

Low-Gradient AS and LV Dysfunction

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ET DE PNEUMOLOGIE
DE QUÉBEC



**Université
LAVAL**

Disclosure

Philippe Pibarot

Financial relationship with industry:

- **Research Grant from Edwards Lifesciences for Echo CoreLab Analyses**

Other financial disclosure:

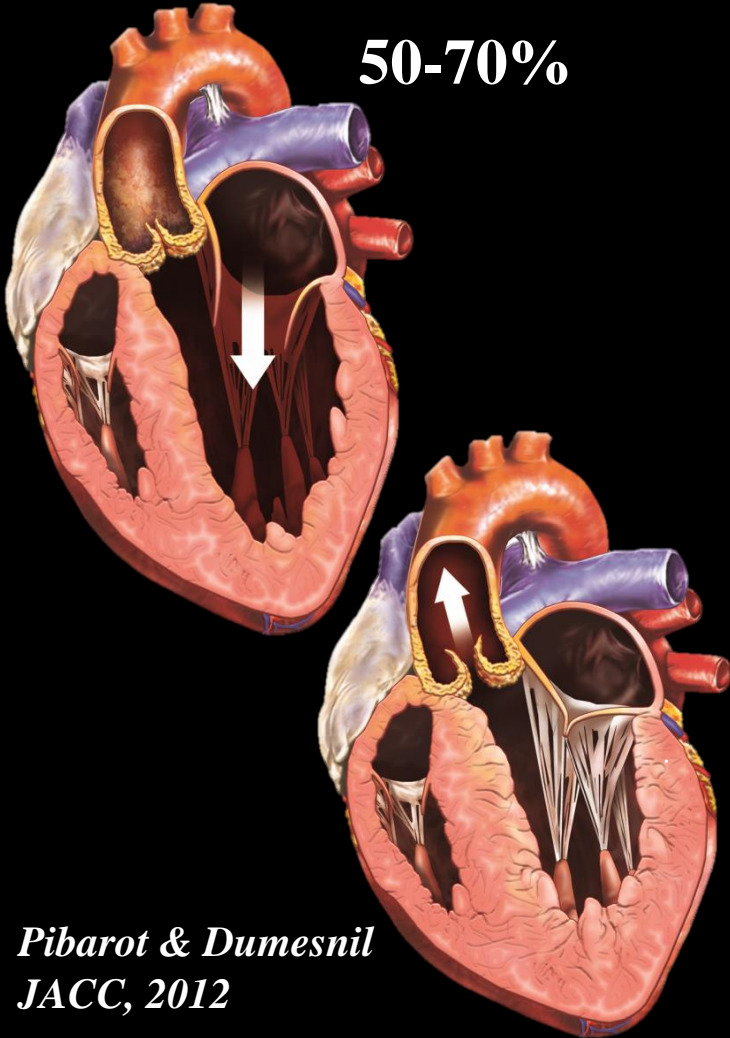
- **Research Grants from Canadian Institutes of Health Research and Heart & Stroke Foundation of Quebec**

Off label Use: None

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%

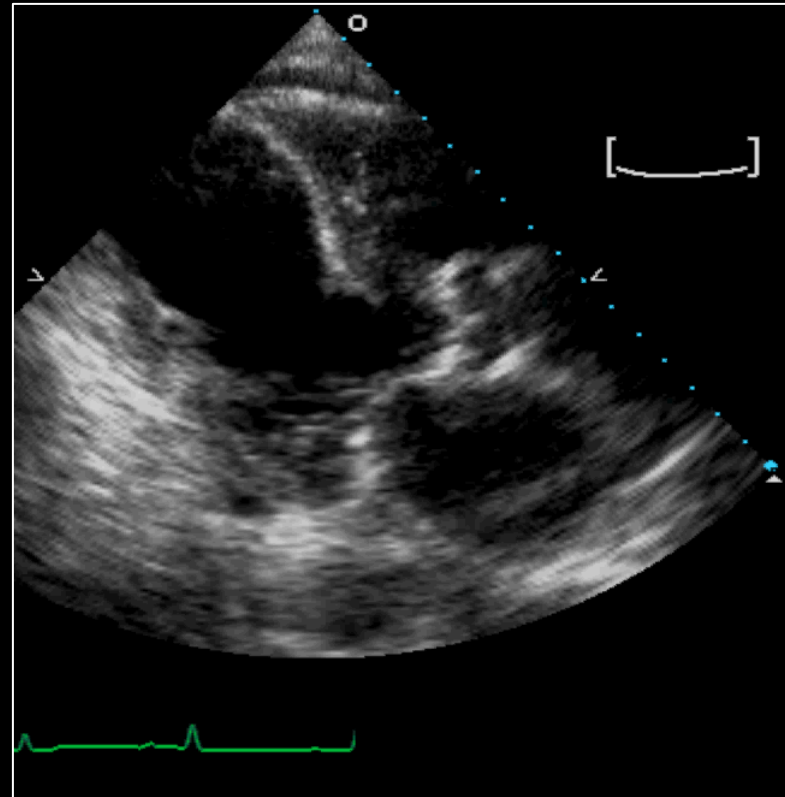


**LOW-LVEF
«CLASSICAL»
LOW-FLOW
LOW-GRADIENT**

5-10%



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



LVEF=25%

SV=42 mL

MG=25 mmHg

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

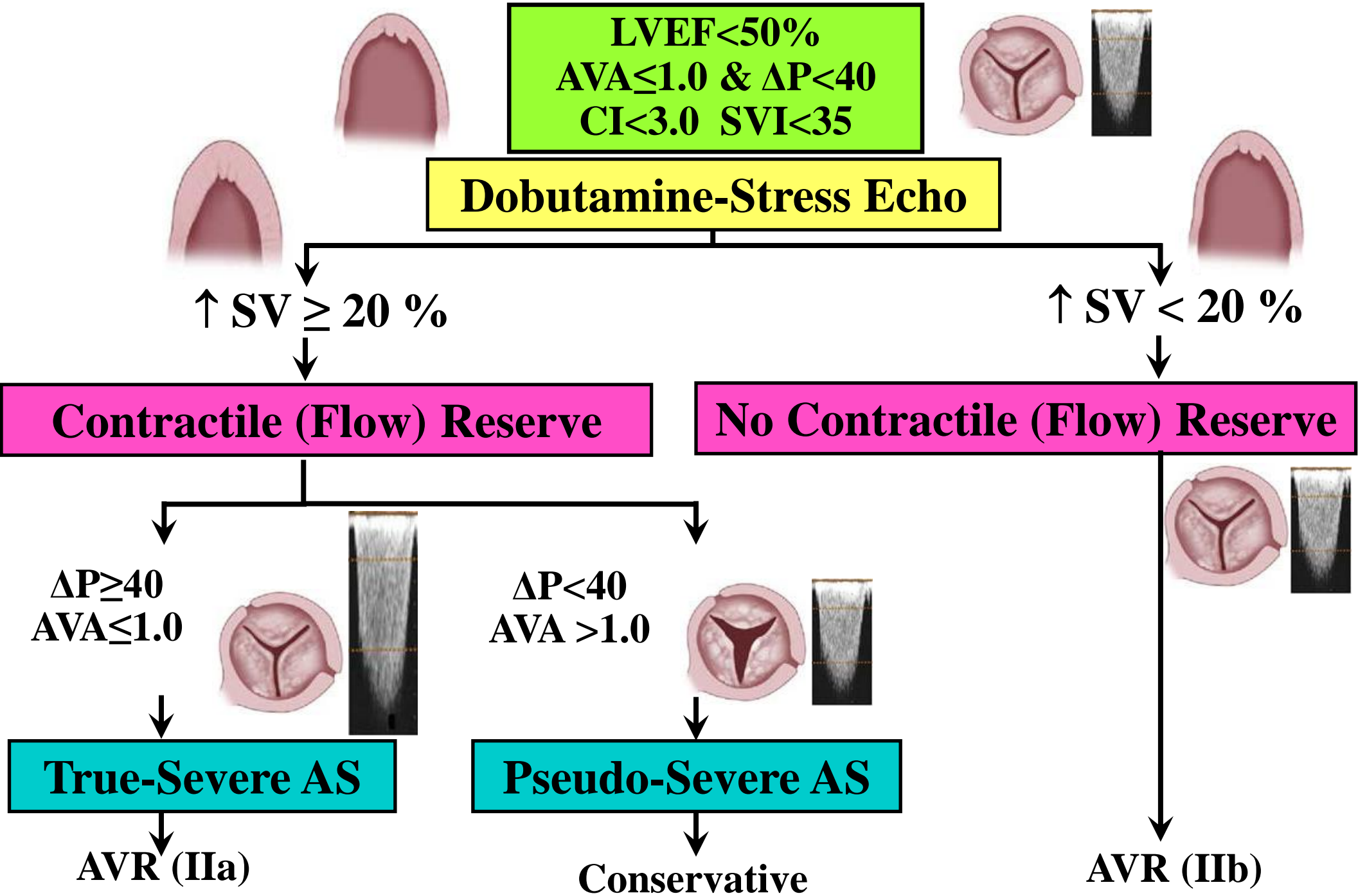
	Class ^a	Level ^b
AVR is indicated in patients with severe AS and any symptoms related to AS.	I	B
AVR is indicated in patients with severe AS undergoing CABG, surgery of the ascending aorta or another valve.	I	C
AVR is indicated in asymptomatic patients with severe AS and systolic LV dysfunction (LVEF <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 favoured by a 'heart team' 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

IIa C

IIb C

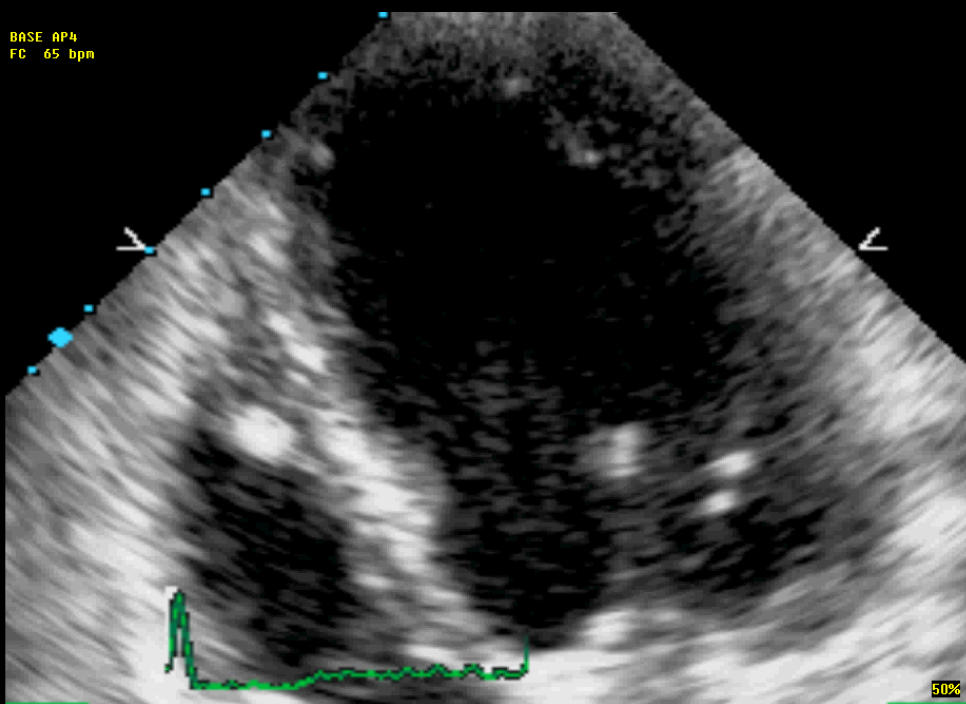
AVR should be considered in evidence of flow reserve.^f

AVR may be considered in flow reserve.^f

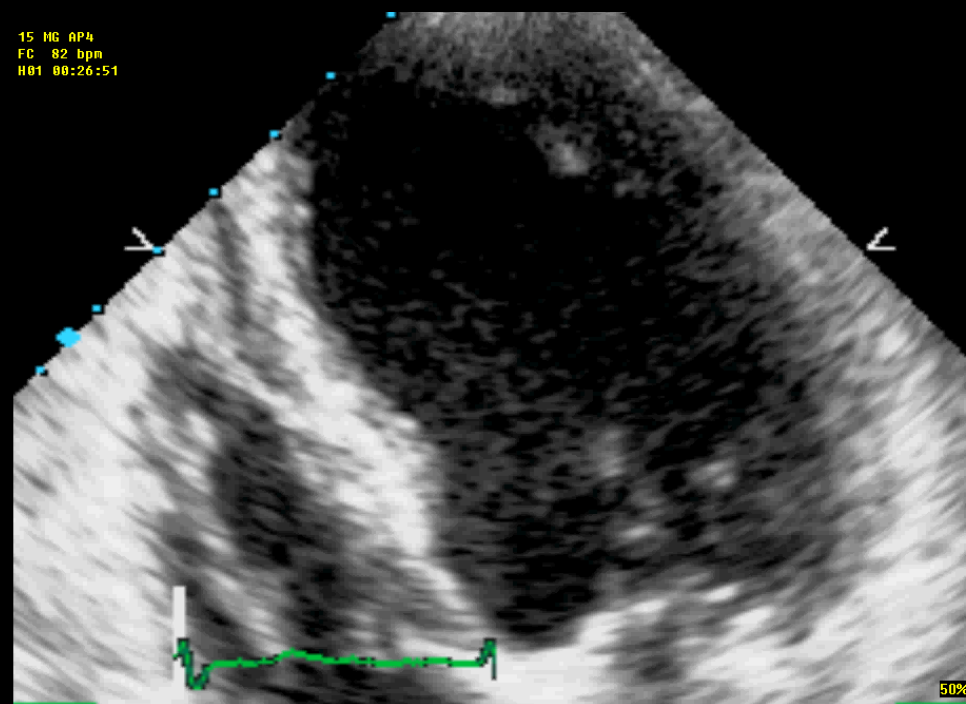


Case #1

Resting Echo

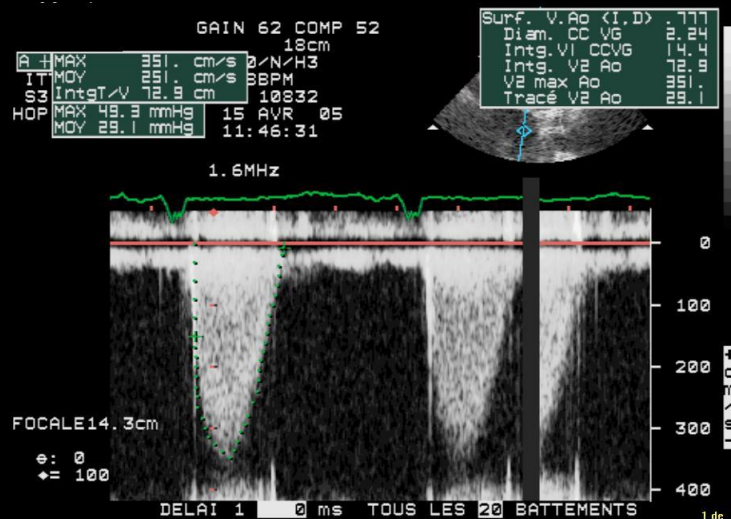
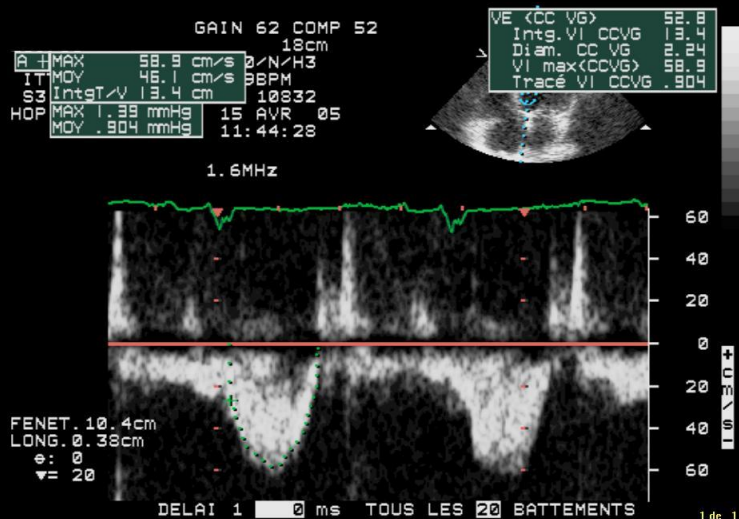


Dobutamine Stress Echo



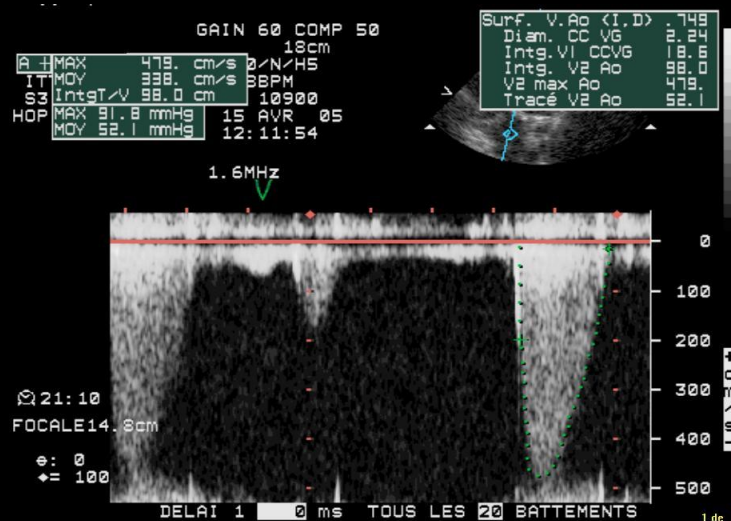
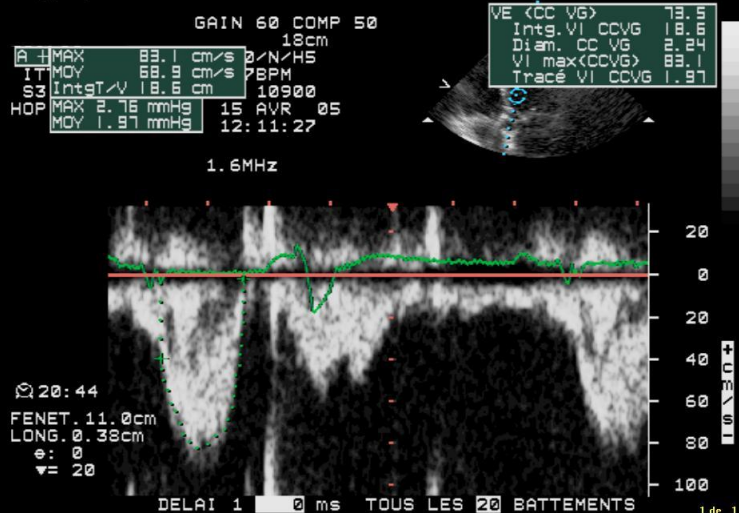
Case #1

Resting Echo



SV= 53 ml
LVEF=40%
Peak $\Delta P= 49$ mmHg
Mean $\Delta P= 29$ mmHg
AVA= 0.77 cm²

Dobutamine Stress Echo



SV= 73 ml
LVEF=50%
Peak $\Delta P= 92$ mmHg
Mean $\Delta P= 52$ mmHg
AVA= 0.75 cm²

Case #1:

- *Contractile/flow reserve: Yes*
- *Stenosis severity: True-severe*

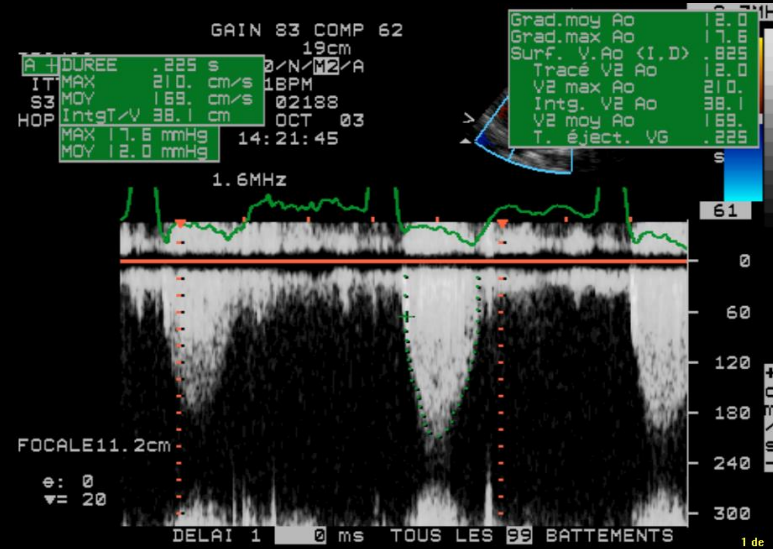
AVR should be considered in symptomatic patients with severe AS, low flow, low gradient with reduced EF, and evidence of flow reserve.^f

IIa

C

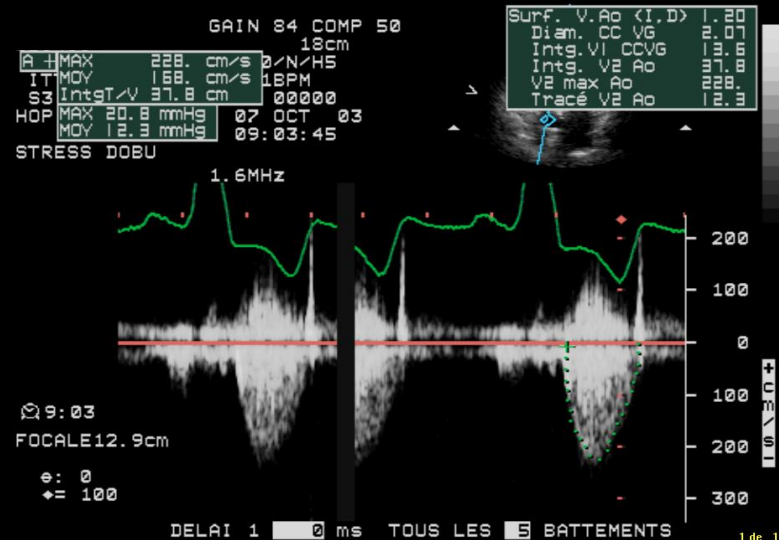
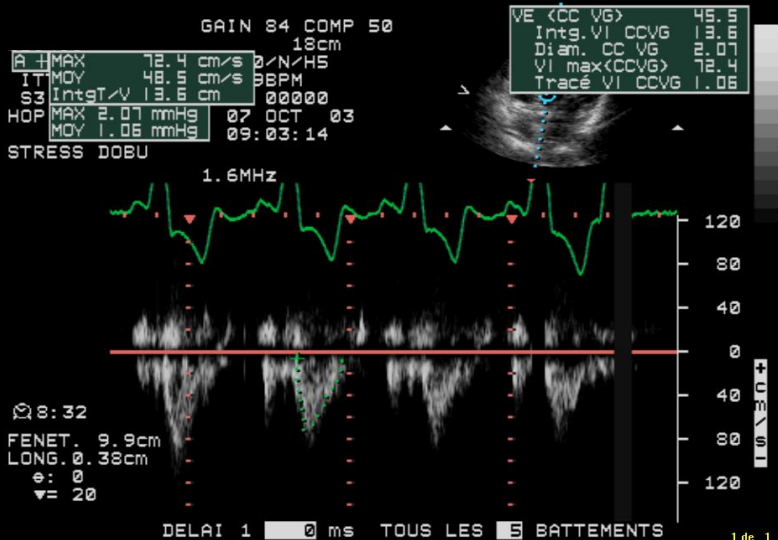
Case #2

Resting Echo



SV= 34 ml
LVEF=15%
Peak $\Delta P= 18$ mmHg
Mean $\Delta P= 12$ mmHg
AVA= 0.85 cm²

Dobutamine Stress Echo



SV= 46 ml
LVEF=25%
Peak $\Delta P= 21$ mmHg
Mean $\Delta P= 13$ mmHg
AVA= 1.2 cm²

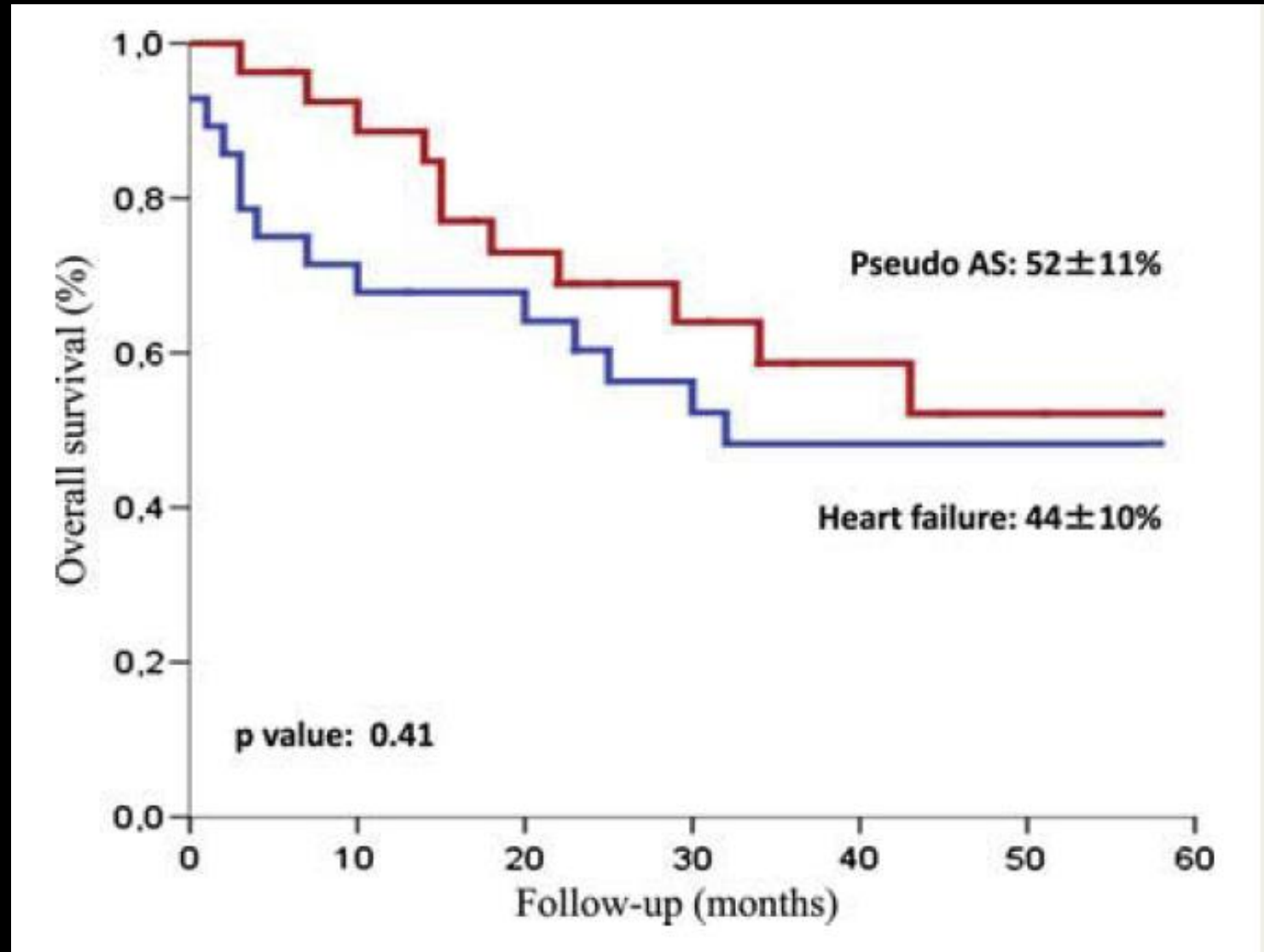
Case Study #2:

- *Contractile/flow reserve: Yes*
- *Stenosis severity: Pseudo-severe*

Outcome of Pseudo-Severe AS Under Conservative Treatment

Pseudo Severe AS:
 $\Delta P < 40$ & $AVA \geq 1.2$
at DSE

29 % had PSAS



Fougères et al.
Eur Heart J. 2012

Case : Low-Flow, Low-Gradient, Aortic Stenosis

	Rest	Dobutamine
Stroke Volume (cc)	40	53
Ejection Fraction	25	33
Mean Gradient (mm Hg)	21	32
AVA (cm²)	0.70	0.85

Case :

- *Contractile/flow reserve: Yes*
- *Stenosis severity: ?*

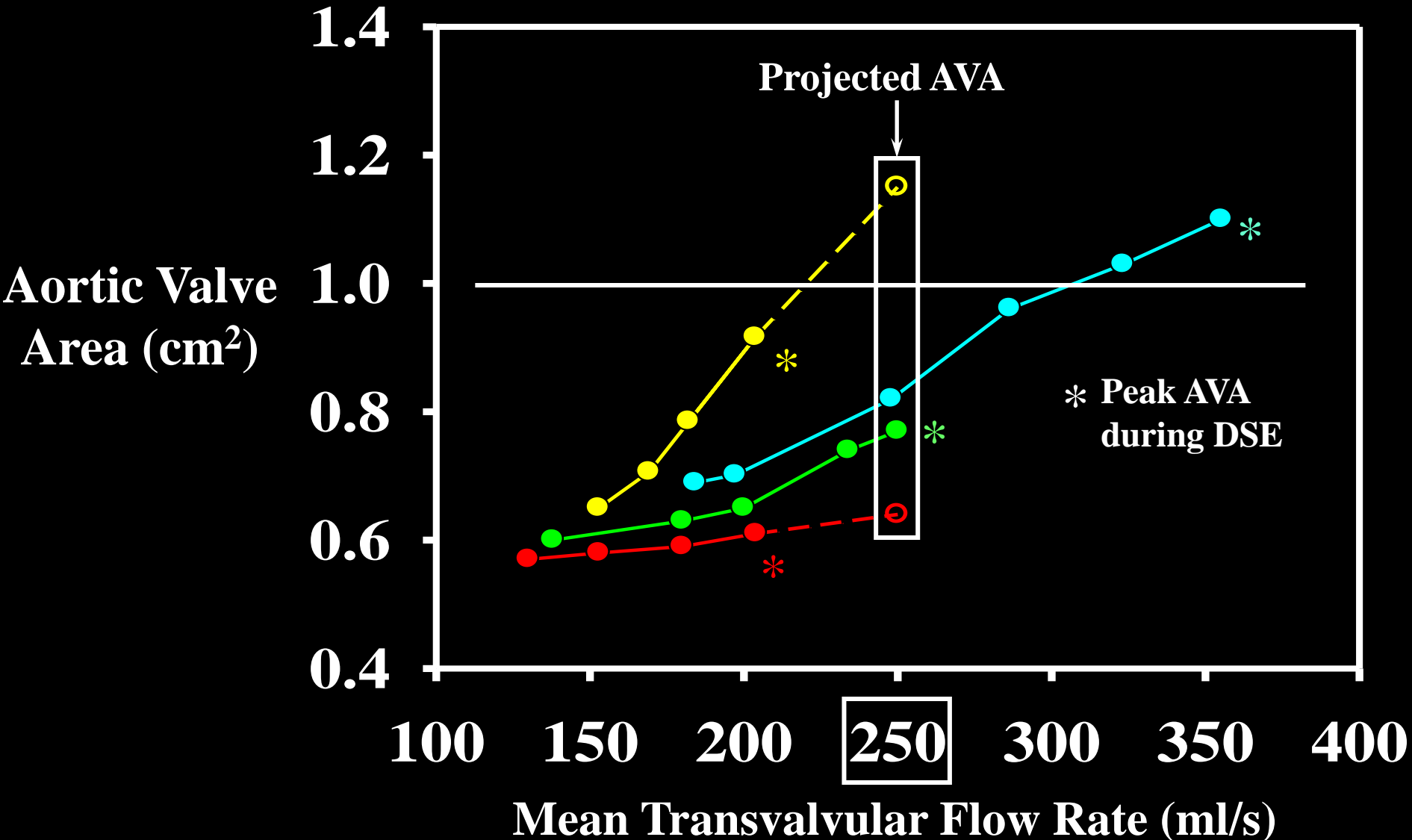
Valvular Heart Disease

Projected Valve Area at Normal Flow Rate Improves the Assessment of Stenosis Severity in Patients With Low-Flow, Low-Gradient Aortic Stenosis

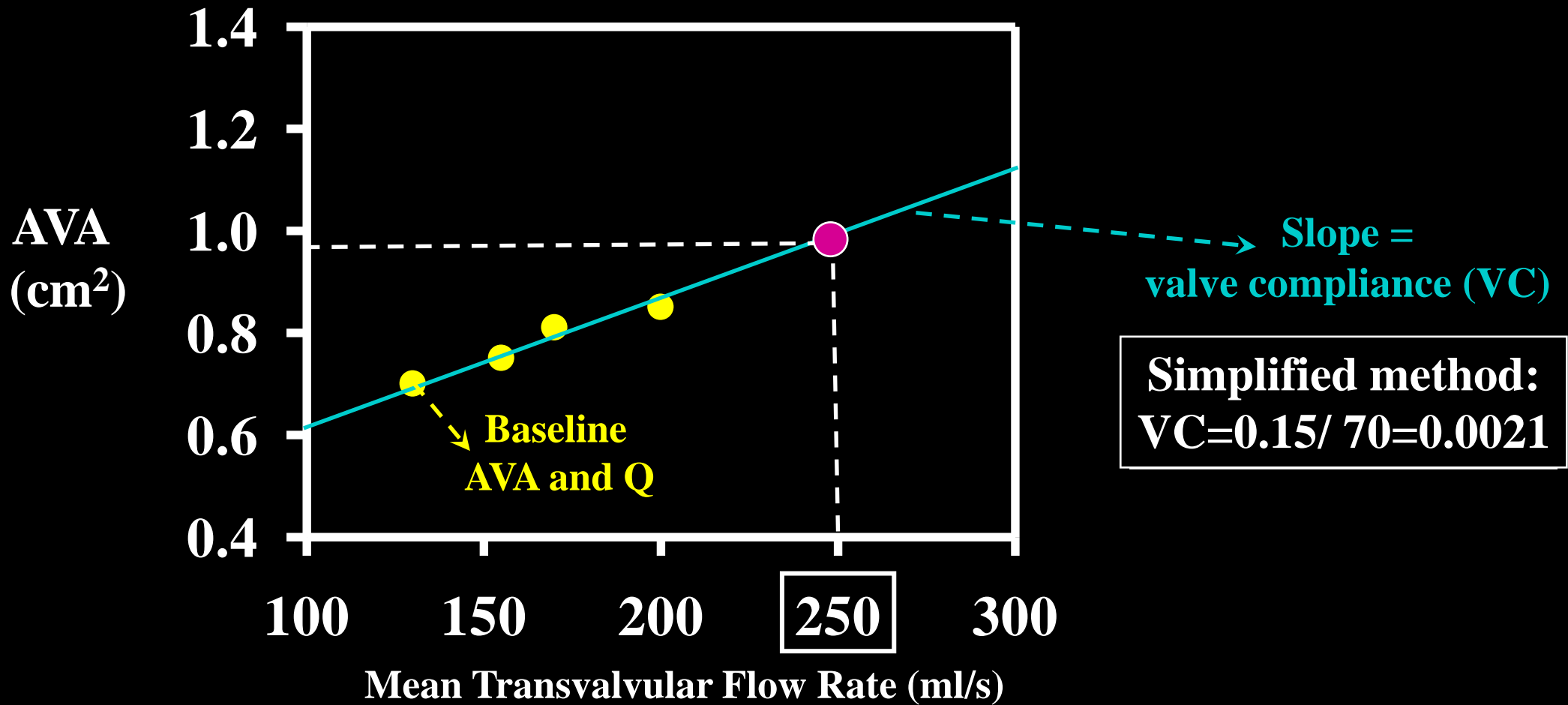
The Multicenter TOPAS (Truly or Pseudo-Severe Aortic Stenosis) Study

Claudia Blais, MSc; Ian G. Burwash, MD; Gerald Mundigler, MD; Jean G. Dumesnil, MD; Nicole Loho, MD; Florian Rader, MD; Helmut Baumgartner, MD; Rob S. Beanlands, MD; Boris Chayer, Eng; Lyes Kadem, Eng, PhD; Damien Garcia, Eng, PhD; Louis-Gilles Durand, Eng, PhD; Philippe Pibarot, DVM, PhD

Concept of the Projected AVA (250 mL/s)



Calculation of the Projected AVA

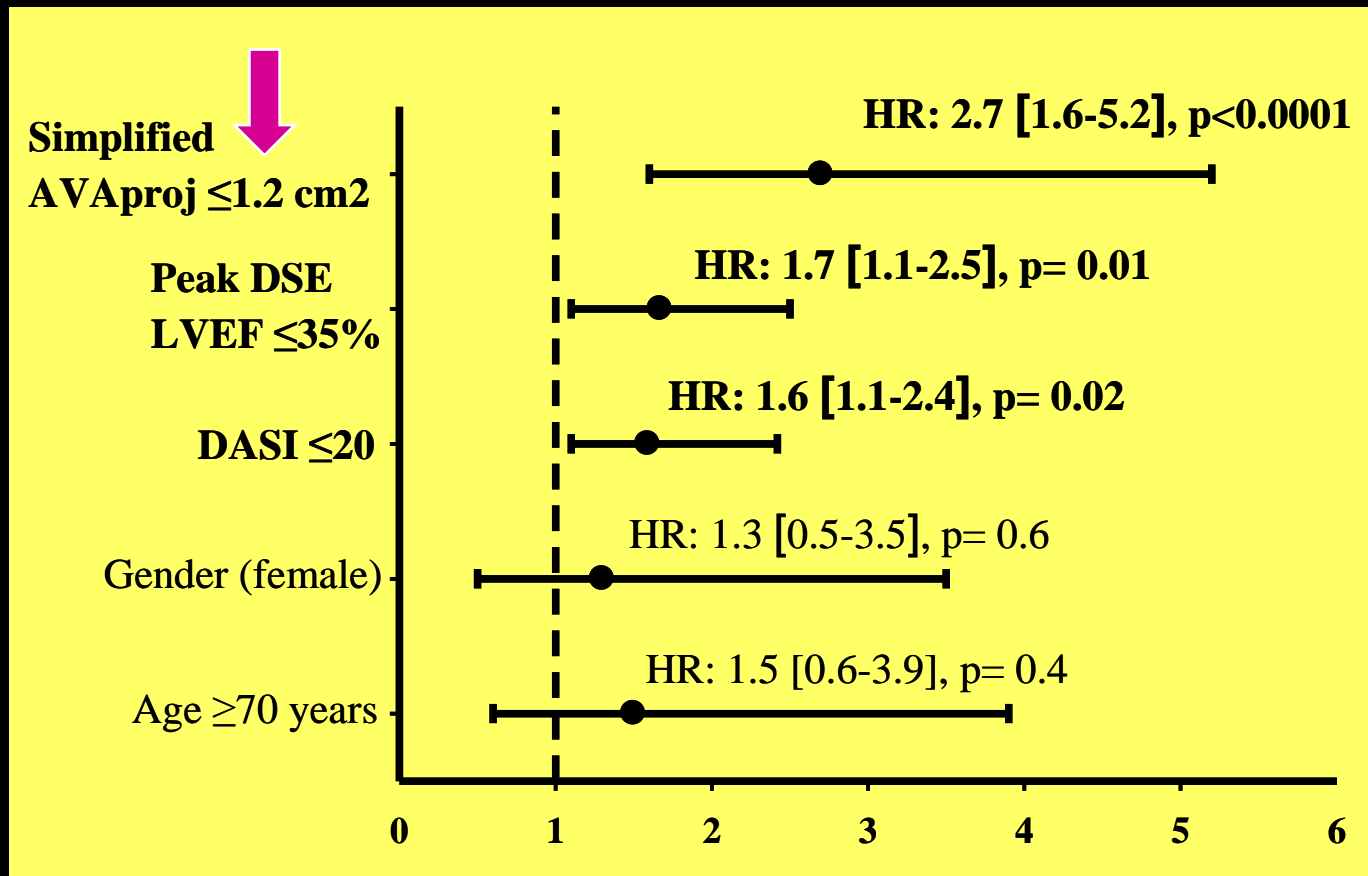


$$AVA_{\text{projected}} = 0.70 + 0.0021 \times (250 - 130) = 0.96 \text{ cm}^2$$

Case Study: Low-Flow, Low-Gradient, Aortic Stenosis

	Rest	Dobutamine
Stroke Volume (cc)	40	53
Ejection Fraction	25	33
Mean Gradient (mm Hg)	21	32
AVA (cm²)	0.70	0.85
Projected AVA (cm²)		0.96

Predictors of Mortality in Patients with Low-EF, Low-Flow, Low-Gradient AS Treated Medically – TOPAS Study

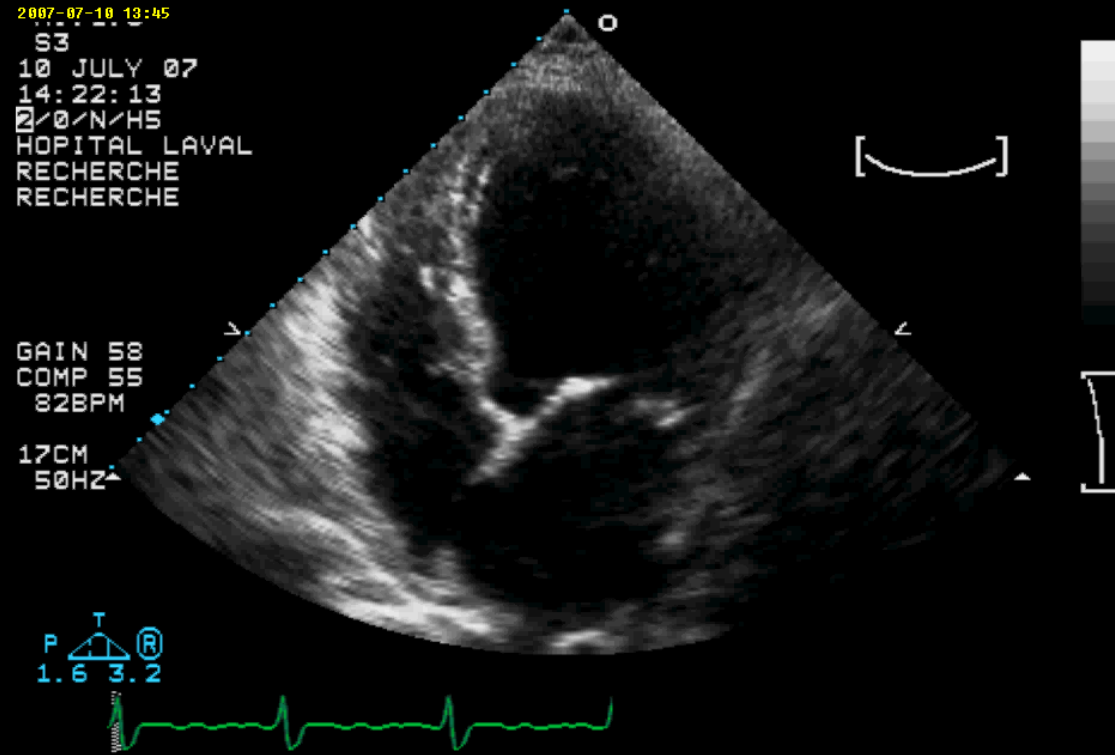


Clavel et al.
Circulation 2008
JASE 2010

What is moderate AS for a good ventricle may be severe for a depressed ventricle

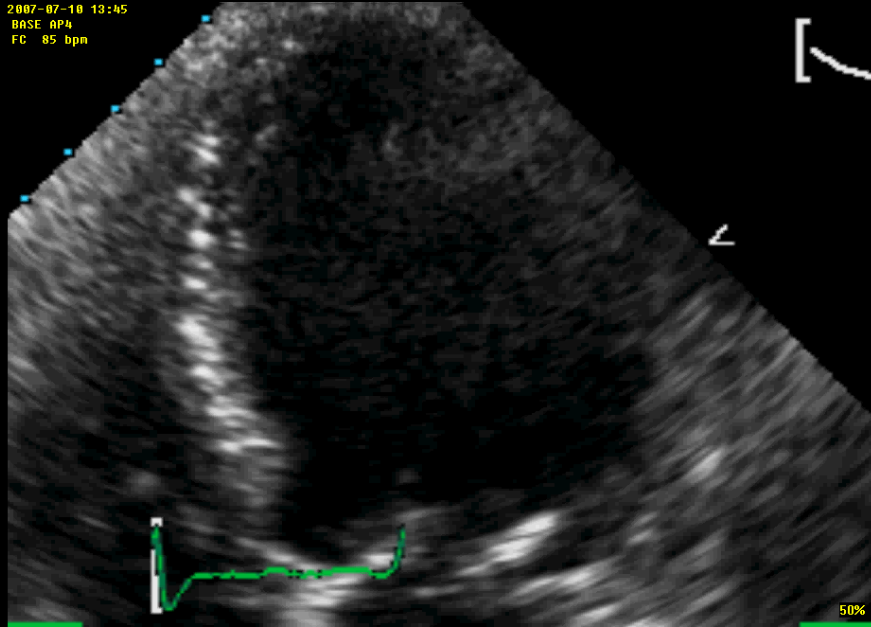
Case #3

- **76 y.o. woman**
- **Risk factors:**
 - **Obese, Hyperchol.**
 - **Hypertension, COPD**
 - **3-vessel CAD**
- **CABG × 3: Aug 95**
- **MI: Jan 96**
- **CHF: LVEDD:64 mm, LVEF: 25%, BNP: 832 pg/ml**
- **Aortic stenosis, mild mitral regurgitation**
- **Current medication: ASA, ARBs, Statin, Digoxin, Brochodil.**



Resting Echo

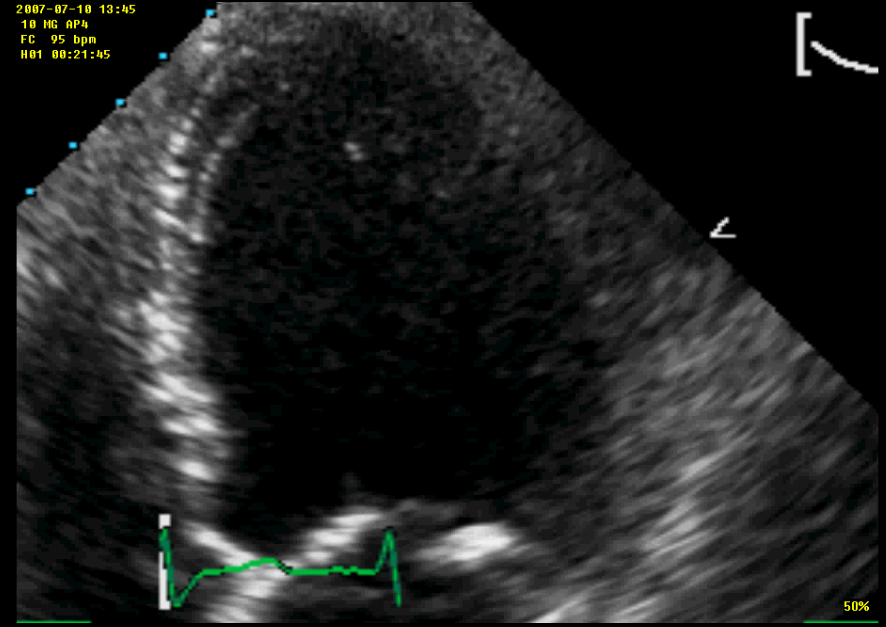
2007-07-10 13:45
BASE AP4
FC 85 bpm



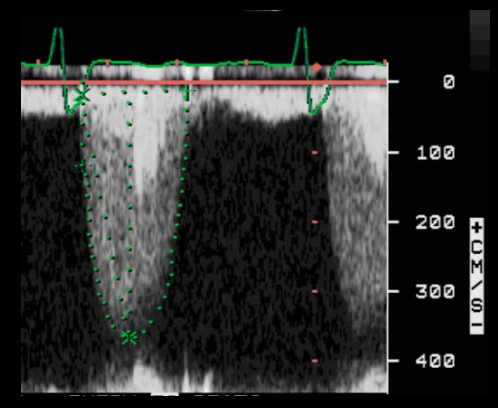
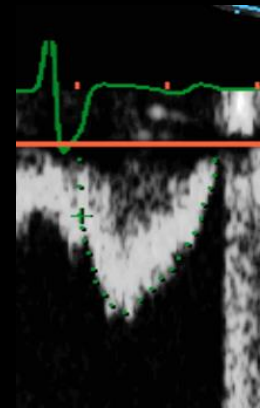
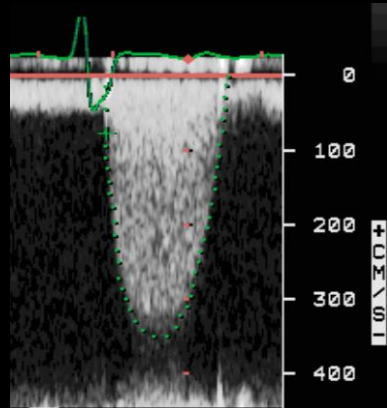
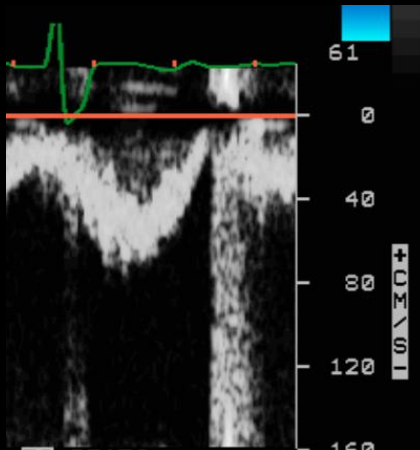
LVEF=25% SV= 51 ml
AVA= 0.8 cm²
 $\Delta P= 46 / 27$ mmHg

Dobutamine Stress Echo

2007-07-10 13:45
10 HG AP4
FC 95 bpm
H01 00:21:45



LVEF=30% SV= 57 ml
AVA= 0.8 cm²
 $\Delta P= 52 / 30$ mmHg



Case #3:

- *Contractile/flow reserve: No*
- *Stenosis severity: Indeterminate*

AVR may be considered in symptomatic patients with severe AS low flow, low gradient, and LV dysfunction without flow reserve.^f

IIb

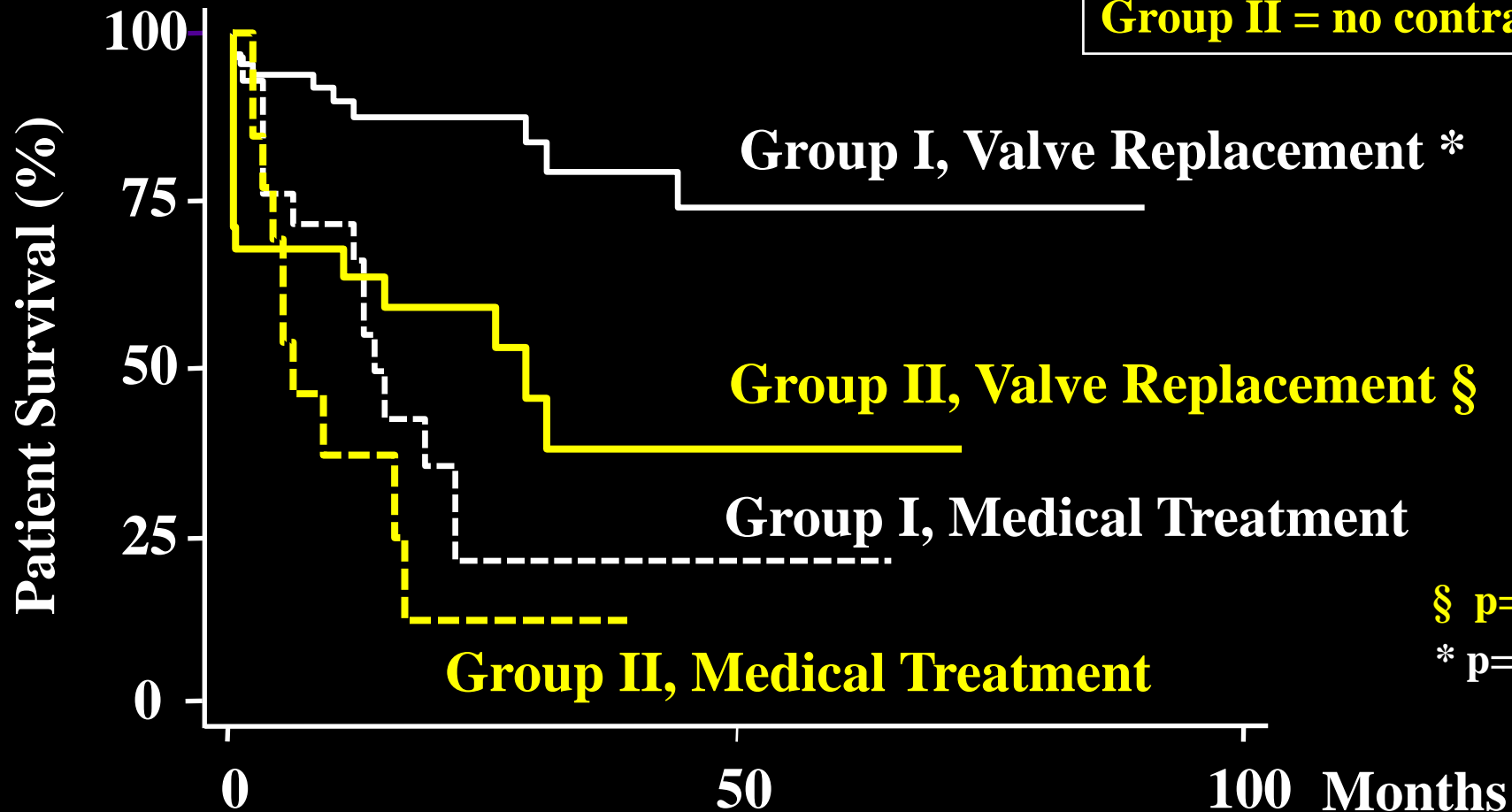
C

Risk Stratification using Contractile Reserve

126 Patients

Group I = contractile reserve
 $\Delta SV \geq 20\%$ under DSE

Group II = no contractile reserve



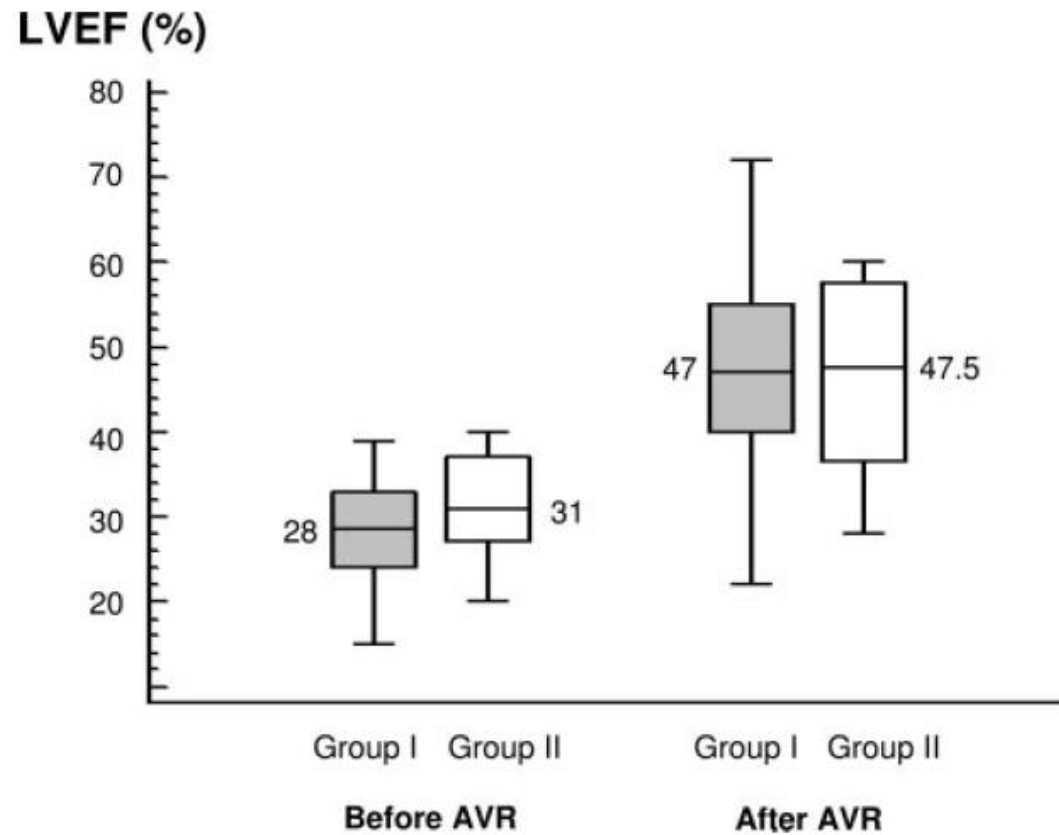
§ p=0.07 vs medical

* p=0.001 vs medical

Preoperative Contractile Reserve vs. Postoperative Ejection Fraction

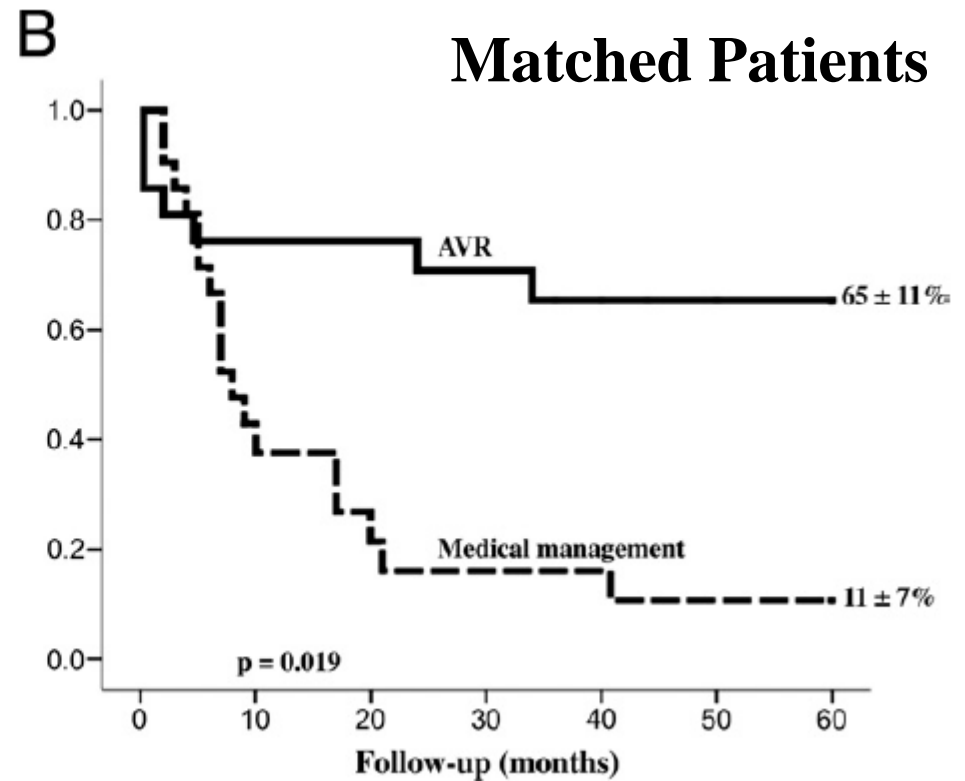
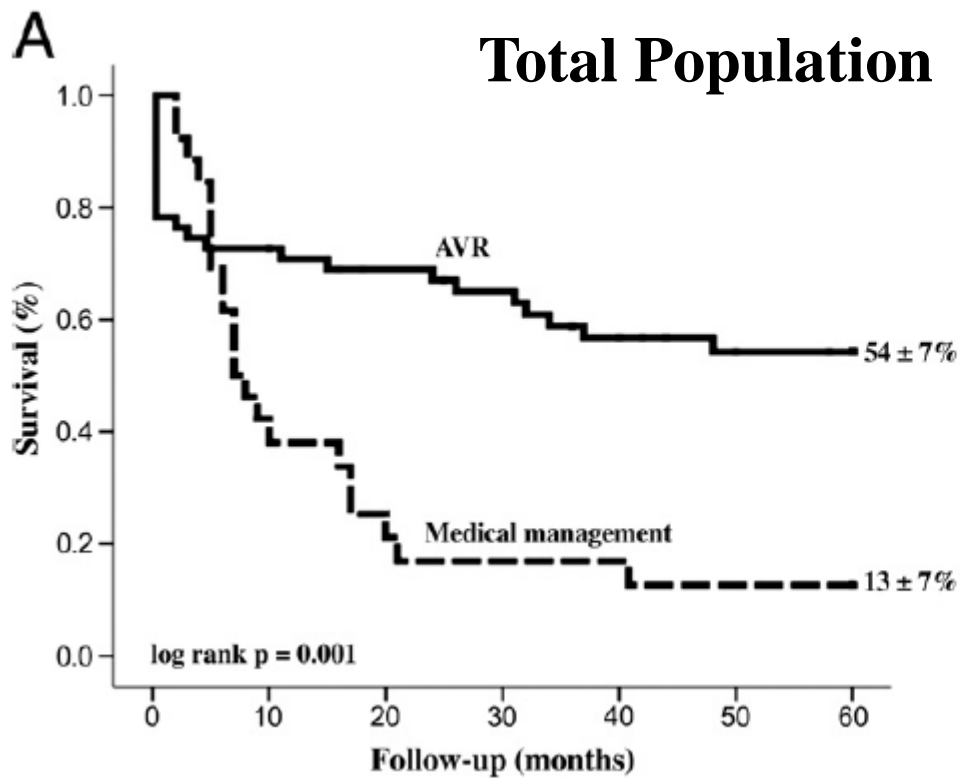
66 Patients who underwent AVR

	Group I (CR+)	Group II (CR-)
Operative Mortality	6%	33%
2-year Survival	97±7%	90±5%



Outcome After Aortic Valve Replacement for Low-Flow/Low-Gradient Aortic Stenosis Without Contractile Reserve on Dobutamine Stress Echocardiography

Christophe Tribouilloy, MD, PHD,* Franck Lévy, MD,† Dan Rusinaru, MD,† Pascal Guéret, MD,‡ Hélène Petit-Eisenmann, MD,§ Serge Baleynaud, MD,|| Yannick Jobic, MD,¶ Catherine Adams, MD,# Bernard Lelong, MD,** Agnès Pasquet, MD,†† Christophe Chauvel, MD,‡‡ Damien Metz, MD,§§ Jean-Paul Quéré, MD,* Jean-Luc Monin, MD, PHD‡



Case #3:

- *Contractile/flow reserve: No*
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AVR may be considered in symptomatic patients with severe AS low flow, low gradient, and LV dysfunction without flow reserve.^f

IIb

C

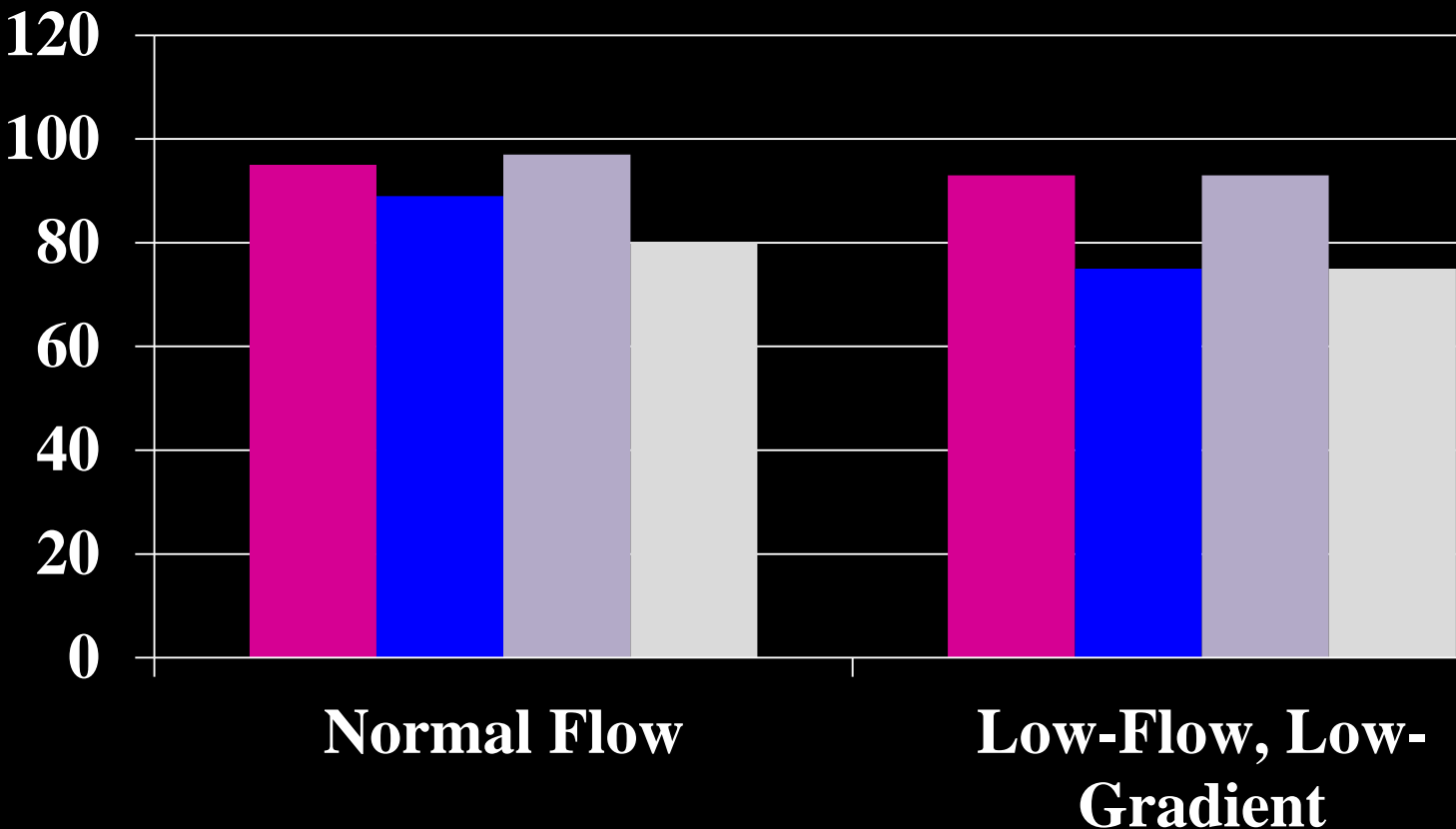


Measurement of aortic valve calcification using multislice computed tomography: correlation with haemodynamic severity of aortic stenosis and clinical implication for patients with low ejection fraction

Caroline Cueff,¹ Jean-Michel Serfaty,^{2,3} Claire Cimadevilla,¹ Jean-Pierre Laissy,² Dominique Himbert,¹ Florence Tubach,⁴ Xavier Duval,⁵ Bernard Jung,¹ Maurice Enriquez-Sarano,⁶ Alec Vahanian,¹ David Messika-Zeitoun^{1,3}

Performance of **MSCT Calcium score > 1651 AU** to correctly differentiate severe from non-severe AS

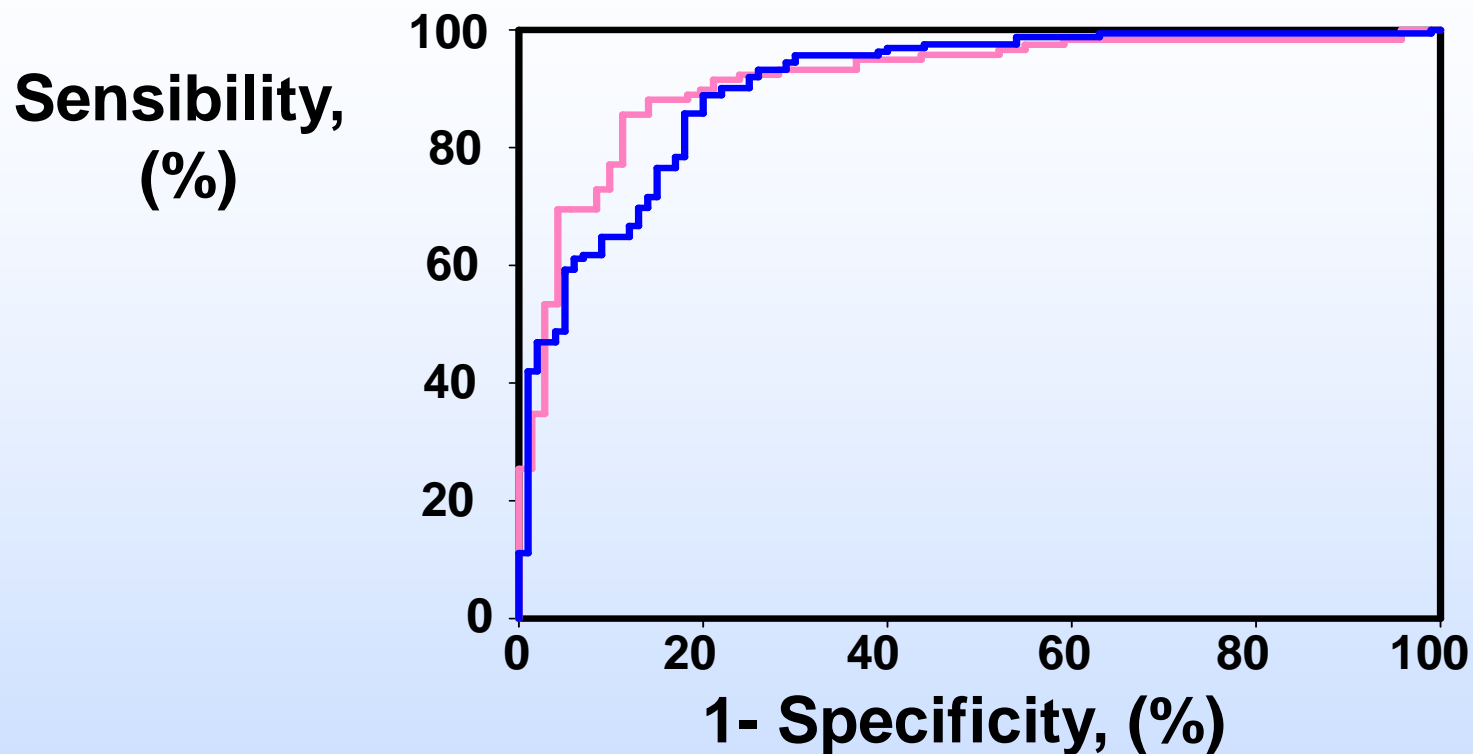
Case study #3
Score: 2010



Cueff et al. Heart
97:721-6, 2011

Mayo-Québec-Bichat Collaboration:

Accuracy of AVC to identify severe AS

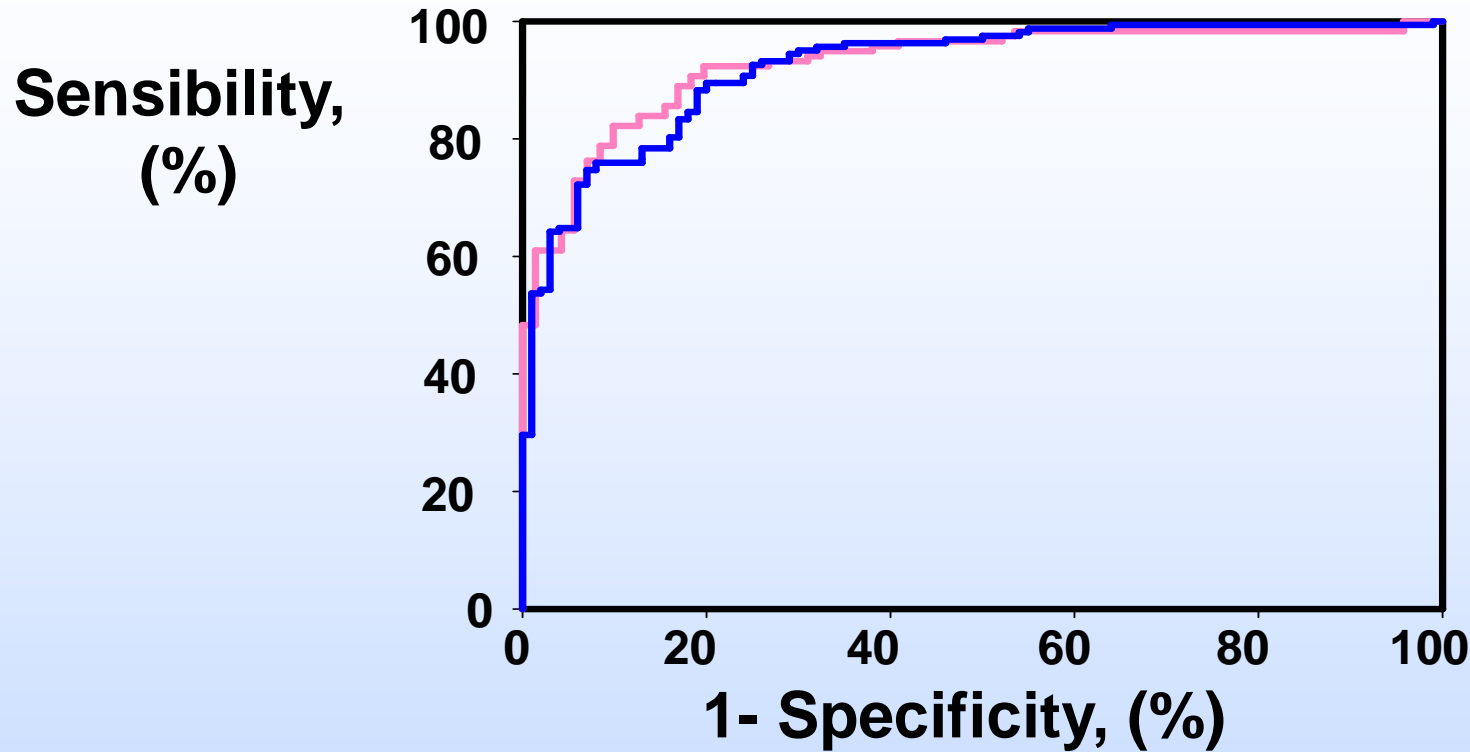


Case #3:
2010 AU

Gender	Threshold	AUC	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Women	1274 AU	0.91	89	86	93	79
Men	2065 AU	0.90	89	80	88	82

Mayo-Québec-Bichat Collaboration:

Accuracy of AVC density to identify severe AS



**AVC Density =
AVC/CSA_{AA}**

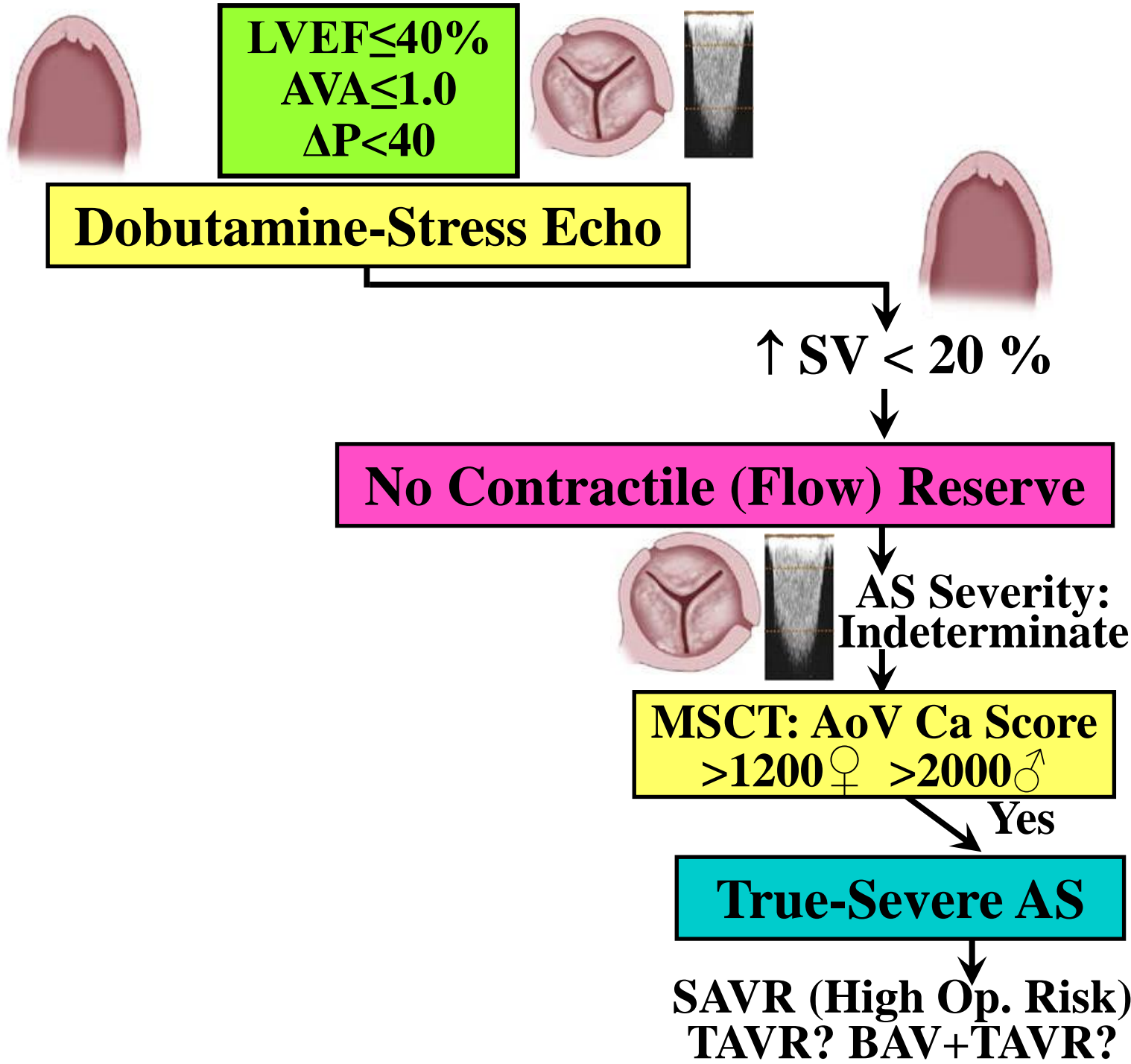
**Case #3:
528 AU/cm²**

Gender	Threshold	AUC	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Women	292 AU/cm ²	0.93	92	81	87	86
Men	476 AU/cm ²	0.92	90	80	88	82

Aortic Valve Surgery: Unveiling the Mystery of a Woman's Heart

Philippe Pibarot

Laval Hospital Research Center, Québec Heart Institute, Department of Medicine, Laval University,
Québec, Canada



Case #3:

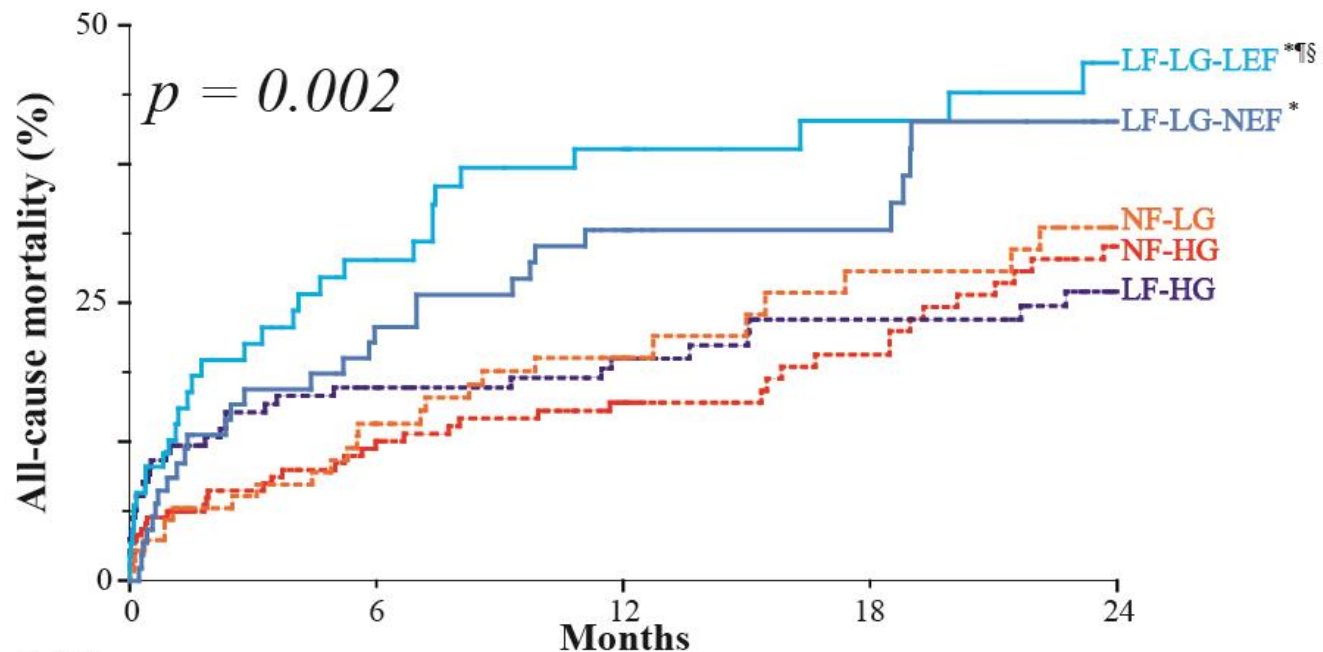
No Contractile Reserve
High BNP (832 pg/ml)
Logistic Euroscore: 60%

- 1- Medical**
- 2- SAVR**
- 3- TAVR**
- 4- BAV...TAVR**



Outcome of Low-Flow, Low-Gradient AS Following TAVR

The Québec-Vancouver Experience

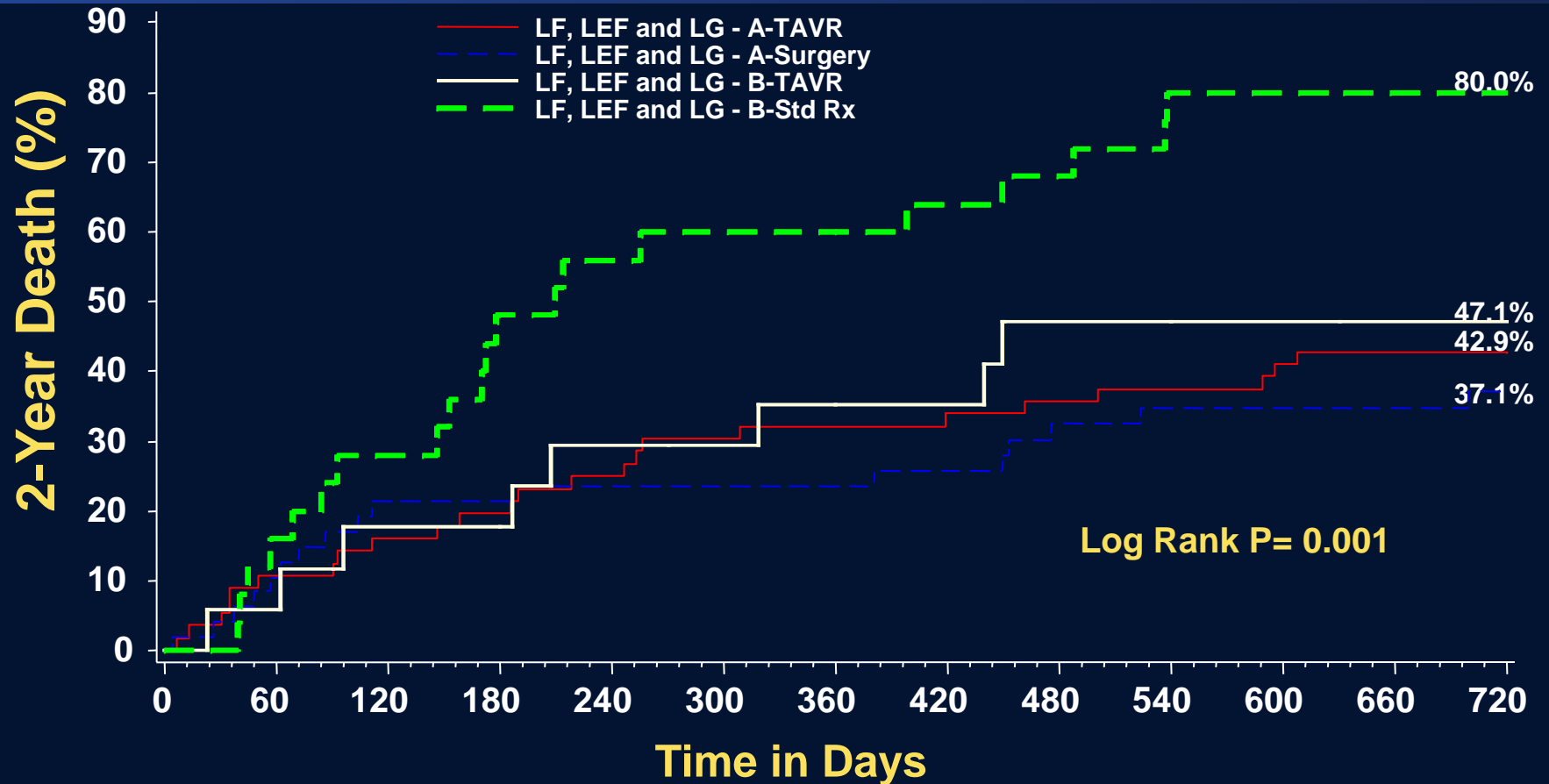


Patients at risk

NF-HG	195	135	112	75	57
NF-LG	110	76	60	37	31
LF-HG	158	107	88	63	53
LF-LG-NEF	86	55	44	28	17
LF-LG-LEF	90	46	34	23	18

LeVen F et al.
JACC 2013

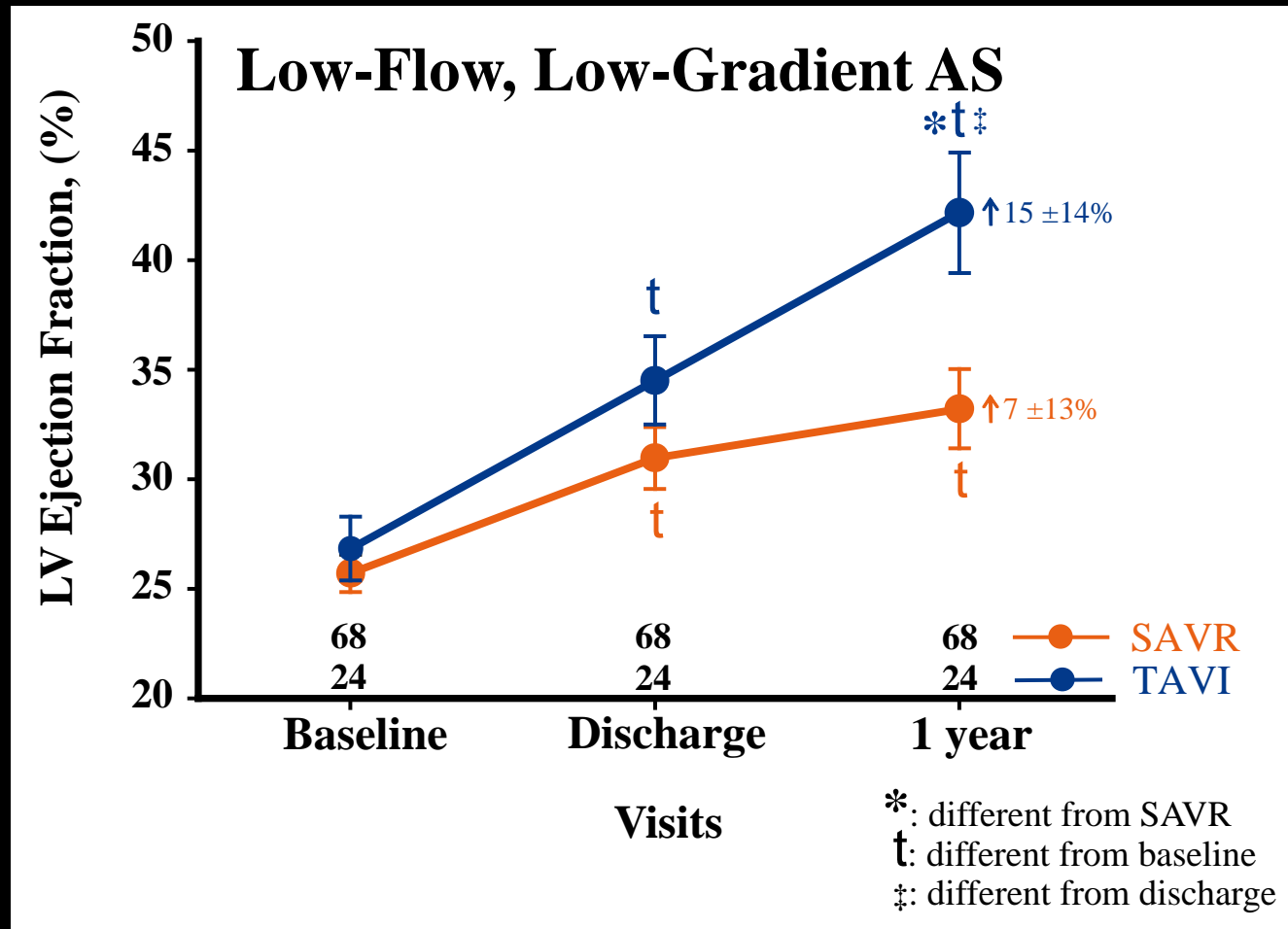
Treatment Comparison in Low-EF, Low-Flow, Low-Gradient (both cohorts)

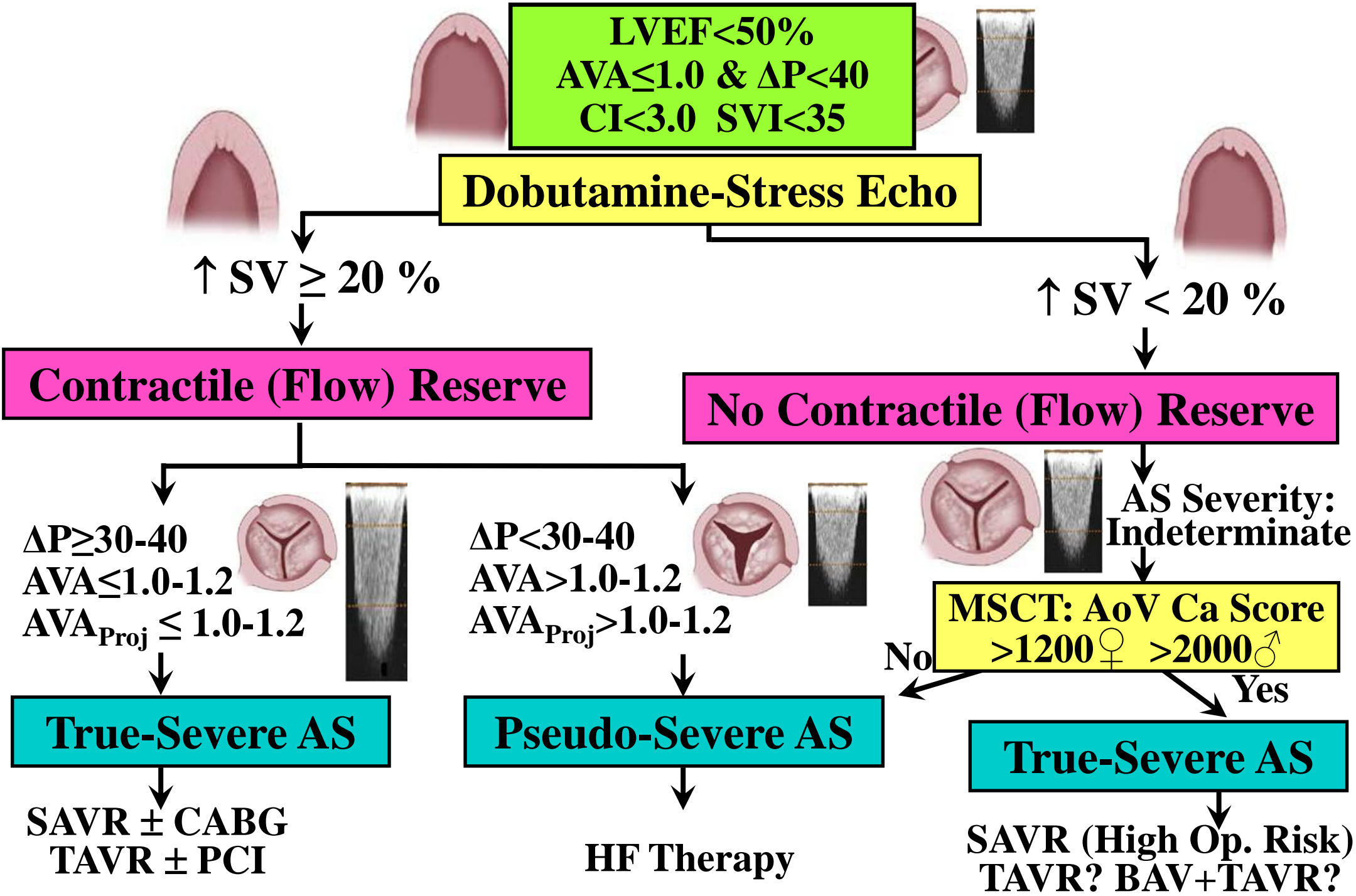


Number At Risk

A-TAVR	56	50	45	39	38	37	35	32	32
A-Surgery	49	38	36	35	35	32	29	29	27
B-TAVR	17	15	14	12	11	9	9	9	9
B-Std Rx	25	19	13	10	10	8	5	5	5

Recovery of LVEF in Patients with Low-LVEF, Low-Flow, Low-Gradient AS: TAVR versus SAVR

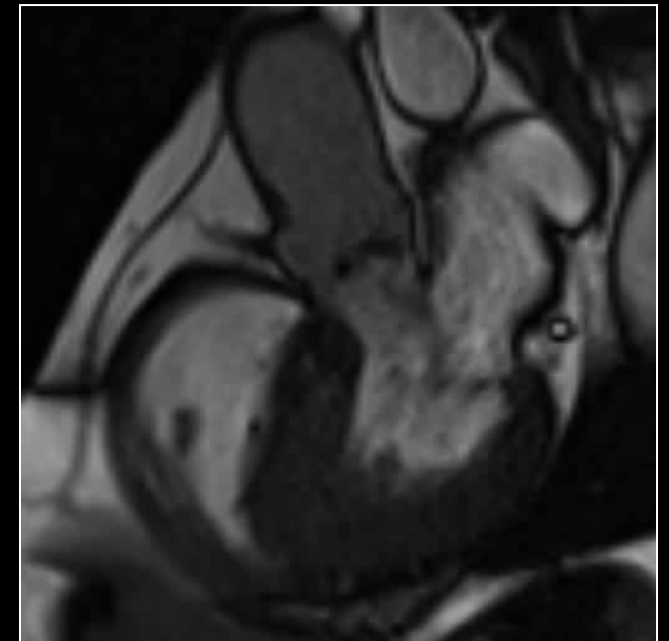




“Paradoxical” Low-Flow, Low-Gradient AS with Preserved LVEF



↑ Age
Women
Hypertension
MetS – Diabetes



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

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
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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
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AVR should be considered in asymptomatic patients with severe AS and abnormal exercise test showing fall in blood pressure below baseline.	IIa	C
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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

*The eyes do not see what
the guidelines does not show!*



*And once the guidelines finally shows...
the eyes see it everywhere!*

