<0.001
Coronary artery disease, n (%)	4998 (56.1)	2656 (52.2)	926 (68.3)	1417 (57.5)	<0.001	<0.001	<0.001
History of PCI, n (%)	2439 (27.4)	1198 (23.5)	502 (37.0)	739 (30.0)	<0.001	<0.001	<0.001
History of myocardial infarction, n (%)	1072 (12.0)	488 (9.6)	337 (24.9)	247 (10.0)	<0.001	0.535	<0.001
Peripheral artery disease, n (%)	1378 (15.5)	715 (14.0)	291 (21.5)	372 (15.1)	<0.001	0.221	<0.001
History of cardiac surgery, n (%)	855 (9.6)	344 (6.8)	228 (16.8)	283 (11.5)	<0.001	<0.001	<0.001
Dyspnea, NYHA class, n (%)					<0.001	0.001	<0.001
NYHA I	894 (10.3)	573 (11.5)	90 (6.8)	231 (9.7)	<0.001	0.017	0.003
NYHA II	2737 (31.5)	1676 (33.7)	311 (23.5)	750 (31.4)	<0.001	0.044	<0.001
NYHA III	4306 (49.6)	2358 (47.4)	702 (52.9)	1246 (52.1)	<0.001	<0.001	0.631
NYHA IV	751 (8.6)	363 (7.3)	223 (16.8)	165 (6.9)	<0.001	0.563	<0.001
CCS angina class, n (%)					0.189	0.276	0.093
No angina	7023 (80.0)	3994 (79.6)	1105 (82.5)	1924 (79.5)	0.017	0.902	0.026
CCS1	359 (4.1)	215 (4.3)	46 (3.4)	98 (4.0)	0.187	0.666	0.376
CCS2	923 (10.5)	521 (10.4)	120 (9.0)	282 (11.6)	0.138	0.102	0.011
CCS3	386 (4.4)	236 (4.7)	54 (4.0)	96 (4.0)	0.338	0.168	0.931
CCS4	87 (1.0)	52 (1.0)	14 (1.0)	21 (0.9)	1.000	0.532	0.596
STS-PROM, %	4.68±3.76	4.38±3.51	6.14±4.77	4.48±3.41	<0.001	0.229	<0.001

RESULTADOS TAVI

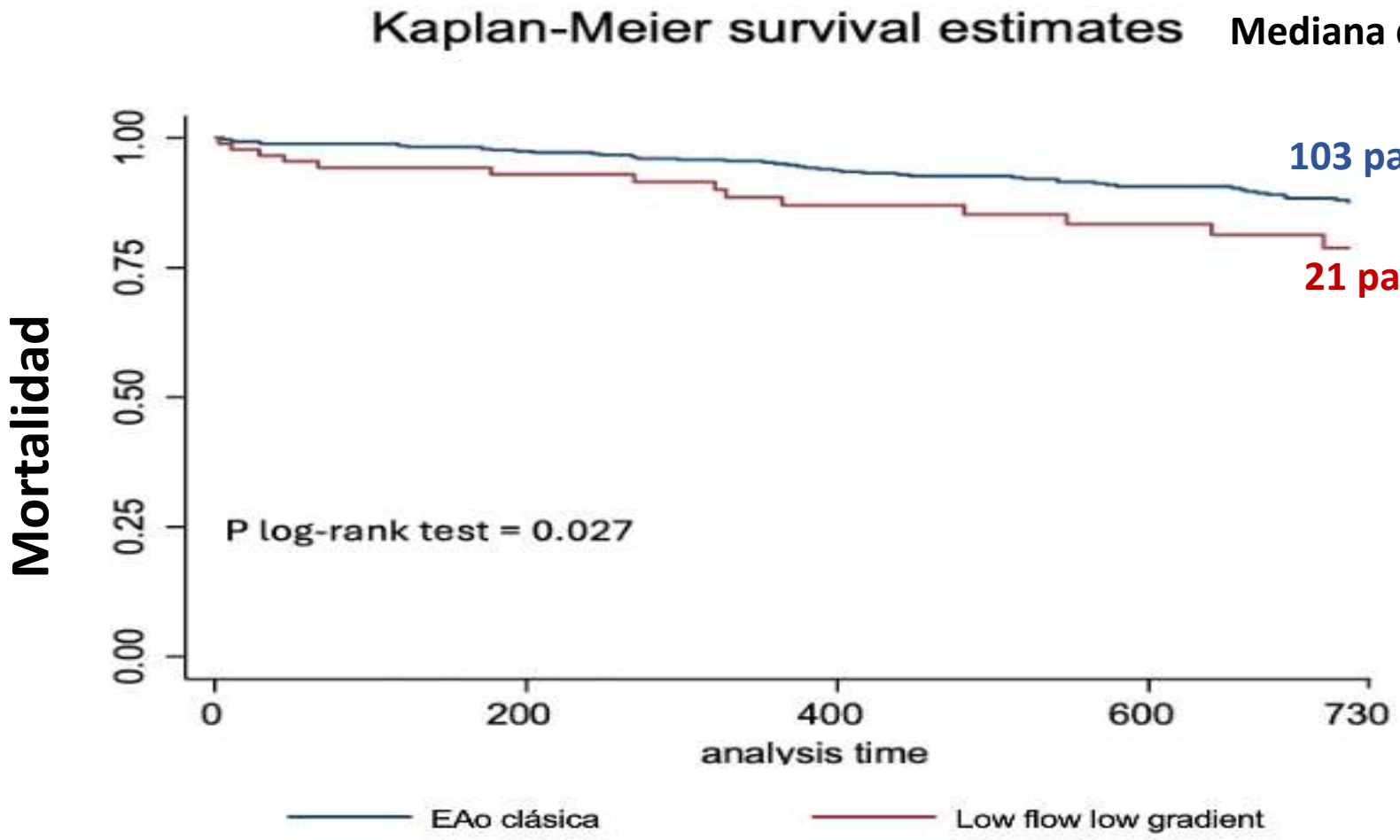




L. Chopra, et al.

RESULTADOS TAVI TAVI LF-LG (Vigo)

Total de pacientes con seguimiento: 594
Estenosis Aórtica severa clásica: 517 (86%)
Low flow low gradiente clásico: 87 (14%)
Mediana de seguimiento: 678 (306 – 928)



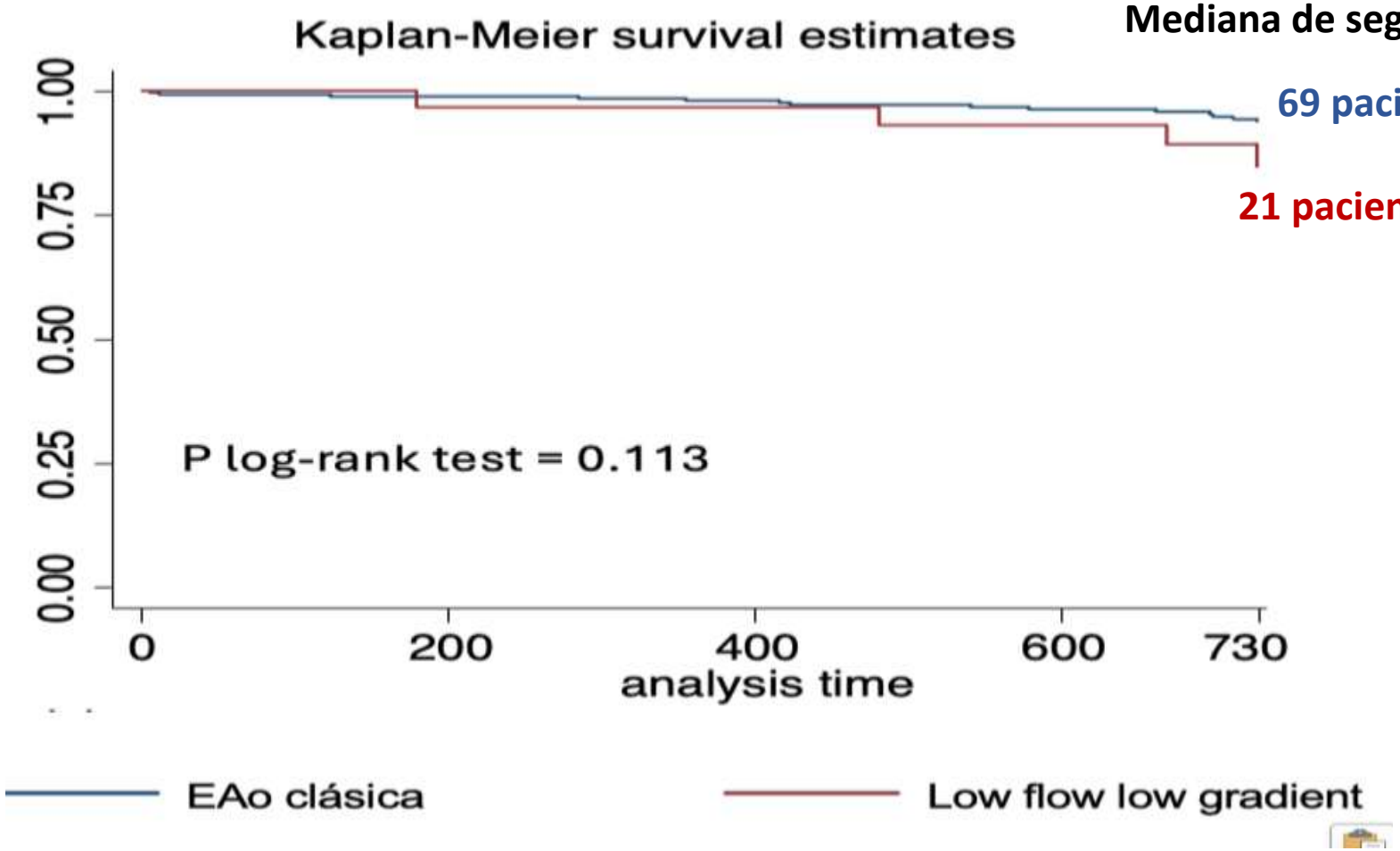
103 pacientes (20.2%)

(P =0.285)

21 pacientes (25.3%)

RESULTADOS TAVI LF-LG (Vigo)

Periodo 2020 – 2023
Total de pacientes con seguimiento: 445
Estenosis Aórtica severa clásica: 394 (89%)
Low flow low gradiente clásico: 51 (11%)
Mediana de seguimiento: 801 (656 – 1113)



69 pacientes (20.5%)

(P =0.870)

21 pacientes (21.6%)

RESULTADOS TAVI

Transcatheter Aortic Valve Replacement in Patients With Low-Flow, Low-Gradient Aortic Stenosis

The TOPAS-TAVI Registry

Henrique Barbosa Ribeiro, MD, PhD,[a] Stamatios Lerakis, MD,[b] Martine Gilard, MD, PhD,[c] João L. Cavalcante, MD,[d] Raj Makkar, MD,[e] Howard C. Herrmann, MD,[f] Stephan Windecker, MD,[g] Maurice Enriquez-Sarano, MD,[h] Asim N. Cheema, MD,[i] Luis Nombela-Franco, MD, PhD,[j] Ignacio Amat-Santos, MD, PhD,[k] Antonio J. Muñoz-Garcia, MD, PhD,[l] Bruno Garcia del Blanco, MD,[m] Alan Zajarias, MD,[n] John C. Lisko, MD,[o] Salim Hayek, MD,[p] Vasilis Babaliaros, MD,[q] Florent Le Ven, MD,[r] Thomas G. Gleason, MD,[s] Tarun Chakravarty, MD,[t] Wilson Y. Saeto, MD,[t] Marie-Annick Clavel, DVM, PhD,[u,v] Alberto de Agustin, MD, PhD,[l] Vicenç Serra, MD,[w] John T. Schindler, MD,[x] Abdellaziz Dahou, MD, PhD,[y] Rishi Puri, MBBS, PhD,[z] Emilie Pelletier-Beaumont, MSc,[aa] Melanie Côté, MSc,[aa] Philippe Pibarot, DVM, PhD,[aa] Josep Rodés-Cabau, MD[aa]

TAVR in Patients with Low-Flow, Low-Gradient Aortic Stenosis

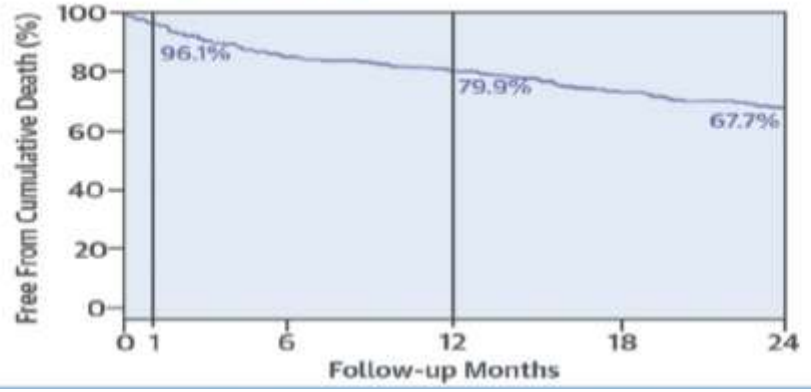
- LVEF ≤40%
- ΔP <35 mmHg
- AVA <1.0 cm²

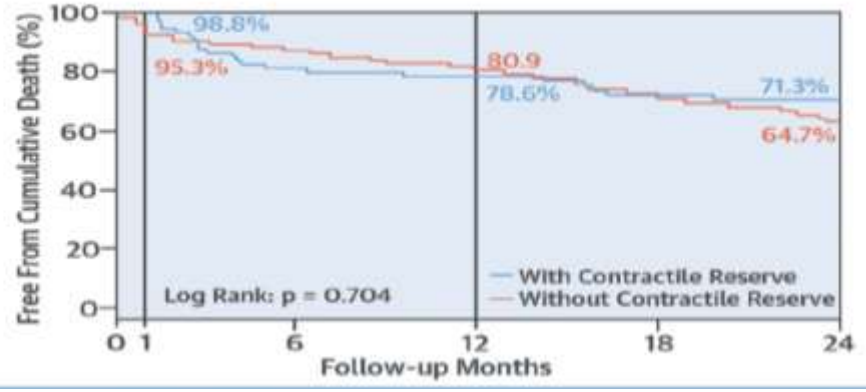
n = 287

Dobutamine Stress-Echo
n = 234

Contractile (Flow) Reserve
↑SV ≥20%
(45%)

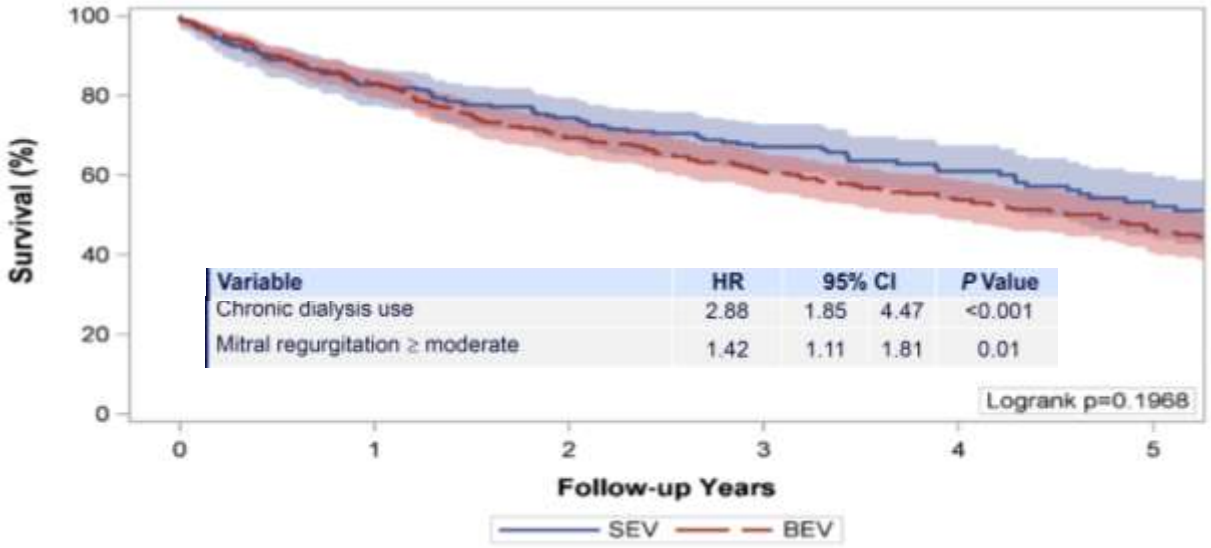
No Contractile (Flow) Reserve
↑SV <20%
(55%)





J Am Coll Cardiol 2018;71:1297–308)

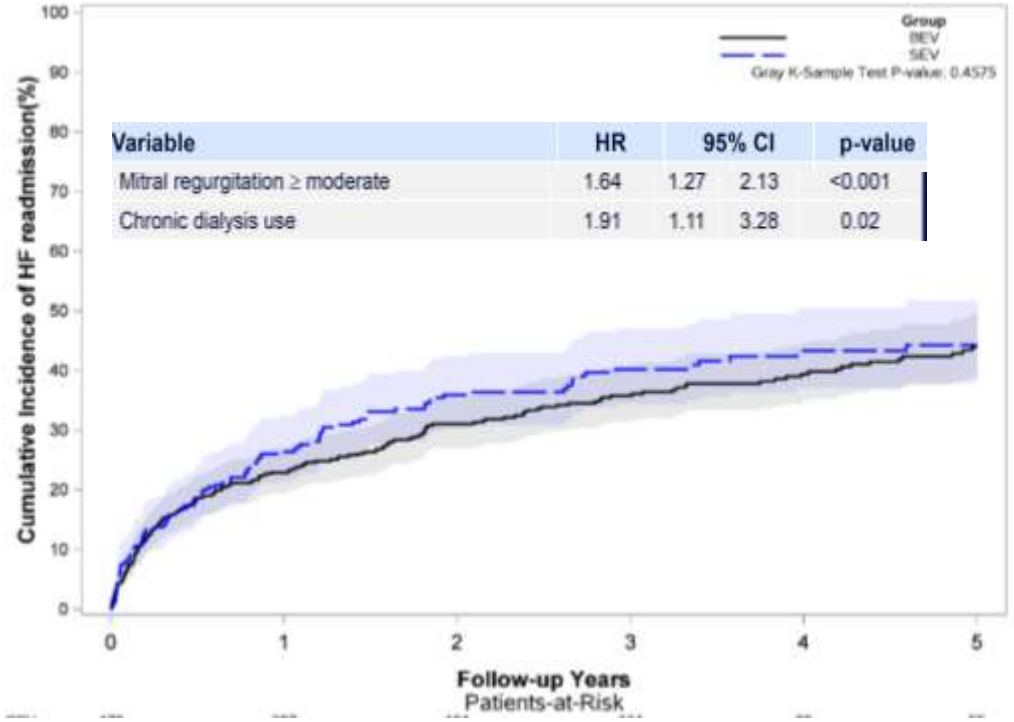
Resultados TAVI: BEV Vs SEV



Variable	HR	95% CI		P Value
Chronic dialysis use	2.88	1.85	4.47	<0.001
Mitral regurgitation ≥ moderate	1.42	1.11	1.81	0.01

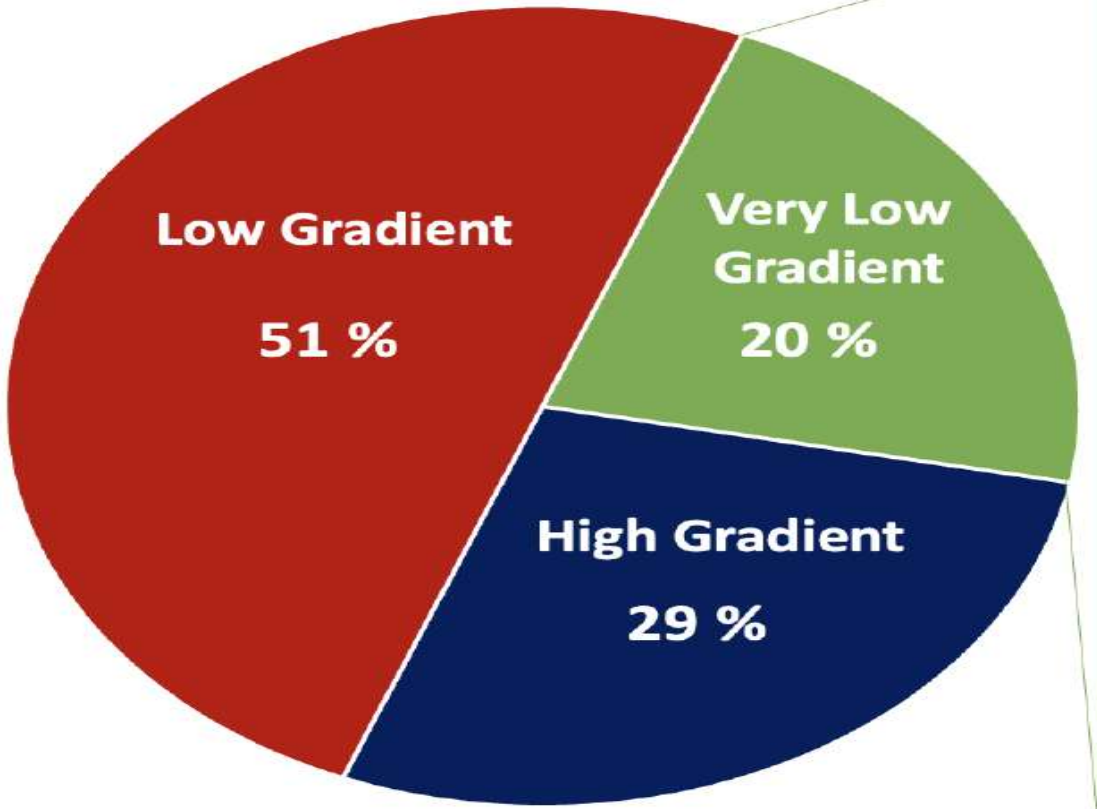
OUTCOME	BEV n = 478	SEV n = 254	P Value
30-day mortality	10 (2.09%)	7 (2.76%)	0.57
Stroke	7 (1.46%)	7 (2.76%)	0.23
Atrial fibrillation	6 (1.26%)	3 (1.18%)	1.00
Permanent pacemaker placement	36 (7.53%)	27 (10.63%)	0.16
Major vascular complication	3 (0.63%)	0 (0.00%)	0.56
Ejection fraction	46.2 ± 14.3	47.3 ± 13.7	0.35
AV mean gradient	10.0 ± 4.16	6.73 ± 3.49	<0.001
Paravalvular leak Mild Moderate+	 87 (18.95%) 7 (1.53%)	 70 (28.46%) 10 (4.07%)	0.001

913 patients
732 LFLG AS (14.9%)
478 balloon-expandable valve (BEV)
1.254 self-expanding valve (SEV)



Variable	HR	95% CI		p-value
Mitral regurgitation ≥ moderate	1.64	1.27	2.13	<0.001
Chronic dialysis use	1.91	1.11	3.28	0.02

RESULTADOS TAVI



Higher comorbidities

- Older age
- Coronary artery disease
- History of PCI
- Myocardial Infarction
- Chronic kidney disease
- Atrial fibrillation
- Higher STS score

Extensive Cardiac Damage

- Low LV ejection fraction
- Low SVI
- Large LV diameter
- ≥ Moderate TR
- ≥ Moderate MR

L. Chopra, et al.

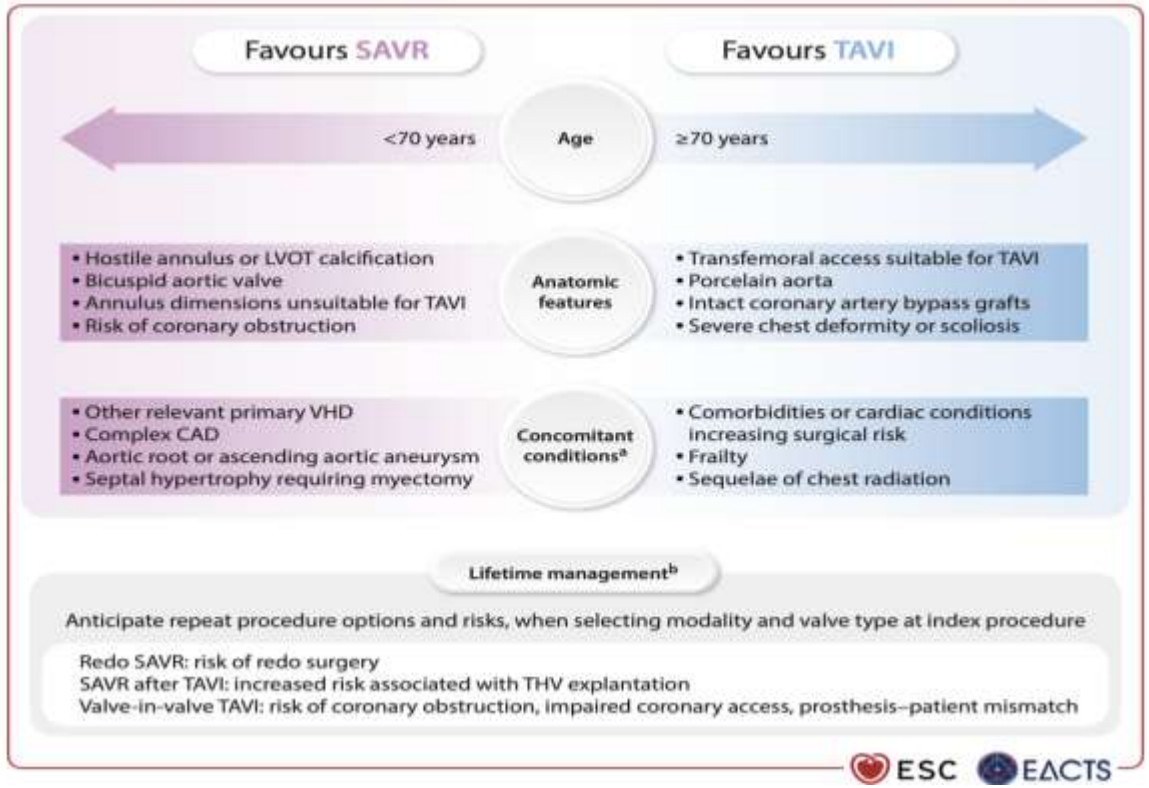
Agenda

4 Guías Clínicas

Guías Clínicas 2025

ESC European Society of Cardiology
European Heart Journal (2025) **00**, 1–102
https://doi.org/10.1093/eurheartj/ehaf194
ESC GUIDELINES

Recommendations	Class[a]	Level[b]
Symptomatic patients with severe aortic stenosis		
Intervention is recommended in symptomatic patients with severe, high-gradient AS [mean gradient ≥40 mmHg, V_{max} ≥4.0 m/s, AVA ≤1.0 cm^2 (or ≤0.6 cm^2/m^2 BSA)].	I	B
Intervention is recommended in symptomatic patients with low-flow (SVi ≤35 mL/m^2), low-gradient (<40 mmHg) AS with reduced LVEF (<50%) after careful confirmation that AS is severe.	I	B
Intervention should be considered in symptomatic patients with low-flow (SVi ≤35 mL/m^2), low-gradient (<40 mmHg) AS with normal LVEF (≥50%) after careful confirmation that AS is severe.[c]	IIa	B
Asymptomatic patients with severe aortic stenosis		
Intervention is recommended in asymptomatic patients with severe AS and LVEF <50% without another cause.	I	B
Intervention should be considered in asymptomatic patients (confirmed by a normal exercise test, if feasible) with severe, high-gradient AS and LVEF ≥50% as an alternative to close active surveillance, if the procedural risk is low.	IIa	A
Intervention should be considered in asymptomatic patients with severe AS and LVEF ≥50% if the procedural risk is low and one of the following parameters is present: • Very severe AS (mean gradient ≥60 mmHg or V_{max} >5.0 m/s). • Severe valve calcification (ideally assessed by CCT) and V_{max} progression ≥0.3 m/s/year. • Markedly elevated BNP/NT-proBNP levels (more than three times age- and sex-corrected normal range, confirmed on repeated measurement without other explanation). • LVEF <55% without another cause.	IIa	B
Intervention should be considered in asymptomatic patients with severe AS and a sustained fall in BP (>20 mmHg) during exercise testing.	IIa	C
Mode of intervention		
It is recommended that AV interventions are performed in Heart Valve Centres that report their local expertise and outcome data, have on-site interventional cardiology and cardiac surgical programmes, and a structured collaborative Heart Team.	I	C
It is recommended that the mode of intervention is based on Heart Team assessment of individual clinical, anatomical, and procedural characteristics, incorporating lifetime management considerations and estimated life expectancy.	I	C
TAVI is recommended in patients ≥70 years of age with tricuspid AV stenosis, if the anatomy is suitable.[d]	I	A
SAVR is recommended in patients <70 years of age, if the surgical risk is low.[e]	I	B
SAVR or TAVI are recommended for all remaining candidates for an aortic BHV according to Heart Team assessment.	I	B
Non-transfemoral TAVI should be considered in patients who are unsuitable for surgery and transfemoral access.	IIa	B
TAVI may be considered for the treatment of severe BAV stenosis in patients at increased surgical risk, if the anatomy is suitable.	IIb	B
Balloon aortic valvotomy may be considered as a bridge to SAVR or TAVI in haemodynamically unstable patients, and (if feasible) in those with severe AS who require urgent high-risk NCS.	IIb	C



Agenda

5 Mensajes finales

Mensajes finales

- ✓ En pacientes con EAo de bajo flujo y bajo gradiente con FEVI reducida, la ecocardiografía de estrés con dobutamina (ESD) puede ayudar a distinguir entre EAo pseudo-grave y una EAo grave real en presencia de reserva de flujo (aumento del volumen sistólico ≥20%).
- ✓ La puntuación de calcio Valvular Aórtico mediante CT está fácilmente disponible y proporciona información complementaria importante en pacientes con EAo de bajo flujo y bajo gradiente, ya que se correlaciona con la gravedad hemodinámica, la progresión y los resultados clínicos. Valores de >2000 unidades Agatston (UA) en hombres y >1200 UA en mujeres indican EA grave con alta sensibilidad y especificidad (~85%).
- ✓ La medición de NT-PRO<BNP puede ayudarnos a sentar las bases de la necesidad terapéutica.

Mensajes finales

- ✓ La EA paradójica de bajo gradiente a pesar de la función ventricular izquierda (VI) preservada se presenta en el 20,8% de los pacientes sometidos a TAVI, y es incluso más frecuente que una EA de bajo gradiente con deterioro de la función ventricular izquierda (11,7%).
- ✓ Las tasas de mortalidad y complicaciones precoces y al año tras TAVI para la EA de bajo gradiente paradójica son bajas y comparables a las de la EA de alto gradiente.
- ✓ Por el contrario, la TAVI para la EA de bajo gradiente y deterioro de la función ventricular izquierda se asocia con una mortalidad al año y una tasa de MACCE significativamente mayores.
- ✓ El pronóstico en estos diferentes grupos de EAo está muy relacionado con las características basales y comorbilidades de los mismos.

Mensajes finales

- ✓ El reemplazo Valvular Ao. reduce la mortalidad en pacientes con EAo de cualquier tipo Vs el Tto. Conservador
- ✓ Los pacientes con EAo de BG-FN parecen tener un mayor riesgo de re-hospitalización por insuficiencia cardíaca al año, en comparación con los pacientes con EA HG.
- ✓ Un gradiente bajo parece correlacionarse con peores resultados en comparación con EA HG. Especialmente por debajo de 20 mmHg.
- ✓ Es importante incorporar patrones de gradiente de flujo en la evaluación de los candidatos a TAVR, y uso de multimodalidad de DG por imagen (ECO, CT), y NT-proBNP para sentar la indicación y el momento adecuado de la terapéutica.

¡GRACIAS!

SERVIZO GALEGO de SAÚDE

CARDIOLOGÍA
Área Sanitaria de Vigo

Fundación Biomédica Galicia Sur

IIS Galicia Sur

Mensajes finales

- High-gradient AS [mean gradient ≥40 mmHg, Vmax ≥4.0 m/s, AVA ≤1 cm2 (or ≤0.6 cm2 /m2)] is considered severe irrespective of LV function and flow conditions.

Discordant criteria:

- Low-flow, low-gradient AS with reduced LVEF (mean gradient 35 mL/m2 , LVEF ≥50%).
- Discordant high-gradient AS (mean gradient ≥40 mmHg, AVA >1 cm2).

Patients with discordant normal-flow, low-gradient AS usually have moderate stenosis.293–295
Discordant high-gradient AS (mean gradient ≥40 mmHg, AVA >1 cm2) is considered severe if not caused by a reversible high-flow status.296–298
In patients with low-flow, low-gradient AS with reduced LVEF, dobutamine stress echocardiography (DSE) can help to discriminate between pseudo-severe and true severe AS in the presence of flow reserve (increase in stroke volume of ≥20%).289,299
Cardiac computed tomography calcium AV scoring is readily available and provides important adjunctive information in patients with low-flow, low-gradient AS because it correlates with haemodynamic severity, progression, and clinical outcomes.300,301
Values of >2000 Agatston units (AU) in men and >1200 AU in women indicate severe AS with high sensitivity and specificity (~85%).302,303 While higher thresholds (men >3000 AU, women >1600 AU) are very specific, severe AS becomes unlikely in patients with calcium AV scoring of

Estenosis aórtica: cuándo intervenir y cómo elegir entre TAVI y SAVR

Pacientes sintomáticos con **estenosis aórtica grave de alto gradiente** (gradiente medio ≥40 mmHg, **Vmax ≥4,0 m/s**, **área valvular ≤1,0 cm²** o ≤0,6 cm^2/m^2) deben ser intervenidos. También se recomienda recomienda intervenir en **bajo flujo–bajo gradiente** (SVi ≤35 mL/m^2) con **FEVI <50%**, tras confirmar severidad; severidad; con **FEVI ≥50%**, la intervención "debería considerarse" si se confirma AS grave.

Pacientes asintomáticos: se recomienda intervenir si **FEVI <50%** sin otra causa. Además, **debería considerarse** intervenir (como alternativa a vigilancia activa estrecha) cuando el riesgo procedimental sea bajo y exista **AS de muy alta gravedad** (gradiente ≥60 mmHg o Vmax >5,0 m/s), **calcificación severa con con progresión ≥0,3 m/s/año**, **biomarcadores muy elevados** (BNP/NT-proBNP >3× del límite ajustado por por edad/sexo, confirmados) o **FEVI <55%** sin otra causa. Estas recomendaciones refinan el manejo de asintomáticos con riesgo anatómico o biológico alto.

Elección del modo de intervención: la **figura 9** resume factores clínicos, anatómicos y de manejo a lo largo de de la vida. En general, **TAVI es el tratamiento de elección** en **≥70 años** con válvula tricúspide y anatomía adecuada por acceso transfemoral; **SAVR** es preferible si **<70 años** con bajo riesgo quirúrgico. Para el resto de de candidatos a **bioprótesis**, el Heart Team seleccionará TAVI o SAVR según riesgo, anatomía, expectativas de durabilidad y preferencias del paciente. La **TAVI no transfemoral** debe considerarse cuando no son factibles cirugía ni acceso transfemoral. En **válvula bicúspide**, TAVI puede considerarse si el riesgo quirúrgico es mayor mayor y la anatomía es adecuada.

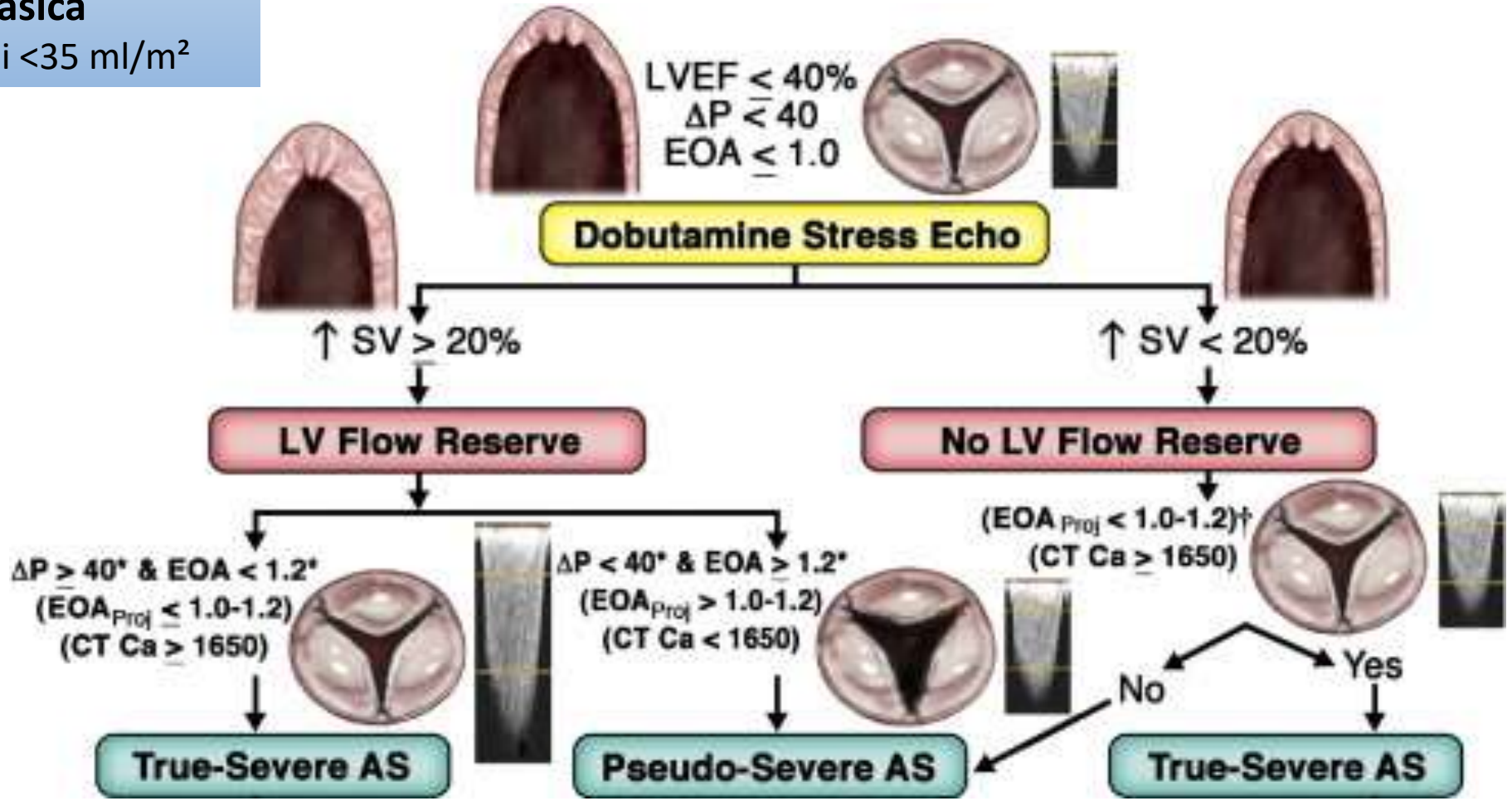
DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

TABLE 2 Studies That Examined the Natural History of NFLG Severe AS

First Author	Design	Enrollment Year	Follow-Up, Mo[a]	HG Severe AS, n	LFLG Severe AS, n	NFLG Severe AS, n	Moderate AS, n	Symptomatic Status	Primary Outcome[b]	Comparisons and Results[c]
Jander et al[38]	Prospective	1985-2008	46 ± 14	–	223	212	184	None	CV mortality	NFLG vs LFLG: 1.07 (0.56-2.04) NFLG vs MAS: 1.57 (0.85-2.92)
Mehrotra et al[39]	Retrospective	2008 (Jan-Dec)	36	–	38	75	70	Both	All-cause mortality	NFLG vs LFLG: 21% vs 42%; $P = 0.01$ NFLG vs MAS: 21% vs 15%; $P = 0.49$
Chadha et al[21]	Retrospective	2000-2015	41 (20-70)	1,055	–	154	366	Both	All-cause mortality	NFLG vs MAS: 1.13 (0.82-1.56)
Tribouilloy et al[40]	Retrospective	2000-2012	39 (11-69)	247	57	85	420	Both	All-cause mortality	NFLG vs HG: 0.94 (0.65-1.38) NFLG vs LFLG: 1.13 (0.69-1.86) NFLG vs MAS: 1.06 (0.66-1.71)
Eleid et al[41]	Retrospective	2006-2011	28 ± 23	279	28	209	–	Both	All-cause mortality	NFLG vs HG: 0.54 (0.39-0.76) LFLG vs NFLG: 3.23 (2.09-4.98)
Melis et al[42]	Retrospective	2007-2010	25 (15-33)	76	23	44	–	Both	All-cause mortality	NFLG vs HG: 0.67 (0.41-1.10) NFLG vs LFLG: 1.57 (0.63-3.90)
Maes et al[43]	Prospective	2000-2010	28 (3-140)	144	115	90	–	Both	All-cause mortality	NFLG vs HG: 0.76 (0.61-0.95) NFLG vs LFLG: 0.91 (0.59-1.40)
Lancellotti et al[44]	Prospective	2012	27 ± 12	93	11	46	–	None	CV mortality	NFLG vs HG: 0.29 (0.15-0.56) LFLG vs NFLG: 4.18 (2.02-8.65)
Maor et al[45]	Retrospective	2004-2012	35 ± 26	–	110	299	–	Both	All-cause mortality	NFLG vs LFLG: 1.31 (0.87-1.97)
Snir et al[46]	Retrospective	2000-2019	88 ± 45	5,601	1,750	991	–	Both	All-cause mortality CV mortality	NFLG vs HG: 0.94 (0.85-1.03) NFLG vs HG: 0.82 (0.71-0.94)
Yamashita et al[47]	Retrospective	2008-2012	5 (1-58)	154	19	61	151	Both	All-cause mortality	NFLG vs HG: 1.41 (0.50-3.97) NFLG vs MAS: 0.58 (0.09-2.43)

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

EAo BF-BG clásica
FEVI<50% + VSi <35 ml/m²



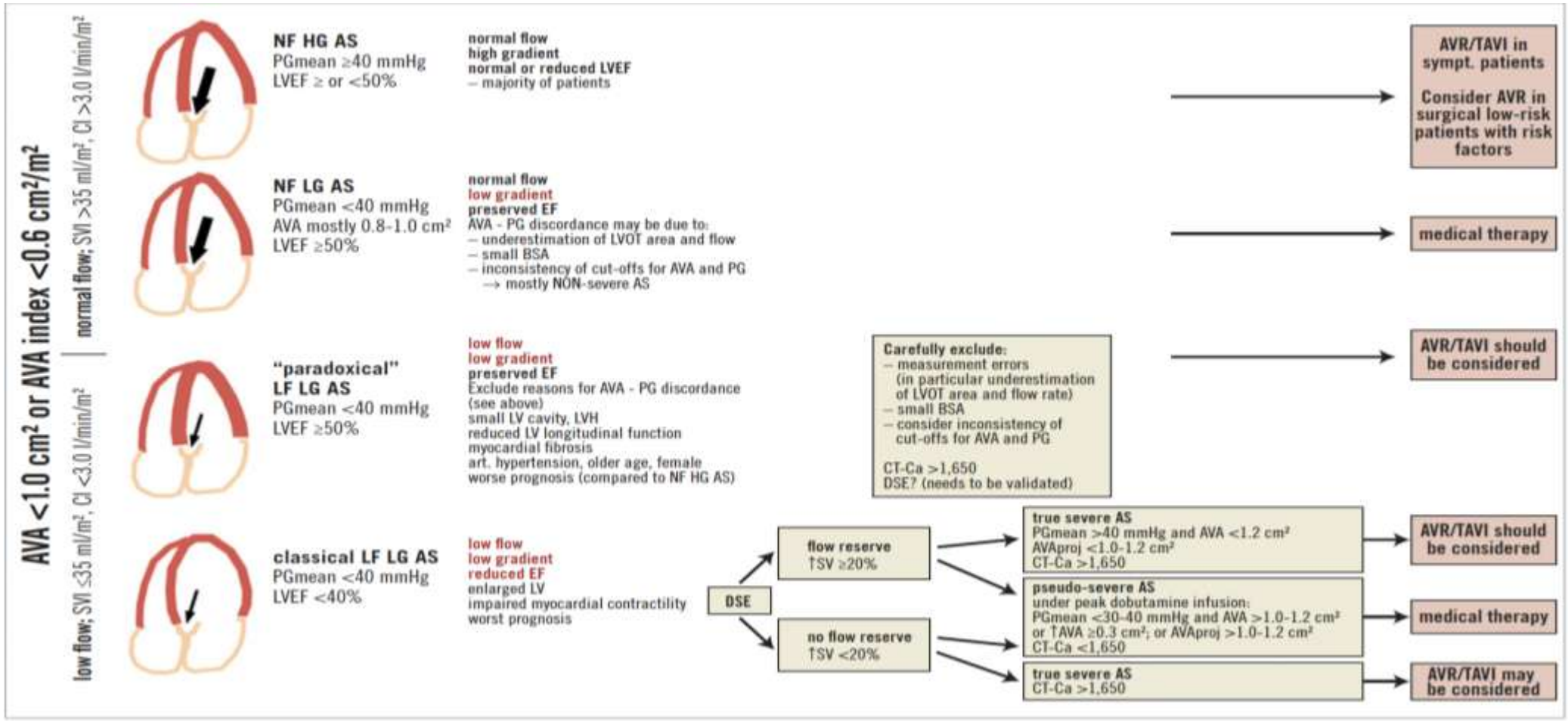
Philippe Pibarot, et al. J Am Coll Cardiol. 2014;63(17):1739-56

Clasificación EAO

Low flow, low gradient severe aortic stenosis: diagnosis, treatment and prognosis

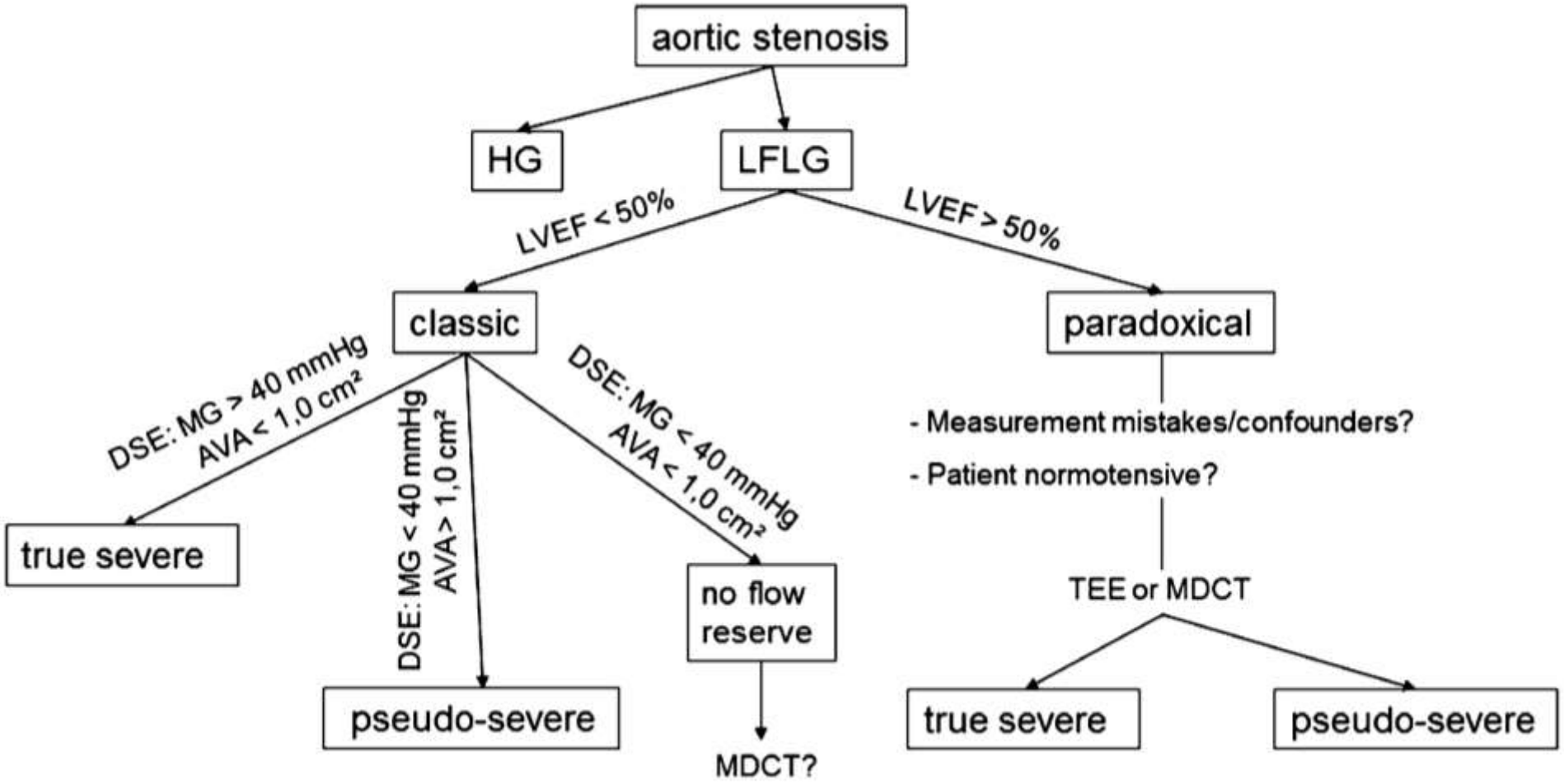
Stefan Orwat, MD; Gerrit Kaleschke, MD; Gregor Kerckhoff, MD; Robert Radke, MD; Helmut Baumgartner*, MD

Division of Adult Congenital and Valvular Heart Disease, Department of Cardiovascular Medicine, University Hospital Muenster, Muenster, Germany



EuroIntervention 2013;9:S38-S42

Clasificación EAO



Clasificación EAO

Group 1 **"Normal flow, high gradient"** EOAi < 0.6 cm²/m² SVi ≥ 35 ml/m² Mean gradient ≥ 40 mmHg	**Group 2** **"Normal flow, low gradient"** EOAi < 0.6 cm²/m² SVi ≥ 35 ml/m² Mean gradient < 40 mmHg
Group 3 **"Low flow, high gradient"** EOAi < 0.6 cm²/m² SVi < 35 ml/m² Mean gradient ≥ 40 mmHg	**Group 4** **"Low flow, low gradient"** EOAi < 0.6 cm²/m² SVi < 35 ml/m² Mean gradient < 40 mmHg

Curr Opin Cardiol 2013, 28:524–530

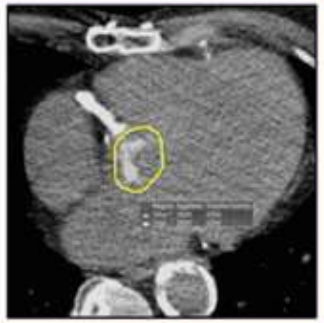
DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

EAo BF-BG paradójica
FEVI>50% + VSi <35 ml/m²

EAo Flujo N-BG paradójica
FEVI>50% + VSi >35 ml/m²

Non contrast CT
Valve Ca Score

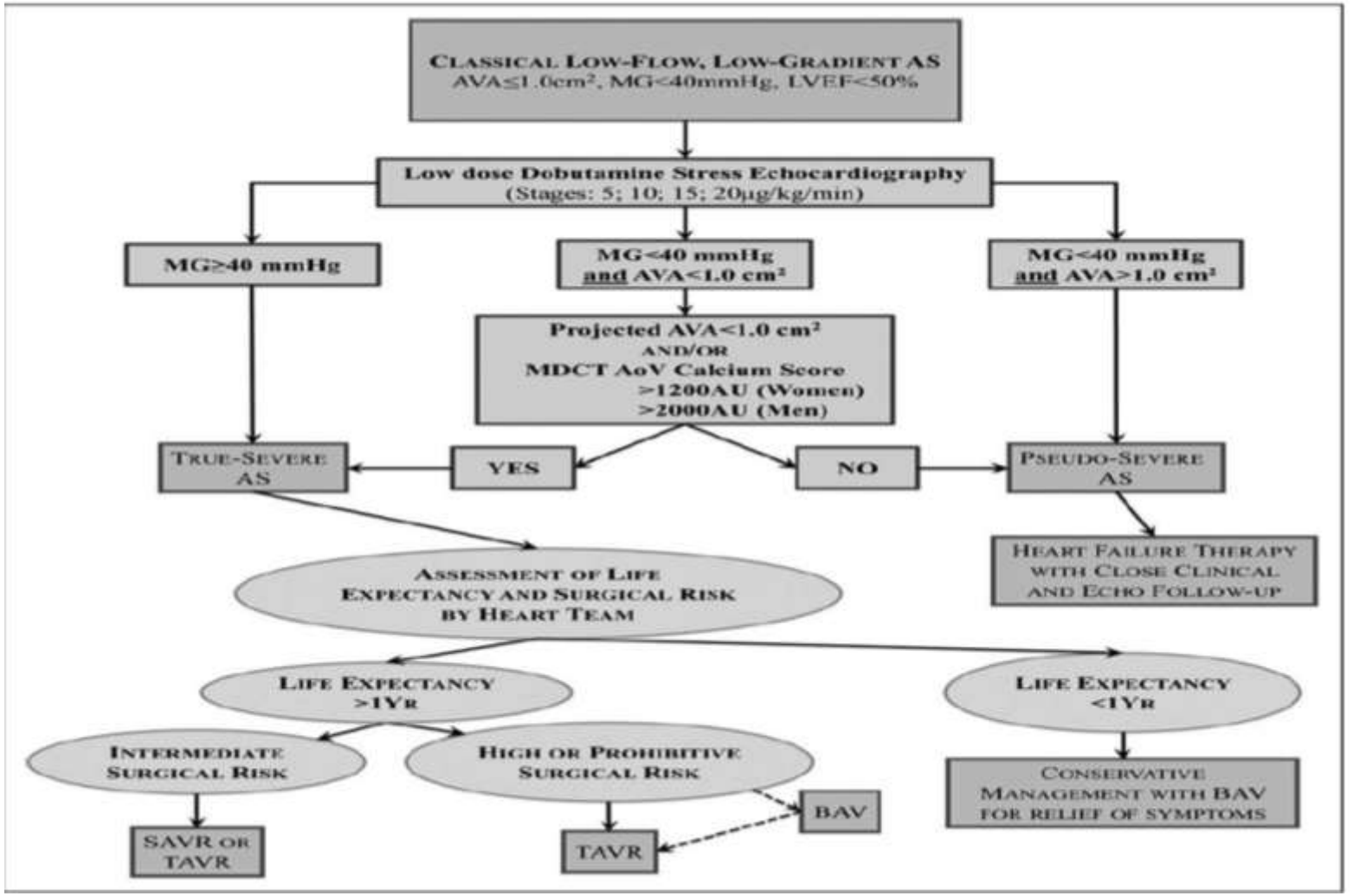
Computed Tomography Aortic Valve Calcium Scoring (CT AVC)



	♂	♀
Noncontrast CT cutoffs		
2020 ACC/AHA	>2000	>1300
2021 ESC	>3000 (high likely) >2000 (likely)	>1600 (high likely) >1200 (likely)
Contrast CT cutoffs		
Our cohort	>1850	>1430

Tiffany Dong, et al. Circ Cardiovasc Imaging. 2025 Jun;18(6):e017377

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA



Curr Opin Cardiol 2020, 35:87–94

Guías Clínicas 2021

Intervention is indicated in[1]

Patients with SYMPTOMATIC Aortic Stenosis	Class[a]	Level[b]
Severe, high-gradient aortic stenosis (mean gradient ≥40 mmHg, peak velocity ≥4.0 m/s, and valve area ≤1.0 cm² (or ≤0.6 cm²/m²)).	I	B
Severe low-flow (SVi ≤35 mL/m²), low-gradient (<40 mmHg) aortic stenosis with reduced ejection fraction (<50%), **AND** evidence of flow (contractile) reserve.	I	B

Patients with ASYMPTOMATIC Severe Aortic Stenosis	Class[a]	Level[b]
Severe aortic stenosis and systolic LV dysfunction (LVEF <50%) without another cause.	I	B
Severe aortic stenosis **AND** demonstrable symptoms on exercise testing.	I	C

Choice of intervention[1]

Heart Team evaluation[c]

Patients < 75 years at low-risk for SAVR (STS-PROM/ EuroSCORE II < 4%)[d] OR Unsuitable for TF TAVI AND operable	ALL other patients	Patients ≥ 75 years OR Unsuitable/High risk for SAVR (STS-PROM/ EuroSCORE II > 8%)[d] AND Suitable for TF TAVI
I B	I B	I A
SAVR[e]	SAVR[e] OR TAVI[e]	TAVI[e]

Patient-centred evaluation for intervention[1]

Key considerations[1]

Lifetime management

"... intervention should be carefully considered by the Heart Team for all patients, accounting for individual age and estimated life expectancy, comorbidities, anatomical and procedural characteristics..."

Early intervention

"Symptomatic severe aortic stenosis has dismal prognosis and early intervention is strongly recommended in all patients."

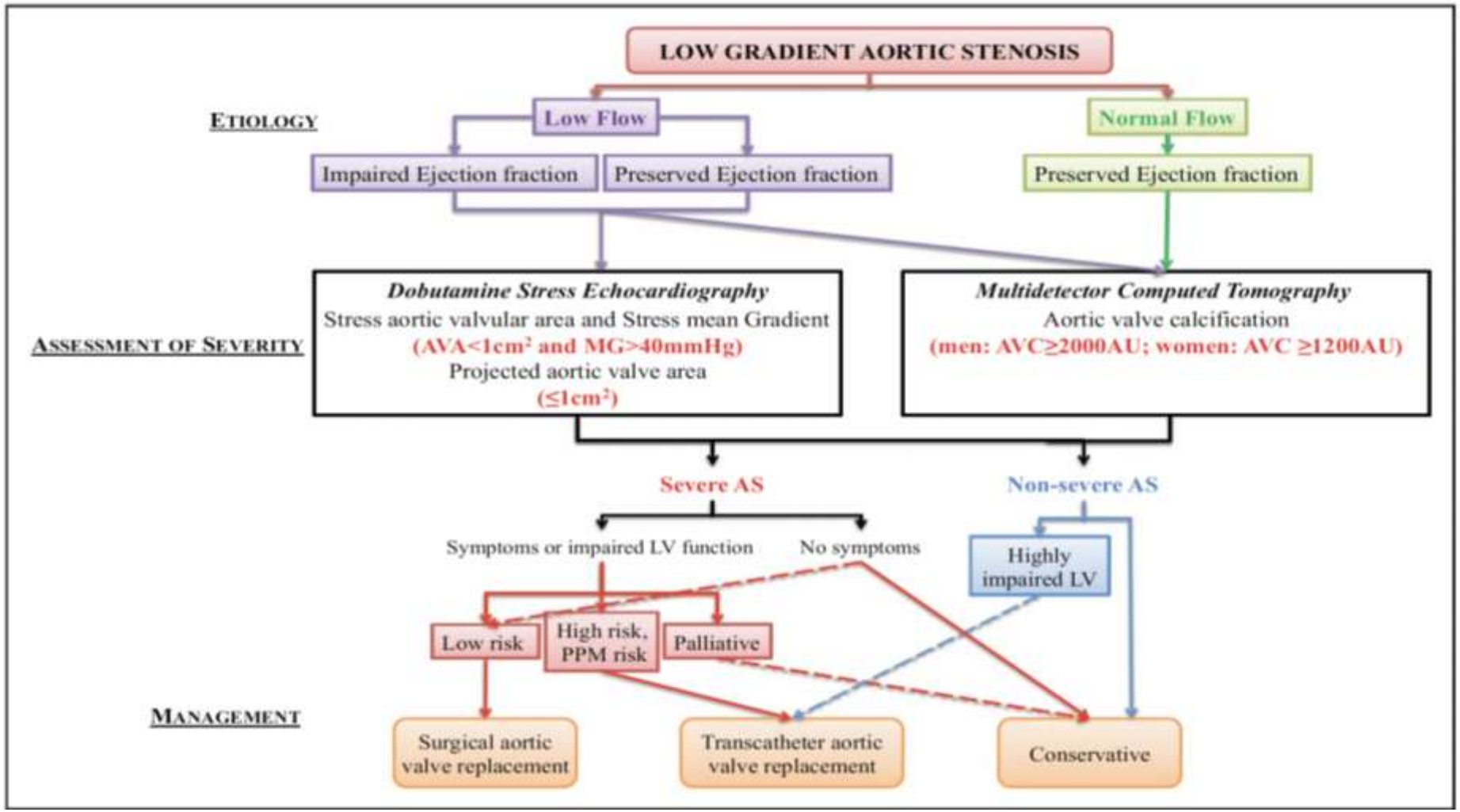
Patient informed-decision

"The Heart Team recommendation should be discussed with the patient who can then make an informed treatment choice."

Heart Valve Centre concept

"The main purpose of Heart Valve Centres as centres of excellence in the treatment of VHD is to deliver optimal quality of care with a patient-centred approach."

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA



DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

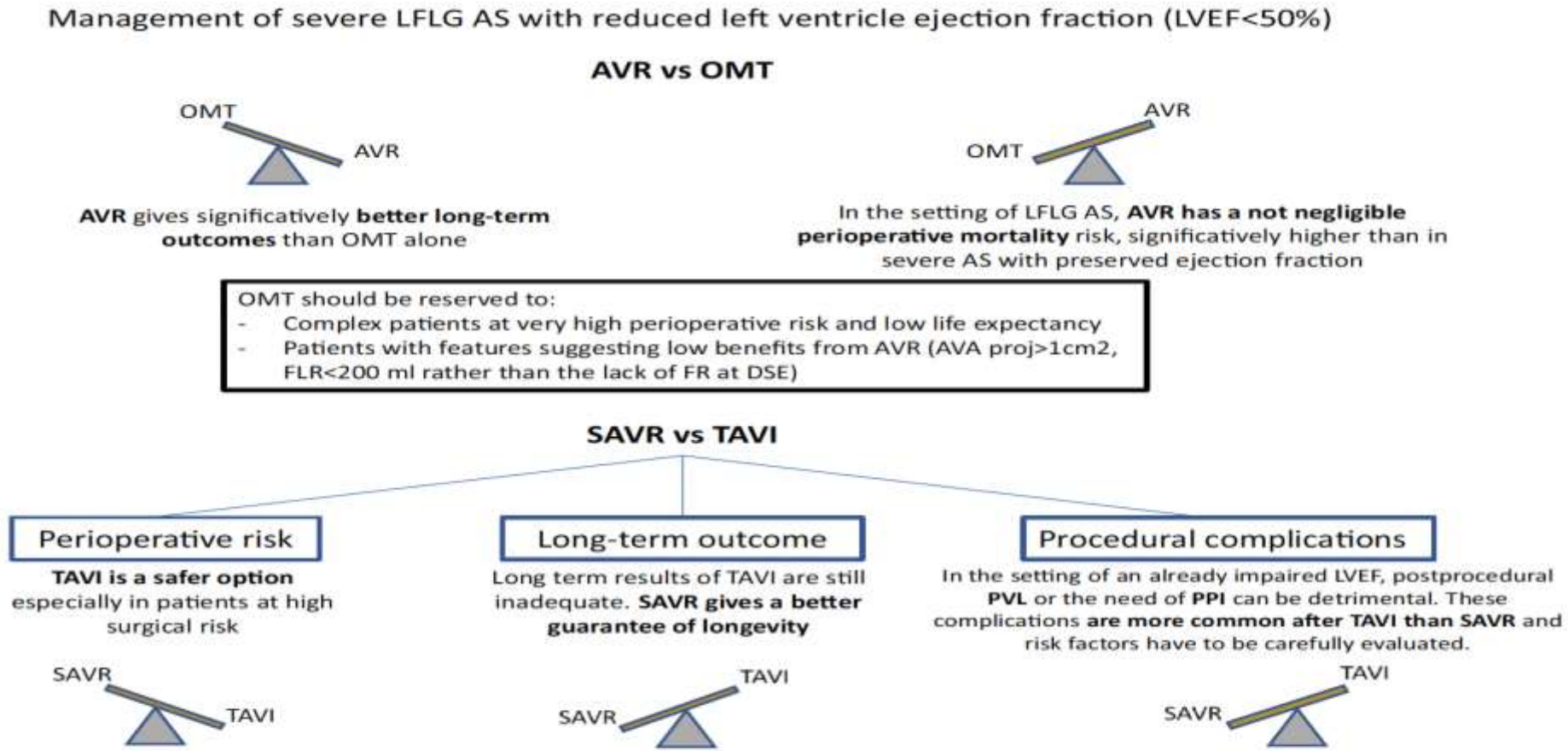
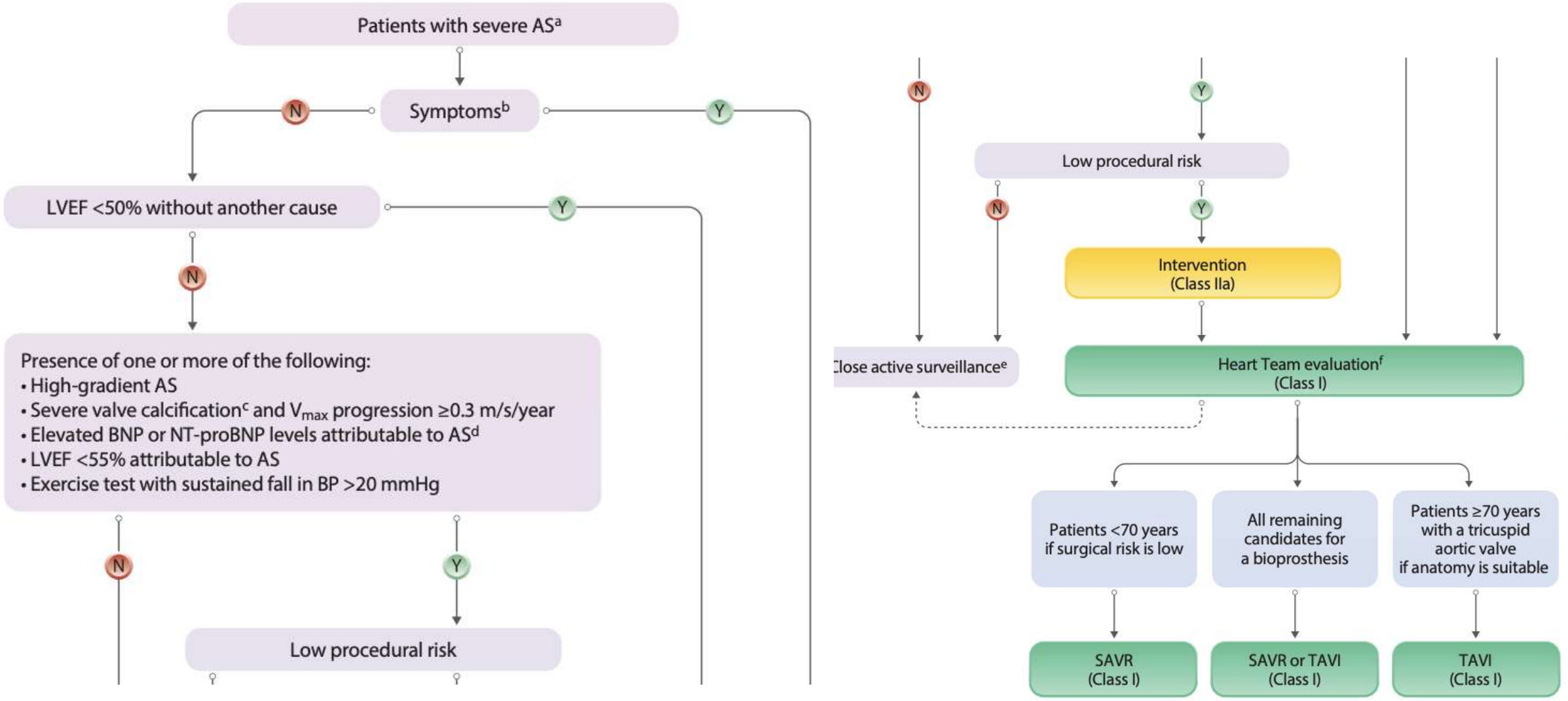


Fig. 2 Proposed algorithm for the management of severe low-flow low-gradient aortic stenosis. Abbreviations: AVR aortic valve replacement, AVAproj: projected aortic valve area; DSE: dobutamine stress echocardiography; FLR: transaortic flow rate at rest; FR: functional reserve; OMT: optimal medical therapy; PPI: permanent pacemaker implantation; PVL: paravalvular leak; SAVR: surgical aortic valve repair; TAVI: transcatheter aortic valve repair

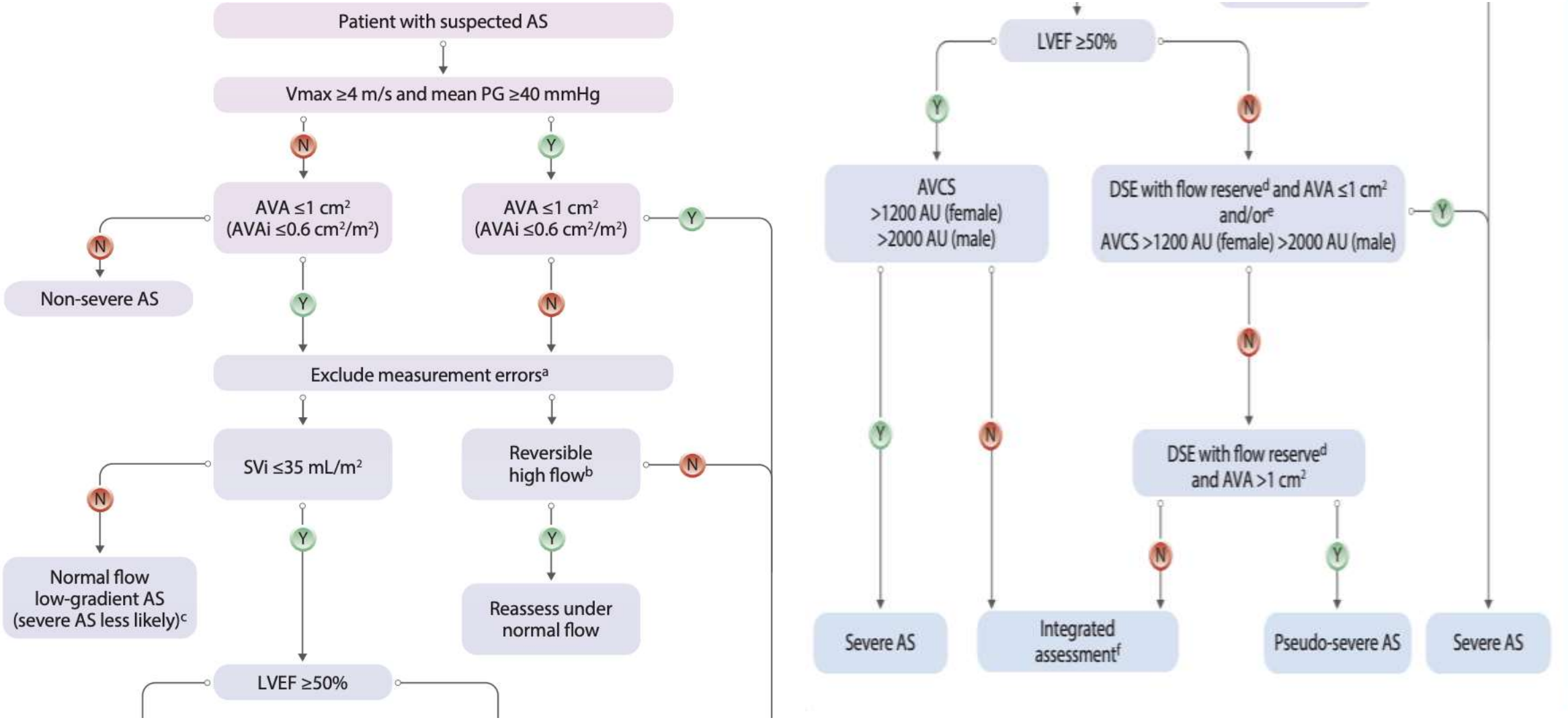
Conceptos

Definition	Valve anatomy	Valve hemodynamics	LV involvement	Symptoms
Symptomatic severe low-flow, low-gradient AS with reduced LVEF	Severe leaflet calcification with severely reduced leaflet motion	• AVA ≤ 1.0 cm^2 with resting aortic V_{max} < 4 m/s or mean ΔP < 40 mm Hg • Dobutamine stress echocardiography shows AVA ≤ 1.0 cm^2 with V_{max} ≥ 4 m/s at any flow rate	• LVEF < 50%	• Heart failure • Angina • Syncope or presyncope
Symptomatic severe low-gradient AS with normal LVEF or low-flow, low-gradient AS with preserved LVEF	Severe leaflet calcification with severely reduced leaflet motion	• AVA ≤ 1.0 cm^2 with aortic V_{max} < 4 m/s or mean ΔP < 40 mm Hg (indexed AVA ≤ 0.6 cm^2/m^2) and • Stroke volume index < 35 mL/m^2 • Measured when patient is normotensive (systolic [BP] < 140 mm Hg)	• LVEF ≥ 50% • Increased LV relative wall thickness (LV hypertrophy) • Small LV chamber with low stroke volume • LV diastolic dysfunction	• Heart failure • Angina • Syncope or presyncope

AS = aortic stenosis; AVA = aortic valve area; BP = blood pressure; LV = left ventricular; LVEF = left ventricular ejection fraction; VHD = valvular heart disease


Patients with severe AS[a]
Symptoms[b]
N
Y
LVEF <50% without another cause
N
Y
Presence of one or more of the following:
• High-gradient AS
• Severe valve calcification[c] and V_{max} progression ≥0.3 m/s/year
• Elevated BNP or NT-proBNP levels attributable to AS[d]
• LVEF <55% attributable to AS
• Exercise test with sustained fall in BP >20 mmHg
N
Y
Low procedural risk
N
Y
Low procedural risk
N
Y
Intervention
(Class IIa)
Close active surveillance[e]
Heart Team evaluation[f]
(Class I)
Patients <70 years
if surgical risk is low
All remaining
candidates for
a bioprosthesis
Patients ≥70 years
with a tricuspid
aortic valve
if anatomy is suitable
SAVR
(Class I)
SAVR or TAVI
(Class I)
TAVI
(Class I)

ESC EACTS


Patient with suspected AS
Vmax ≥4 m/s and mean PG ≥40 mmHg
N
Y
AVA ≤1 cm² (AVAi ≤0.6 cm²/m²)
AVA ≤1 cm² (AVAi ≤0.6 cm²/m²)
N
Non-severe AS
Y
Y
N
Exclude measurement errors[a]
SVi ≤35 mL/m²
Reversible high flow[b]
N
Y
N
Y
Normal flow low-gradient AS (severe AS less likely)[c]
Reassess under normal flow
LVEF ≥50%
LVEF ≥50%
Y
N
AVCS >1200 AU (female) >2000 AU (male)
DSE with flow reserve[d] and AVA ≤1 cm² and/or[e] AVCS >1200 AU (female) >2000 AU (male)
Y
Y
N
Y
N
DSE with flow reserve[d] and AVA >1 cm²
N
Y
Severe AS
Integrated assessment[f]
Pseudo-severe AS
Severe AS

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

CENTRAL ILLUSTRATION Guideline Recommendations for Diagnosis and Management of AS With Different Gradient and Flow Patterns

AVA ≤1 cm² AVAi ≤0.6 cm²/m²	EACVI/ASE (2017)	ACC/AHA (2020)	ESC/EACTS (2021)
High Gradient	Severe AS	Severe AS, consider AVR	Severe AS, consider AVR
Low Gradient Low Flow Low EF	1. Rule out pseudosevere AS with dobutamine stress echocardiography. 2. Rule out measurement errors. 3. Aortic valve calcium score by MDCT.		
Low Gradient Low Flow Normal EF	1. Rule out measurement errors. 2. Aortic valve calcium score by MDCT.		
Low Gradient Normal Flow Normal EF	Usually moderate AS; can consider supportive data	Not discussed	Moderate AS

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TABLE 1 Clinical, Echocardiographic, and Procedural Characteristics of the Study Population (N = 287)

Age, yrs	80 ± 7
Male	207 (72.1)
Body mass index, kg/m²	26 (23-30)
NYHA functional class III-IV	241 (84.0)
Hypertension	239 (83.3)
Diabetes mellitus	121 (42.2)
Coronary artery disease	218 (76.0)
Prior myocardial infarction	107 (37.3)
Prior PCI	130 (45.3)
Prior CABG	115 (40.1)
History of atrial fibrillation	139 (48.4)
Cerebrovascular disease	54 (18.8)
Peripheral vascular disease	88 (30.7)
COPD	103 (35.9)
Hemoglobin levels, g/dl	11.9 ± 1.7
eGFR, ml/min/m²	55.1 (40.3-69.0)
CKD (eGFR <60 ml/min/m²)	156 (54.4)
EuroSCORE 2, %	10.5 (5.5-17.3)
STS-PROM, %	7.7 (5.3-12.0)
Echocardiographic variables	
LVEF, %	30.1 ± 9.7
Mean aortic gradient, mm Hg	25.4 ± 6.6
Peak aortic gradient, mm Hg	43.0 ± 10.5
Aortic valve area, cm²	0.76 ± 0.20
Moderate-severe AR	31 (10.8)
Moderate-severe MR	100 (34.8)
Stroke volume, ml	54.4 ± 15.7
Stroke volume index, ml/m²	29.7 ± 8.3
Pulmonary systolic artery pressure, mm Hg	46.6 ± 14.6

TABLE 1 Continued

Procedural variables	
Procedural success*	251 (87.5)
Prosthesis type	
Sapien	118 (41.1)
Sapien XT	87 (30.3)
Sapien 3	24 (8.4)
CoreValve	48 (16.7)
Evolut R	2 (0.7)
Others (Portico, Lotus, DirectFlow)	5 (1.7)
Prosthesis size, mm	
20	1 (0.3)
23	50 (17.4)
26	126 (43.9)
27	2 (0.7)
29	84 (29.3)
31	17 (5.9)
Approach	
Transfemoral	198 (69.0)
Transapical	59 (20.6)
Transaortic	16 (5.6)
Trans-subclavian	11 (3.8)
Transcaval	3 (1.0)
Post-dilation	50 (17.4)

Values are mean ± SD, n (%), or median (interquartile range). *Following VARC-2 criteria (24).

AR = aortic regurgitation; CABG = coronary artery bypass graft; CKD = chronic kidney disease; COPD = chronic obstructive pulmonary disease; eGFR = estimated glomerular filtration rate; IQR = interquartile range; LVEF = left ventricular ejection fraction; MR = mitral regurgitation; NYHA = New York Heart Association; PCI = percutaneous coronary intervention; STS-PROM = Society of Thoracic Surgeons Predicted Risk of Mortality.

Transcatheter Aortic Valve Replacement in Patients With Low-Flow, Low-Gradient Aortic Stenosis

The TOPAS-TAVI Registry

Henrique Barbosa Ribeiro, MD, PhD,[a] Stamatios Lerakis, MD,[b] Martine Gilard, MD, PhD,[c] João L. Cavalcante, MD,[d] Raj Makkar, MD,[e] Howard C. Herrmann, MD,[f] Stephan Windecker, MD,[g] Maurice Enriquez-Sarano, MD,[h] Asim N. Cheema, MD,[i] Luis Nombela-Franco, MD, PhD,[j] Ignacio Amat-Santos, MD, PhD,[k] Antonio J. Muñoz-Garcia, MD, PhD,[l] Bruno Garcia del Blanco, MD,[m] Alan Zajarias, MD,[n] John C. Lisko, MD,[o] Salim Hayek, MD,[p] Vasilis Babaliaros, MD,[q] Florent Le Ven, MD,[r] Thomas G. Gleason, MD,[s] Tarun Chakravarty, MD,[t] Wilson Y. Szeto, MD,[t] Marie-Annick Clavel, DVM, PhD,[a,b] Alberto de Agustin, MD, PhD,[l] Vicenç Serra, MD,[m] John T. Schindler, MD,[a] Abdellaziz Dahou, MD, PhD,[a] Rishi Puri, MBBS, PhD,[a] Emilie Pelletier-Beaumont, MSc,[a] Melanie Côté, MSc,[a] Philippe Pibarot, DVM, PhD,[a] Josep Rodés-Cabau, MD[a]

	Baseline Echocardiography (n = 234)	Peak Dobutamine (n = 234)	Delta Mean (95% CI)	p Value
Median dobutamine peak dose, µg/kg/min	–	14 (11-17)	–	–
Left ventricular ejection fraction, %	29.5 ± 9.1	36.8 ± 12.3	7.3 (5.9-8.7)	<0.001
Mean aortic gradient, mm Hg	24.5 ± 6.3	36.7 ± 10.7	12.1 (10.8-13.4)	<0.001
Aortic valve area, cm²	0.77 ± 0.21	0.81 ± 0.26	0.04 (0.01-0.08)	0.02
Stroke volume, ml	53.4 ± 15.3	62.6 ± 19.1	10.0 (7.9-12.1)	<0.001
Stroke volume index, ml/m²	29.0 ± 7.9	33.8 ± 9.8	5.3 (4.2-6.4)	<0.001
Increase in stroke volume, %	–	17 (14-35)	–	–
Contractile reserve	–	86/193 (44.6)	–	–
Moderate/severe mitral regurgitation	95/229 (41.5)	39/151 (25.8)	–	–

J Am Coll Cardiol 2013;71:1297–307

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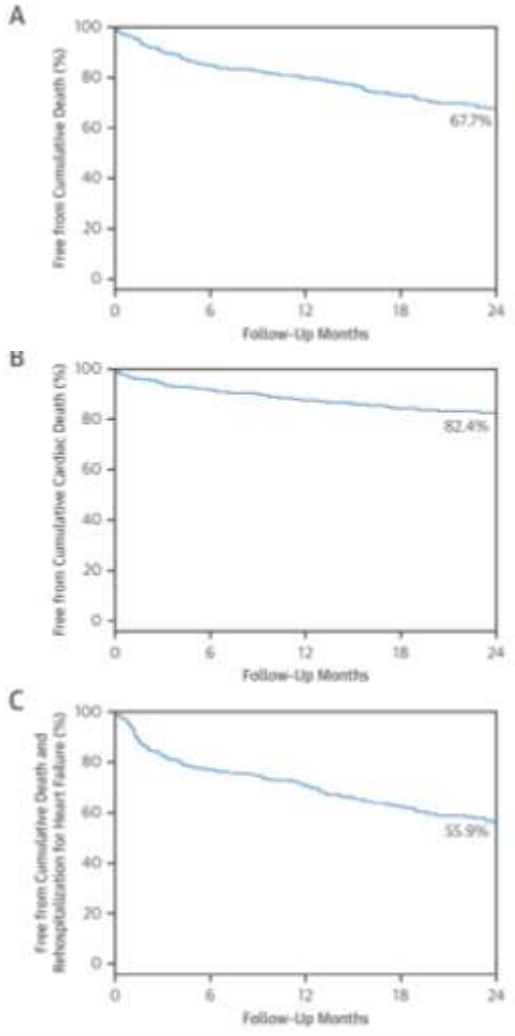
TABLE 3 30-Day Clinical and Echocardiographic Outcomes (N = 287)

30-day outcomes	
All stroke	6 (2.1)
Disabling stroke	3 (1.0)
Nondisabling stroke	3 (1.0)
Myocardial infarction	4 (1.4)
Major vascular complications	13 (4.5)
Major or life-threatening bleeding	19 (6.6)
Need for a second valve	10 (3.5)
Need for hemodynamic support	17 (5.9)
Coronary obstruction	1 (0.3)
Annulus rupture	1 (0.3)
Cardiac tamponade	1 (0.3)
Conversion to open-heart surgery	3 (1.0)
Permanent pacemaker implantation	12 (4.2)
Death	11 (3.8)
Hospitalization length, days	6 (3-8)
Echocardiography post-procedure	
LVEF, %	35.5 ± 11.8
Mean aortic gradient, mm Hg	8.8 ± 3.9
Peak aortic gradient, mm Hg	16.4 ± 7.2
Aortic valve area, cm^2	1.71 ± 0.56
Moderate-severe AR	23 (8.2)
Moderate-severe MR	89 (31.9)
Stroke volume, ml	60.9 ± 19.1
Stroke volume index, ml/m^2	32.9 ± 10.1
Pulmonary systolic artery pressure, mm Hg	44.0 ± 13.1



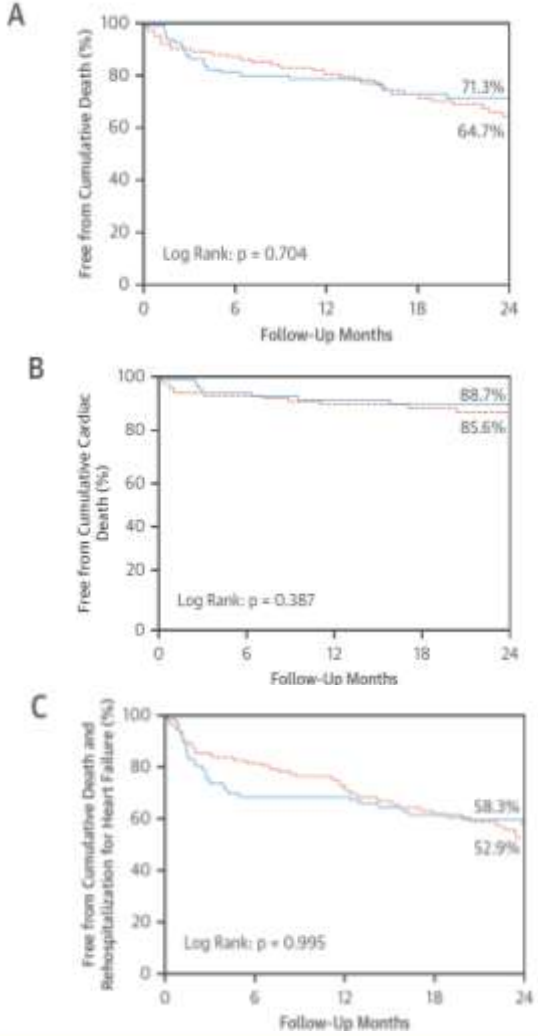


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TABLE 5 Predictors of Clinical Outcomes After TAVR (Univariable and Multivariable Analyses)

	Univariable Model HR (95% CI)	p Value	Multivariable Model HR (95% CI)	p Value
Cumulative mortality (n = 112)				
COPD	1.50 (1.00–2.25)	0.048	1.67 (1.08–2.58)	0.022
Previous CAD	1.62 (0.94–2.78)	0.082	—	—
NYHA functional class III–IV	2.91 (1.22–6.91)	0.016	—	—
eGFR <60 ml/min/m^2	1.53 (0.99–2.33)	0.053	—	—
Hemoglobin levels*	1.25 (1.08–1.43)	0.001	1.27 (1.11–1.45)	<0.001
Moderate-severe MR baseline	1.70 (1.05–2.73)	0.030	—	—
Cumulative cardiac mortality (n = 54)				
Previous PCI	2.26 (1.24–4.11)	0.008	—	—
NYHA functional class III–IV	3.80 (1.14–12.7)	0.030	—	—
Hemoglobin levels*	1.23 (1.02–1.49)	0.033	1.23 (1.02–1.52)	0.037
Moderate-severe MR baseline	1.86 (0.89–3.88)	0.098	—	—
Cumulative mortality and/or rehospitalization for heart failure (n = 143)				
NYHA functional class III–IV	1.69 (0.91–3.14)	0.096	—	—
eGFR <60 ml/min/m^2	1.38 (0.95–2.01)	0.088	—	—
Hemoglobin levels*	1.15 (1.03–1.30)	0.011	1.23 (1.06–1.43)	0.004
LVEF baseline, %	1.02 (1.00–1.04)	0.055	—	—
Moderate/severe AR post-TAVR	1.95 (1.06–3.48)	0.031	2.15 (1.14–4.05)	0.018

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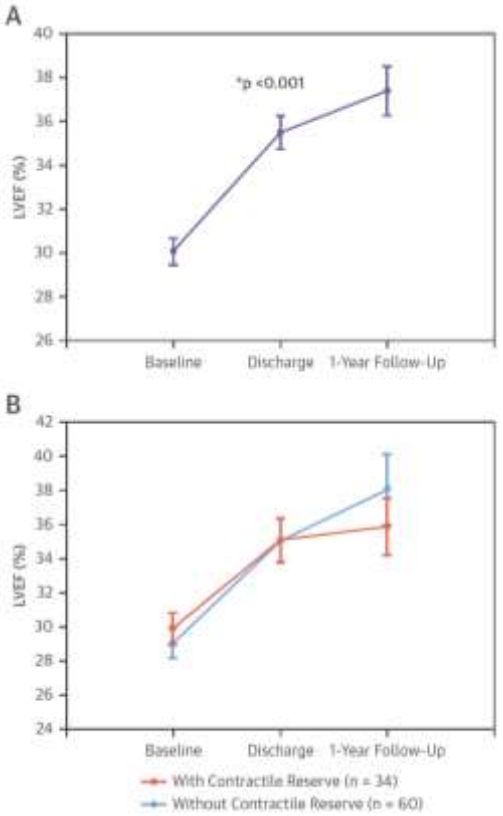

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Clinical Outcomes in High-Gradient, Classical Low-Flow, Low-Gradient, and Paradoxical Low-Flow, Low-Gradient Aortic Stenosis After Transcatheter Aortic Valve Implantation: A Report From the SwissTAVI Registry

Max Wagener, MD; Oliver Reuthebuch, MD; Dik Heg, PhD; David Tüller, MD; Enrico Ferrari, MD; Jürg Grünenfelder, MD; Christoph Huber, MD; Igal Moarof, MD; Olivier Muller, MD, PhD; Fabian Nietlispach, MD, PhD; Stéphane Noble, MD; Marco Roffi, MD; Maurizio Taramasso, MD; Christian Templin, MD, PhD; Stefan Toggweiler, MD; Peter Wenaweser, MD; Stephan Windecker, MD; Stefan Stortecky, MD, MPH; Raban Jeger, MD

Table 3. Secondary Outcomes at 30 Days and 1 Year

	High gradient	C-LFLG	P-LFLG	C-LFLG vs HG		P-LFLG vs HG		P- vs C-LFLG	
	N=5094	N=1356	N=2464	Adjusted HR (95% CI)	Adjusted *P* value	Adjusted HR (95% CI)	Adjusted *P* value	Adjusted HR (95% CI)	Adjusted *P* value
At 30 d									
Death rate	121 (2.4)	54 (4.0)	72 (2.9)	1.36 (0.98–1.89)	0.068	1.23 (0.92–1.64)	0.168	0.90 (0.63–1.30)	0.583
Cardiovascular death	110 (2.2)	48 (3.6)	60 (2.4)	1.33 (0.94–1.88)	0.109	1.13 (0.82–1.54)	0.462	0.85 (0.58–1.25)	0.402
Myocardial infarction	32 (0.6)	6 (0.4)	9 (0.4)	0.70 (0.29–1.71)	0.434	0.58 (0.28–1.21)	0.146	0.82 (0.29–2.36)	0.720
Periprocedural myocardial infarction	25 (0.5)	4 (0.3)	7 (0.3)	0.62 (0.21–1.82)	0.383	0.57 (0.25–1.32)	0.193	0.93 (0.26–3.23)	0.903
Spontaneous myocardial infarction	7 (0.1)	2 (0.2)	2 (0.1)	0.96 (0.19–4.84)	0.963	0.59 (0.12–2.86)	0.517	0.62 (0.08–4.57)	0.637
Cerebrovascular accident	172 (3.4)	40 (3.0)	86 (3.5)	0.85 (0.60–1.21)	0.361	1.02 (0.79–1.32)	0.891	1.20 (0.82–1.76)	0.353
Disabling stroke	104 (2.1)	18 (1.3)	44 (1.8)	0.61 (0.36–1.01)	0.053	0.86 (0.61–1.23)	0.413	1.43 (0.82–2.49)	0.213
Nondisabling stroke	57 (1.1)	15 (1.1)	32 (1.3)	1.01 (0.56–1.80)	0.984	1.14 (0.74–1.76)	0.552	1.13 (0.60–2.13)	0.695
Bleeding	890 (17.5)	226 (16.7)	418 (17.0)	0.96 (0.82–1.11)	0.577	0.95 (0.85–1.07)	0.421	0.99 (0.84–1.17)	0.952
Life-threatening bleeding	268 (5.3)	70 (5.2)	111 (4.5)	0.96 (0.73–1.26)	0.760	0.84 (0.67–1.04)	0.114	0.87 (0.64–1.19)	0.383
Major bleeding	387 (7.6)	93 (6.9)	191 (7.8)	0.92 (0.73–1.16)	0.493	1.00 (0.84–1.19)	0.989	1.08 (0.84–1.40)	0.537
Minor bleeding	253 (5.0)	67 (5.0)	122 (5.0)	1.02 (0.77–1.35)	0.879	1.00 (0.80–1.24)	0.969	0.97 (0.72–1.32)	0.869
Acute kidney injury	146 (2.9)	72 (5.4)	87 (3.6)	1.49 (1.11–1.99)	0.007	1.23 (0.94–1.60)	0.134	0.82 (0.60–1.13)	0.236
Stage 1	70 (1.4)	26 (1.9)	44 (1.8)	1.18 (0.74–1.87)	0.479	1.30 (0.89–1.90)	0.170	1.10 (0.67–1.81)	0.699
Stage 2	32 (0.6)	15 (1.1)	19 (0.8)	1.55 (0.82–2.92)	0.174	1.20 (0.68–2.11)	0.533	0.77 (0.39–1.55)	0.468
Stage 3	44 (0.9)	31 (2.3)	24 (1.0)	1.88 (1.17–3.01)	0.009	1.10 (0.67–1.81)	0.709	0.59 (0.34–1.00)	0.052
Vascular access site/access-related complications	803 (15.8)	193 (14.3)	387 (15.7)	0.93 (0.79–1.10)	0.406	0.98 (0.86–1.10)	0.685	1.04 (0.87–1.25)	0.632
Major vascular complications	501 (9.8)	125 (9.2)	235 (9.5)	0.98 (0.80–1.20)	0.876	0.94 (0.81–1.10)	0.466	0.96 (0.77–1.20)	0.714
Minor vascular complications	305 (6.0)	68 (5.0)	149 (6.1)	0.85 (0.65–1.11)	0.231	1.00 (0.82–1.21)	0.978	1.18 (0.88–1.58)	0.280
Pacemaker implantation	836 (16.6)	238 (17.7)	377 (15.4)	0.97 (0.84–1.12)	0.689	0.93 (0.83–1.06)	0.273	0.96 (0.82–1.14)	0.655

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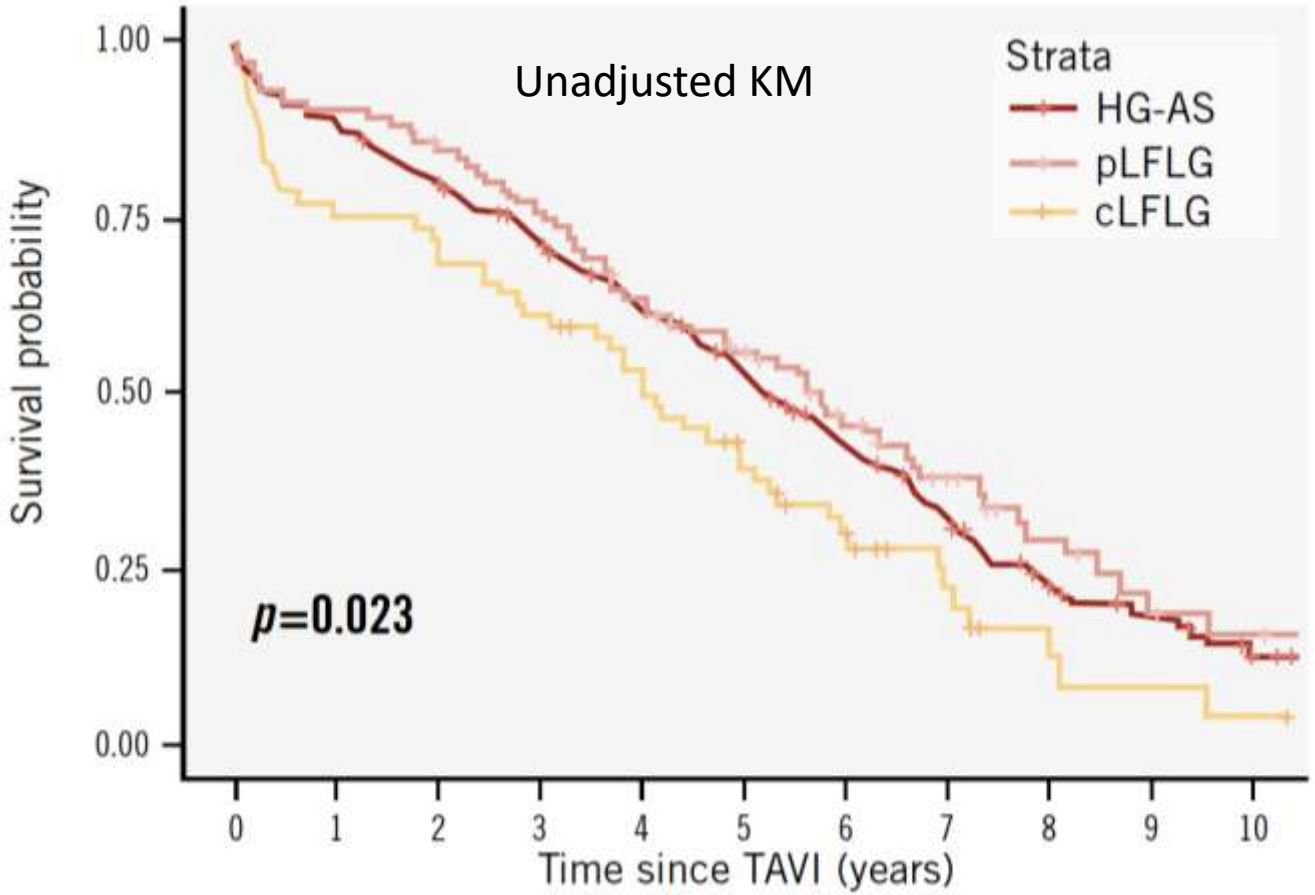
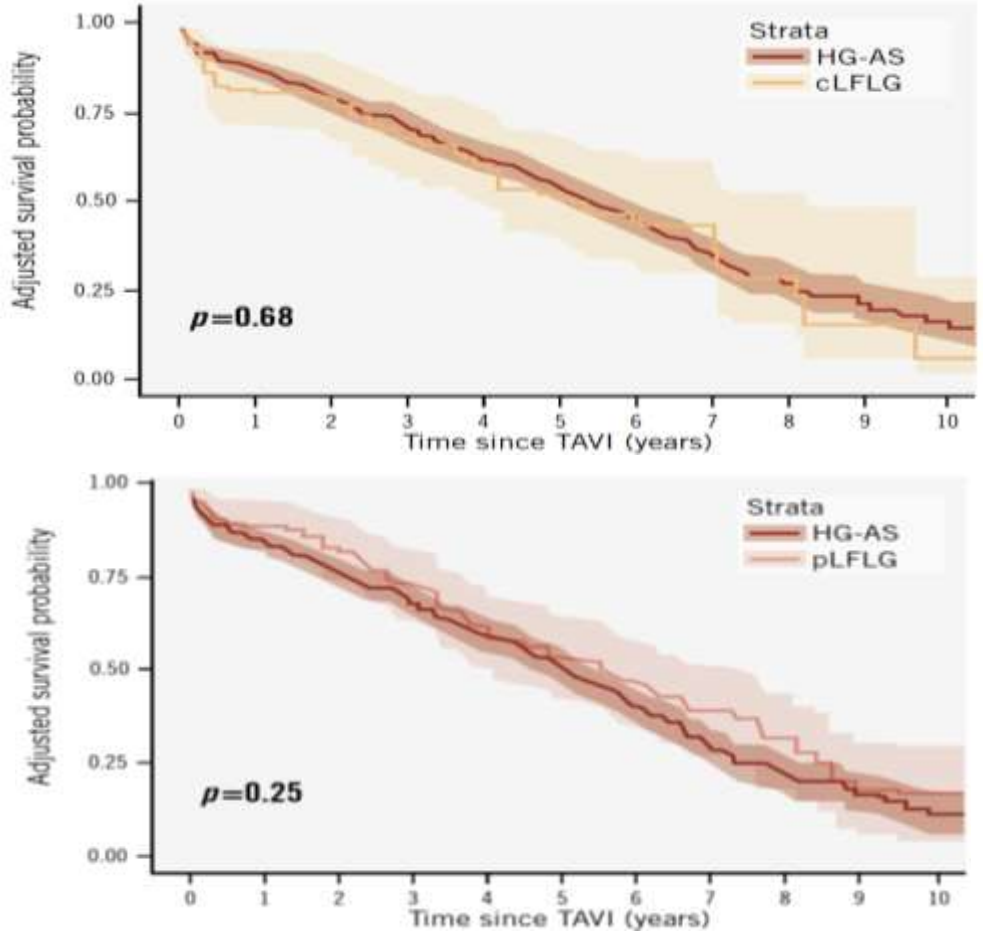


Long-term survival after TAVI in low-flow, low-gradient aortic valve stenosis

Francesco Cardaioli[1], MD; Luca Nai Fovino[1], MD, PhD; Tommaso Fabris[1], MD; Giulia Masiero[1], MD; Federico Arturi[1], MD; Andrea Panza[1], MD; Andrea Bertolini[1], MD; Giulio Rodinò[1], MD; Saverio Continisio[1], MD; Massimo Napodano[1], MD, PhD; Giulia Lorenzoni[2], PhD; Dario Gregori[2], PhD; Chiara Fraccaro[1], MD, PhD; Giuseppe Tarantini[1]*, MD, PhD



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RESULTADOS TAVI

Table 1. Baseline characteristics and procedural data.

Variable	HG-AS (n=419)	cLFLG-AS (n=64)	*p*-value*	pLFLG-AS (n=91)	*p*-value*
Clinical characteristics					
Age, years	81.00±5.91	77.00±11.06	<0.001	81.00±4.80	0.359
Male sex	196 (46.8)	40 (62.5)	0.022	35 (38.5)	0.167
BMI, kg/m²	25.82 [14.87-45.03]	24.50 [19.10-44.92]	0.048	26.04 [17.97-38.86]	0.973
Hypertension	381 (90.9)	55 (85.9)	0.254	82 (90.1)	0.690
Diabetes mellitus	117 (27.9)	23 (35.9)	0.187	29 (31.9)	0.445
Dyslipidaemia	257 (61.3)	44 (68.8)	0.271	54 (59.3)	0.638
Atrial fibrillation	126 (30.1)	26 (40.6)	0.111	34 (37.4)	0.218
Previous TIA/stroke	48 (11.5)	9 (14.8)	0.524	14 (15.4)	0.492
COPD	100 (23.9)	19 (29.7)	0.350	24 (26.4)	0.688
CKD (eGFR <60 ml/min/1.73 m²)	239 (57.0)	39 (60.9)	0.589	48 (52.7)	0.357
Permanent PM	28 (6.7)	11 (17.2)	0.011	7 (7.7)	0.823
CAD	232 (55.4)	44 (68.8)	0.049	48 (52.7)	0.565
Previous PCI	72 (17.2)	13 (20.3)	0.597	22 (24.2)	0.136
Previous CABG	46 (11.0)	11 (17.2)	0.150	11 (12.1)	0.860
Previous AMI	64 (15.3)	17 (26.6)	0.003	19 (20.9)	0.216
EuroSCORE II, %	3.87 [0.91-32.67]	5.92 [0.99-50.07]	<0.001	4.41 [1.13-24.45]	0.232
STS-PROM, %	4.62 [0.70-47.10]	5.42 [1.03-57.20]	0.321	4.78 [1.23-37.00]	0.191
Echocardiographic characteristics					
LVEF, %	59.00 [22.72-78.00]	34.50 [19.00-49.00]	<0.001	60.00 [50.00-76.00]	0.002
Max transaortic gradient, mmHg	71.00 [57.00-132.00]	50.00 [32.00-75.00]	<0.001	48.00 [33.00-75.00]	<0.001
Mean transaortic gradient, mmHg	49.00 [42.00-109.00]	28.00 [6.00-39.00]	<0.001	34.00 [21.00-39.00]	<0.001
AVA, cm²	0.74 [0.27-1.80]	0.82 [0.49-1.56]	0.003	0.84 [0.48-1.60]	<0.001
AVAi, cm²/m²	0.43 [0.11-0.90]	0.48 [0.26-1.03]	0.008	0.48 [0.23-0.87]	<0.001
LVEDVi, ml/m²	59.0 [22.8-135.0]	68.0 [34.2-158.9]	0.002	61.3 [21.5-102.4]	0.189
Moderate or severe MR	10 (2.5)	3 (4.6)	0.213	5 (5.4)	0.092
Moderate or severe TR	13 (3.1)	2 (3.1)	0.742	3 (3.2)	0.453

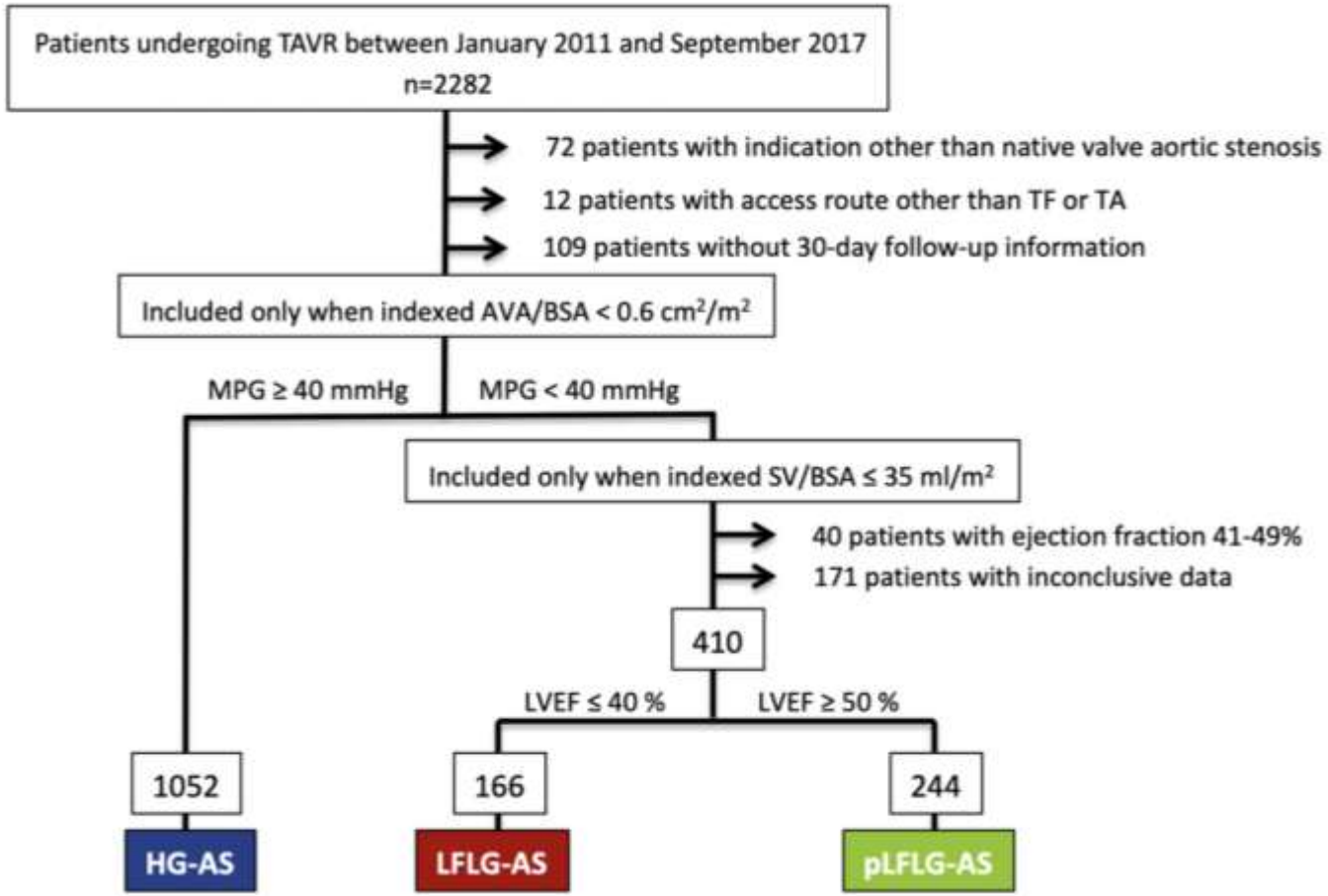
Long-term survival after TAVI in low-flow, low-gradient aortic valve stenosis

Francesco Cardaioli[1], MD; Luca Nai Fovino[1], MD, PhD; Tommaso Fabris[1], MD; Giulia Masiero[1], MD; Federico Arturi[1], MD; Andrea Panza[1], MD; Andrea Bertolini[1], MD; Giulio Rodinò[1], MD; Saverio Continisio[1], MD; Massimo Napodano[1], MD, PhD; Giulia Lorenzoni[2], PhD; Dario Gregori[2], PhD; Chiara Fraccaro[1], MD, PhD; Giuseppe Tarantini[1]*, MD, PhD

Procedural data					
Type of anaesthesia			0.599		0.839
Deep sedation	272 (65.4)	37 (59.7)		62 (68.1)	
General anaesthesia	141 (33.9)	25 (40.3)		29 (31.9)	
Access site			0.054		0.981
Transfemoral	288 (68.7)	37 (57.8)		67 (73.6)	
Trans-subclavian	3 (0.7)	1 (1.6)		1 (1.1)	
Transapical	124 (29.6)	23 (35.9)		23 (25.3)	
Transaortic	4 (1.0)	3 (4.7)		0 (0)	
THV model			0.136		0.289
CoreValve/Evolut R/PRO[a]	64 (15.2)	12 (19.4)		11 (12.1)	
SAPIEN/SAPIEN XT/3[b]	287 (68.4)	45 (70.3)		71 (78.0)	
JenaValve Trilogy[c]	4 (1.0)	2 (3.2)		1 (1.1)	
LOTUS Edge[d]	47 (11.2)	3 (4.8)		4 (4.4)	
ACURATE *neo*[e]	17 (4.1)	0 (0)		4 (4.4)	
Early safety (at 30 days)	344 (82.3)	52 (81.4)	0.471	75 (82.4)	0.486
Device success (at 30 days)	404 (96.5)	61 (95.8)	0.204	88 (96.7)	0.332
Need for PM	54 (13.1)	9 (13.6)	0.231	12 (13.4)	0.763

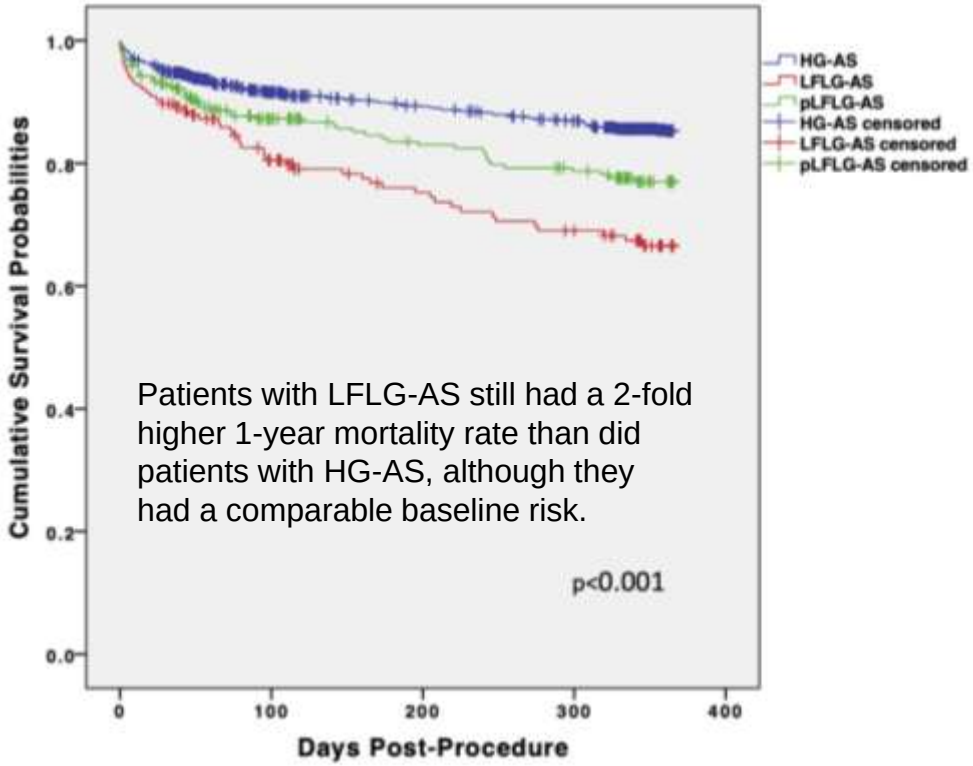
EuroIntervention 2024;20:1380-1389
DOI: 10.4244/EIJ-D-24-00442

RESULTADOS TAVI

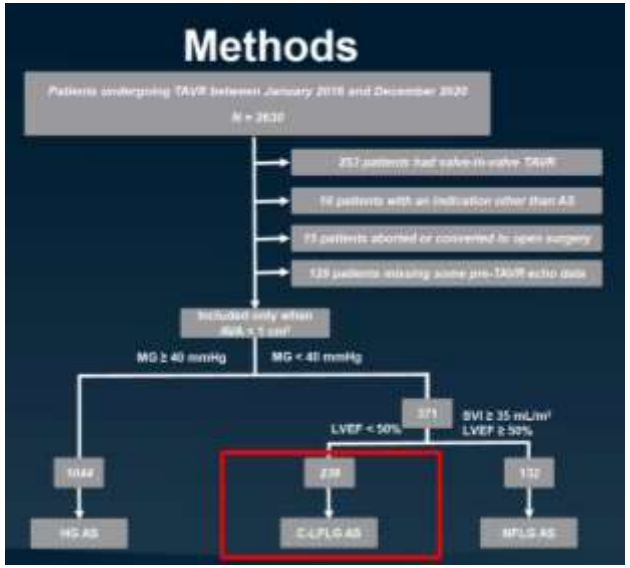


1-Year Survival After TAVR of Patients With Low-Flow, Low-Gradient and High-Gradient Aortic Valve Stenosis in Matched Study Populations

Ulrich Fischer-Rasokat, MD, PhD,[a,b] Matthias Renker, MD,[a,c,d] Christoph Liebetrau, MD, PhD,[a,b,d] Arnaud van Linden, MD,[c,e] Mani Arsalan, MD,[c,e] Maren Weferling, MD,[a] Andreas Rolf, MD, PhD,[a,b,d] Mirko Doss, MD, PhD,[f] Helge Möllmann, MD, PhD,[f] Thomas Walther, MD, PhD,[c,d,e] Christian W. Hamm, MD, PhD,[a,b,d] Won-Keun Kim, MD[a,b,c]



RESULTADOS TAVI

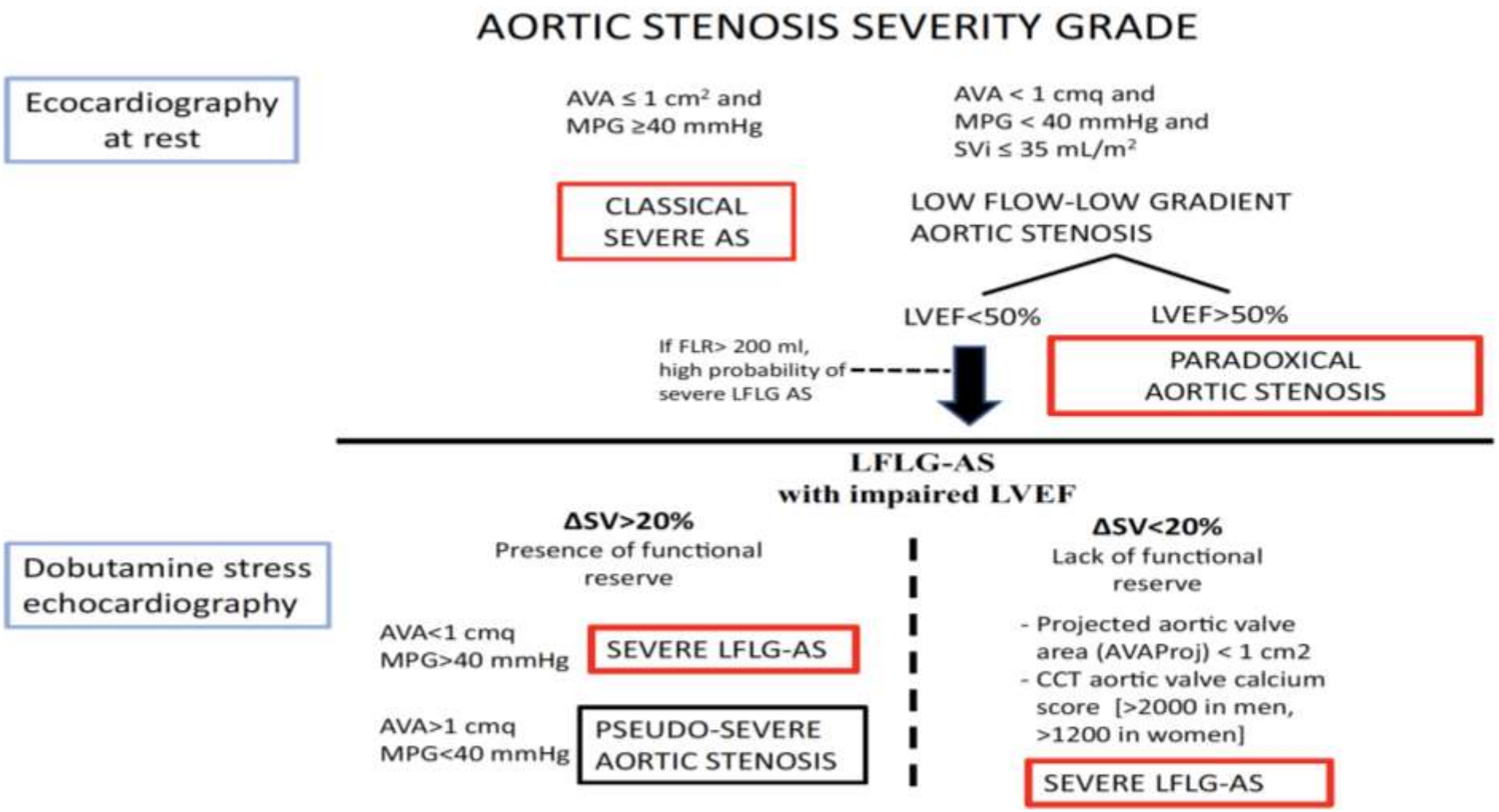


Predictors 2-Year Mortality in C-LFLG AS			
Variable	HR	95% CI	p-value
Age	1.02	0.97-1.07	0.439
Female Sex	0.70	0.31-1.59	0.387
Black Race	1.67	0.40-6.99	0.480
BMI	1.95	0.99-1.13	0.121
Bicuspid Native Aortic Valve	1.08	0.20-5.67	0.931
CAD	0.65	0.24-1.79	0.408
Prior MI	1.77	0.74-4.21	0.198
Prior Stroke	0.25	0.06-1.02	0.053
Carotid Disease	0.91	0.41-2.02	0.812
Diabetes Mellitus	1.52	0.71-3.26	0.279
Current or Recent Smoking	0.79	0.19-3.23	0.745
ESRD	***5.87***	1.53-22.57	***0.010***
Chronic Lung Disease	0.80	0.36-1.78	0.579
History of AF or Aflutter	***3.53***	1.39-9.06	***0.008***
Prior Pacemaker	0.84	0.33-2.12	0.710
Prior ICD	0.83	0.26-2.62	0.752
Predilation	0.91	0.35-2.39	0.854
Postdilation	0.91	0.43-1.90	0.803
Non-Transfemoral Access	***5.64***	2.02-15.74	***0.001***
Self-Expanding Valve	***10.90***	3.33-35.74	***<0.001***
Moderate or More MR Pre-TAVR	0.61	0.29-1.27	0.183
Moderate or More TR Pre-TAVR	***2.65***	1.28-5.51	***0.009***
Hemoglobin Pre-TAVR	***0.71***	0.57-0.87	***0.001***
LVEF Pre-TAVR	***0.94***	0.90-0.99	***0.010***
SVI Pre-TAVR	1.05	0.99-1.12	0.133
AV Mean gradient Pre-TAVR	0.97	0.92-1.02	0.240

RESULTADOS TAVI

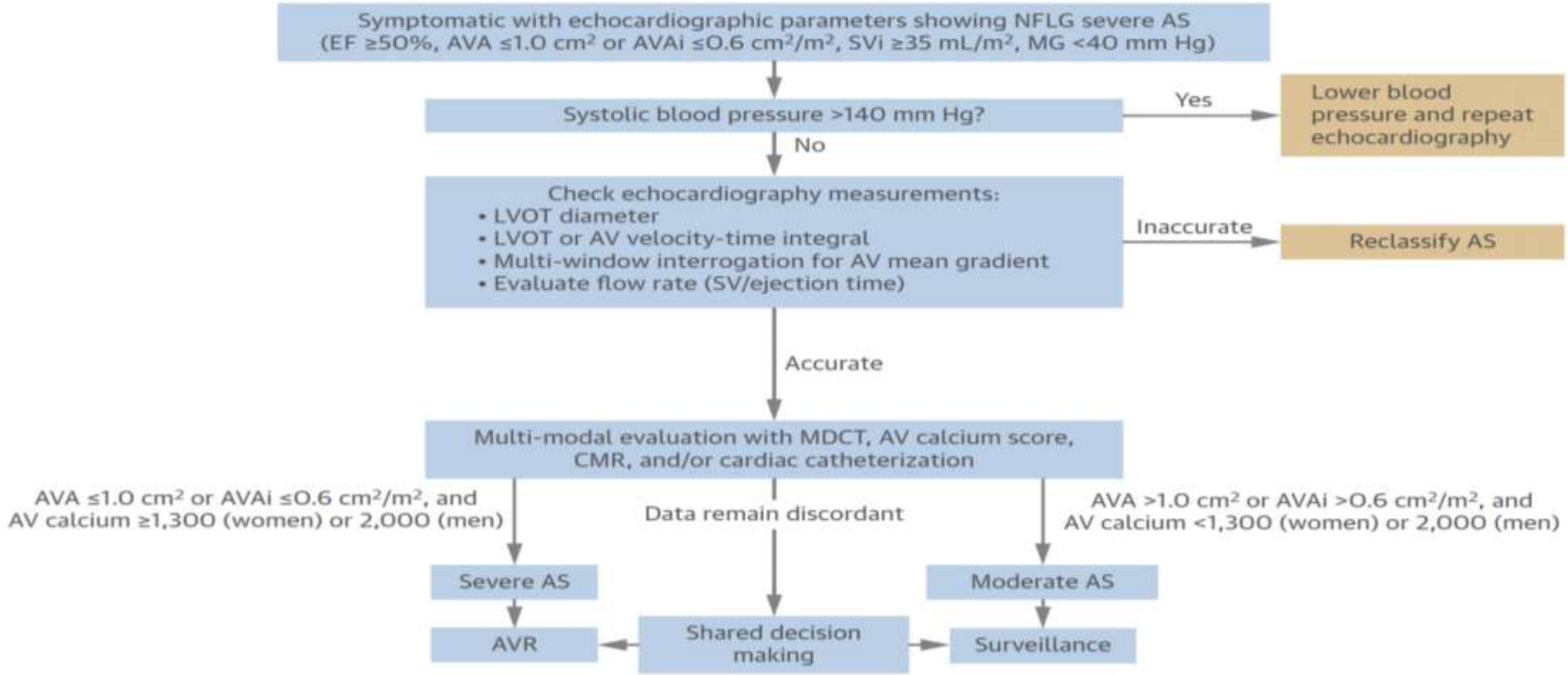
	High gradient n = 17,952	Low gradient Preserved LVEF n =1,615	Low gradient Impaired LVEF n = 1,116	*P* Value
Age, years	81.6±6.6	81.7±5.9	79.2±7.2	<0.001
Female	10356 (57.7%)	869 (53.8%)	355 (31.8%)	<0.001
Peripheral vascular disease	2407 (13.6%)	235 (15.1%)	225 (20.5%)	<0.001
History of myocardial infarction	2026 (11.5%)	220 (8.7%)	278 (26.1%)	<0.001
Dyslipidemia	10474 (58.7%)	8.3% (63.7%)	717 (64.5%)	<0.001
STS-Score	4.8 (3.1-8.2)	4.3 (2.8-6.6)	6.6 (3.1-8.1)	<0.001
Echocardiographic parameters				
Mean Gradient, mmHg	55.2±13.7	33.0±5.8	29.2±6.7	<0.001
LVEF, %	58.7±11.6	62.5±7.2	34.6±8.5	<0.001

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA



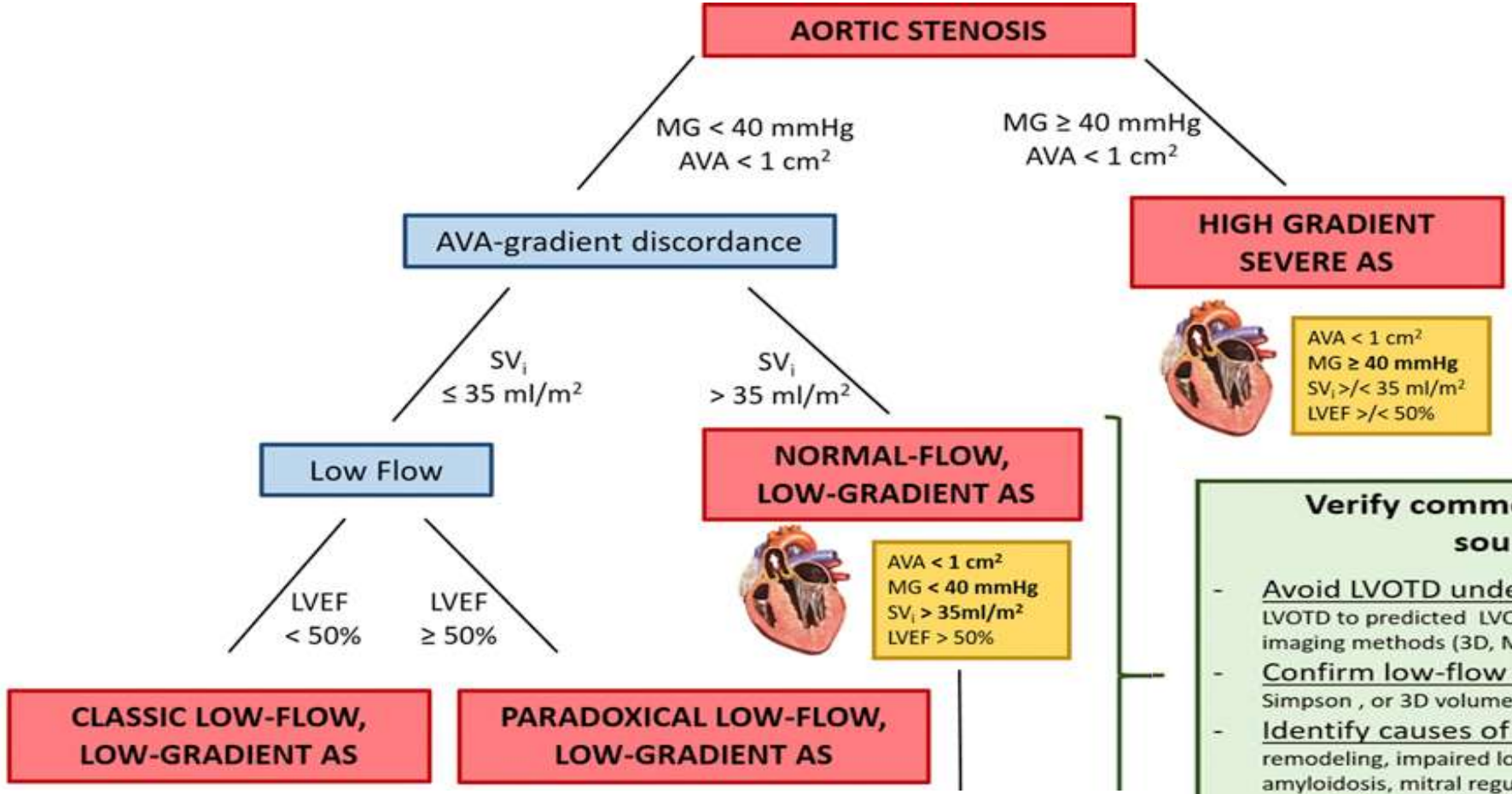
DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

FIGURE 2 **Proposed Algorithm for Evaluation of NFLG Severe AS**



JACC Cardiovasc Imaging 2024;17:926–936

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

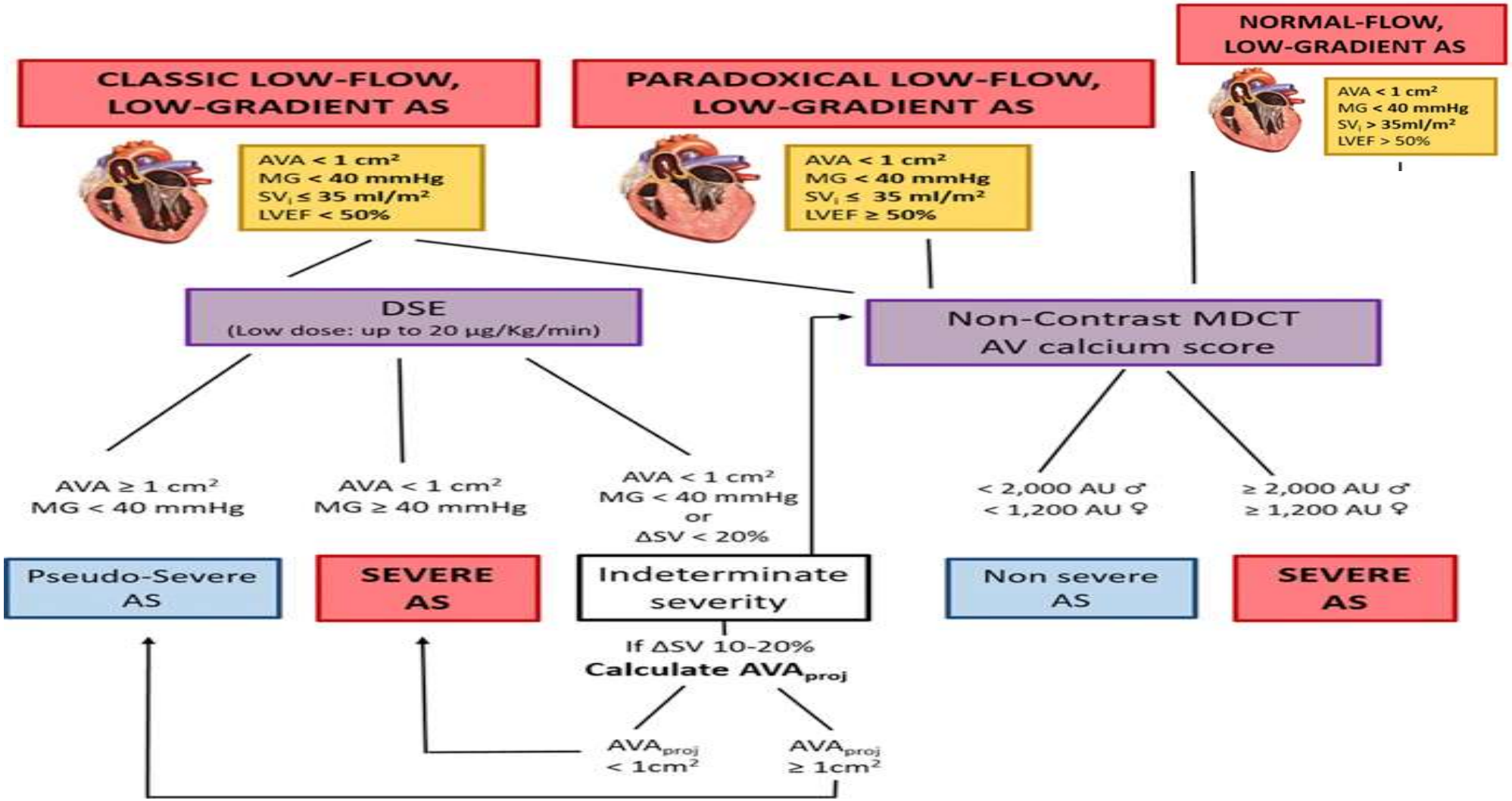


Verify common echocardiographic sources of error

- Avoid LVOTD underestimation: i) Compare measured LVOTD to predicted LVOTD. ii) Corroborate LVOT area by other imaging methods (3D, MDCT).
- Confirm low-flow state by: Teichholz method, Biplane Simpson , or 3D volumetric.
- Identify causes of low-flow state: LV concentric remodeling, impaired longitudinal function, atrial fibrillation, amyloidosis, mitral regurgitation/stenosis, tricuspid regurgitation, right ventricle dysfunction.
- Confirm low-gradient: multi-window interrogation (apical, right parasternal and suprasternal).

Faria Silva, et al. JACC Case Rep. 2022 Feb 2;4(3):170-177.

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA



Faria Silva, et al. JACC Case Rep. 2022 Feb 2;4(3):170-177.

DIAGNÓSTICO DIFERENCIAL: PSEUDO SEVERA

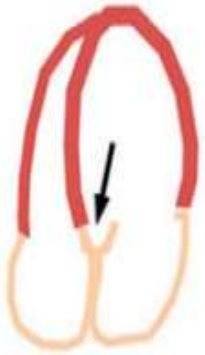
"paradoxical"
LF LG AS
PGmean <40 mmHg
LVEF ≥50%

low flow
low gradient
preserved EF
Exclude reasons for AVA - PG discordance (see above)
small LV cavity, LVH
reduced LV longitudinal function
myocardial fibrosis
art. hypertension, older age, female
worse prognosis (compared to NF HG AS)

Carefully exclude:
– measurement errors (in particular underestimation of LVOT area and flow rate)
– small BSA
– consider inconsistency of cut-offs for AVA and PG

CT-Ca >1,650
DSE? (needs to be validated)

→ **AVR/TAVI should be considered**



classical LF LG AS
PGmean <40 mmHg
LVEF <40%

low flow
low gradient
reduced EF
enlarged LV
impaired myocardial contractility
worst prognosis

DSE

flow reserve
↑SV ≥20%
→ **true severe AS**
PGmean >40 mmHg and AVA <1.2 cm²
AVAproj <1.0-1.2 cm²
CT-Ca >1,650
→ **AVR/TAVI should be considered**

→ **pseudo-severe AS**
under peak dobutamine infusion:
PGmean <30-40 mmHg and AVA >1.0-1.2 cm²
or ↑AVA ≥0.3 cm²; or AVAproj >1.0-1.2 cm²
CT-Ca <1,650
→ **medical therapy**

no flow reserve
↑SV <20%
→ **true severe AS**
CT-Ca >1,650
→ **AVR/TAVI may be considered**

DEFINICIÓN ESTENOSIS AÓRTICA BG

➢ La estenosis aórtica de bajo gradiente (EA-BG) se caracteriza por:

- **Área valvular <1 cm² (indexada <0.6cm2/m2)***
  (<0.5 cm2/m2 SI IMC > 30 kg/m2)
- **Gradiente medio <40 mmHg***
- **VTI TSVI / VTI Vao <0,25**

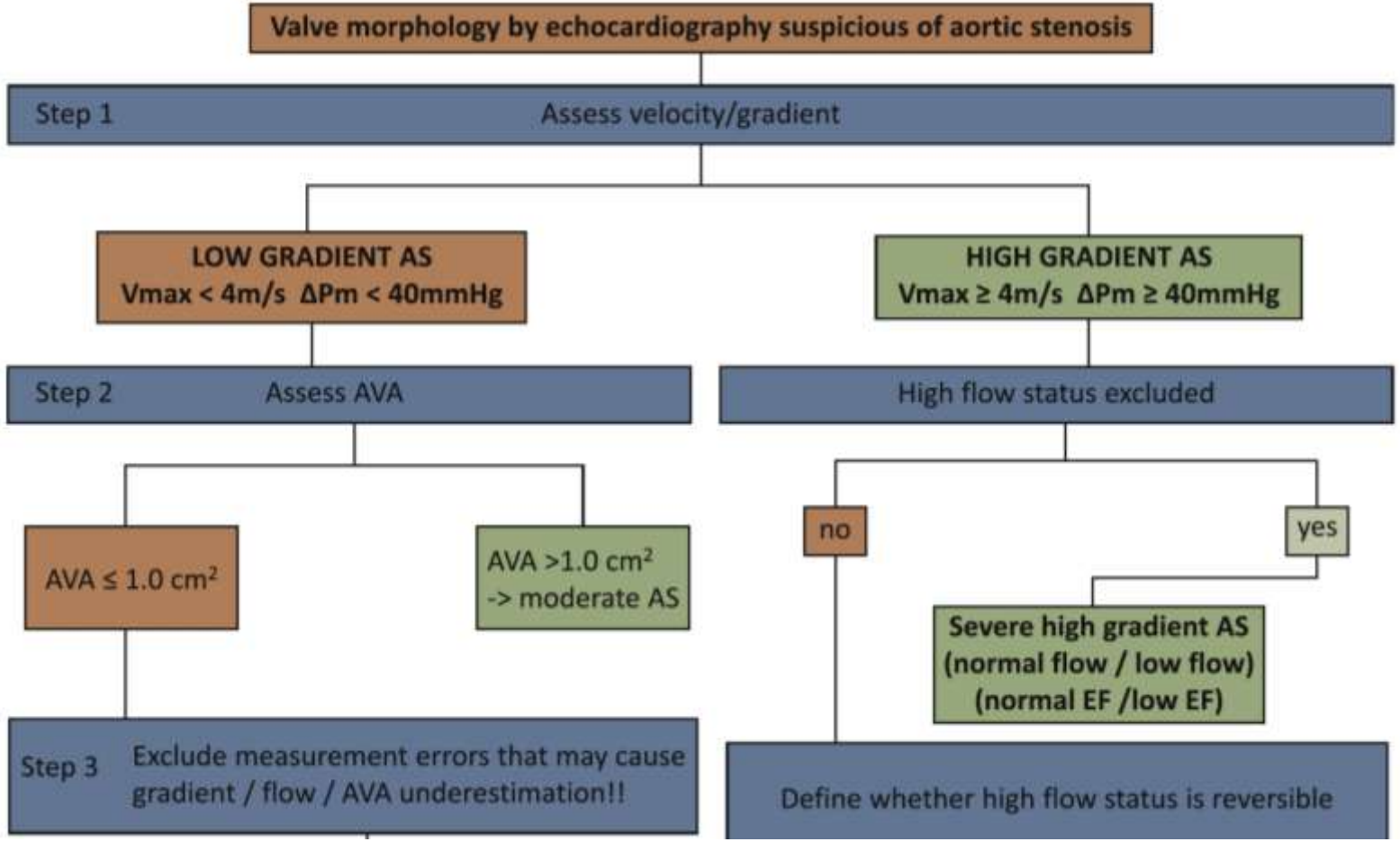
*Tras excluir errores medición

✓ Registro gradientes transvalvulares subóptimo
  - Valoración desde varias ventanas: apical, supraesternal y paraesternal derecho

✓ Confirmar situación de bajo flujo

✓ Infraestimación diámetro tracto salida V.Izq
  - Comprobar métodos 3D, ETE, TAC

Diagnostico

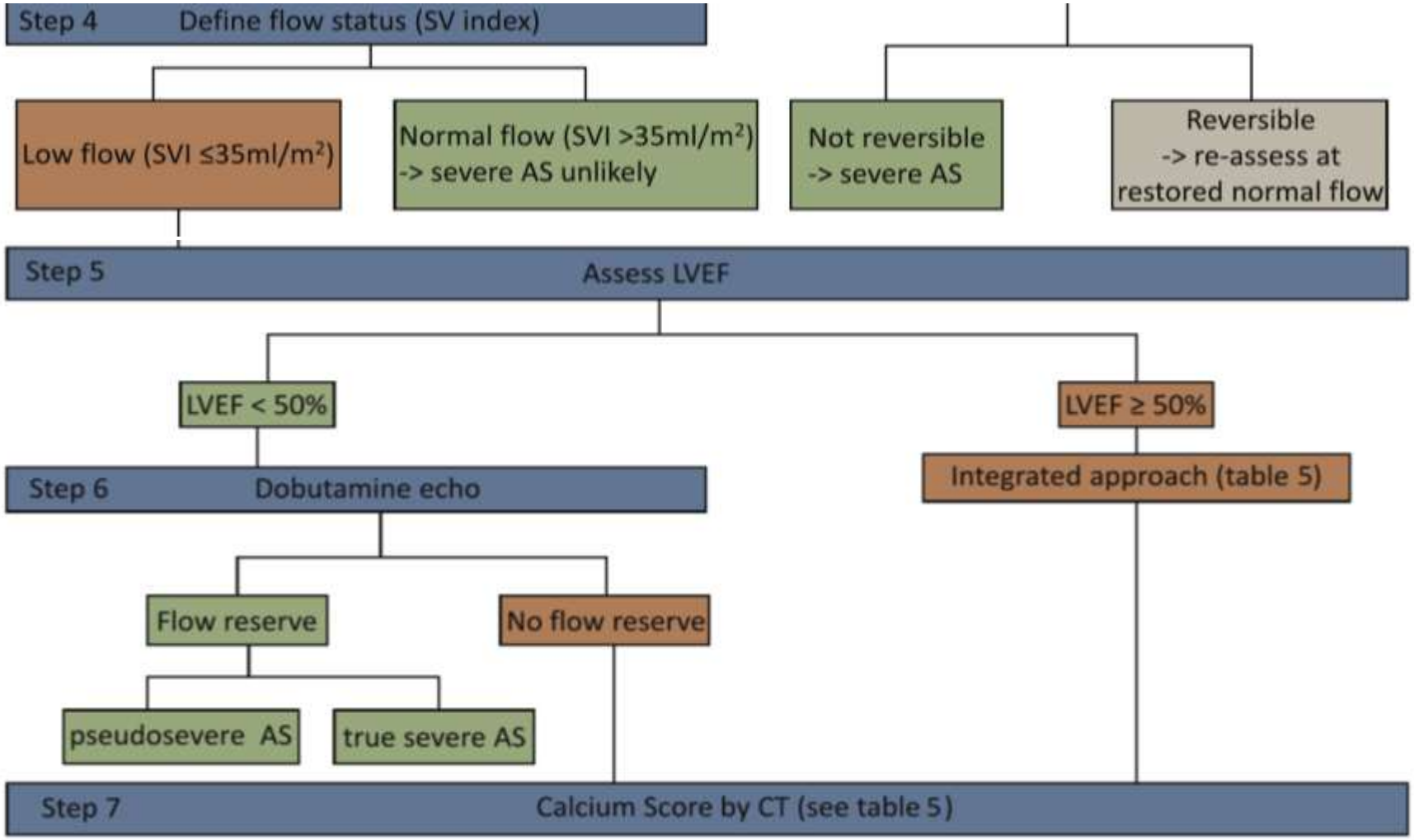


Helmut Baumgartner et al. EACVI/ASE/ESC CLINICAL RECOMMENDATIONS

http://dx.doi.org/10.1016/j.echo.2016.12.009

XIII CONGRESO INTERNACIONAL DE CARDIOLOGÍA
CARDIOLOGÍA INTERVENCIONISTA - LII JORNADA ACCI-SOLACI
DE LA PREVENCIÓN A LA INTERVENCIÓN
CARDIOLOGÍA
Área Sanitaria de Vigo

Diagnostico



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CARDIOLOGÍA INTERVENCIONISTA - LII JORNADA ACCI-SOLACI
DE LA PREVENCIÓN A LA INTERVENCIÓN

CARDIOLOGÍA
Área Sanitaria de Vigo

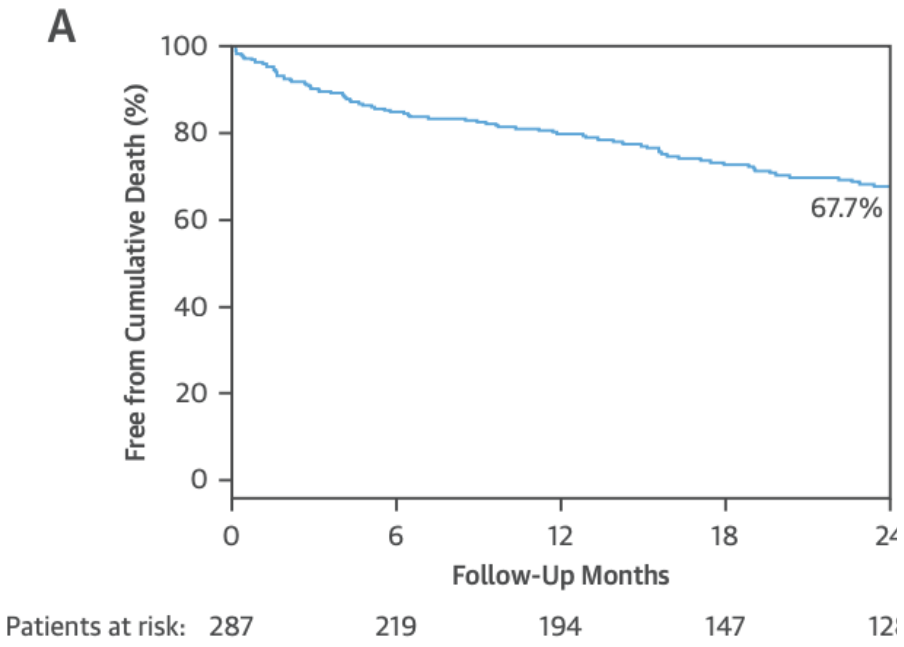
RESULTADOS TAVI

Table 1 LFLG AS with reduced LVEF (EF < 50%)—comparison between AVR and OMT

	Population of interest (LFLG AS with reduced LVEF)	Type of AVR	AVR vs OMT HR for death at long-term follow-up
Sato et al. [17][a]	86	TAVI and SAVR	HR 0.32 [6, 6] $p < 0{,}001$
Tribouilloy et al. [18]	81	SAVR	HR 0.16 to 5.21 varying with time [0.12–3.16 to 0.21–8.50], $p < 0.00026$[b]
Monin et al. [19]	136 pt	SAVR	HR 0.3 (p 0,001)
Herrmann et al. [20]	42 pt (considering only inoperable true severe LFLG AS with low EF, cohort B)	TAVI	HR 0.43; 95% CI [0.19–0.98] P = 0.04
Clavel et al. [21]	101 pt	TAVI and SAVR	HR 0.57 [0.40 to 0.82] P = 0.02

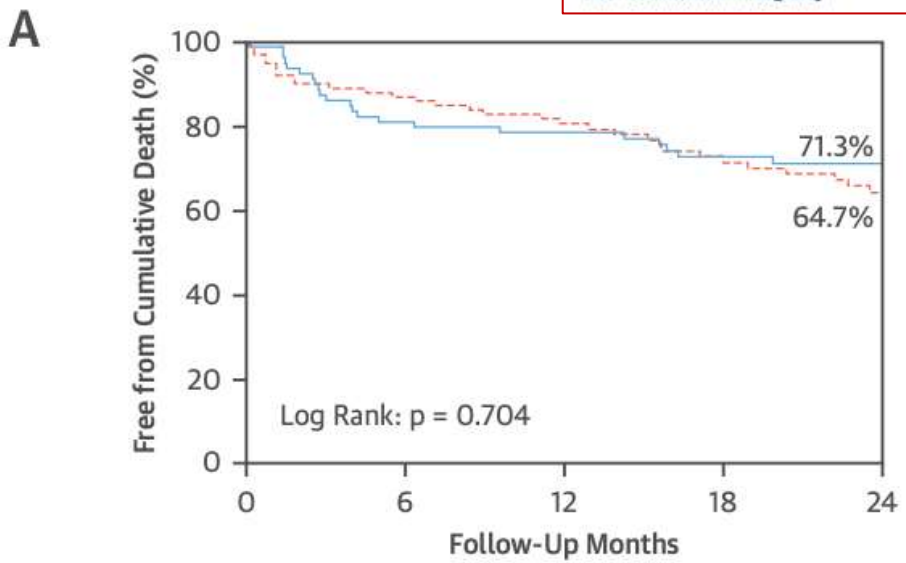
RESULTADOS TAVI: Reserva contráctil no predictor

FIGURE 1 Clinical Events at 2-Year Follow-Up



Transcatheter Aortic Valve Replacement in Patients With Low-Flow, Low-Gradient Aortic Stenosis

The TOPAS-TAVI Registry



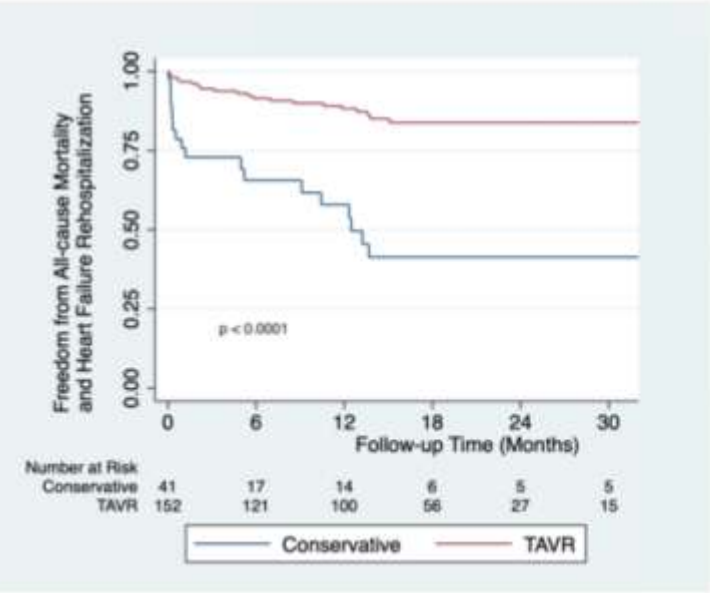
Patients at risk:					
With contractile reserve	86	65	63	49	45
Without contractile reserve	107	87	72	55	46

- Mortality rates were 3.8%, 20.1%, and 32.3% at 30 days, 1 year, and 2 years, respectively.
- The absence of contractile reserve at baseline DSE was not associated with any negative effect on clinical outcomes or LVEF changes at follow-up.

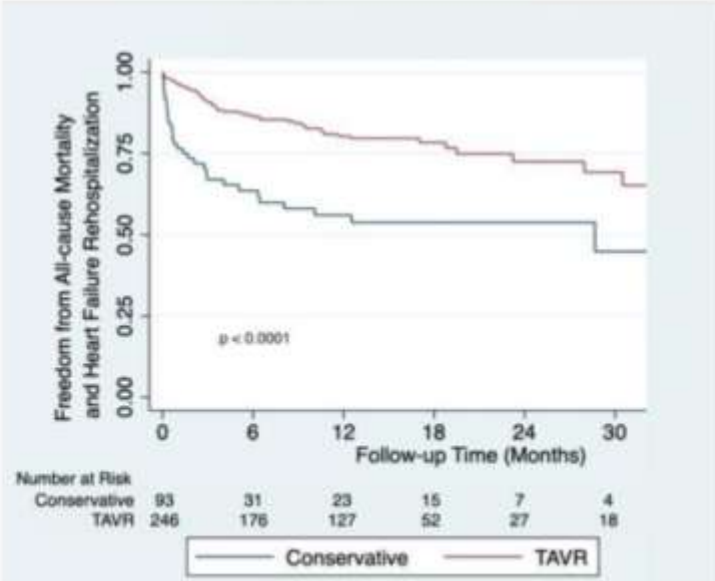
RESULTADOS TAVI

Composite endpoint: conservative management vs TAVR

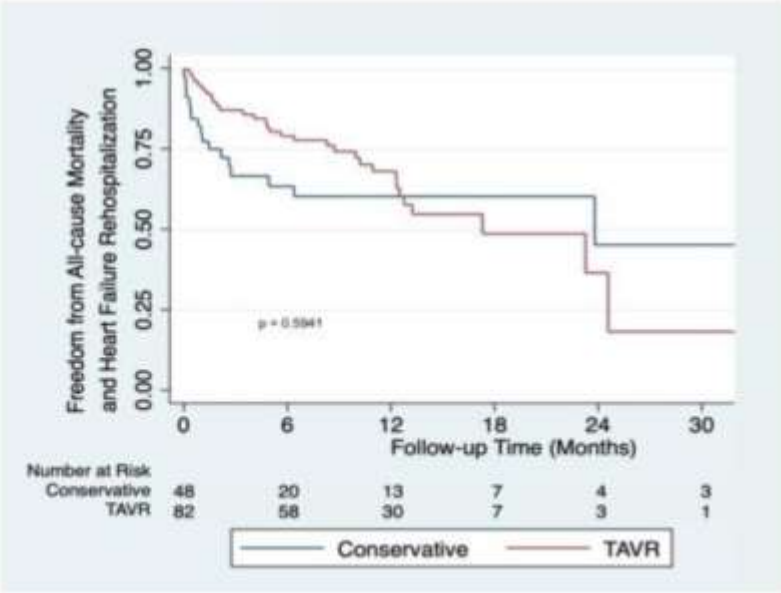
High-Gradient
MPG≥40mmHg



Low-Gradient
20mmHg<MPG<40mmHg



Very Low-Gradient
MPG≤20mmHg



L. Chopra, et al.

RESULTADOS TAVI: Características Diferenciales

	Very Low Gradient (n=130)	Low Gradient (n=339)	High Gradient (n=193)	p-value
Age, yrs	82.0 [75.0, 89.0]‡	81.0 [74.0, 86.0]§	79.0 [72.0, 84.0]	**0.001**
Female	52 (40.0)	130 (38.3)	81 (42.0)	0.712
Body mass index, kg/m2	25.2 [21.8, 29.2]*‡	27.5 [24.1, 31.3]	27.4 [24.0, 31.3]	**0.001**
Coronary artery disease	87 (66.9)*‡	182 (53.7)	88 (45.6)	**0.001**
Prior CABG	25 (19.2)	55 (16.2)	24 (12.4)	0.241
Prior PCI	69 (53.1)*‡	122 (36.0)	62 (32.1)	**<0.001**
Prior myocardial infarction	37 (28.5)‡	74 (21.8)	28 (14.5)	**0.009**
Prior cerebrovascular accident	27 (20.8)	71 (20.9)	27 (14.0)	0.119
Peripheral artery disease	18 (13.8)	45 (13.3)	23 (11.9)	0.859
Chronic kidney disease	62 (48.1)	140 (41.4)	66 (34.4)	**0.046**
Atrial fibrillation	54 (41.5)	131 (38.6)	56 (29.0)	**0.034**
STS-PROM > 8%	27 (20.8) *‡	44 (13)	20 (10.4)	**0.024**
Brain natriuretic peptide, pg/mL	393 [136, 996]‡	269 [111, 768]	242 [122, 661]	**0.035**
Medications				
Beta-blockers	83 (63.8)	203 (59.9)	108 (56.0)	0.36
ACE inhibitor/ARB	55 (42.3)	161 (47.5)	82 (42.5)	0.422
MRA	13 (10.0) ‡	24 (7.1) §	1 (0.5)	**0.001**
SGLT-2 inhibitor	15 (11.5) *	16 (4.7)	11 (5.7)	**0.023**
Loop diuretics	62 (47.7)‡	137 (40.4)§	53 (27.5)	**0.001**
Implantable cardioverter defibrillator	16 (12.3)*‡	13 (3.8)	2 (1.0)	**<0.001**
Cardiac resynchronization therapy	10 (7.7)*‡	5 (1.5)	2 (1.0)	**<0.001**

	Very Low Gradient (n=130)	Low Gradient (n=339)	High Gradient (n=193)	p-value
LV ejection fraction, %	45.0 [33.0, 60.8]*‡	57.0 [40.5, 65.0]§	60.0 [50.0, 65.0]	**<0.001**
LV ejection fraction < 50%	74 (56.9)*‡	120 (35.4)§	45 (23.3)	**<0.001**
Aortic valve area, cm2	0.76 [0.68, 0.86]*‡	0.69 [0.58, 0.79]§	0.55 [0.45, 0.65]	**<0.001**
Indexed aortic valve area, cm2/m2	0.42 [0.38, 0.48]*‡	0.37 [0.32, 0.41]§	0.30 [0.25, 0.34]	**<0.001**
Peak aortic jet velocity, m/s	2.76 [2.50, 2.90]*‡	3.50 [3.29, 3.80]§	4.30 [4.10, 4.60]	**<0.001**
Peak gradient, mmHg	30.0 [25.0, 34.0]*‡	50.0 [43.0, 58.0]§	74.00 [67.0, 85.0]	**<0.001**
Mean gradient, mmHg	16.0 [13.0, 18.0]*‡	29.0 [25.0, 34.0]§	46.0 [42.0, 52.0]	**<0.001**
Stroke volume index, ml/m2	24.6 [20.0, 29.2]*‡	28.7 [25.4, 31.9]§	30.4 [26.9, 33.0]	**<0.001**
LV end-diastolic diameter, mm	47.0 [42.0, 54.0]‡	46.0 [39.0, 51.8]	44.0 [40.0, 50.5]	**0.027**
LV end-systolic diameter, mm	34.0 [27.3, 44.8]*‡	31.0 [26.0, 37.0]	30.0 [26.0, 35.0]	**0.001**
LV mass, g	192.5 [151.0, 237.3]	184.5 [151.0, 234.3]	195.5 [146.5, 236.5]	0.912
LV mass index, g/m2	102.5 [86.8, 131.3]	96.5 [79.9, 123.0]	103.6 [83.8, 125.1]	0.257
≥ Moderate aortic regurgitation	5 (3.8)	21 (6.2)	13 (6.7)	0.526
≥ Moderate mitral regurgitation	33 (25.4)‡	54 (15.9)	27 (14.1)	**0.021**
≥ Moderate tricuspid regurgitation	32 (24.6)*‡	48 (14.2)	18 (9.3)	**0.001**

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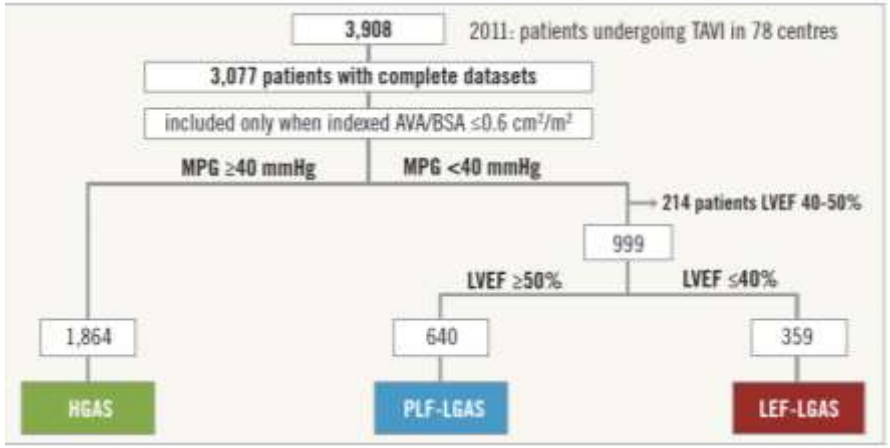
Table 1. Baseline characteristics.

		LEF-LGAS (n=359)	p* LEF-LGAS vs. PLF-LGAS	PLF-LGAS (n=640)	p* PLF-LGAS vs. HGAS	HGAS (n=1,864)	p*
Age, years±SD		79.1±6.1	0.001	80.5±5.6	<0.001	81.4±6.1	<0.001
Female, n (%)		121 (33.7)	<0.001	370 (57.8)	0.207	1,132 (60.7)	<0.001
Body mass index (kg/m²)		26.5±4.4	<0.001	27.7±4.9	0.001	27.0±4.9	<0.001
Logistic EuroSCORE (%)		36.7±20.9	<0.001	22.6±15.7	0.071	24.3±17.4	<0.001
German AV score (%)		11.0±10.7	<0.001	7.4±7.5	0.031	8.2±8.9	<0.001
Previous medical history							
Chronic obstructive pulmonary disease, n (%)		79 (22.0)		138 (21.6)		362 (19.4)	0.328
Peripheral vascular disease, n (%)		105 (29.2)	0.005	136 (21.3)	0.116	343 (18.4)	<0.001
Pulmonary hypertension, n (%)		163 (45.4)	0.009	235 (36.7)	0.599	662 (35.5)	0.002
Systolic pulmonary pressure (mmHg)		48.6±15.6	<0.001	43.1±14.5	0.010	45.5±15.3	<0.001
Coronary artery disease (CAD), n (%)		255 (71.0)	<0.001	346 (54.1)	0.199	952 (51.1)	<0.001
1-CAD		60 (16.7)		99 (15.5)		358 (19.2)	0.083
2-CAD		67 (18.7)	0.087	92 (14.4)	0.381	242 (13.0)	0.020
3-CAD		128 (35.7)	<0.001	155 (24.2)	0.004	352 (18.9)	<0.001
Previous PCI		154 (42.9)	<0.001	188 (29.4)	0.122	488 (26.2)	<0.001
Previous myocardial infarction, n (%)		119 (33.1)	<0.001	114 (17.8)	0.133	285 (15.3)	<0.001
Myocardial infarction <91 days, n (%)		32 (8.9%)	0.123	39 (6.1)	0.552	102 (5.5)	0.050
Previous cardiac surgery, n (%)		110 (30.6)	<0.001	131 (20.5)	0.026	307 (16.5)	<0.001
Diabetes mellitus, n (%)		143 (39.8)	0.588	243 (38.0)	0.009	601 (32.2)	0.002
Mitral regurgitation ≥II°, n (%)		145 (40.4)	<0.001	157 (24.5)	0.032	540 (29.0)	<0.001
Chronic renal failure, n (%) *		228 (63.5)	0.343	386 (60.3)	0.003	998 (53.5)	<0.001
Dialysis	acute	11 (3.1)		11 (1.7)		35 (1.9)	0.288
	chronic	16 (4.5)		25 (3.9)		58 (3.1)	0.314
Stroke or TIA, intracranial haemorrhage		36 (10.0)		63 (9.8)		152 (8.2)	0.266
Permanent pacemaker/defibrillator		91 (25.3)	<0.001	96 (15.0)	<0.001	180 (9.7)	<0.001

TAVI for low-flow, low-gradient severe aortic stenosis with preserved or reduced ejection fraction: a subgroup analysis from the German Aortic Valve Registry (GARY)

Alexander Lauten[1]*, MD; Hans R. Figulla[2], MD; Helge Möllmann[3], MD; David Holzhey[3], MD; Joachim Kötting[4], MSc; Andreas Beckmann[5], MD; Christof Veit[4], MD; Jochen Cremer[6], MD; Karl-Heinz Kuck[7], MD; Rüdiger Lange[8], MD; Ralf Zahn[9], MD; Stefan Sack[10], MD; Gerhard Schuler[3], MD; Thomas Walther[11], MD; Friedhelm Beyersdorf[12], MD; Michael Böhm[13], MD; Gerd Heusch[14], MD; Thomas Meinertz[15], MD; Till Neumann[16], MD; Armin Welz[17], MD; Friedrich W. Mohr[1], MD; Christian W. Hamm[1], MD; on behalf of the GARY Executive Board



EuroIntervention 2014;10:850-859

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Table 3. Primary endpoints: mortality and MACCE – in-hospital and at 12-month follow-up.

		LEF-LGAS (n=359)	p* LEF-LGAS vs. PLF-LGAS	PLF-LGAS (n=640)	p* HGAS vs. PLF-LGAS	HGAS (n=1,864)	p* LEF-LGAS vs. HGAS	p*
In-hospital mortality		28 (7.8)	0.133	34 (5.3)	0.674	91 (4.9)	0.029	0.084
Combined endpoints (in-hospital)								
MACCE (death, MI, stroke)		40 (11.1%)	0.266	57 (8.9%)	0.404	147 (7.9%)	0.048	0.121
Combined MAE (MACCE, re-op, bleeding (≥1 unit), new dialysis		140 (39.0%)	1.000	250 (39.1%)	0.351	768 (41.2%)	0.447	0.538
12-month mortality		116 (32.3)	0.001	143 (22.3)	0.192	370 (19.8)	<0.001	<0.001
Patient alive		235 (65.5)	0.001	483 (75.5)	0.229	1,451 (77.8)	<0.001	<0.001
Survival status unknown		8 (2.2)	1.000	14 (2.2)	1.000	43 (2.2)	1.000	1.000
Cause of death	Cardiovascular	43 (12.0)	0.032	50 (7.8)	0.057	105 (5.6)	<0.001	<0.001
	Non-cardiovascular	22 (6.1)	0.165	26 (4.1)	0.821	81 (4.3)	0.169	0.273
	Unknown	51 (14.2)	0.083	67 (10.5)	0.648	184 (9.9)	0.019	0.050
Combined endpoints (12-month)								
No MACCE		193 (53.8)	0.038	388 (60.6)	0.096	1,199 (64.3)	<0.001	0.001
MACCE (death, MI, stroke)		124 (34.5)	0.021	176 (27.5)	0.063	443 (23.8)	<0.001	<0.001
Patient alive but MACCE unknown		42 (11.7)	1.000	76 (11.9)	1.000	222 (11.9)	1.000	0.994

TAVI for low-flow, low-gradient severe aortic stenosis with preserved or reduced ejection fraction: a subgroup analysis from the German Aortic Valve Registry (GARY)

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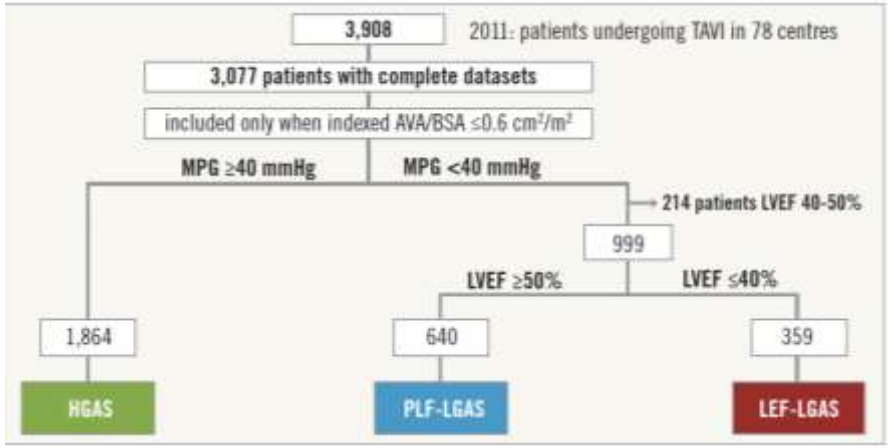

EuroIntervention 2014;10:850-859

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TAVI for low-flow, low-gradient severe aortic stenosis with preserved or reduced ejection fraction: a subgroup analysis from the German Aortic Valve Registry (GARY)

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	LEF-LGAS (n=359)	p* LEF-LGAS vs. PLF-LGAS	PLF-LGAS (n=640)	p* HGAS vs. PLF-LGAS	HGAS (n=1,864)	p* LEF-LGAS vs. HGAS	p*
Duration of treatment on ICU	4.3±5.3		4.0±6.3		3.8±5.2		0.321
Postoperative complications							
Low cardiac output	35 (9.7)	0.003	31 (4.8)	0.107	125 (6.7)	0.045	0.013
Medical treatment	18 (5.0)	0.013	13 (2.0)	0.320	54 (2.9)	0.049	0.034
Intra-aortic balloon pump	5 (1.4)	0.006	0 (0.0)	0.027	14 (0.8)	0.215	0.009
Other type of circulatory support	12 (3.3)	–	18 (2.8)	–	57 (3.1)	–	0.883
Myocardial infarction	3 (0.8)	–	1 (0.2)	–	8 (0.4)	–	0.240
Stroke	12 (3.3)	–	24 (3.8)	–	63 (3.4)	–	0.895
Minor stroke (Rankin score <2)	7 (1.9)	–	13 (2.0)	–	28 (1.5)	–	0.536
Major stroke (Rankin score ≥2)	5 (1.4)	–	11 (1.7)	–	35 (1.9)	–	0.891
Acute kidney injury (modif. RIFLE classification)							
Stage 1 (creatinine increase 150-199%)	19/130 (14.6)	–	43/252 (17.1)	–	129/862 (15.0)	–	0.697
Stage 2 (creatinine increase 200-299%)	7/130 (5.4)	–	12/252 4.8	–	42/862 4.9	–	0.962
Stage 3 (creatinine increase >300%)	8/130 (6.2)	–	7/252 (2.8)	–	21/862 (2.4)	–	0.062
Vascular complications	47 (13.1)	–	75 (11.7)	–	236 (12.7)	–	0.769
Bleeding complications	–	–	–				
Life-threatening or disabling (≥4 RBC units)	44 (12.3)	–	70 (10.9)	–	208 (11.2)	–	0.791
Major bleeding (2 or 3 RBC units)	59 (16.4)	–	112 (17.5)	–	368 (19.7)	–	0.217
Minor bleeding (1 RBC unit)	12 (3.3)	–	31 (4.8)	–	100 (5.4)	–	0.277
Number unknown but ≥1	8 (2.2)	–	8 (1.3)	–	22 (1.2)	–	0.272
Cardiopulmonary resuscitation	28 (7.8)	0.006	23 (3.6)	0.225	90 (4.8)	0.028	0.016
Permanent pacemaker/defibrillator (new)	64 (23.9)	–	109 (20.0)	–	377 (22.4)	–	0.383
Postoperative day of mobilisation							
Day 1	155 (43.2)	–	286 (44.7)	–	870 (46.7)	–	0.392
Day 2	98 (27.3)	–	148 (23.1)	–	445 (23.9)	–	0.303
≥Day 3	60 (16.7)	–	128 (20.0)	–	358 (19.2)	–	0.434

RESULTADOS TAVI

TAVI in patients with low-flow low-gradient aortic stenosis–short-term and long-term outcomes

Julius Steffen[1,2] · Nikolas Reißig[1] · David Andreae[1] · Markus Beckmann[1] · Magda Haum[1] · Julius Fischer[1] · Hans Theiss[1] · Daniel Braun[1] · Martin Orban[1] · Konstantinos Rizas[1,2] · Sebastian Sadoni[3] · Michael Näbauer[1] · Sven Peterss[3] · Jörg Hausleiter[1,2] · Steffen Massberg[1,2] · Simon Deseive[1]

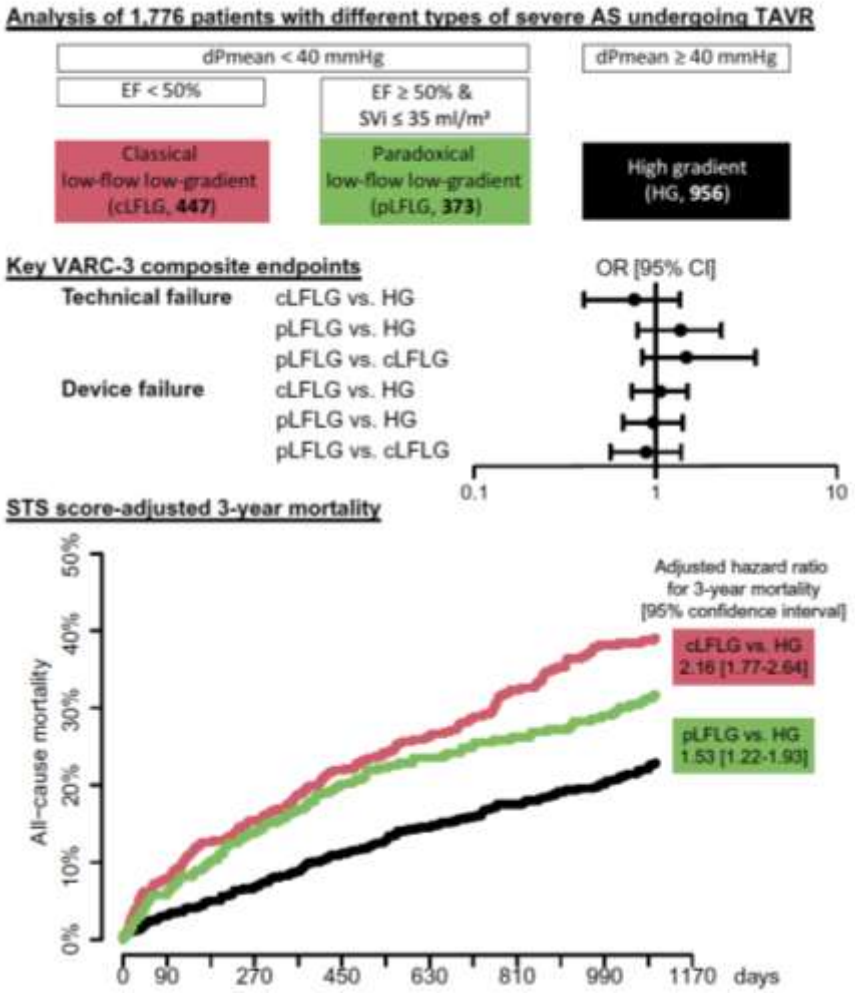

Table 1 Patient characteristics

	HG (N=956)	cLFLG (N=447)	pLFLG (N=373)	Total (N=1776)	p value
Male sex	440 (46.0%)	311 (69.6%)	166 (44.5%)	917 (51.6%)	**< 0.01**
Age (years)	81.2 [77.3–85.4]	82.0 [77.4–86.3]	82.2 [78.3–85.6]	81.7 [77.5–85.7]	0.19
Body mass index (kg/m²)	25.8 [23.4–29.4]	25.5 [22.7–28.8]	26.0 [23.8–28.7]	25.8 [23.4–29.1]	0.19
Body surface area (m²)	1.8 [1.7–2.0]	1.9 [1.7–2.0]	1.8 [1.7–2.0]	1.8 [1.7–2.0]	**0.02**
STS-score	3.0 [2.0–5.0]	5.0 [3.0–7.3]	3.9 [2.2–6.0]	3.8 [2.1–6.0]	**< 0.01**
Diabetes mellitus type 2	249 (28.3%)	148 (35.3%)	118 (33.8%)	515 (31.2%)	**0.02**
Hypertension	785 (88.7%)	392 (92.9%)	324 (92.8%)	1501 (90.6%)	**0.01**
Smoker (active or past)	174 (19.7%)	103 (24.5%)	54 (15.4%)	331 (20.0%)	**< 0.01**
Hypercholesterolemia	351 (40.3%)	170 (41.3%)	161 (46.4%)	682 (41.8%)	0.14
Positive family history	86 (9.0%)	35 (7.8%)	46 (12.3%)	167 (9.4%)	0.07
Chronic kidney disease	367 (38.4%)	279 (62.4%)	178 (47.7%)	824 (46.4%)	**< 0.01**
Atrial fibrillation	193 (20.2%)	163 (36.5%)	155 (41.6%)	511 (28.8%)	**< 0.01**
Coronary artery disease	500 (56.2%)	314 (73.5%)	222 (63.4%)	1036 (62.2%)	**< 0.01**
Prior MI	107 (11.2%)	119 (26.6%)	50 (13.4%)	276 (15.5%)	**< 0.01**
Prior PCI	258 (29.3%)	195 (46.2%)	113 (32.3%)	566 (34.2%)	**< 0.01**

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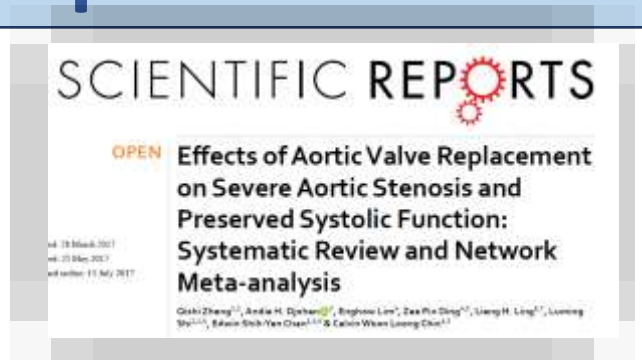
SCIENTIFIC REPORTS

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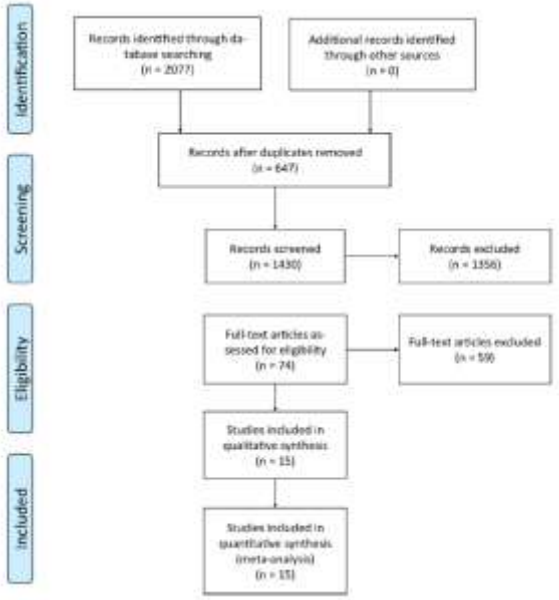

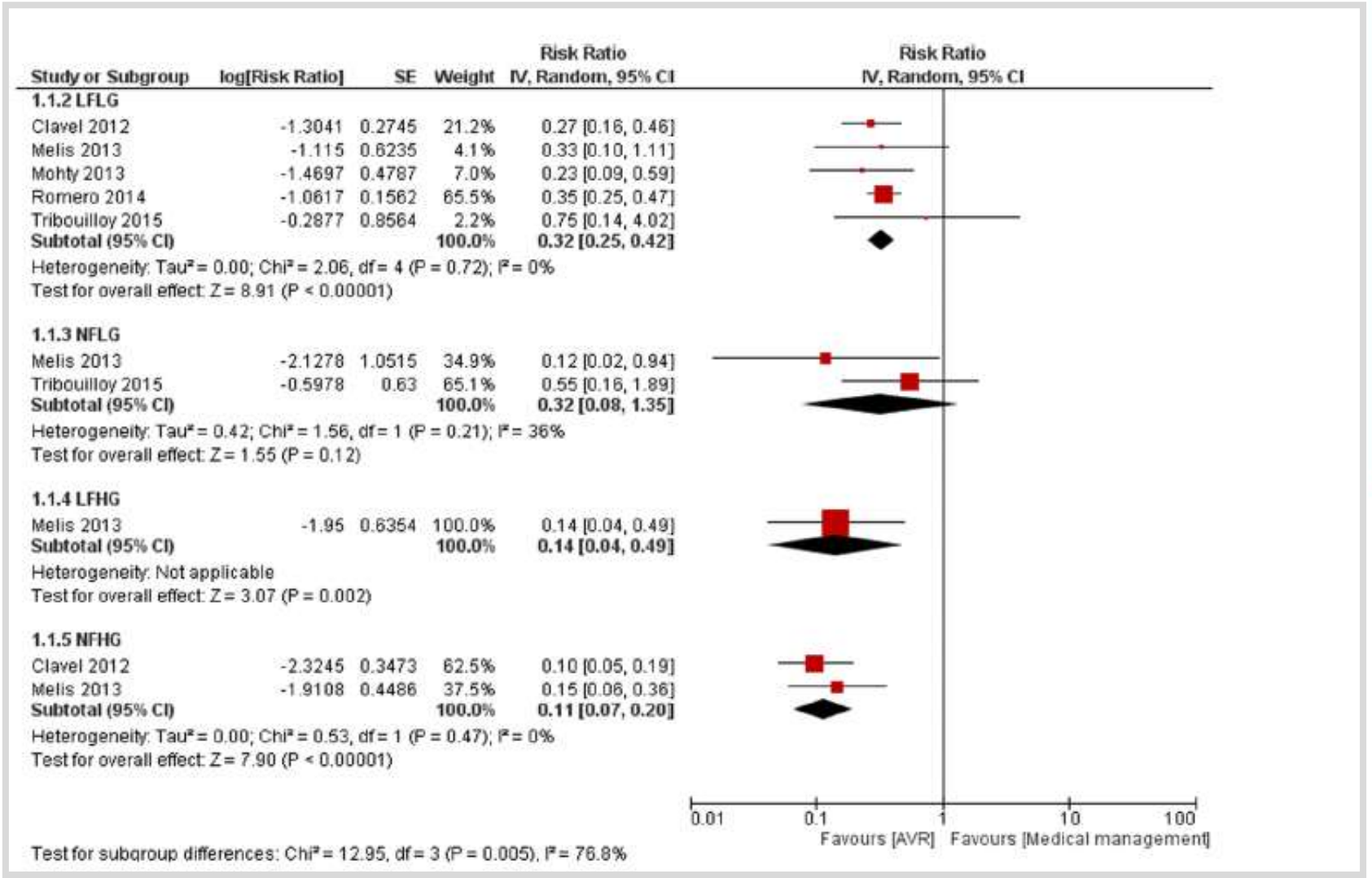

Study or Subgroup	log[Risk Ratio]	SE	Weight	Risk Ratio IV, Random, 95% CI
1.1.2 LFLG				
Clavel 2012	-1.3041	0.2745	21.2%	0.27 [0.16, 0.46]
Melis 2013	-1.115	0.6235	4.1%	0.33 [0.10, 1.11]
Mohty 2013	-1.4697	0.4787	7.0%	0.23 [0.09, 0.59]
Romero 2014	-1.0617	0.1562	65.5%	0.35 [0.25, 0.47]
Tribouilloy 2015	-0.2877	0.8564	2.2%	0.75 [0.14, 4.02]
Subtotal (95% CI)			**100.0%**	**0.32 [0.25, 0.42]**
Heterogeneity: Tau² = 0.00; Chi² = 2.06, df = 4 (P = 0.72); I² = 0%				
Test for overall effect: Z = 8.91 (P < 0.00001)				
1.1.3 NFLG				
Melis 2013	-2.1278	1.0515	34.9%	0.12 [0.02, 0.94]
Tribouilloy 2015	-0.5978	0.63	65.1%	0.55 [0.16, 1.89]
Subtotal (95% CI)			**100.0%**	**0.32 [0.08, 1.35]**
Heterogeneity: Tau² = 0.42; Chi² = 1.56, df = 1 (P = 0.21); I² = 36%				
Test for overall effect: Z = 1.55 (P = 0.12)				
1.1.4 LFHG				
Melis 2013	-1.95	0.6354	100.0%	0.14 [0.04, 0.49]
Subtotal (95% CI)			**100.0%**	**0.14 [0.04, 0.49]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 3.07 (P = 0.002)				
1.1.5 NFHG				
Clavel 2012	-2.3245	0.3473	62.5%	0.10 [0.05, 0.19]
Melis 2013	-1.9108	0.4486	37.5%	0.15 [0.06, 0.36]
Subtotal (95% CI)			**100.0%**	**0.11 [0.07, 0.20]**
Heterogeneity: Tau² = 0.00; Chi² = 0.53, df = 1 (P = 0.47); I² = 0%				
Test for overall effect: Z = 7.90 (P < 0.00001)				
Test for subgroup differences: Chi² = 12.95, df = 3 (P = 0.005), I² = 76.8%				

Scientific Reports Nature 2017

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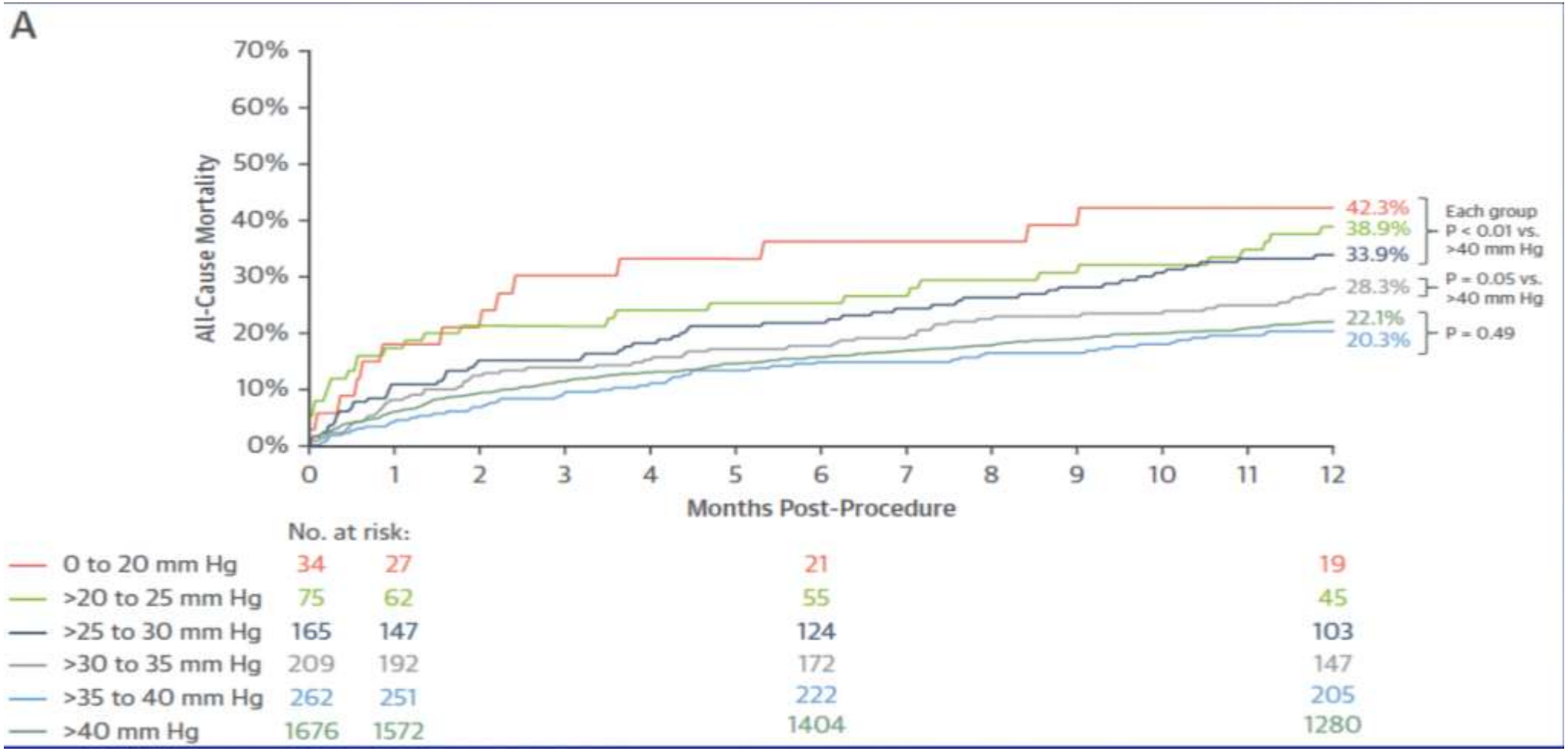
Clinical Outcomes in High-Gradient, Classical Low-Flow, Low-Gradient, and Paradoxical Low-Flow, Low-Gradient Aortic Stenosis After Transcatheter Aortic Valve Implantation: A Report From the SwissTAVI Registry

Max Wagener, MD; Oliver Reuthebuch, MD; Dik Heg, PhD; David Tüller, MD; Enrico Ferrari, MD; Jürg Grünenfelder, MD; Christoph Huber, MD; Igal Moarof, MD; Olivier Muller, MD, PhD; Fabian Nietlispach, MD, PhD; Stéphane Noble, MD; Marco Roffi, MD; Maurizio Taramasso, MD; Christian Templin, MD, PhD; Stefan Toggweiler, MD; Peter Wenaweser, MD; Stephan Windecker, MD; Stefan Stortecky, MD, MPH; Raban Jeger, MD

	High gradient	C-LFLG	P-LFLG	C-LFLG vs HG		P-LFLG vs HG		P- vs C-LFLG	
	N=5094	N=1356	N=2464	Adjusted HR (95% CI)	Adjusted *P* value	Adjusted HR (95% CI)	Adjusted *P* value	Adjusted HR (95% CI)	Adjusted *P* value
At 1 y									
Mortality	438 (8.8)	261 (19.8)	276 (11.5)	1.93 (1.64–2.26)	<0.001	1.35 (1.16–1.56)	<0.001	0.70 (0.59–0.83)	<0.001
Cardiovascular death	285 (5.8)	188 (14.6)	180 (7.6)	2.11 (1.74–2.55)	<0.001	1.34 (1.12–1.62)	0.002	0.64 (0.52–0.79)	<0.001
Myocardial infarction	57 (1.2)	11 (0.9)	24 (1.1)	0.69 (0.36–1.34)	0.275	0.88 (0.55–1.42)	0.613	1.28 (0.62–2.64)	0.512
Spontaneous myocardial infarction	32 (0.7)	7 (0.6)	17 (0.8)	0.75 (0.33–1.74)	0.507	1.14 (0.63–2.05)	0.669	1.51 (0.61–3.71)	0.371
Cerebrovascular accident	226 (4.6)	62 (4.9)	140 (6.0)	1.02 (0.76–1.35)	0.917	1.28 (1.04–1.58)	0.021	1.26 (0.93–1.72)	0.135
Disabling stroke	135 (2.7)	29 (2.3)	66 (2.8)	0.78 (0.52–1.18)	0.237	1.01 (0.75–1.35)	0.962	1.29 (0.83–2.02)	0.263
Nondisabling stroke	73 (1.5)	22 (1.7)	56 (2.4)	1.14 (0.70–1.86)	0.597	1.59 (1.12–2.25)	0.009	1.39 (0.84–2.31)	0.200
Bleeding	975 (19.3)	264 (20.0)	487 (20.1)	1.02 (0.89–1.17)	0.800	1.02 (0.91–1.14)	0.719	1.00 (0.86–1.17)	0.980
Life-threatening bleeding	313 (6.2)	92 (7.1)	149 (6.2)	1.09 (0.86–1.38)	0.482	0.97 (0.80–1.18)	0.766	0.89 (0.68–1.16)	0.397
Major bleeding	429 (8.5)	105 (7.9)	212 (8.7)	0.94 (0.76–1.17)	0.603	1.00 (0.85–1.18)	0.968	1.06 (0.84–1.35)	0.616
Minor bleeding	281 (5.6)	80 (6.1)	145 (6.0)	1.07 (0.82–1.38)	0.627	1.07 (0.88–1.31)	0.480	1.01 (0.76–1.34)	0.951
Pacemaker implantation	890 (17.8)	264 (20.0)	422 (17.4)	1.03 (0.89–1.18)	0.727	0.98 (0.88–1.10)	0.783	0.96 (0.82–1.12)	0.606

Adjusted for age, sex, and STS-PROM number of first event (%). Administrative censoring was performed at 30 days and 1 year of follow-up. adj. adjusted; HG indicates high gradient; C-LFLG, classical low-flow, low-gradient; P-LFLG, paradoxical low-flow, low-gradient; and STS-PROM, Society of Thoracic Surgeons Predicted Risk of Mortality.

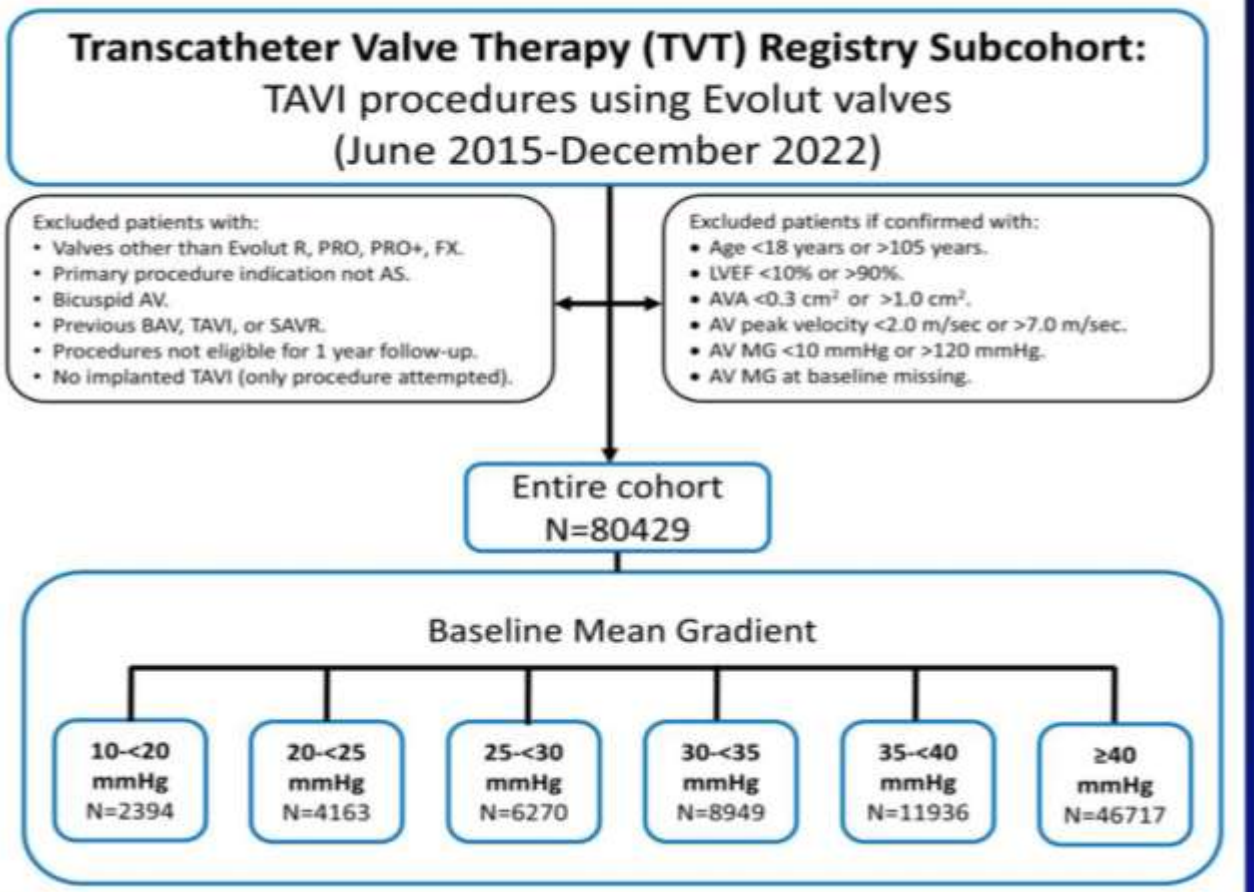
RESULTADOS según Gradiente



Chetcuti *et al.* JACC Cardiovasc Imaging. 2019;12(1):67-80.

RESULTADOS TAVI

Patient flow

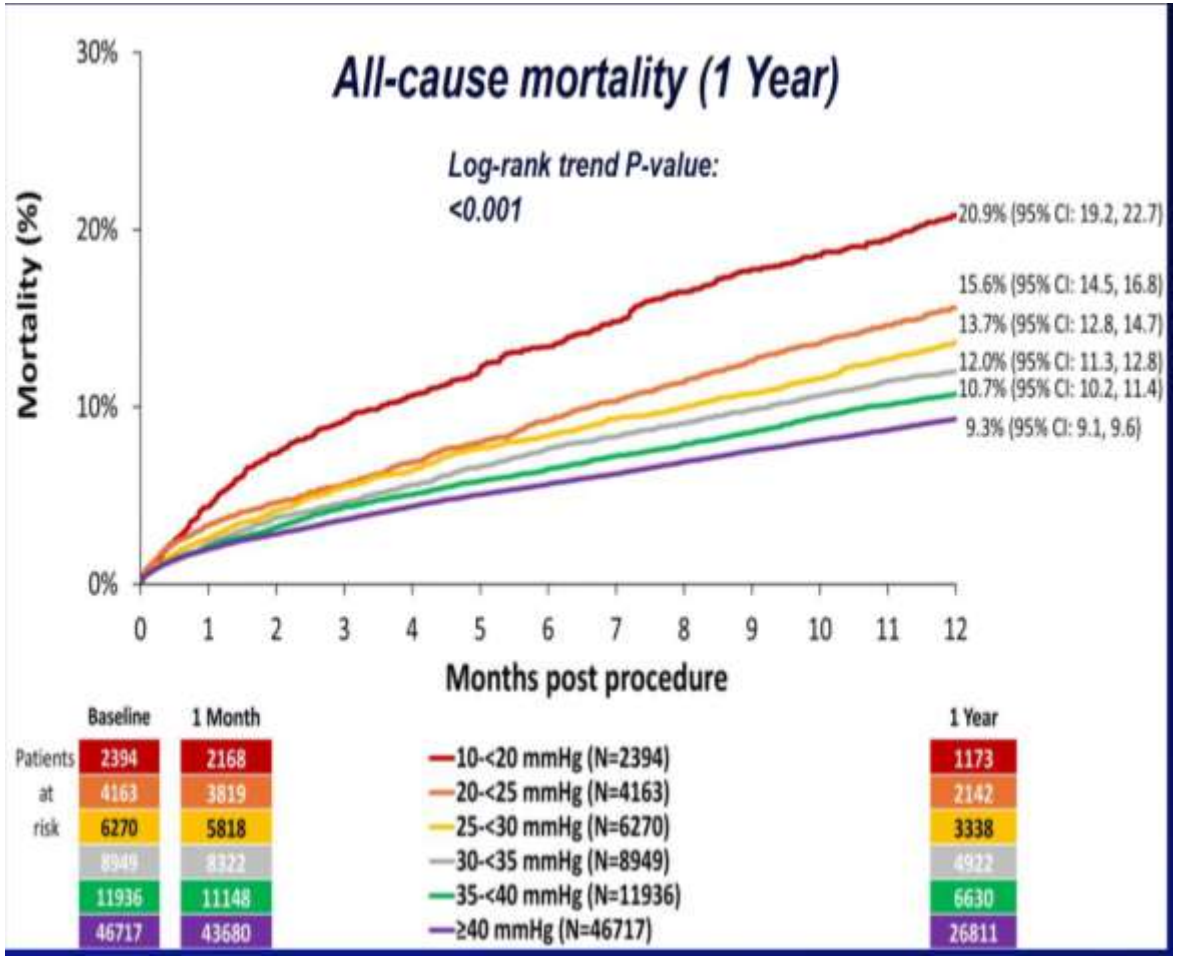


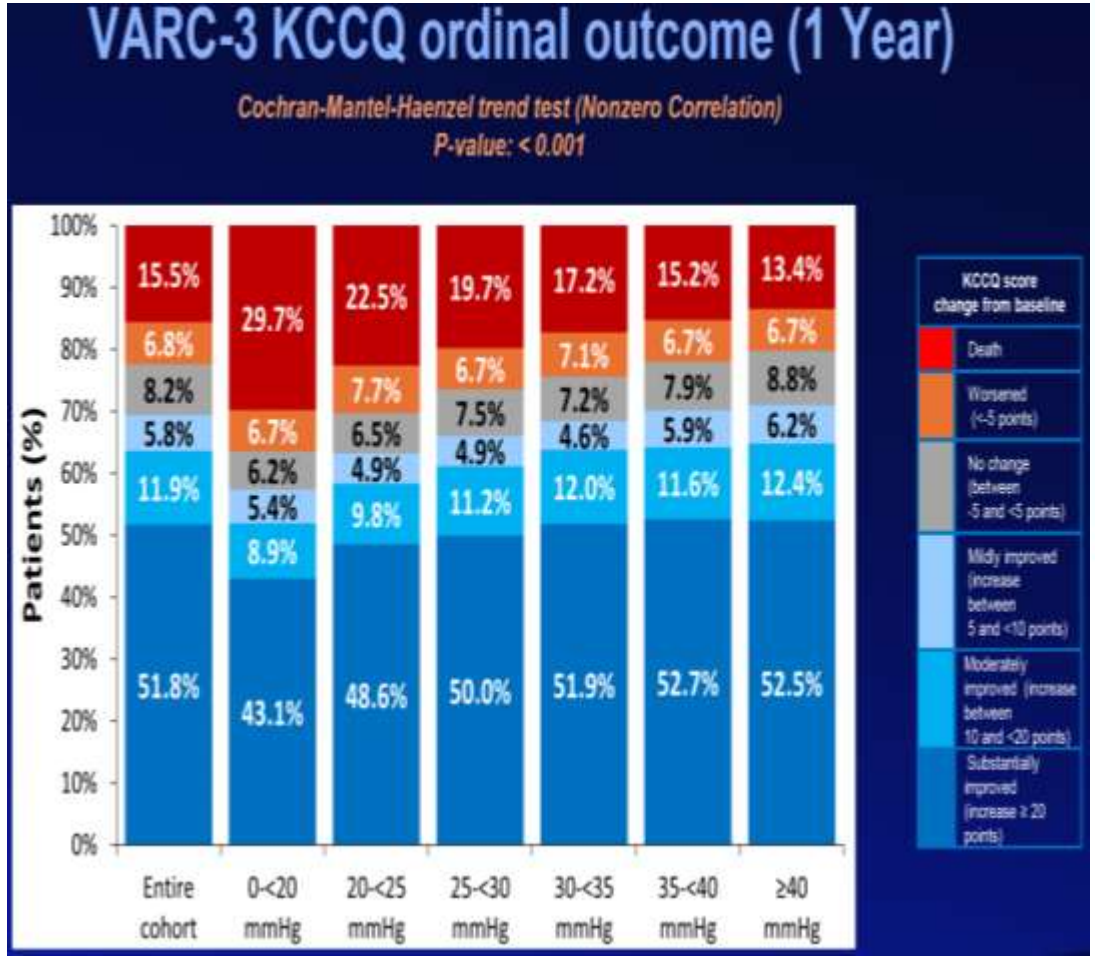
Baseline characteristics

Mean or %	Entire cohort (80429)	10-<20 mmHg (2394)	20-<25 mmHg (4163)
Age (years)	80.7	82.1	81.7
Female	53.9%	49.0%	48.5%
STS-PROM Score (%)	5.1	6.9	6.2
NYHA Class III/IV	67.1%	76.5%	74.1%
LVEF (%)	57.2	46.0	50.5
AVA (cm^2)	0.70	0.77	0.76
AV MG (mmHg)	42.3	16.3	22.2

Czarny, M. "TAVI outcomes for severe aortic stenosis according to baseline resting gradient." EuroPCR 2025.
"Evolut" is a trademark of Medtronic

RESULTADOS TAVI

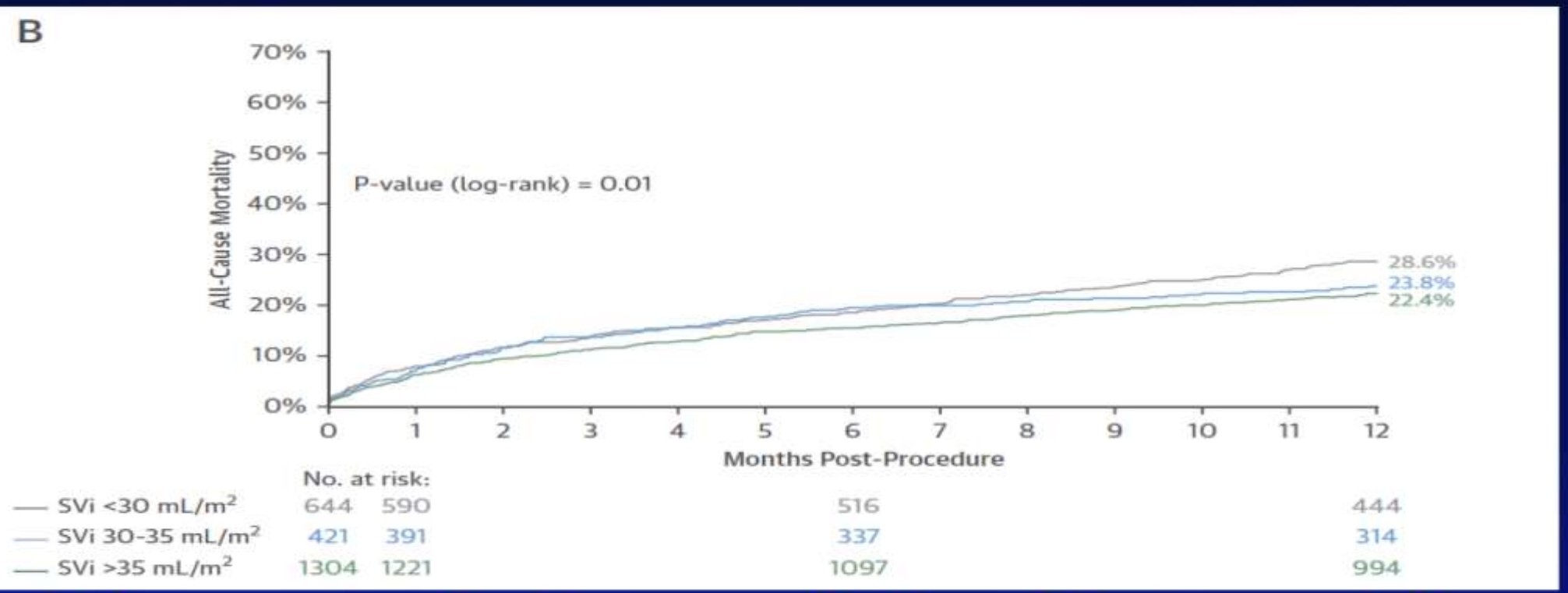




Czarny, M. "TAVI outcomes for severe aortic stenosis according to baseline resting gradient." EuroPCR 2025.
"Evolut" is a trademark of Medtronic

RESULTADOS TAVI

Does Flow Matter?



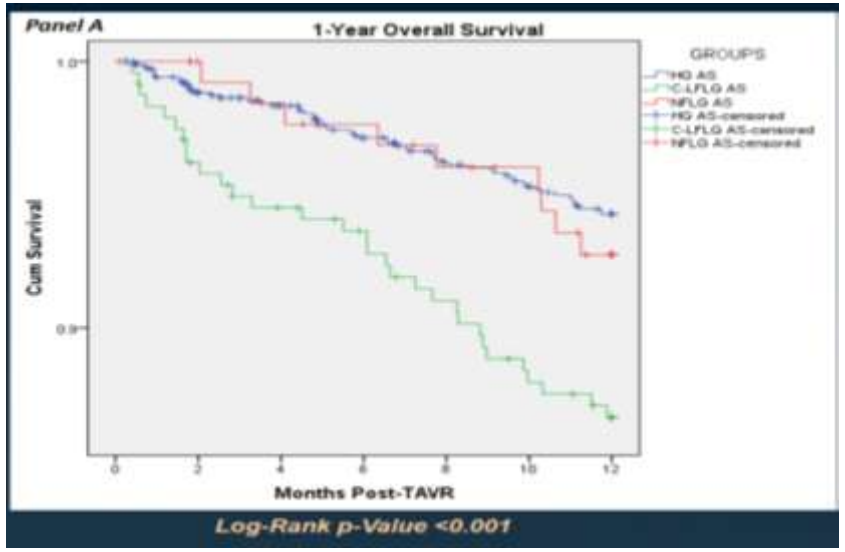
Only mean gradient was predictive of 1 year mortality

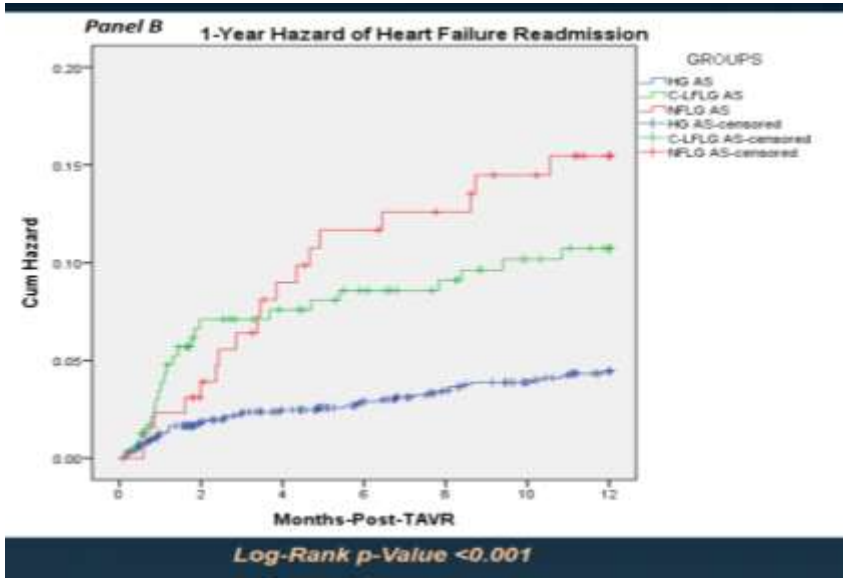
Chetcuti *et al.* JACC Cardiovasc Imaging. 2019;12(1):67-80.

RESULTADOS TAVI

1 Year Outcomes	Group	Adjusted HR	95% CI	p-value
Primary Outcomes				
Overall Mortality	C-LFLG vs HG	***1.69***	1.06-2.70	***0.029***
	NFLG vs HG	1.01	0.49-2.06	0.984
Heart Failure Hospitalization	C-LFLG vs HG	***2.08***	1.22-3.56	***0.007***
	NFLG vs HG	***3.28***	1.86-5.77	***<0.001***
Secondary Outcomes				
Stroke	C-LFLG vs HG	1.20	0.38-3.77	0.759
	NFLG vs HG	1.55	0.44-5.41	0.495
Acute Myocardial Infarction	C-LFLG vs HG	1.04	0.25-4.36	0.959
	NFLG vs HG	0.69	0.08-5.89	0.737
Bleeding	C-LFLG vs HG	1.31	0.73-2.34	0.366
	NFLG vs HG	1.68	0.87-3.27	0.124
Adjusted for age, sex, and STS Risk Score.				

HG AoS (1044) / cLFLG AoS (230) / NFLG AoS (132)





ALGORITMO MANEJO EAO BF-BG

EAo BF-BG clásica
FEVI<50% + VSi <35 ml/m²

TRAS CONFIRMAR SEVERIDAD REAL

Reserva contráctil ≥20% → TAVI

Sin reserva contráctil <20% → HEART TEAM TAVI / BAV puente a TAVI

EAo BF-BG paradójica
FEVI>50% + VSi <35 ml/m²

TRAS CONFIRMAR SEVERIDAD REAL → HEART TEAM TAVI /BAV puente a TAVI

EAo flujo N-BG paradójica
FEVI>50% + VSi >35 ml/m²

→ SEGUIMIENTO CERCANO
Mismo manejo que en EAO moderada

INDICACIONES DE TRATAMIENTO

EAo BF-BG clásica
FEVI<50% + VSi <35 ml/m²

Intervention is recommended in symptomatic patients with low-flow (SVi ≤35 mL/m^2), low-gradient (<40 mmHg) AS with reduced LVEF (<50%) after careful confirmation that AS is severe.[342,345,346,348,475]	I	B

EAo BF-BG paradójica
FEVI>50% + VSi <35 ml/m²

Intervention should be considered in symptomatic patients with low-flow (SVi ≤35 mL/m^2), low-gradient (<40 mmHg) AS with normal LVEF (≥50%) after careful confirmation that AS is severe.[c] [293,348,349,476–481]	IIa	B

EAo flujo N-BG paradójica
FEVI>50% + VSi >35 ml/m²

- Prognosis of these patients is similar to that of moderate AS
- Surveillance is recommended