

«Paradoxical» low-flow, low-gradient AS with preserved LV function: *A Silent Killer*

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ET DE PNEUMOLOGIE
DE QUÉBEC



**Université
LAVAL**

Disclosure:

None except that...

Gilbert Habib is a very good friend!

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This is a very hot topic!







*There's No Smoke
without Fire*





Burning Questions about Paradoxical Low-Flow, Low-Gradient AS:

- **Does it exist?**
- **Does it have impact on survival?**
- **Does AVR help?**

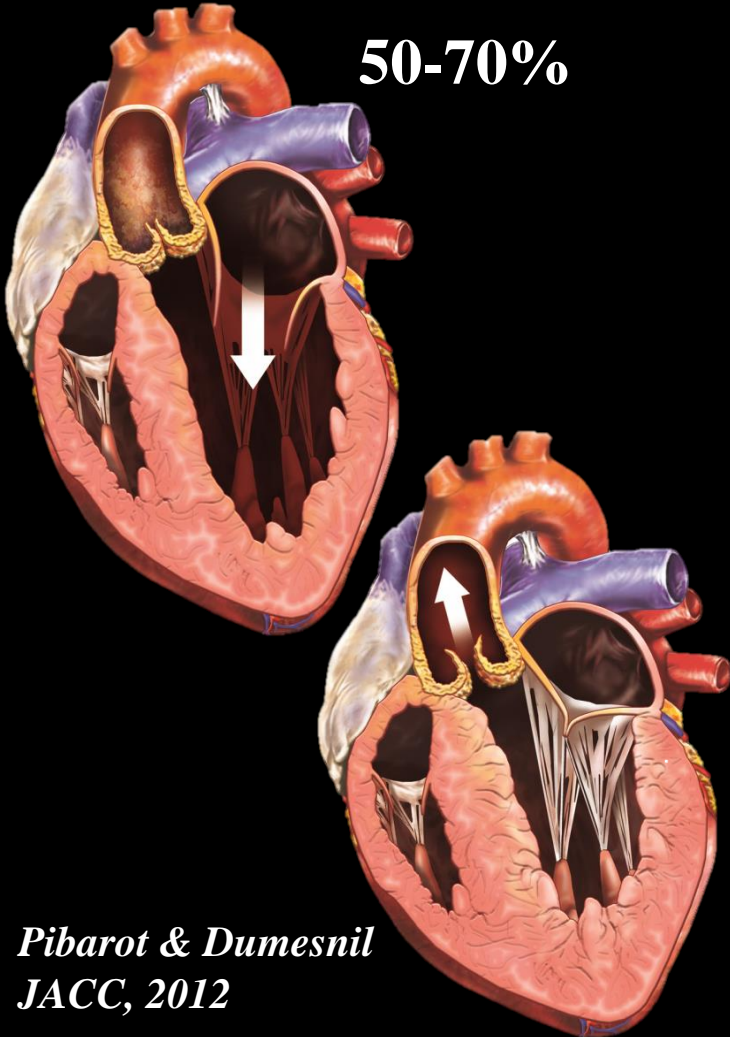


*Paradoxical Low-Flow,
Low-Gradient AS:
Does it exist?*

Two Different Patterns of Low-Flow, Low-Gradient AS

**NORMAL-LVEF
NORMAL-FLOW
HIGH-GRADIENT**

50-70%



**NORMAL-LVEF
«PARADOXICAL»
LOW-FLOW
LOW-GRADIENT**

10-15%



**LOW-LVEF
«CLASSICAL»
LOW-FLOW
LOW-GRADIENT**

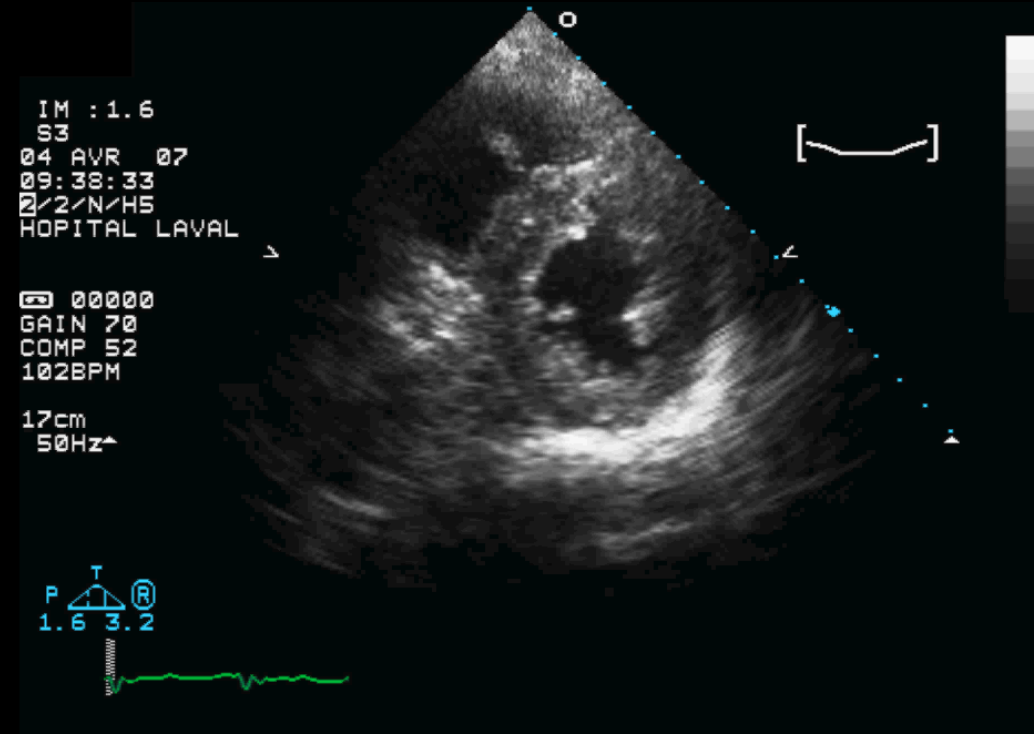
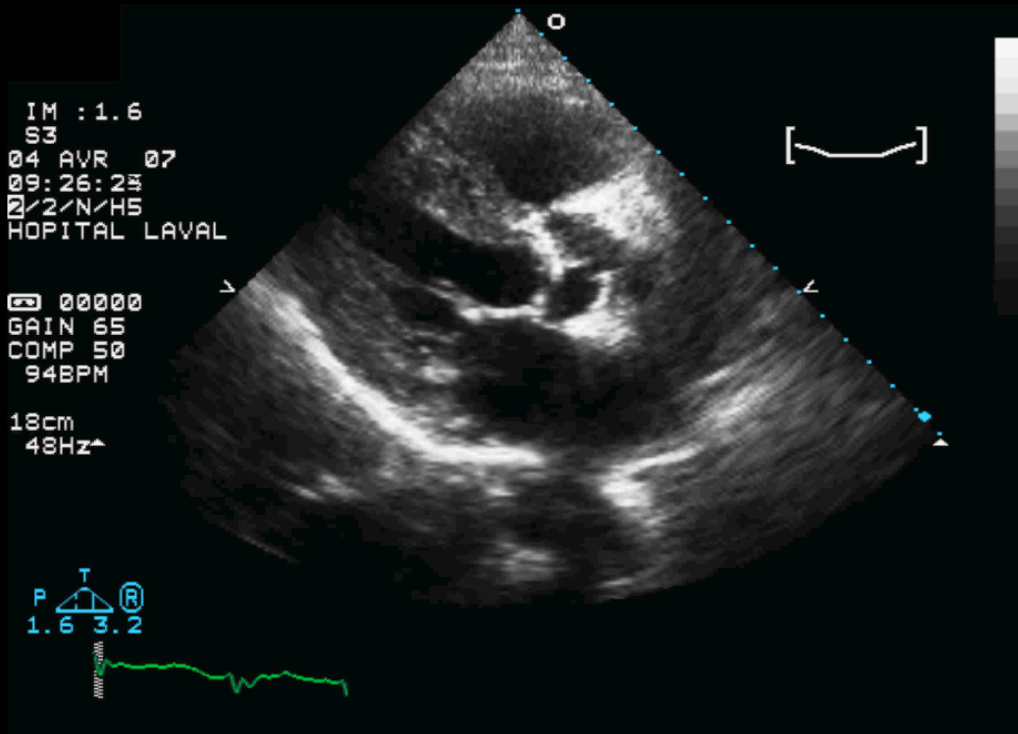
5-10%



Case Study

- **78 y.o. female with history of calcific AS**
- **NYHA class III**
- **Mild hypertension**
- **No evidence of obstructive CAD**
- **LVEF: 60%**
- **AS severity on echo:**
 - **AVA: 0.7 cm²**
 - **BSA: 1.7 m², indexed AVA: 0.4 cm²/m²**
 - **Peak/mean gradient: 51/29 mmHg**

Case Study: Discrepancy between AVA and Gradient

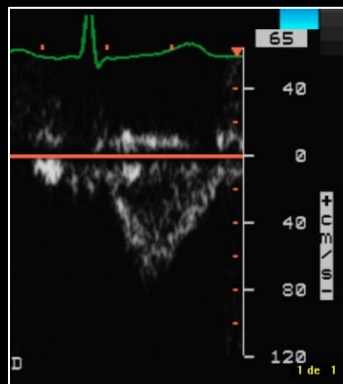


LVEF: 60%

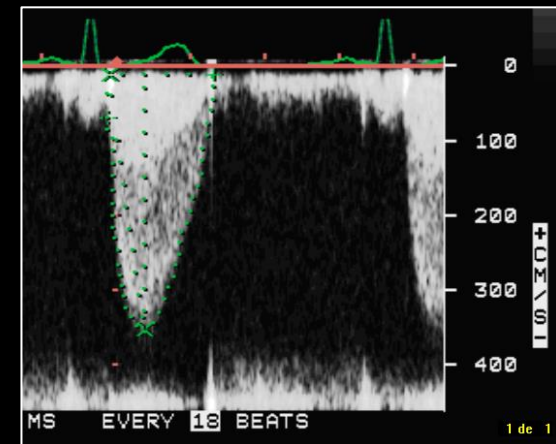
Small LV cavity: LVEDD: 39 mm LVEDV: 79 ml



LVOT-D: 2.0 cm
LVOT-A: 3.1 cm²



LVOT-VTI: 15 cm



Peak ΔP : 51 mmHg
Mean ΔP : 29 mmHg
Ao-VTI: 65 cm



LVOT- SV: 46 mL
(SVi=27 mL/m²)



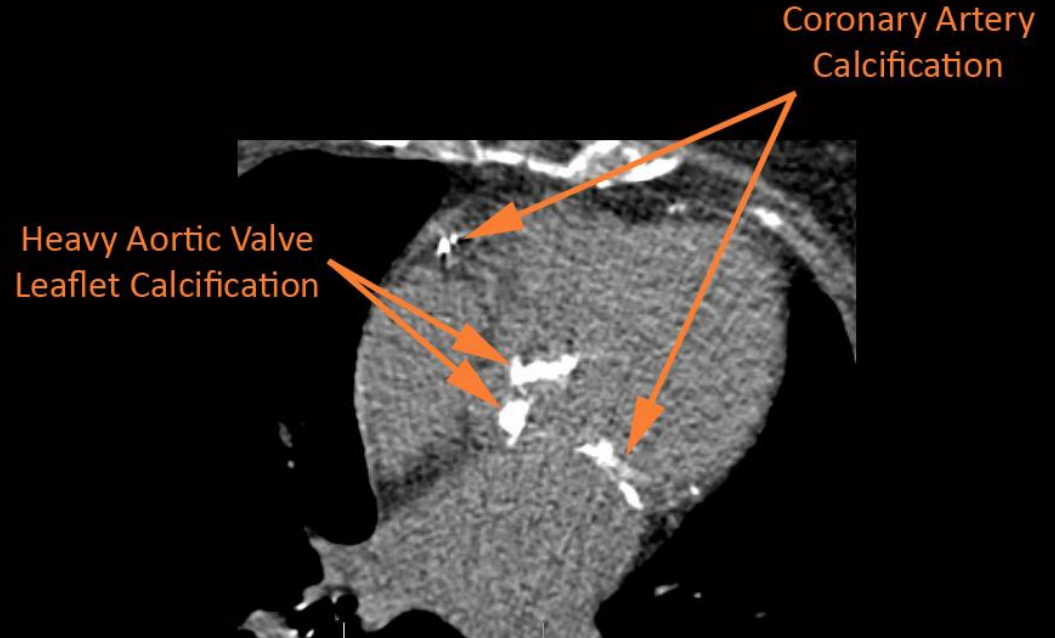
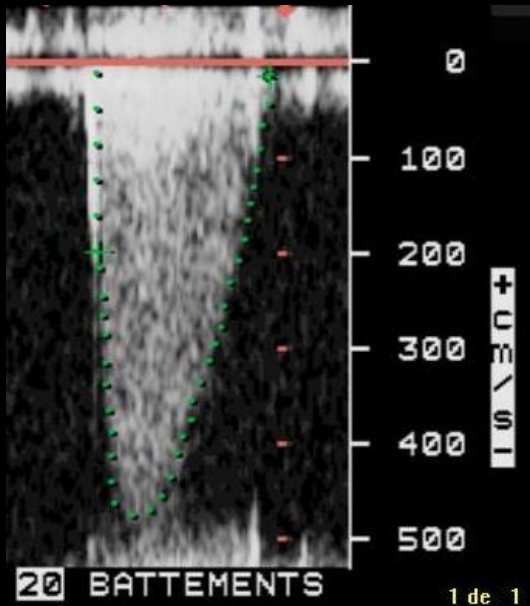
AVA: 0.7 cm²

**2D Volumetric method to corroborate SV measure:
 LVEDV (79 mL) \times LVEF (60%) = 48 mL**

Dobutamine Stress Echocardiography

Multislice CT

15 $\mu\text{g}/\text{kg}/\text{min}$

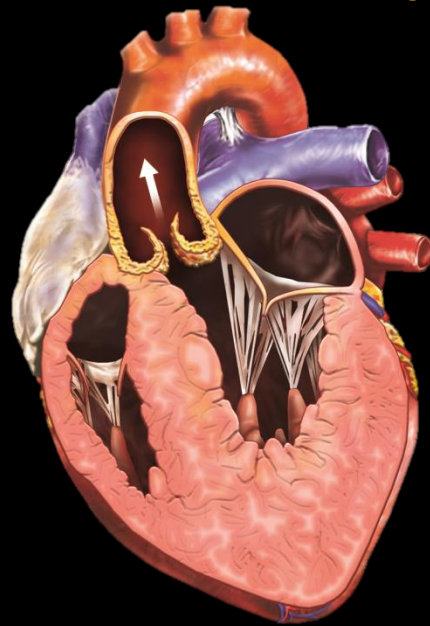
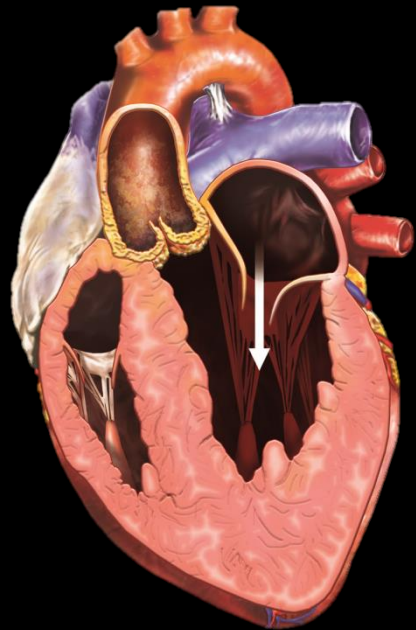


Peak ΔP : 94 mmHg
Mean ΔP : 57 mmHg
AVA: 0.77 cm^2

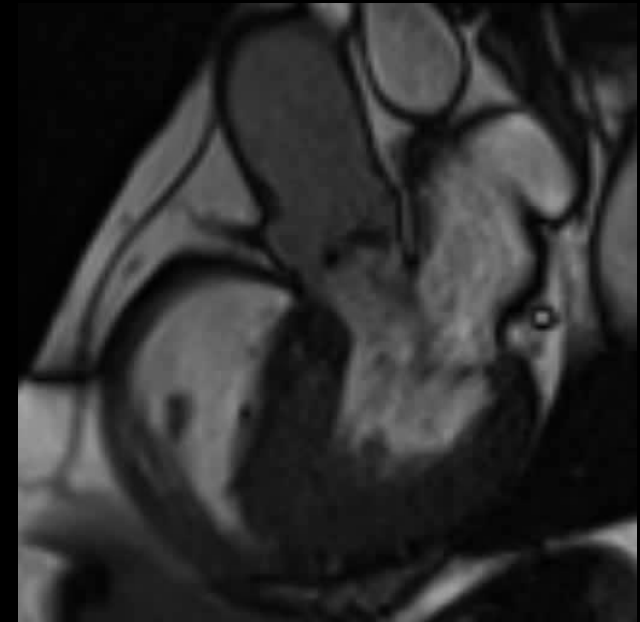
Valve Calcium score: 1900 AU

Paradoxical Low-Flow, Low-Gradient Severe Aortic Stenosis Despite Preserved Ejection Fraction Is Associated With Higher Afterload and Reduced Survival

Zeineb Hachicha, MD; Jean G. Dumesnil, MD; Peter Bogaty, MD; Philippe Pibarot, DVM, PhD

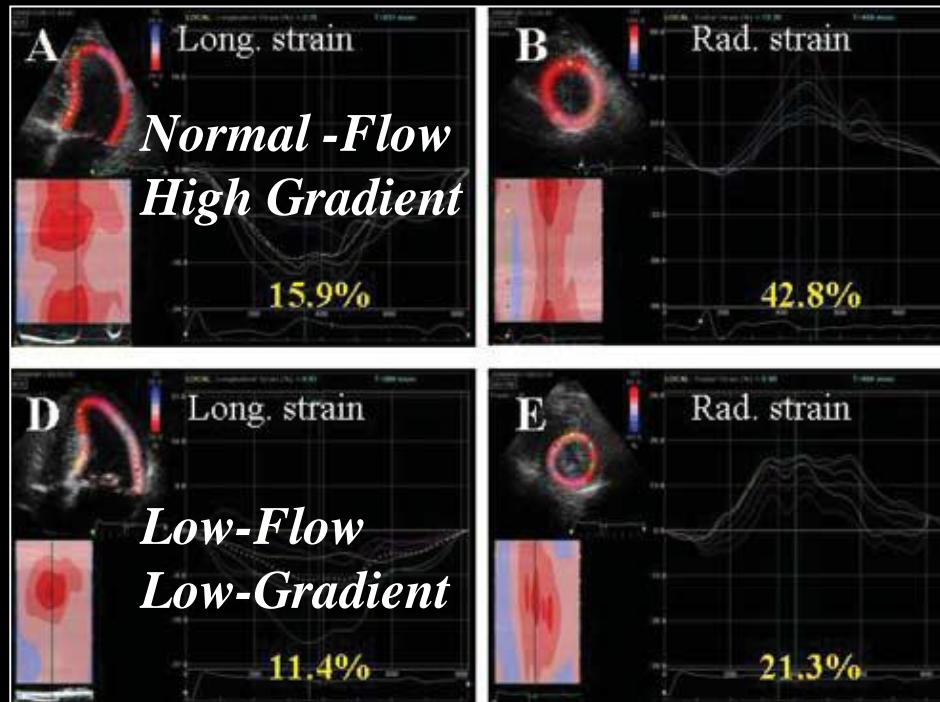


↑Age
Women
Hypertension
MetS - Diabetes

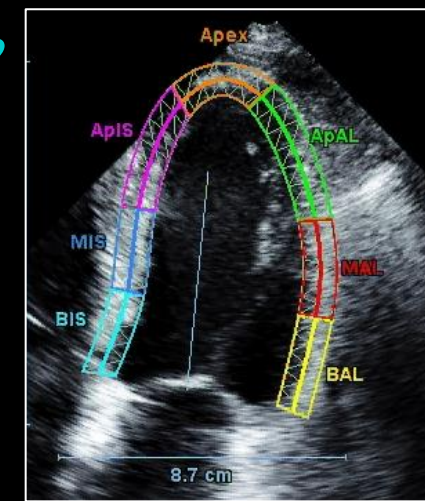


Hachicha Z et al., Circulation, 2007
Dumesnil et al. Eur Heart J, 2009
Pibarot & Dumesnil JACC, in press, 2012

Patients with paradoxical low-flow AS have abnormal myocardial systolic function



Lancellotti et al. Eur J Echo 2010



Deterioration of Myocardial Function in Paradoxical Low-Flow Severe Aortic Stenosis: Two-Dimensional Strain Analysis

Seung-Pyo Lee, MD, Yong-Jin Kim, MD, PhD, Ji-Hyun Kim, MD, Kyungil Park, MD, Kyung-Hee Kim, MD, Hyung-Kwan Kim, MD, PhD, Goo-Yeong Cho, MD, PhD, Dae-Won Sohn, MD, PhD, Byung-Hee Oh, MD, PhD, and Young-Bae Park, MD, PhD, *Seoul and Seongnam, Korea*

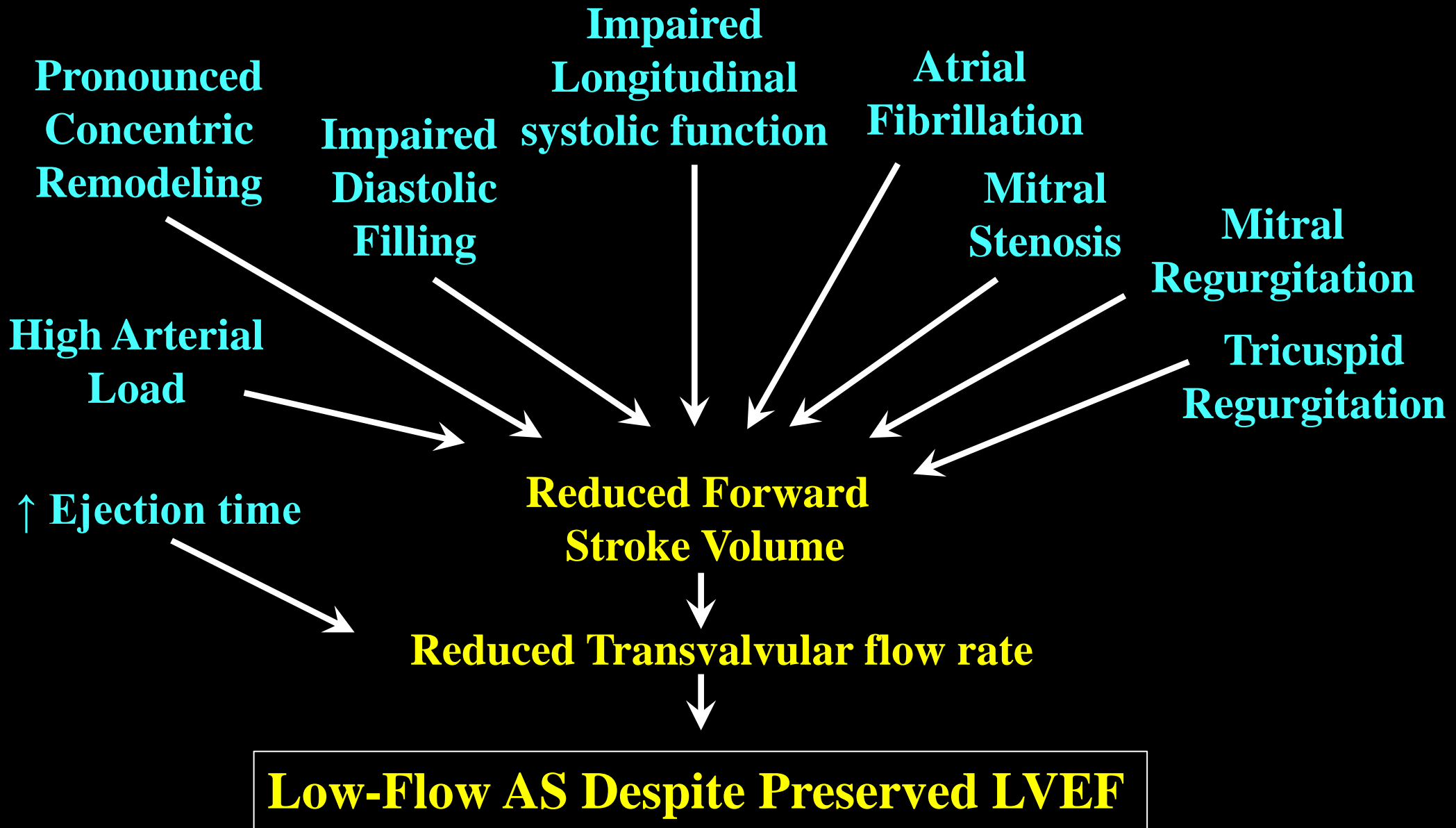
Lee et al. J Am Soc Echocardiogr, 2011

Low-Flow, Low-Gradient Severe Aortic Stenosis Despite Normal Ejection Fraction Is Associated with Severe Left Ventricular Dysfunction as Assessed by Speckle-Tracking Echocardiography: A Multicenter Study

Jérôme Adda, Christopher Mielot, Roch Giorgi, Frédéric Cransac, Xavier Zirphile, Erwan Donal, Catherine Sportouch-Dukhan, Patricia Réant, Stéphane Lafitte, Stéphane Cade, Yvan Le Dolley, Franck Thuny, Nathalie Touboul, Cécile Lavoute, Jean-François Avierinos, Patrizio Lancellotti and Gilbert Habib

Circ Cardiovasc Imaging published online November 22, 2011;

Adda et al. Circulation CV Imaging, 2012



Normal Flow AS

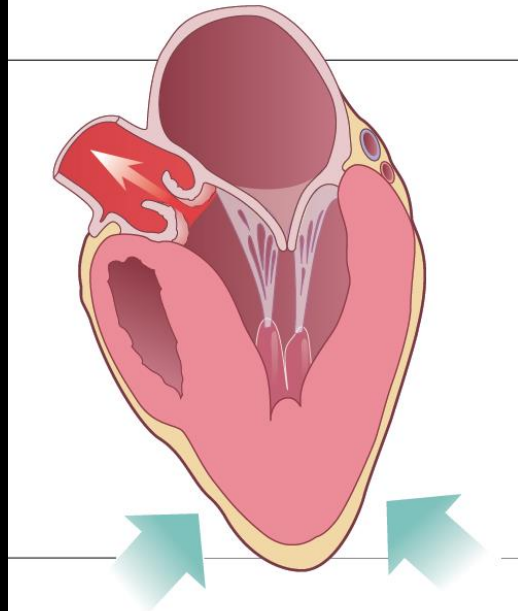
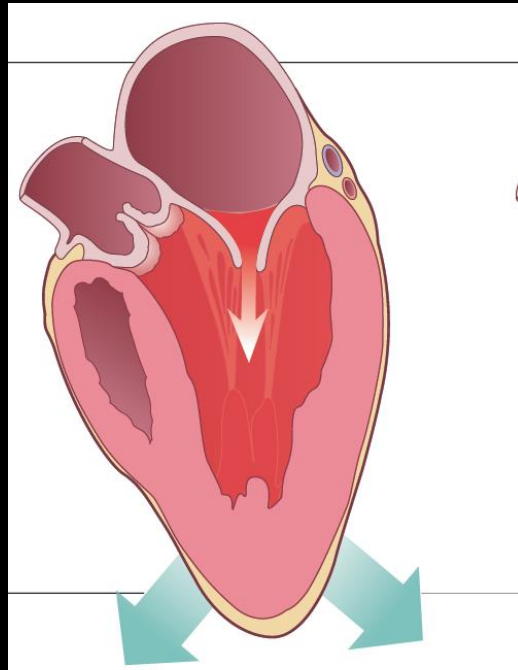
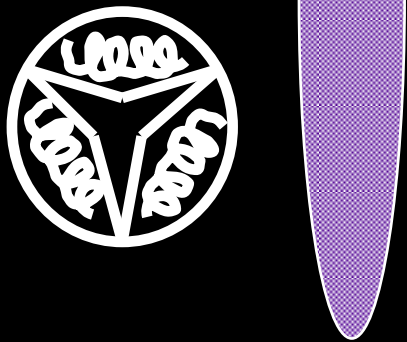
LVEDV:
115 ml

LVEF: 60%

SV: 70 ml

AVA: 0.7 cm²

ΔP : 45 mmHg



Paradoxical Low-Flow AS

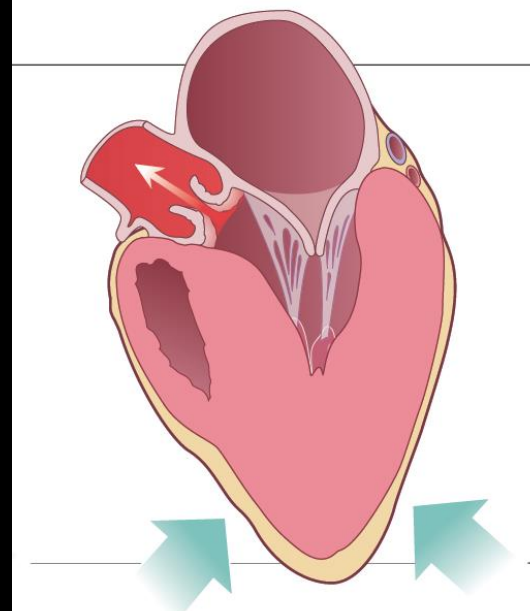
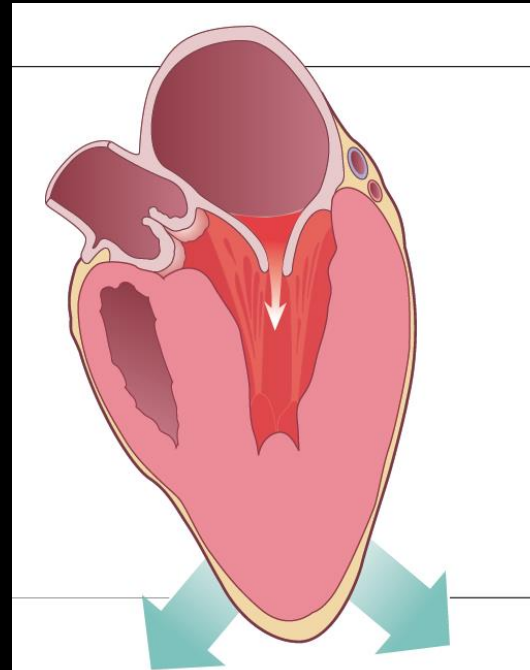
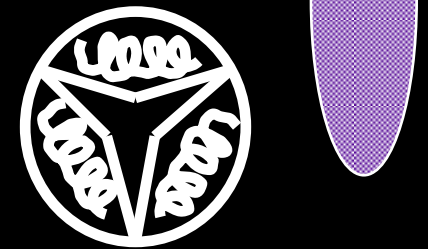
LVEDV:
85 ml

LVEF: 60%

SV: 50 ml

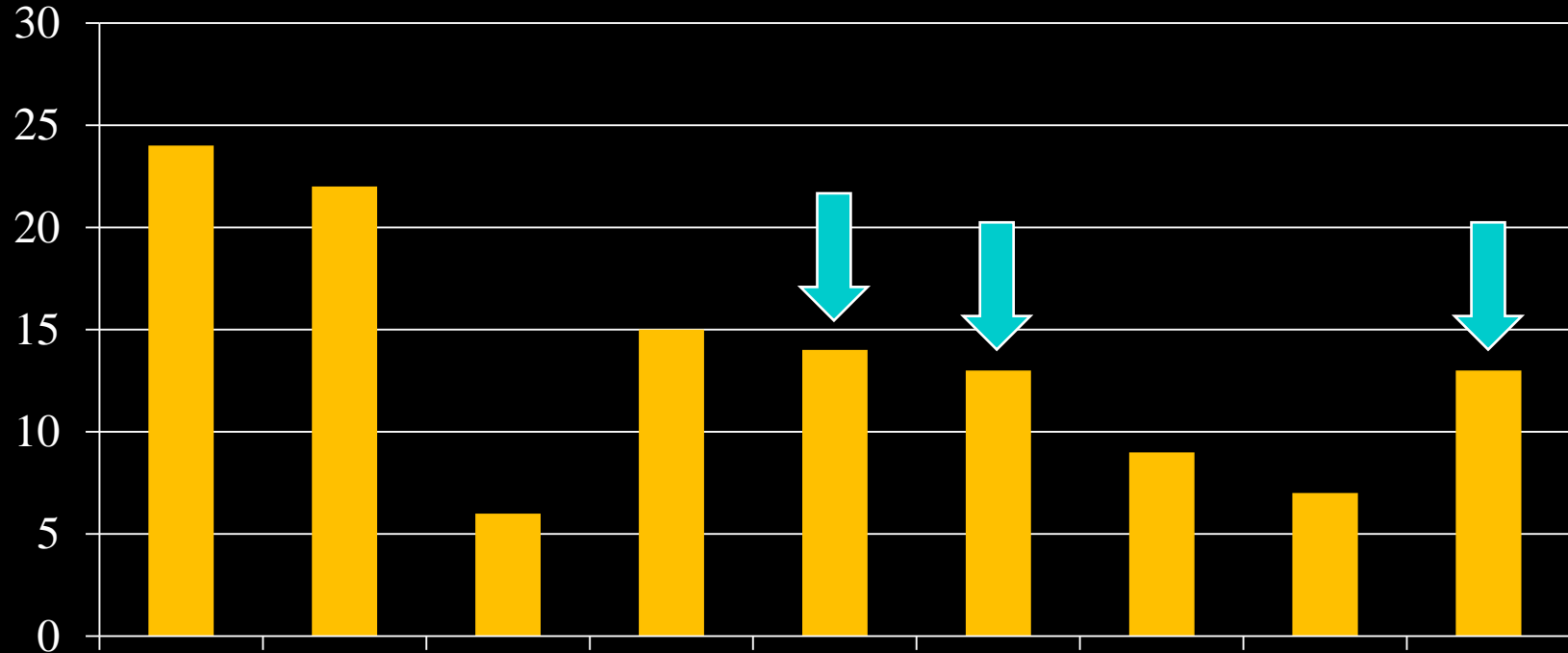
AVA: 0.7 cm²

ΔP : 25 mmHg



Prevalence of Paradoxical Low-Flow, Low-Gradient AS

Prevalence (%)



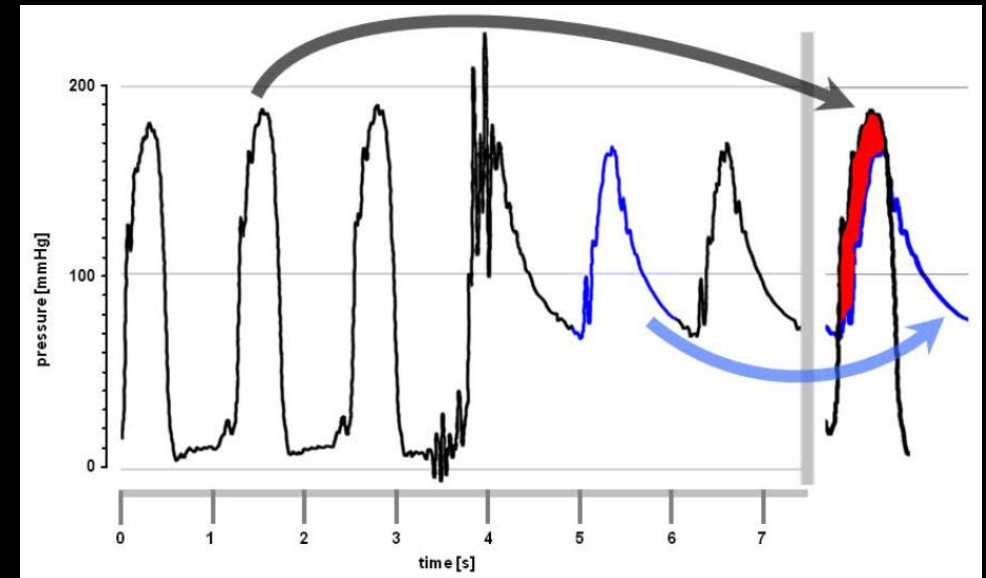
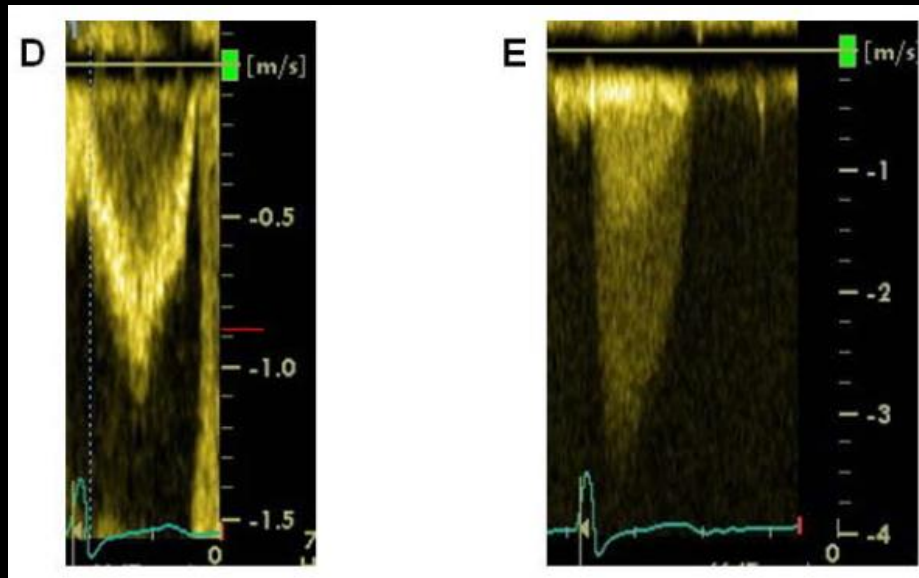
Hachicha 2006 Echo (512 pts)	Barasch 2006 Echo (215 pts)	Cramariuc 2009 Echo (1591 pts)	Minners 2010 Echo (333 pts)	Minners 2010 Cath (333 pts)	Hermann 2011 Echo & Cath (86 pts)	Adda 2011 Echo (150 pts)	Lancellotti 2012 Echo (150 pts)	Mohty 2013 Cath (768 pts)
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Paradoxical Low-Flow, Low-Gradient

AVA < 1.0 cm²; MG < 40 mmHg

LVEF > 50%; SVi < 35 mL/m²

Invasive Hemodynamic Characteristics of Low-Flow, Low-Gradient Severe AS Despite Preserved LVEF



Occurrence of paradoxical low-flow, low-gradient AS was confirmed by invasive hemodynamics and was not the result of a systematic bias in the echo calculation of AVA

Circulation

Cardiovascular Imaging

JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart
Association



Learn and Live

Low-Flow, Low-Gradient Severe Aortic Stenosis Despite Normal Ejection Fraction Is Associated with Severe Left Ventricular Dysfunction as Assessed by Speckle-Tracking Echocardiography: A Multicenter Study

Jérôme Adda, Christopher Mielot, Roch Giorgi, Frédéric Cransac, Xavier Zirphile, Erwan Donal, Catherine Sportouch-Dukhan, Patricia Réant, Stéphane Lafitte, Stéphane Cade, Yvan Le Dolley, Franck Thuny, Nathalie Touboul, Cécile Lavoute, Jean-François Avierinos, Patrizio Lancellotti and Gilbert Habib

Circ Cardiovasc Imaging published online November 22, 2011;

DOI: 10.1161/CIRCIMAGING.111.967554

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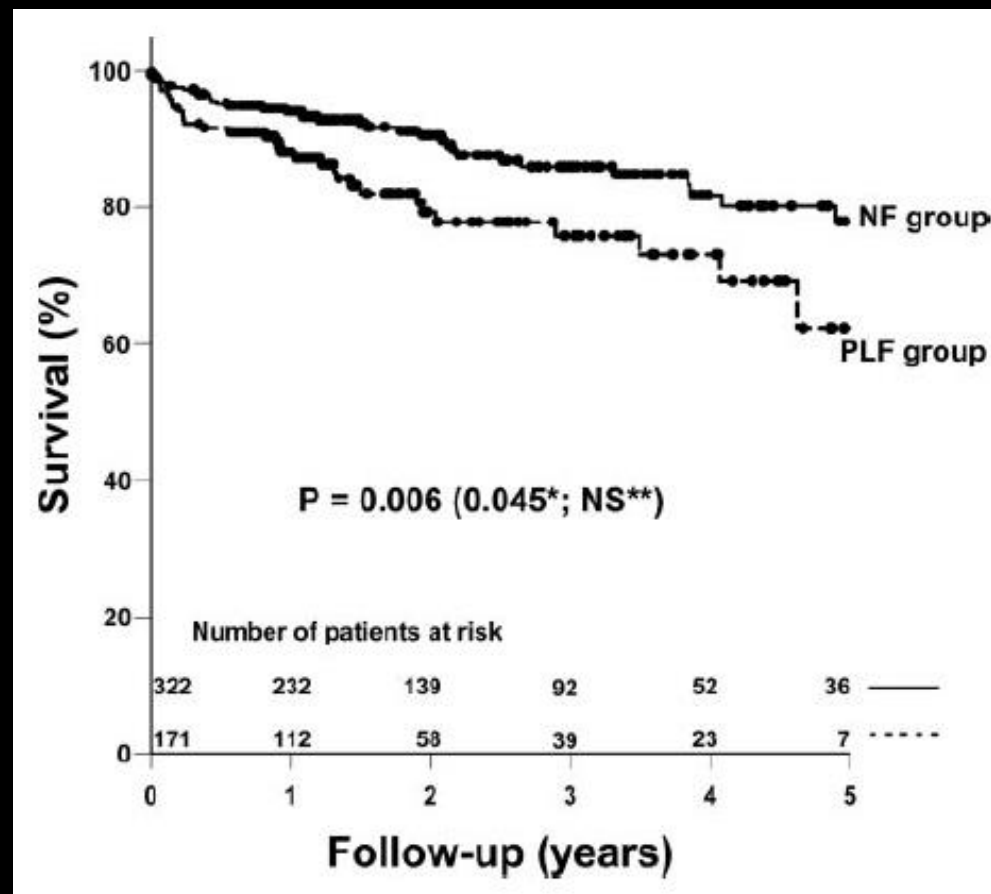
Conclusions—LFLG AS is observed in 9% of patients with severe AS and normal ejection fraction and is associated with high global afterload and reduced longitudinal systolic function. Patients with normal-flow low-gradient AS are more frequent and present with less severe AS, normal afterload, and less severe longitudinal dysfunction. Severe left ventricular longitudinal dysfunction is a new explanation to the concept of LFLG AS. (*Circ Cardiovasc Imaging*. 2012;5:27-35.)



*Paradoxical Low-Flow,
Low-Gradient AS:
Does it have impact on survival?*

Paradoxical Low-Flow, Low-Gradient Severe Aortic Stenosis Despite Preserved Ejection Fraction Is Associated With Higher Afterload and Reduced Survival

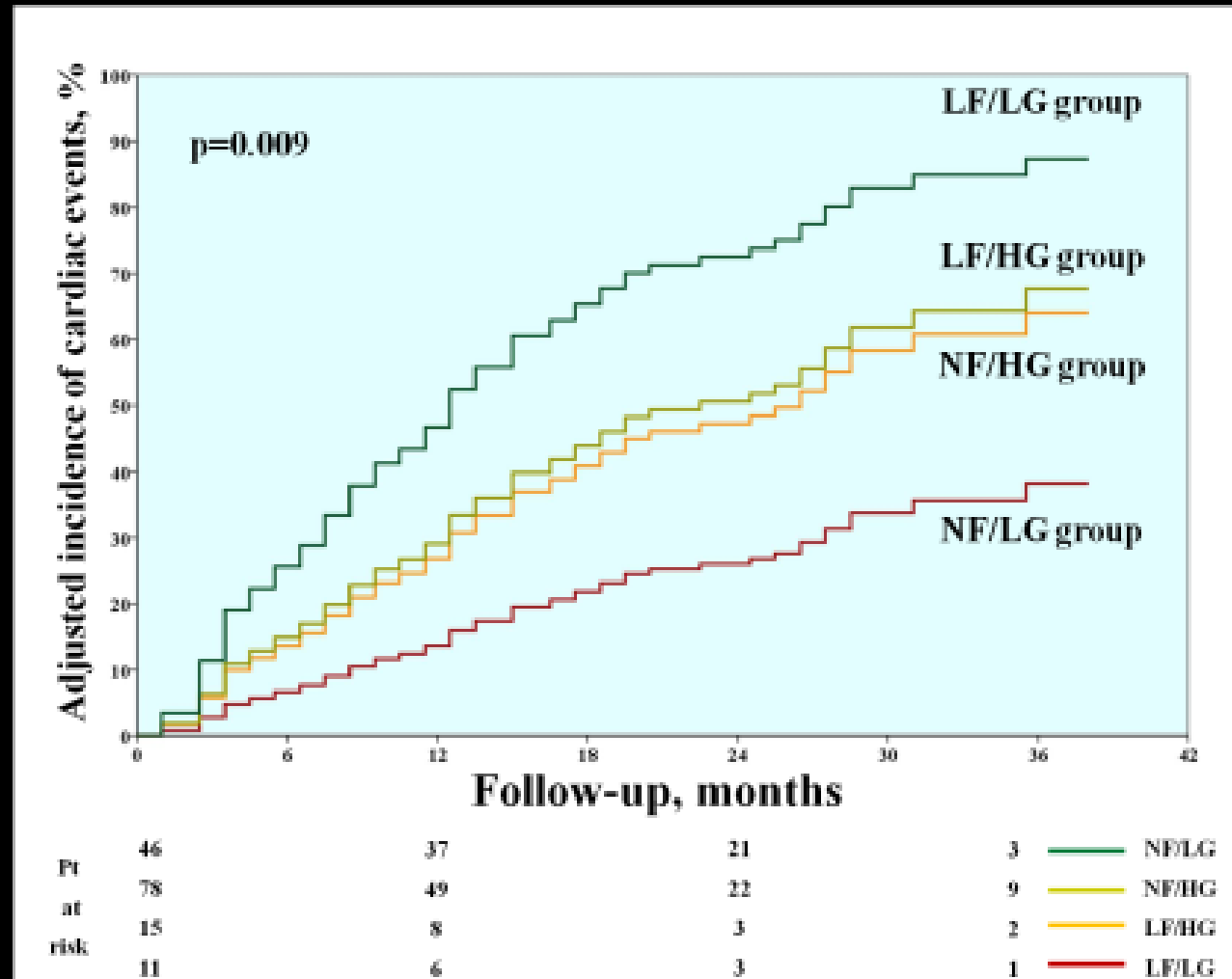
Zeineb Hachicha, MD; Jean G. Dumesnil, MD; Peter Bogaty, MD; Philippe Pibarot, DVM, PhD



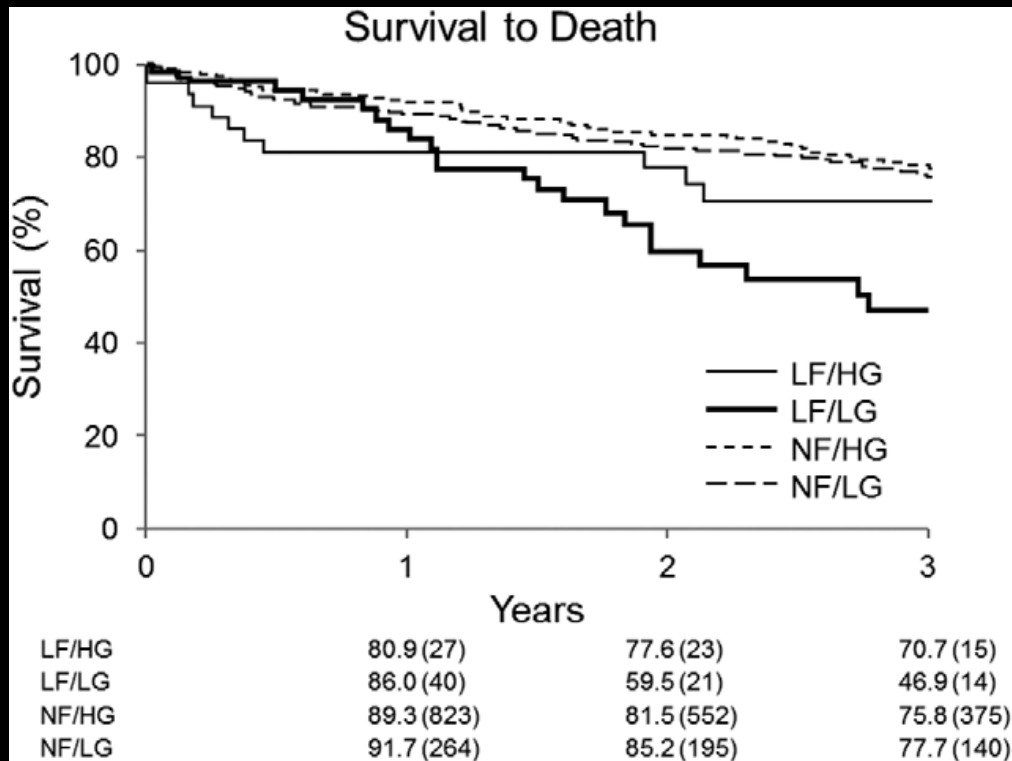
Hachicha Z et al.,
Circulation.
115:2856-2864, 2007

Outcome of Patients with Paradoxical Low-Flow, Low-Gradient AS

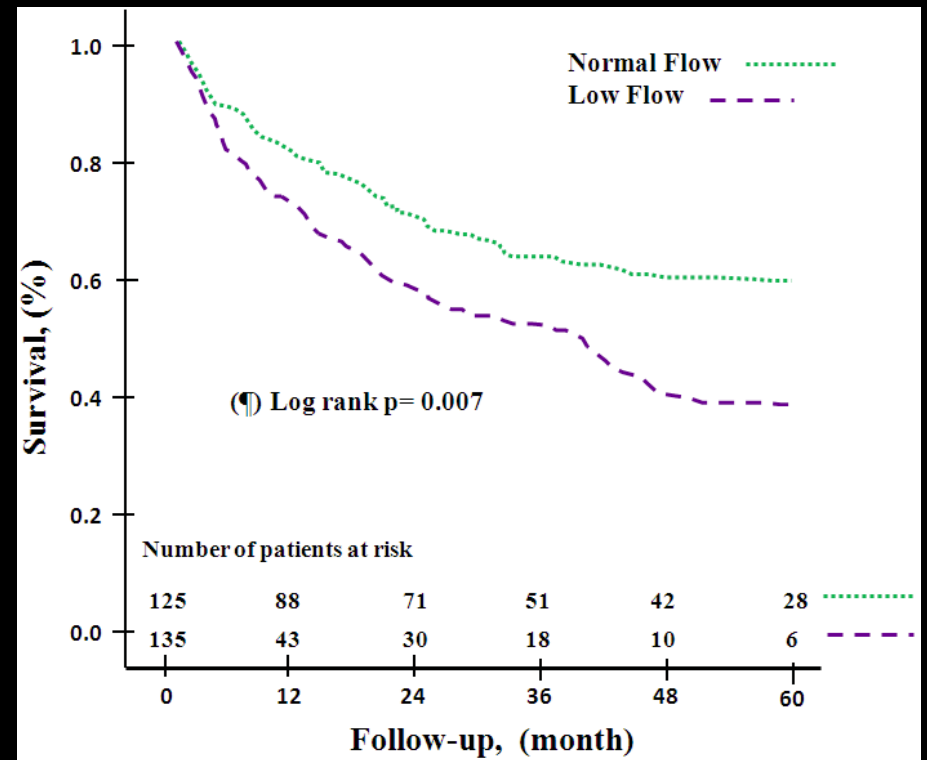
150 Pts with asymptomatic severe (AVA < 1.0 cm²) AS
LVEF > 50%



Outcome of Patients with Paradoxical Low-Flow, Low-Gradient AS

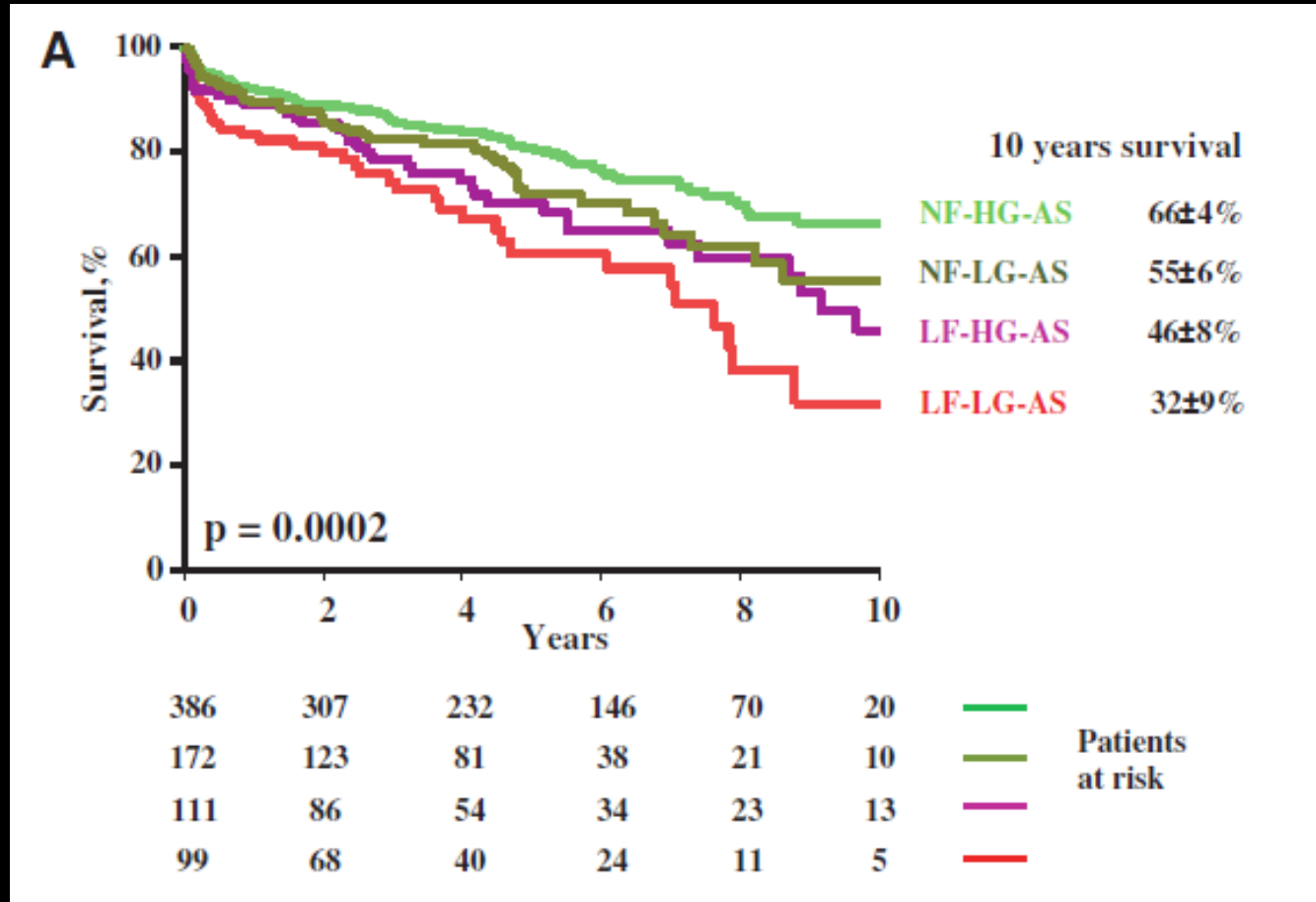


Eleid et al. Circulation 2013



Ozkan Circulation 2013

Outcome in Paradoxical Low-Flow, Low-Gradient Severe Aortic Stenosis and Preserved LVEF A Cardiac Catheterization Study

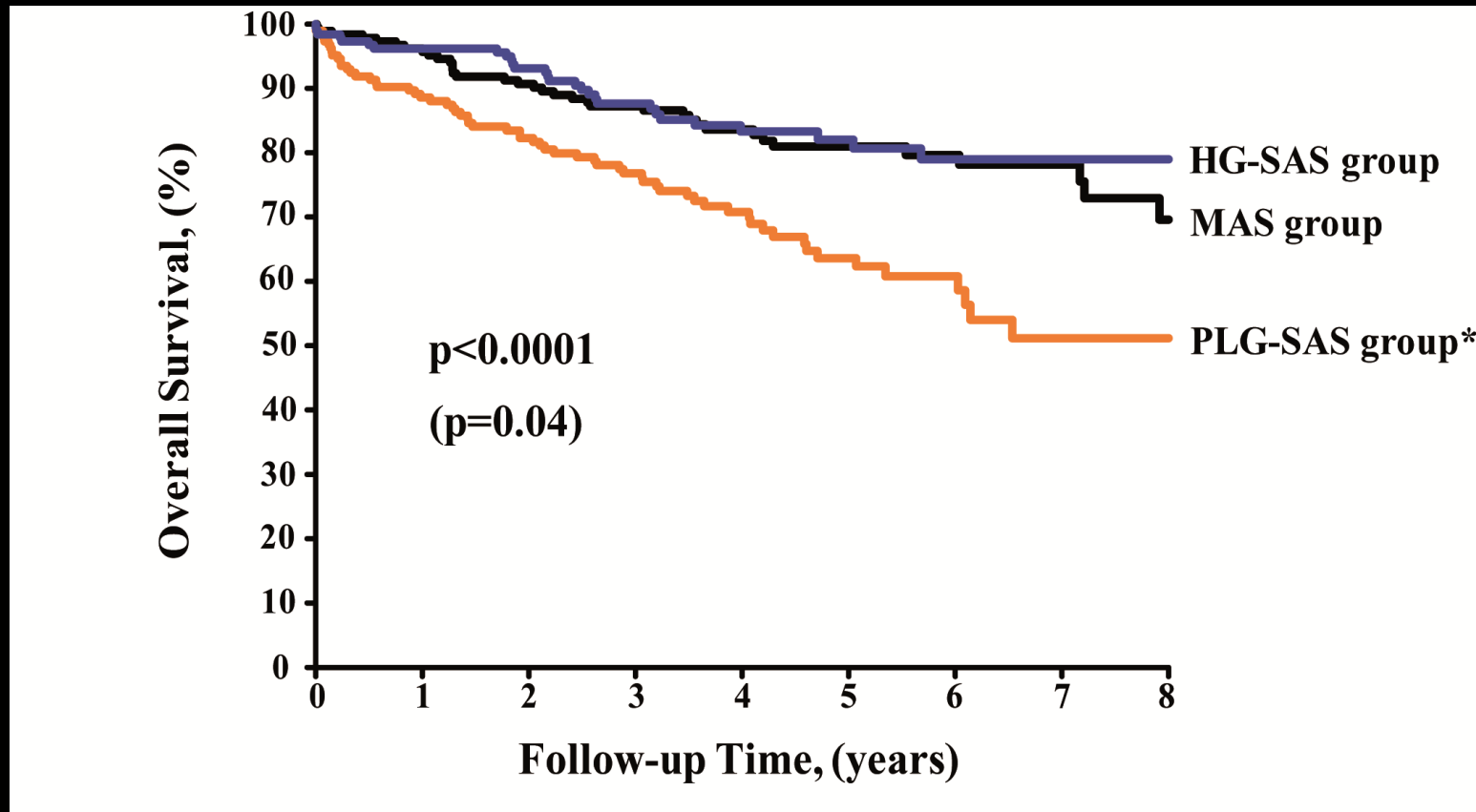


Mohty et al.

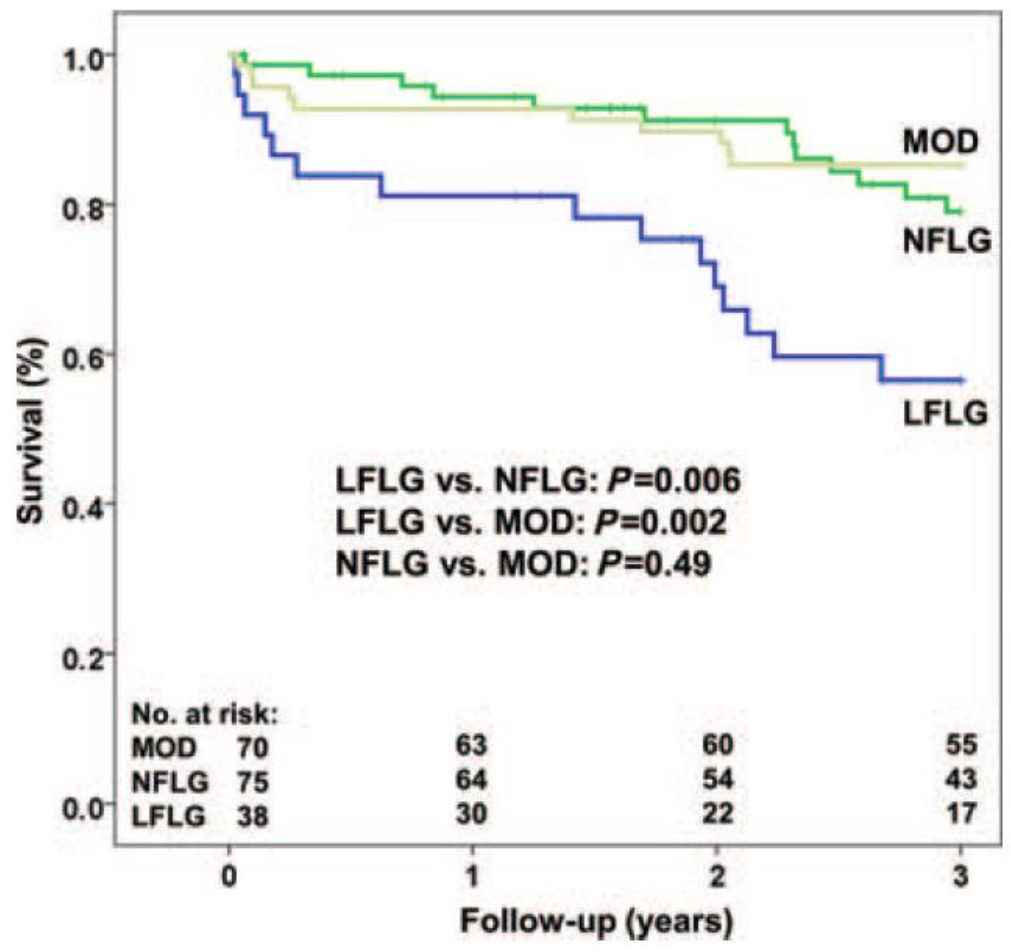
Circulation 2013

Outcome of Patients with Paradoxical Low-Flow, Low-Gradient AS

Case Match Study: 3 × 187 patients



Outcome of Patients with Paradoxical Low-Flow, Low-Gradient AS



Conclusions:

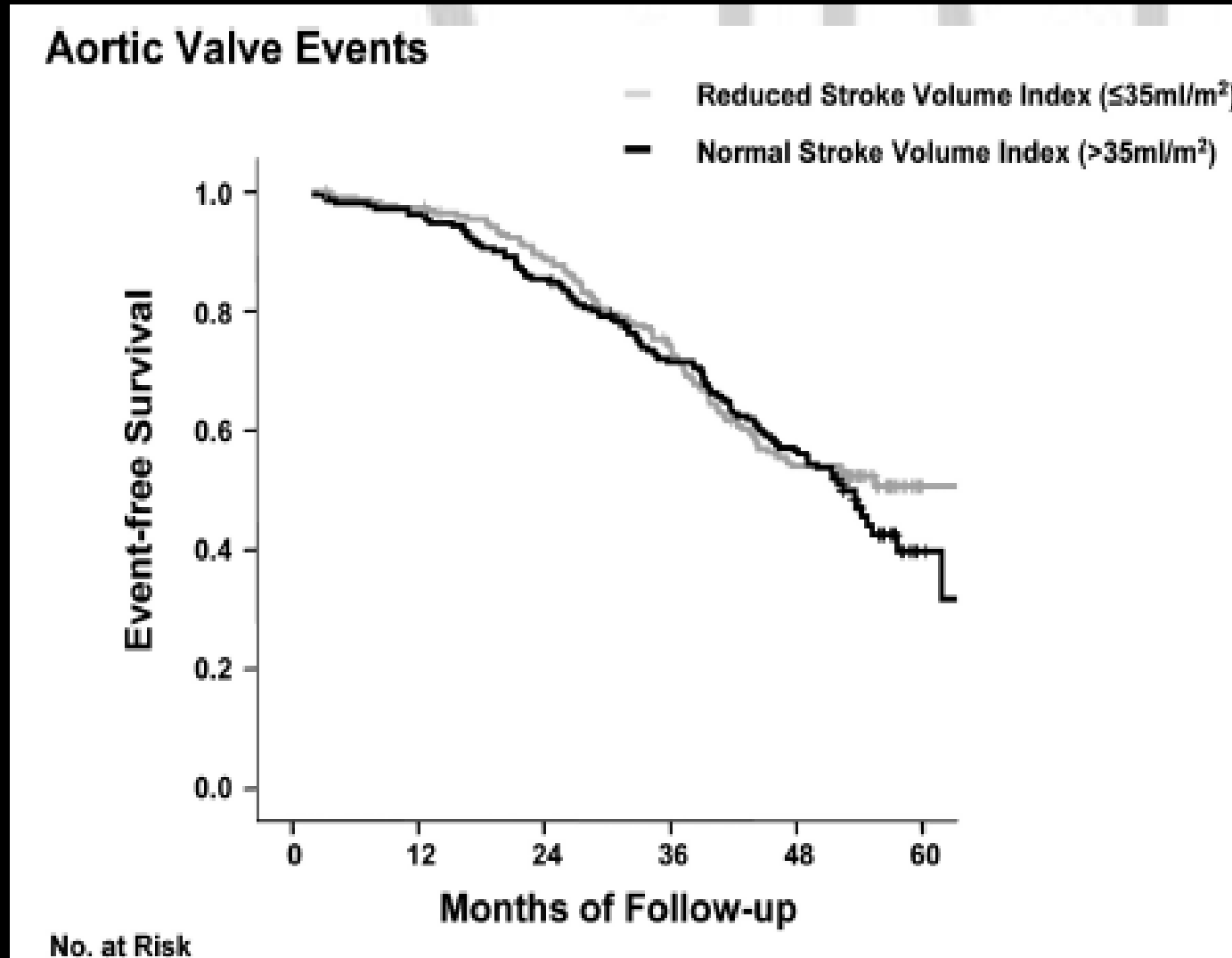
Patients with paradoxical LFLG AS exhibit marked concentric remodelling, impaired LV longitudinal function and worse prognosis

Normal-flow, low-gradient AS patients have outcomes similar to moderate AS



Outcome of Patients With Low-Gradient "Severe" Aortic Stenosis and Preserved LVEF

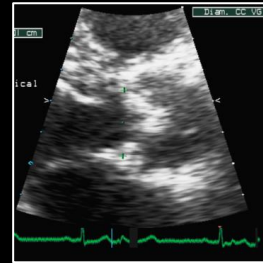
A Substudy of the SEAS trial



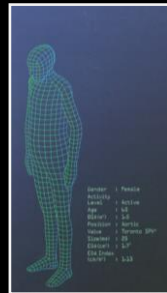
*Jander et al.
Circulation.
2011;123:887-895.*

Potential Causes of Discordance between AVA (e.g. 0.8) and gradient (e.g. 30) in Pts. With Preserved LVEF With Preserved LVEF

➤ Measurement errors

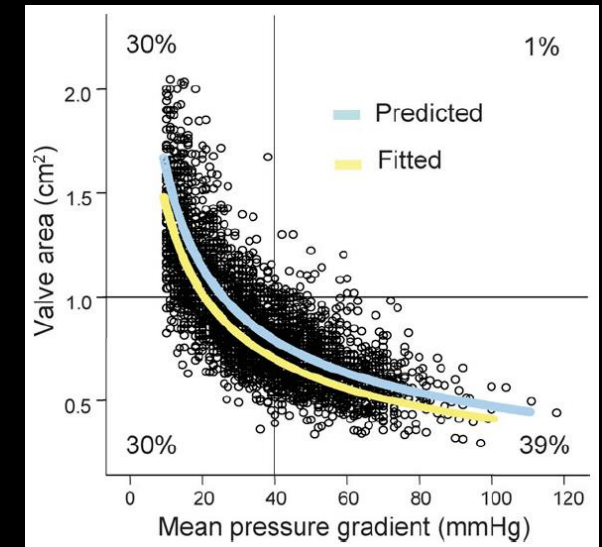
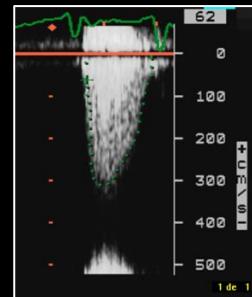


➤ Small body size



➤ Inconsistency in guidelines criteria

➤ Paradoxical low-flow, low-gradient severe AS



Minners et al.
Eur Heart J, 2008

Table 1. Baseline Characteristics

	Aortic Valve Stenosis		<i>P</i>
	Low-Gradient “Severe” (AVA <1.0 cm ² ; MPG ≤40 mm Hg) (n=435)	Moderate (AVA 1.5–1.0 cm ² ; MPG 25–40 mm Hg) (n=184)	
Age, y	69.8±9.2	66.8±9.2	<0.01
Female gender, n (%)	240 (55.2)	50 (27.2)	<0.01
Height, cm	167.2±8.8	173.2±8.7	<0.01
Weight, kg	74.4±13.6	80.2±13.1	<0.01
Body surface area, m ²	1.83±0.2	1.94±0.2	<0.01
Body mass index, kg/m ²	26.6±4.3	26.7±3.9	0.69

- **Paradoxical low flow severe AS**
- **Measurement error**
- **Small body size**
- **Inconsistency in guidelines criteria**

*Jander et al.
Circulation.
2011;123:887-895.*

Table 2. Baseline Echocardiographic Parameters

	Aortic Valve Stenosis		<i>P</i>
	Low-Gradient “Severe” (AVA <1.0 cm ² ; MPG ≤40 mm Hg) (n=435)	Moderate (AVA 1.5–1.0 cm ² ; MPG 25–40 mm Hg) (n=184)	
Aortic valve			
Peak aortic jet velocity, m/s	3.3±0.5	3.6±0.3	<0.01
Transaortic peak pressure gradient, mm Hg	44.8±11.9	53.0±7.4	<0.01
Transaortic mean pressure gradient, mm Hg	26.2±7.3	31.2±4.1	<0.01
Aortic valve area, cm	0.82±0.13	1.0	1.19±0.13 1.0 <0.01
Aortic valve area index, cm /m	0.46±0.08	0.63±0.09	<0.01
Velocity time integral aortic valve, cm	78.0±13.0	82.0±10.0	<0.01
Dimensionless velocity index	0.26±0.06	0.30±0.06	<0.01
Stroke volume			
LV outflow tract diameter, mm	20.2±0.2	22.8±0.2	<0.01
Velocity time integral LV outflow tract, cm	20.1±4.1	24.2±4.9	<0.01
Stoke volume, mL	63.8±13.1	77	97.5±13.9 83 <0.01
Stoke volume index, mL/m	35.1±7.3	50.7±8.5	<0.01
Cardiac output, L/min	4.3±1.0	6.6±1.2	<0.01
Cardiac index, L/min	2.4±0.56	3.4±0.71	<0.01
LV			
LV ejection fraction, %	66.9±5.7	66.7±5.8	0.68
LV end-diastolic diameter, mm	49.0±6.1	50.7±5.6	<0.01
LV end-diastolic diameter index, mm/m	26.9±3.4	26.3±3.2	0.04
LV end-diastolic volume, mL	115.3±32.7	124.4±31.1	<0.01

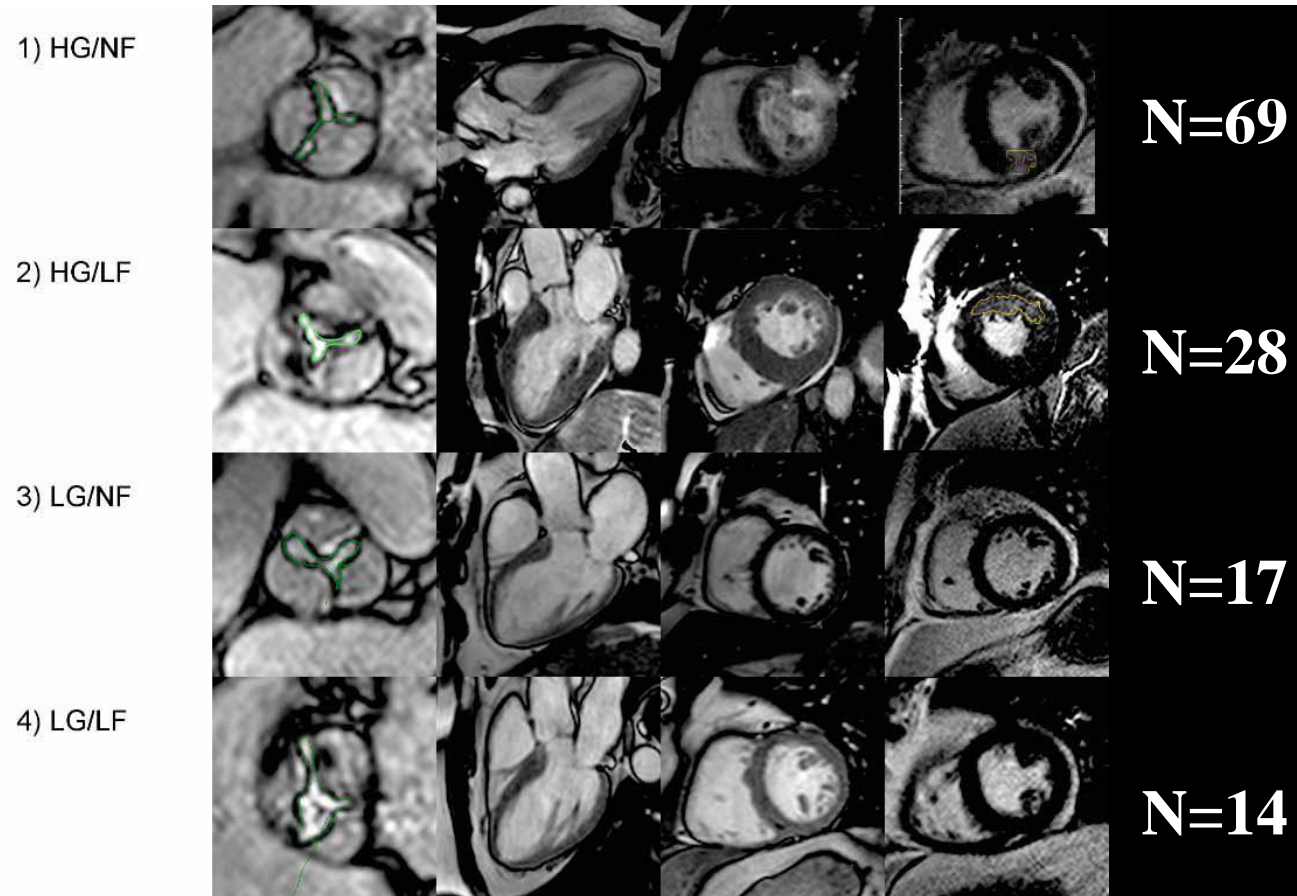
	Aortic Valve Stenosis		<i>P</i>
	Low-Gradient "Severe" (AVA <1.0 cm ² ; MPG ≤40 mm Hg) (n=435)	Moderate (AVA 1.5–1.0 cm ² ; MPG 25–40 mm Hg) (n=184)	
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LV end-diastolic diameter, mm	49.0±6.1	50.7±5.6	<0.01
LV end-diastolic diameter index, mm/m	26.9±3.4	26.3±3.2	0.04
LV end-diastolic volume, mL	115.3±32.7	124.4±31.1	<0.01
LV end-diastolic volume index, mL/m	63.0±16.5	64.3±15.6	0.36
LV end-systolic diameter, mm	31.0±5.1	31.6±5.0	0.18
LV end-systolic diameter index, mm/m	17.0±2.7	16.4±2.7	<0.01
Fractional shortening, %	36.8±5.6	37.8±6.0	0.05
LV end-diastolic septum thickness, mm	11.4±2.8	12.3±2.9	<0.01
LV end-diastolic posterior wall thickness, mm	8.8±1.9	9.4±1.9	<0.01
LV mass, g	182.3±63.6	211.6±67.5	<0.01
LV mass index, g/m	98.9±30.6	108.9±33.3	<0.01
Relative wall thickness, %	36.5±9.5	37.3±8.9	0.30

Criteria for Paradoxical low-flow AS

- EDD < 47 mm EDV < 55 mL/m²
- RWT ratio > 0.50

Aortic Valve Area, Stroke Volume, Left Ventricular Hypertrophy, Remodeling and Fibrosis in Aortic Stenosis Assessed by Cardiac MRI: Comparison Between High and Low Gradient, and Normal and Low Flow Aortic Stenosis

Gilles Barone-Rochette, Sophie Piérard, Stéphanie Seldrum, Christophe de Meester de Ravenstein, Julie Melchior, Frédéric Maes, Anne-Catherine Pouleur, David Vancraeynest, Agnes Pasquet, Jean-Louis Vanoverschelde and Bernhard L. Gerber



Low-Gradient Aortic Valve Stenosis

Myocardial Fibrosis and Its Influence on Function and Outcome

Sebastian Herrmann, MD,*† Stefan Störk, MD, PhD,*† Markus Niemann, MD,*†
 Volkmar Lange, MD,§ Jörg M. Strotmann, MD,* Stefan Frantz, MD,*† Meinrad Beer, MD,†||
 Stefan Gattenlöhner, MD,‡ Wolfram Voelker, MD,*† Georg Ertl, MD,*† Frank Weidemann, MD*†
 Würzburg, Germany

Table 3 Baseline Left Heart Catheterization, Magnetic Resonance Imaging, Myocardial Histology, and Cardiac Biomarkers

	Severe AS, High Gradient (n = 49)	Severe AS, Low Gradient, EF ≥ 50% (n = 11)	Severe AS, Low Gradient, EF < 50% (n = 9)
Left heart catheterization			
Aortic valve area, cm ²	0.7 ± 0.1	0.7 ± 0.2	0.8 ± 0.1
Indexed aortic valve area, cm ² ·m ⁻²	0.39 ± 0.12	0.41 ± 0.14	0.46 ± 0.11
Pulmonary capillary wedge pressure, mm Hg	14 ± 7	15 ± 7	18 ± 7
Stroke volume, ml	72 ± 12	56 ± 13	63 ± 13
Stroke volume index, ml·m ⁻²	40 ± 5	31 ± 4	34 ± 3
Mean aortic pressure gradient, mm Hg	53 ± 8	37 ± 8*	27 ± 8*†
Transvalvular flow rate, ml/s	241 ± 40	179 ± 30*	184 ± 20*
Central venous oxygen saturation, %	69 ± 4	63 ± 4*	59 ± 4*†
cMRI			
Ejection fraction, %	55 ± 13	56 ± 12	38 ± 17*†
Late enhancement–positive segments: 0/1/>1, %	47/19/34	0/20/80	0/23/77
Myocardial histology			
Interstitial fibrosis, %	1.8 ± 0.8	3.9 ± 0.6*	4.8 ± 0.6*
Myocyte diameter, μm	12.2 ± 1.3	13.1 ± 1.5	13.7 ± 1.3*
Cardiac biomarkers			
NT-proBNP, pg/ml	1,418 (377–1,505)	3,730 (1,858–5,671)*	5,016 (4,182–5,704)*
PIIINP, μg/ml	3.4 ± 0.8	4.6 ± 0.4	5.0 ± 1.3*

Abstract: P252

Low-flow Low-gradient aortic stenosis: prognosis and effect of surgery.

Authors:

J Adda¹, C Mielot², F Cransac¹, X Zirphile³, P Reant³, C Sportouch-Dukhan¹, S Lafitte³, E Donal⁴, P Lancellotti⁵, G Habib², ¹University Hospital of Montpellier - Montpellier - France, ²la Timone Hospital - Marseille - France, ³University Hospital of Bordeaux - Bordeaux - France, ⁴University of Rennes - Rennes - France, ⁵university of Liège - Liège - Belgium,

Topic(s):

Aortic stenosis

Citation:

Eur J Echocardiography Abstracts Supplement (2011) 12 (S2), ii13

Background: Low-flow low-gradient aortic stenosis with preserved ejection fraction is a recently described entity, but its prognosis and influence of surgery are uncertain.

Methods: In a multicentre study, 362 patients with severe aortic stenosis (aortic valve area $\leq 0.6 \text{ cm}^2/\text{m}^2$), and preserved LV function (LVEF $\geq 50\%$) were prospectively included. Four groups were defined depending on flow and gradient: low flow was defined as a stroke volume index (SVi) $\leq 35 \text{ ml}/\text{m}^2$, and low gradient as a mean gradient (MG) $\leq 40 \text{ mmHg}$.

Results: Group 1 (normal flow high gradient) represented the majority of our patients (231 patients, 63.5%). 3-year survival was 87%. Referral rate for surgery was 75%. There was a significant improvement of survival among the surgery group (88% vs 75% in the medical group, $p=0.035$). Group 2 (low flow high gradient) included 46 patients (12.6%). 3-year survival was 95% ($p=\text{ns}$ vs group 1). Referral rate for surgery was 76%. There was a significant improvement of survival among the surgery group (100% vs 76% in the medical group, $p=0.01$). Group 3 (high flow low gradient) included 57 patients (15.7%). 3-year survival was 85% ($p=\text{ns}$ vs group 1). Referral rate for surgery was 55%. There was a significant improvement of survival among the surgery group (90.6% vs 74.7% in the

Conclusion: Paradoxical low-flow, low-gradient AS is associated with severe prognosis

Abstract: P252

Low-flow Low-gradient aortic stenosis: prognosis and effect of surgery.

Authors:

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Topic(s):

Aortic stenosis

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Eur J Echocardiography Abstracts Supplement (2011) 12 (S2), ii13

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Conclusion: Paradoxical low-flow, low-gradient AS is associated with severe prognosis.

Its prognosis does not seem to be improved by surgery.

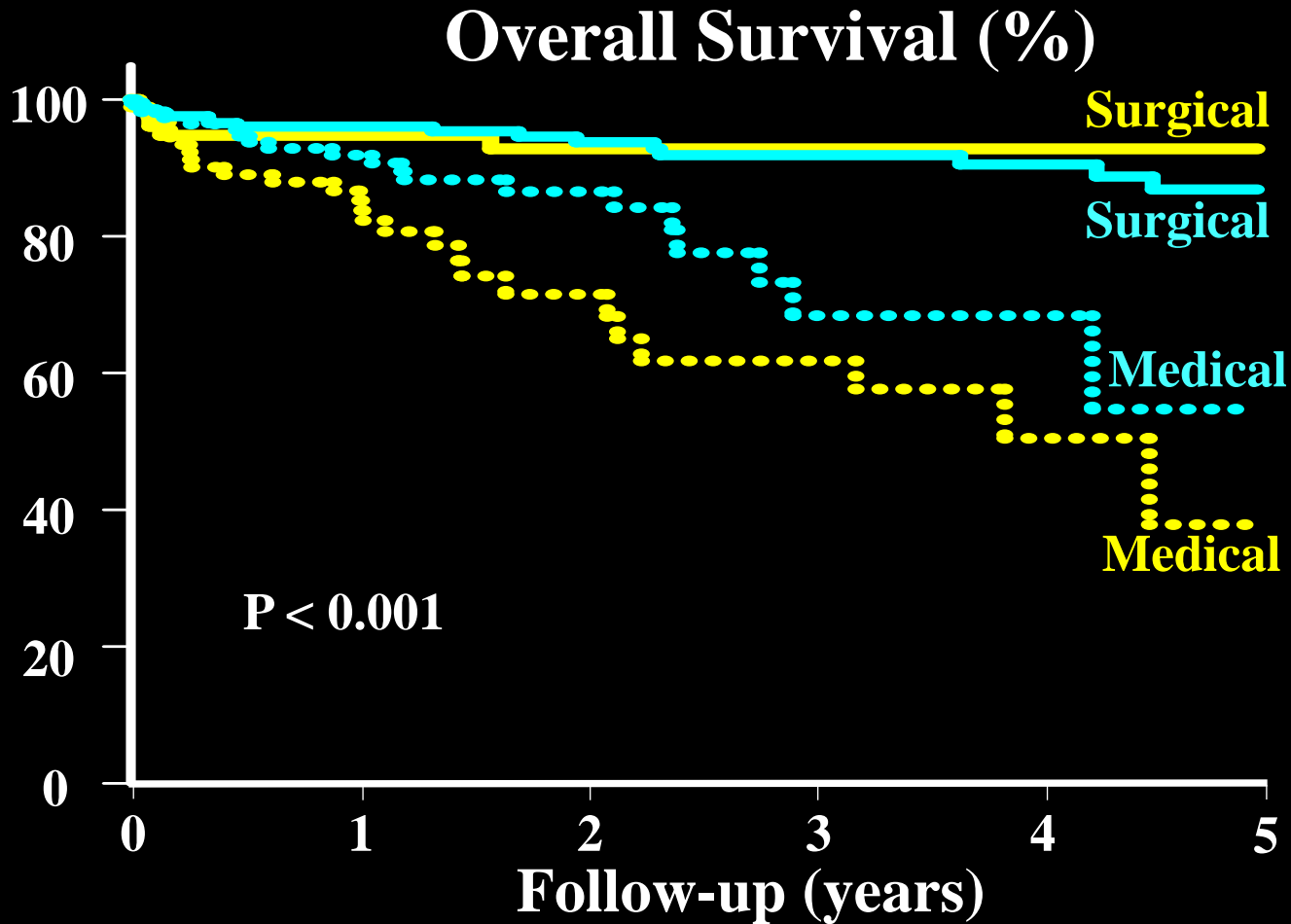
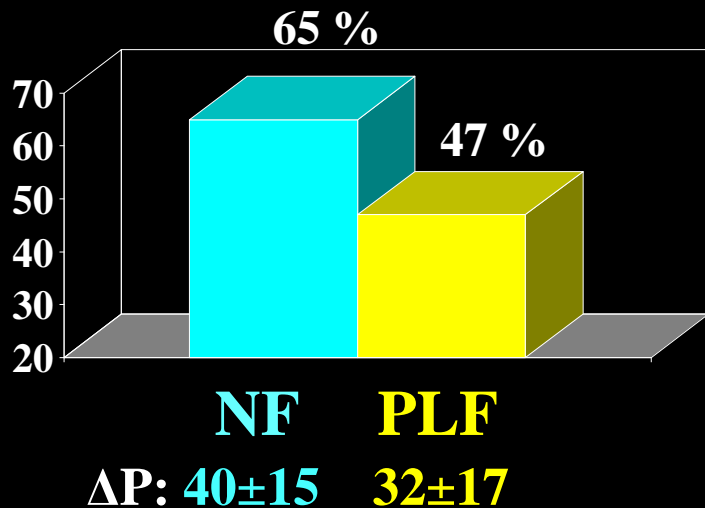


*Paradoxical Low-Flow,
Low-Gradient AS:
Does AVR help?*

Outcome of Patients with Paradoxical Low-Flow AS

512 Patients with indexed AVA <math> < 0.6 \text{ cm}^2 </math>, LVEF $\geq 50\%$

Percentage of Patients Treated Surgically

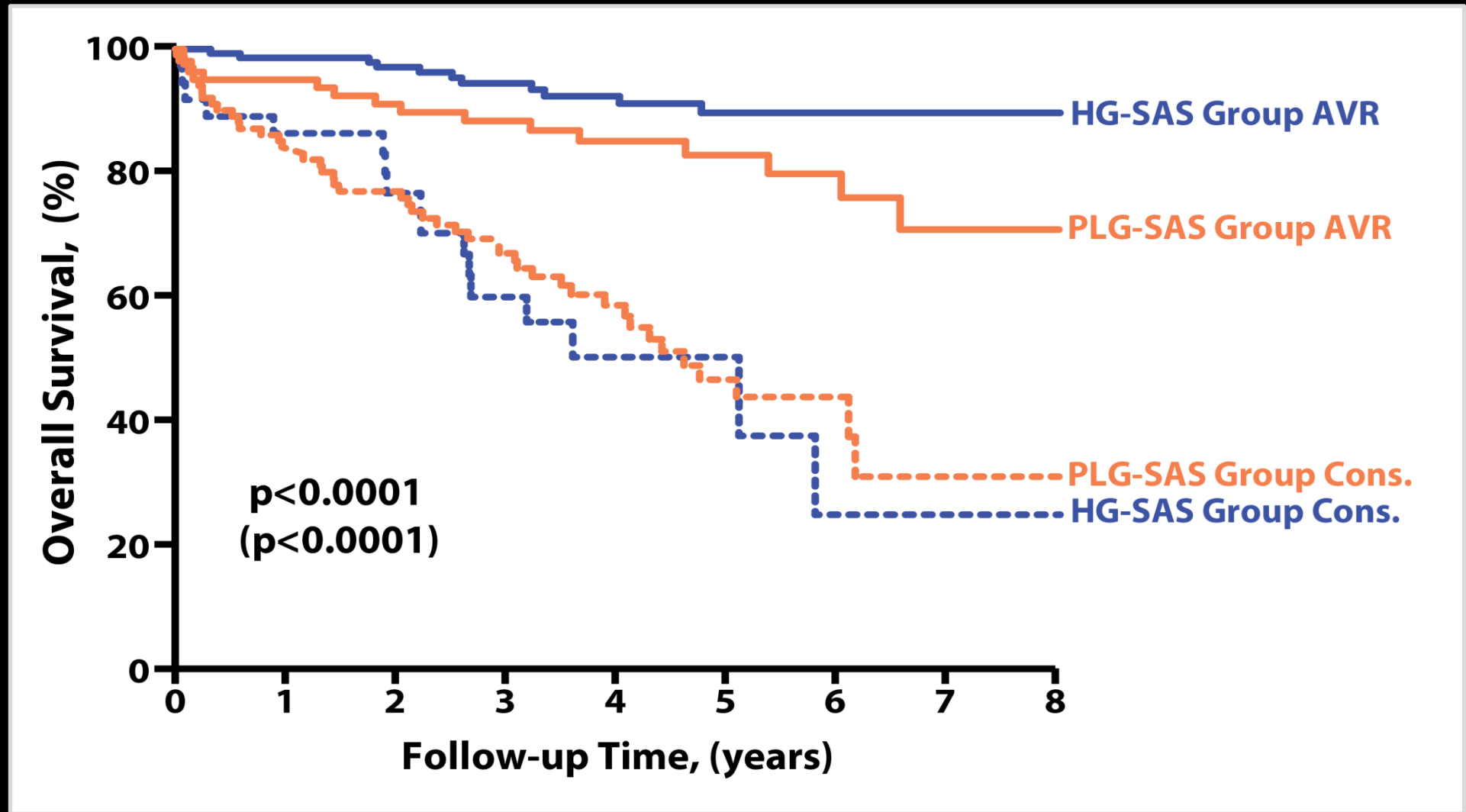


Hachicha Z et al., Circulation. 115:2856-2864, 2007

NF: Normal Flow: SVI > 35 (65%)

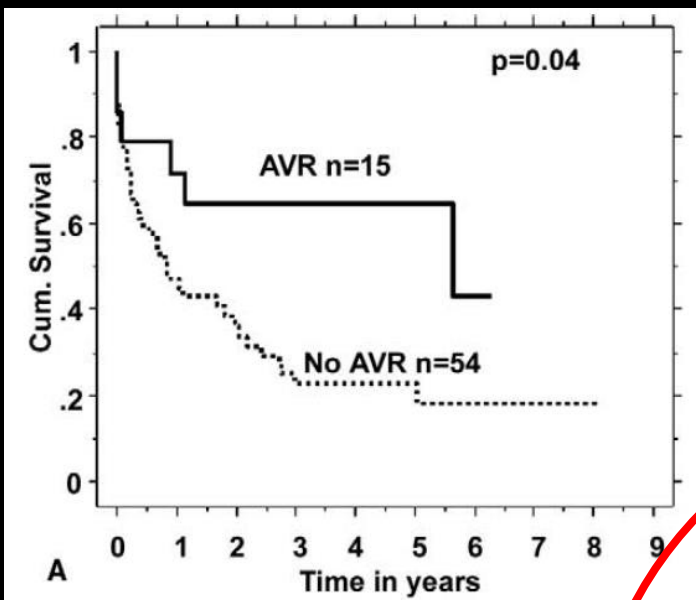
PLF: Paradoxical Low Flow: SVI ≤ 35 (35%)

Impact of AVR on Survival in Patients with Paradoxical Low-Flow, Low-Gradient AS



Impact of AVR on Survival According to LVEF in Patients with Low Gradient

LVEF < 35%

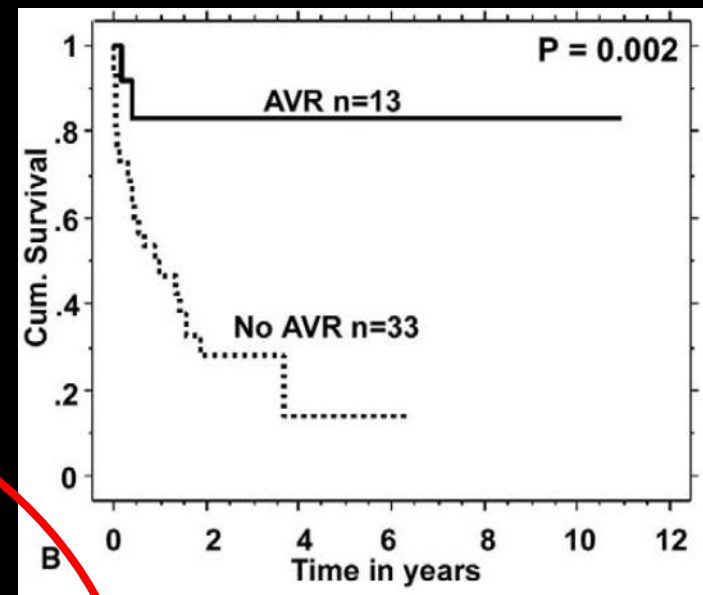


168 patients

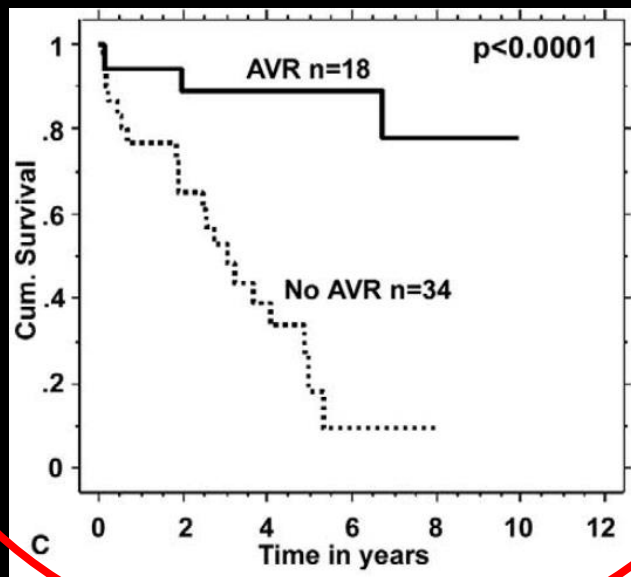
AVA ≤ 0.8 cm²

ΔP ≤ 30 mmHg

LVEF < 35-54%



LVEF ≥ 55%



Pai et al.,
Ann Thorac Surg
86:1781-90, 2008

Impact of AVR on Survival in Patients with Low-Gradient Severe AS and Preserved LVEF

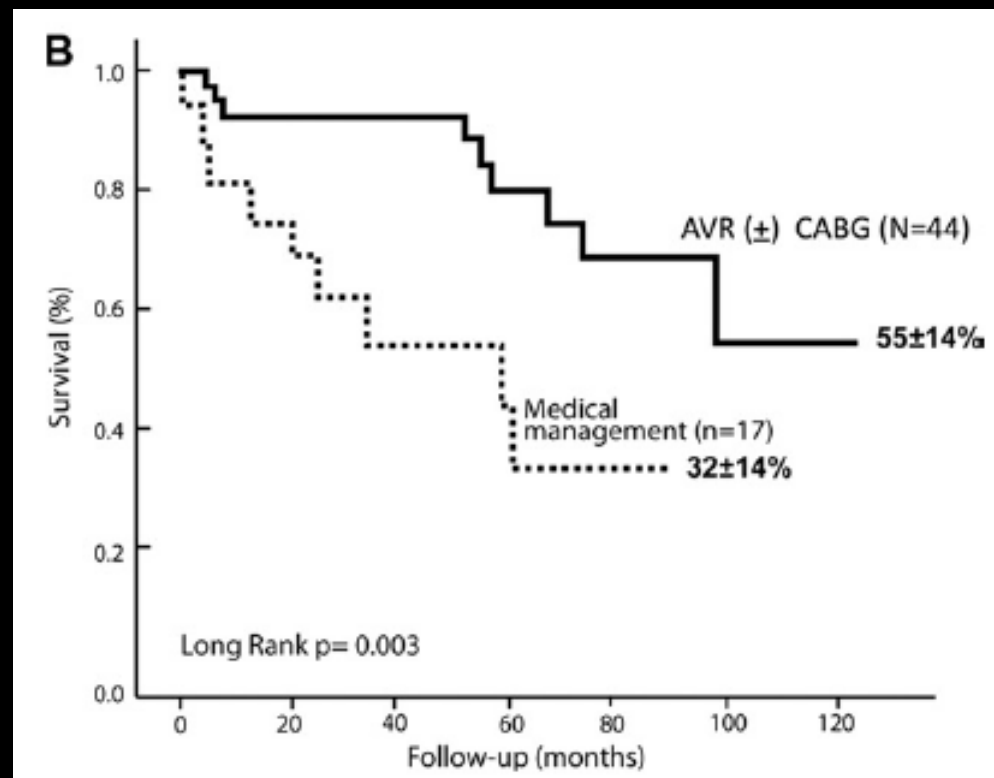
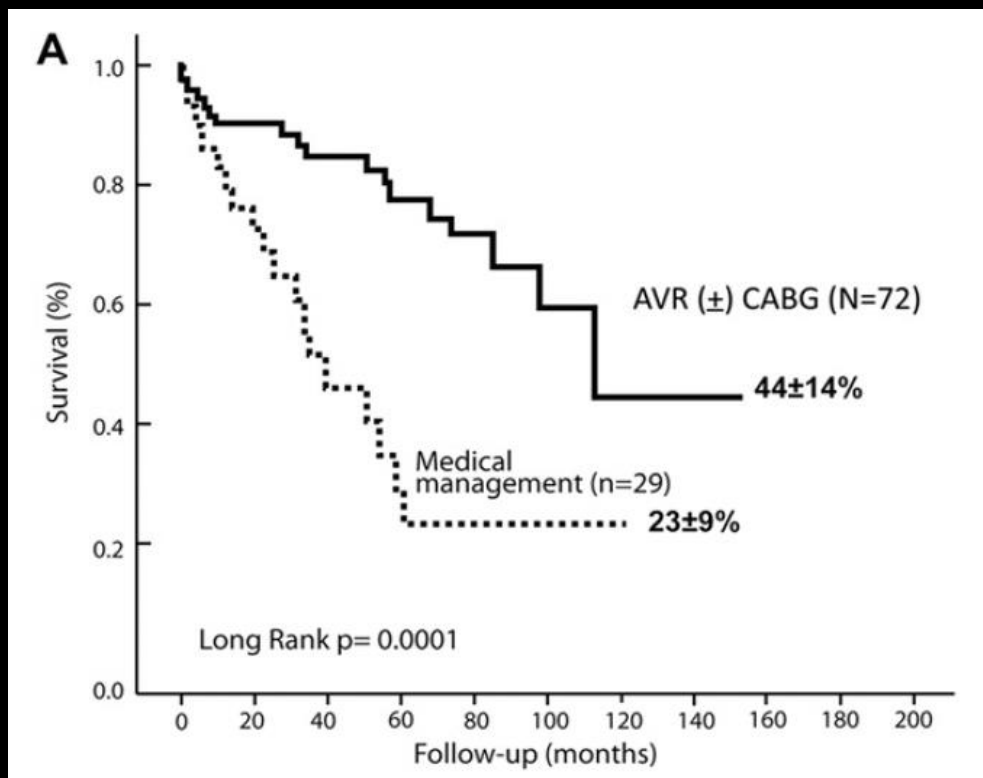
102 patients, AVA < 1.0 cm²

$\Delta P_{Mean} < 40$ mmHg

LVEF $\geq 50\%$

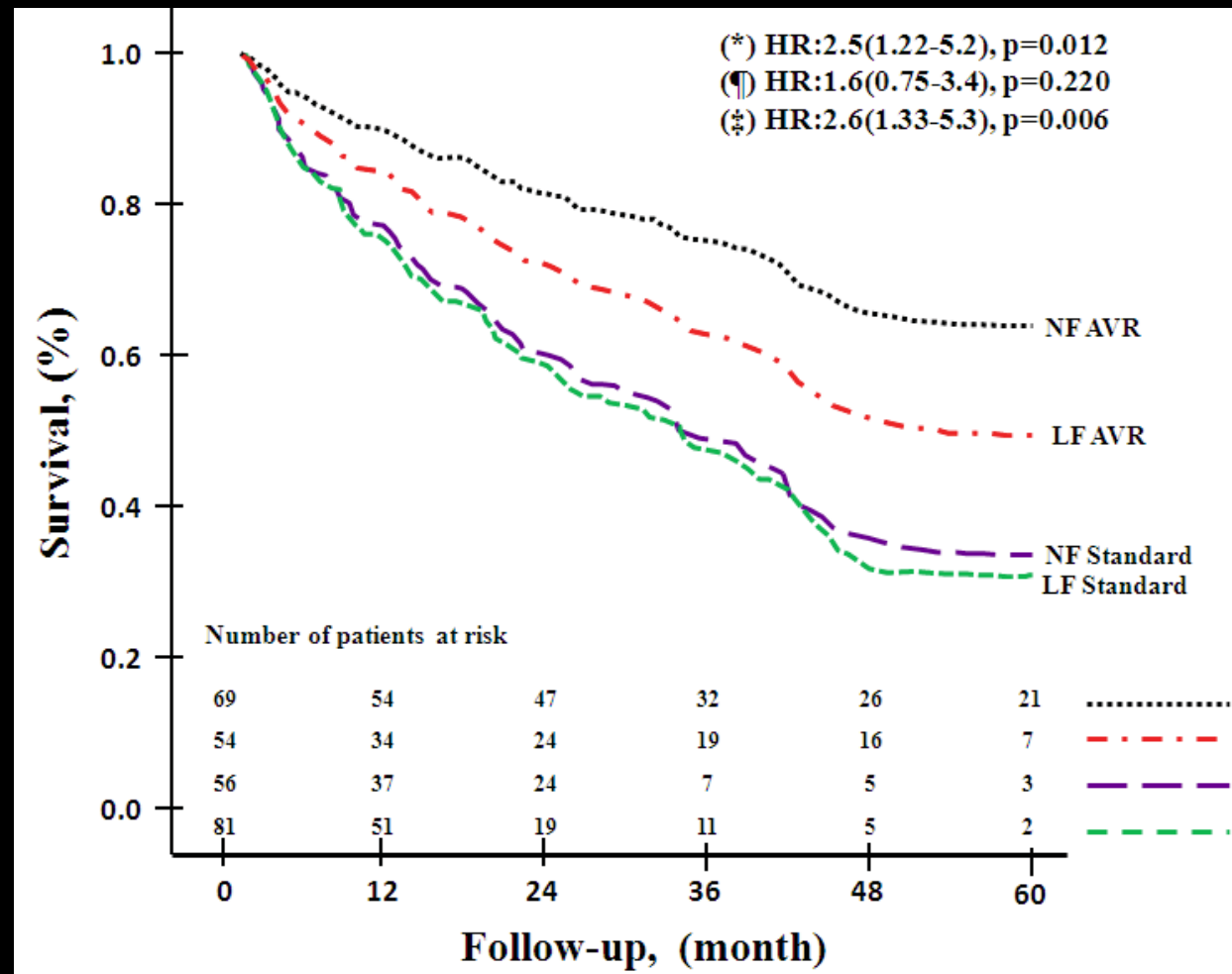
Whole Cohorts

Propensity Score-Matched Cohorts



Impact of AVR on Outcome of Symptomatic Patients with Severe Stenosis, Low Gradient, and Preserved LVEF

260 symptomatic Pts
 Severe AS ($AVA_i < 0.6 \text{ cm}^2/\text{m}^2$)
 Low gradient ($< 40 \text{ mmHg}$)
 Preserved LVEF ($> 50\%$)



Impact of AVR on Outcome of Symptomatic Patients with Severe Stenosis, Low Gradient, and Preserved LVEF

1704 Patients

Table 5. Multivariable Predictors of All-Cause Mortality

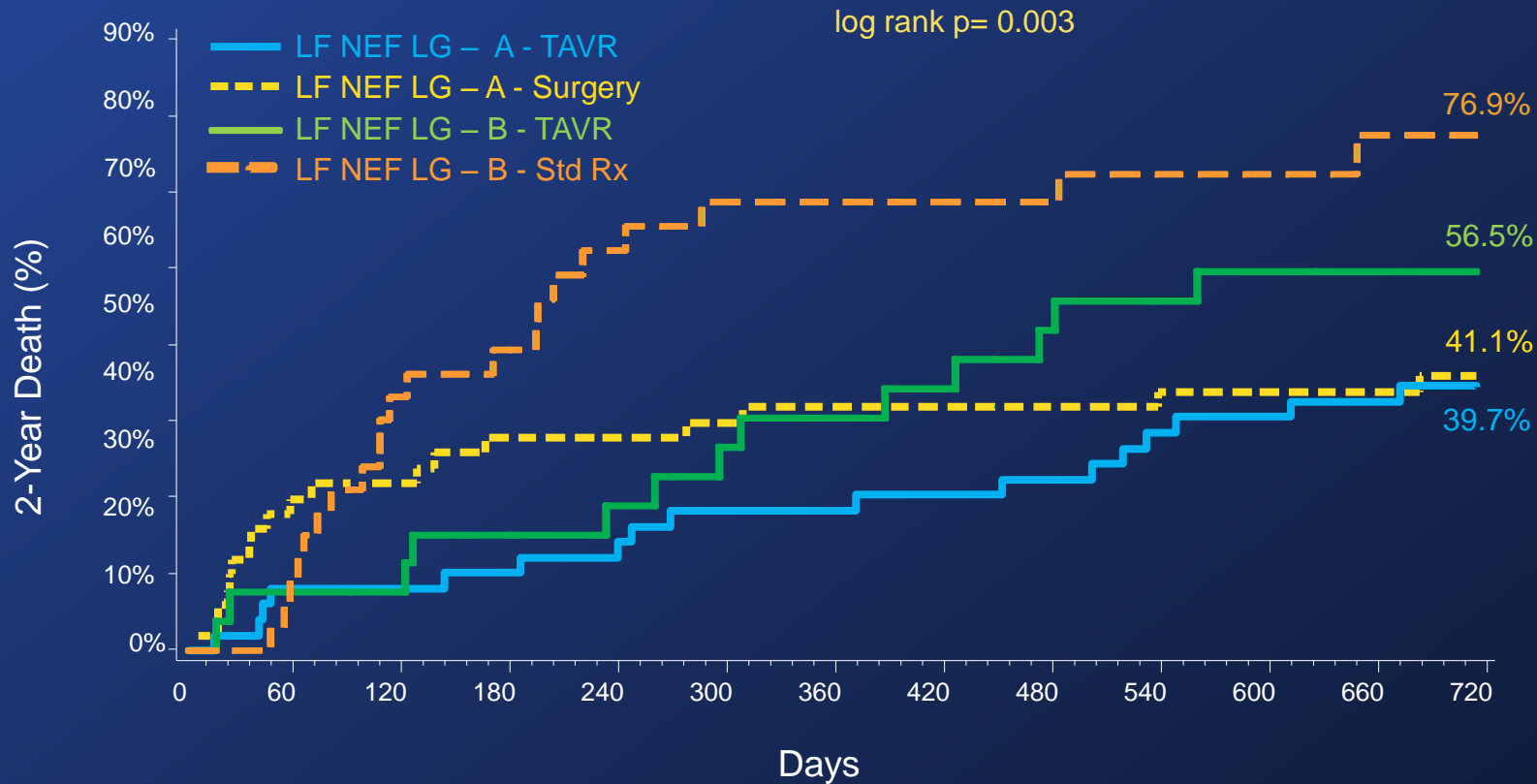
Variable	RR	Lower 95%	Upper 95%	P Value
Flow-gradient patterns				
NF/LG no AVR	1.00	Reference group		
NF/LG+AVR	0.86	0.518	1.414	0.54
LF/LG no AVR	3.26	1.713	6.217	0.0003
LF/LG+AVR	0.94	0.384	2.297	0.89
NF/HG no AVR	2.81	1.905	4.140	<0.0001
NF/HG+AVR	0.69	0.450	1.048	0.08
LF/HG no AVR	1.55	0.615	3.904	0.35
LF/HG+AVR	0.89	0.396	1.994	0.77
Clinical				
Age	1.02	1.012	1.034	<0.0001
Male sex	1.46	1.169	1.821	0.0008
Obesity	1.51	1.214	1.885	0.0002
Hypertension	1.42	1.076	1.868	0.01
Previous HF	1.29	0.984	1.684	0.07
Echocardiographic				
Aortic valve area	0.07	0.026	0.163	<0.0001
Ejection fraction	0.98	0.968	1.000	0.05

AVR indicates aortic valve replacement; HF, heart failure; HG, high gradient; LF, low flow; LG, low gradient; HG, high gradient; NF, normal flow; and RR, relative risk.

Eleid et al.
Circulation 2013

PARTNER-I (Cohorts A+B)

Paradoxical LF, NEF, and LG (12% of cohort)



Numbers at Risk

A – TAVR	43	39	38	34	34	33	29	26	22
A – Surgery	44	33	30	30	28	27	27	26	23
B – TAVR	23	21	19	17	15	13	11	10	10
B – Std Rx	29	22	15	10	9	9	6	5	4

2012 ESC/EACTS Guidelines on Management of VHD: Indications for AVR in AS

“The newly recognized entity of paradoxical low-flow, low-gradient AS has attracted attention because of the limited amount of data on the natural history and outcome a

	Class ^a	Level ^b
AVR is indicated in patients with severe AS and any symptoms related to AF.	I	B/C
AVR is indicated in patients with severe AS undergoing CABG, surgery of the ascending aorta or another valve.	I	C
AVR is indicated in asymptomatic patients with severe AS and systolic LV dysfunction (LVEF <50%) not due to another cause.	I	C
AVR is indicated in asymptomatic patients with severe AS and abnormal exercise test showing symptoms on exercise clearly related to AS.	I	C
AVR should be considered in high risk patients with severe symptomatic AS who are suitable for TAVI, but in whom surgery is favored. The final decision is based on the individual risk profile and anatomic suitability.	IIa	B
AVR should be considered in asymptomatic patients with severe AS and abnormal exercise test showing fall in blood pressure below baseline.	IIa	C
AVR should be considered in patients with moderate AS ^d undergoing CABG, surgery of the ascending aorta or another valve.	IIa	C
AVR should be considered in symptomatic patients with low flow, low gradient (<40 mmHg) AS with normal EF only after careful confirmation of severe AS. ^e	IIa	C
AVR should be considered in symptomatic patients with severe AS, low flow, low gradient with reduced EF, and evidence of flow reserve. ^f	IIa	C
AVR should be considered in asymptomatic patients, with normal EF and none of the above mentioned exercise test abnormalities, if the surgical risk is low, and one or more of the following findings is present: <ul style="list-style-type: none"> • Very severe AS defined by a peak transvalvular velocity >5.5 m/s or; • Severe valve calcification and a rate of peak transvalvular velocity progression ≥0.3 m/s per year. 	IIa	C
AVR may be considered in symptomatic patients with severe AS low flow, low gradient, and LV dysfunction without flow reserve. ^f	IIb	C
AVR may be considered in asymptomatic patients with severe AS, normal EF and none of the above mentioned exercise test abnormalities, if surgical risk is low, and one or more of the following findings is present: <ul style="list-style-type: none"> • Markedly elevated natriuretic peptide levels confirmed by repeated measurements and without other explanations • Increase of mean pressure gradient with exercise by >20 mmHg • Excessive LV hypertrophy in the absence of hypertension. 	IIb	C



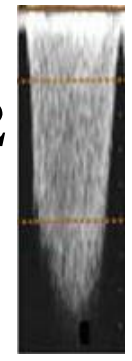
**LVEF \geq 50% SVi $<$ 35 mL/m²
AVA \leq 1.0 Δ P $<$ 40
Symptomatic**



**Exercise Stress Echo /
Dobutamine Stress Echo**

**MSCT
AoV Ca Score**

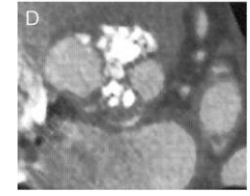
Δ P \geq 30-40
AVA $<$ 1.0-1.2



Δ P $<$ 30-40
AVA \geq 1.0-1.2



$<$ 1200 ♀
 $<$ 2000 ♂



$>$ 1200 ♀
 $>$ 2000 ♂

True-Severe AS

Pseudo-Severe AS

True-Severe AS

**SAVR \pm CABG
TAVR \pm PCI?
BAV+TAVR?**

HTN Therapy

**SAVR \pm CABG
TAVR \pm PCI?
BAV+TAVR?**



Answers to Burning Questions: Paradoxical low-flow, low-gradient AS

- **Does it exist: YES!** this a real entity that occurs in 10-15% of AS patients
- **Does it have impact on survival: YES!**
- **Does AVR help: YES!** AVR improves outcome in patients with true paradoxical low-flow, low-gradient severe AS
- TAVR may provide a valuable alternative to SAVR

Key Messages: Paradoxical Low-Flow AS

➤ **When confronted to AVA-gradient discordance:**

1- Rule out measurement errors

2- Rule out small body size

3- Document the presence of low-flow: $SV_i < 35 \text{ ml/m}^2$

4- Identify typical echo features of paradoxical LFLG:

**Small LV with concentric remodeling, impaired filling,
reduced longitudinal function**

5- Identify other causes of low flow:

AFib, MR, TR, MS, bradychardia

6- Rule out pseudo-severe AS:

MSCT and stress echo



G I L B E R T

Mastfile

