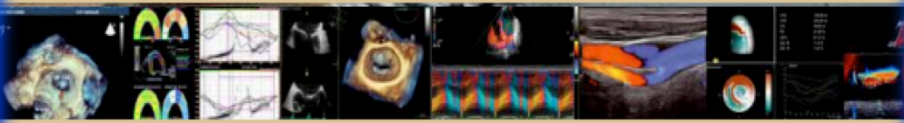




Società Italiana di Ecografia Cardiovascolare

WWW.SIEC.IT



**ECOCARDIOGRAFIA 2015**  
**XVII Congresso Nazionale SIEC**

Hotel Royal Continental

Napoli, 16-18 Aprile 2015

# Quali parametri per la stenosi aortica severa asintomatica

C.M.Rao  
MD, PhD

Azienda Ospedaliera "Bianchi-Melacrino-Morelli"

U.O. di Cardiologia

Reggio Calabria



## Stenosi aortica severa sintomatica

### Sintomi:

Angina pectoris

Sincope

Scompenso cardiaco

Se non operati mortalità  $\approx$  75% a  
3 anni

## Stenosi aortica severa asintomatica

### Clinicamente silente

Intervento « precoce » di sostituzione per:

Prevenire la morte improvvisa

Prevenire la disfunzione ventricolare

Evitare che il pz diventi a rischio



IDENTIFICAZIONE DEI  
PAZIENTI

# ESC/EACTS Guidelines for the Management of Valvular Heart Disease

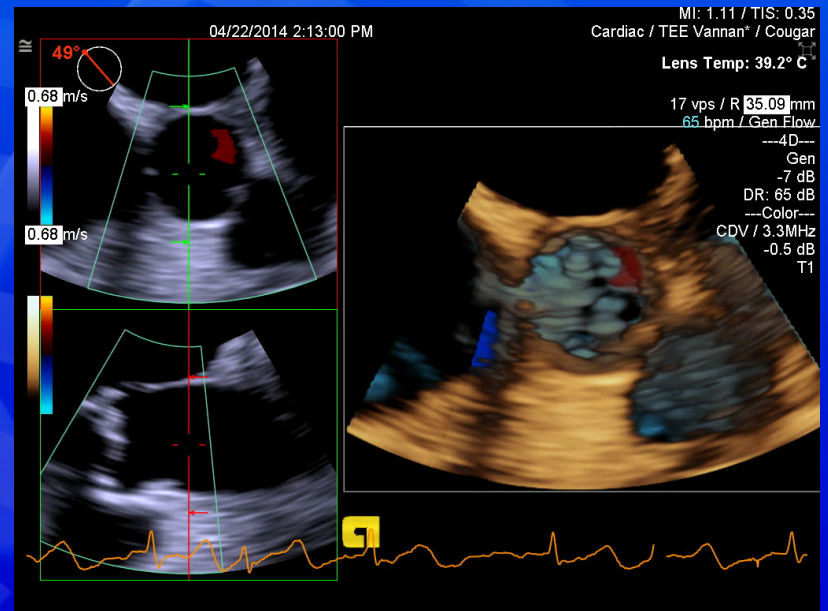
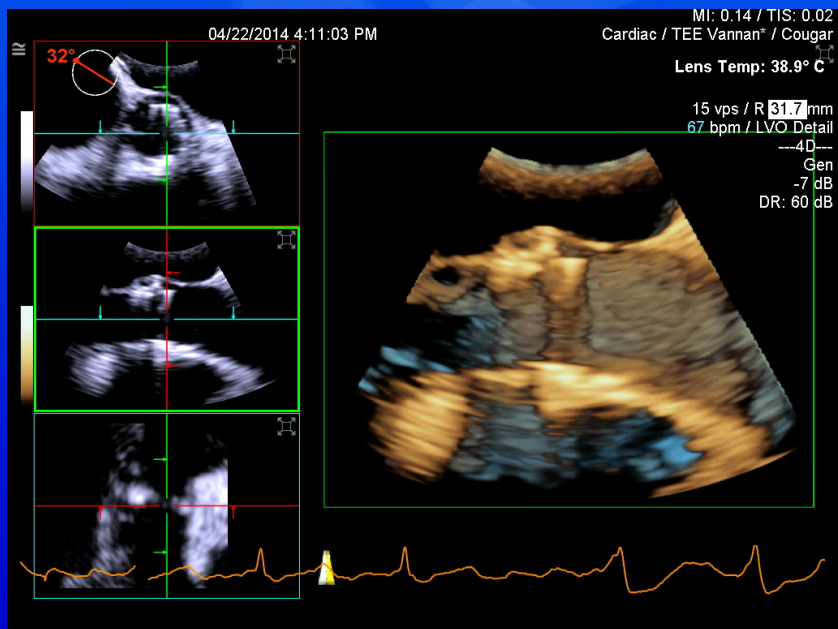
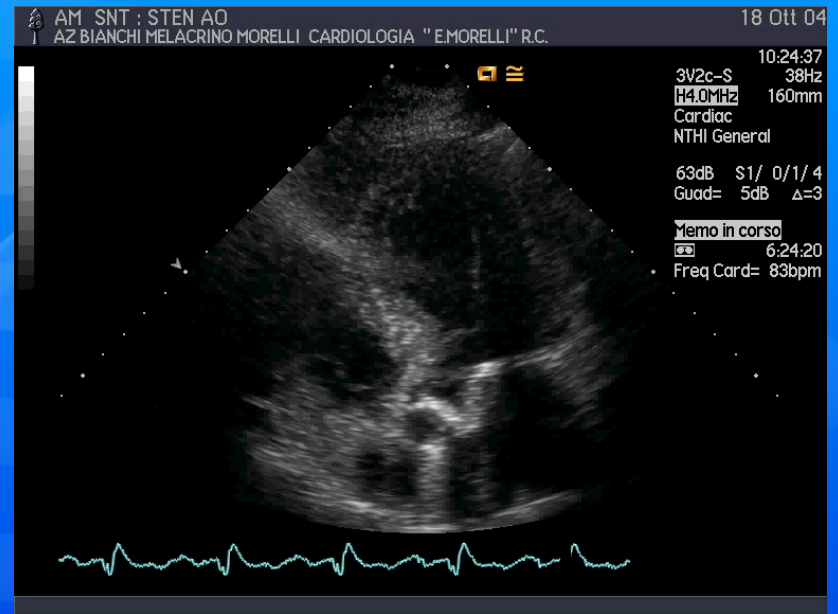
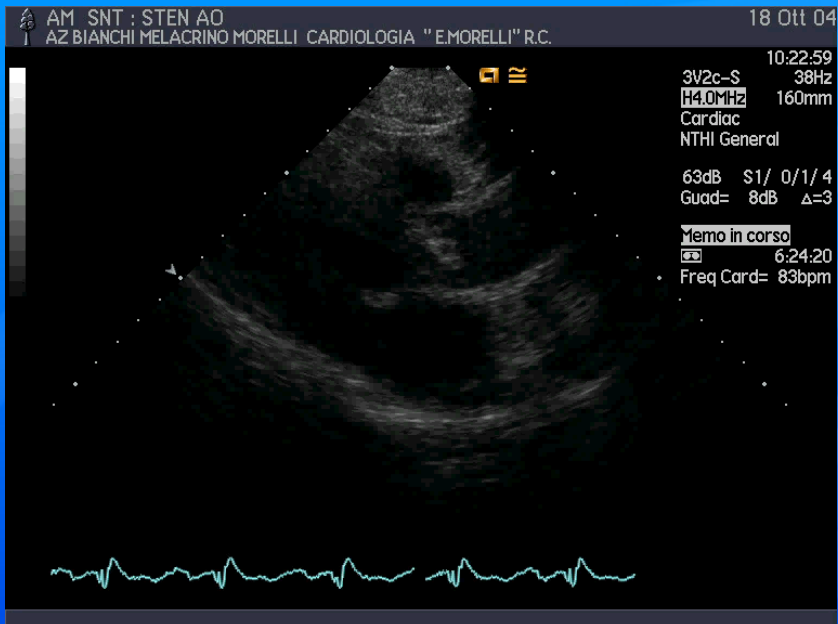
Echocardiographic criteria for the definition of severe valve stenosis: *an integrative approach*



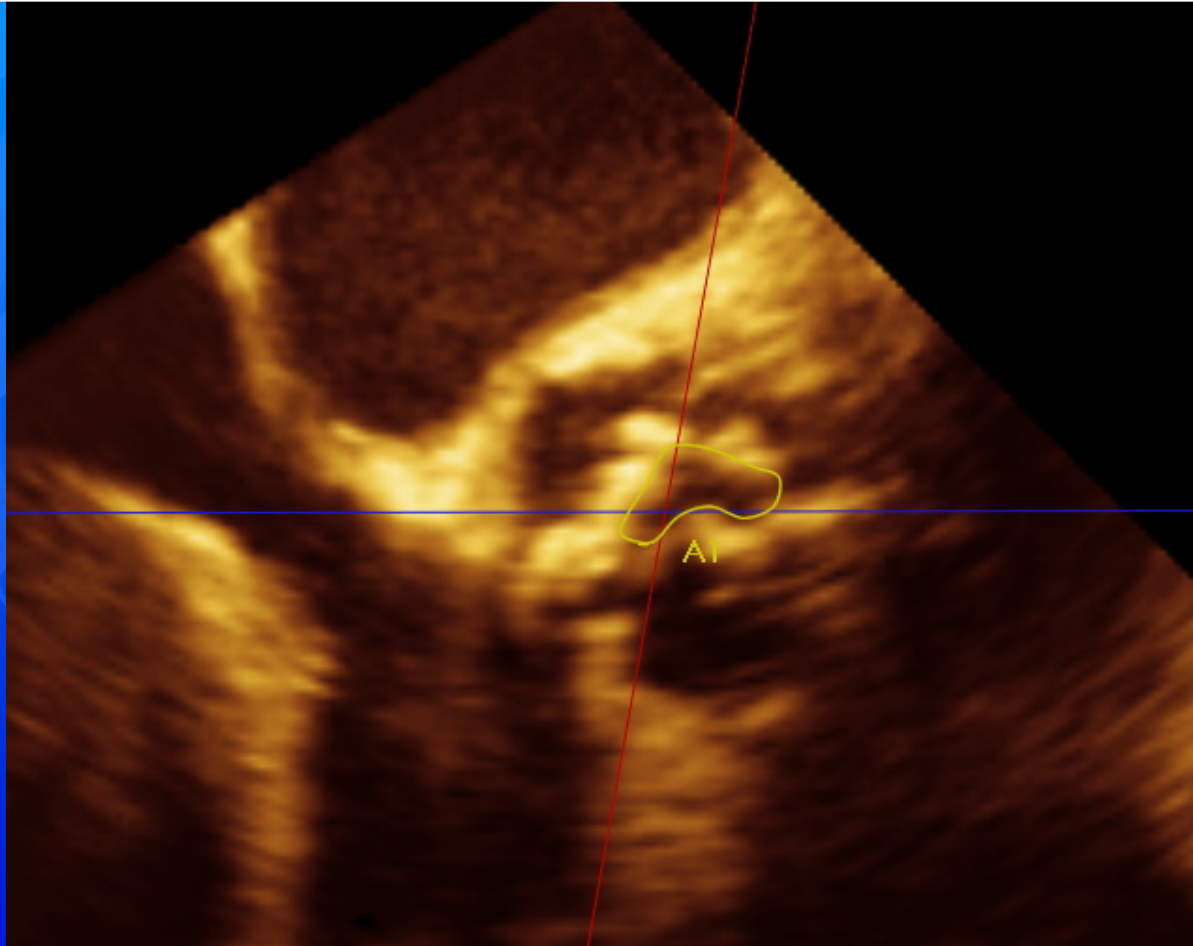
ECHO  
Multiparametrico

Clinica

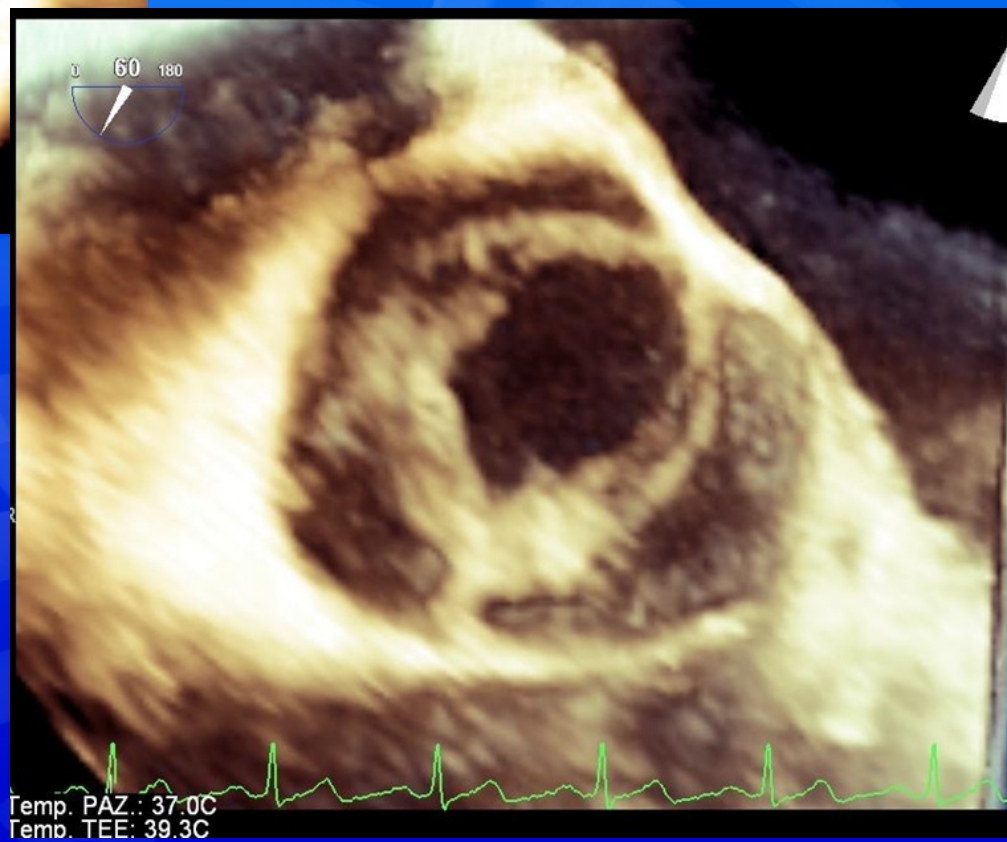




# 3D vs 2D



Migliore valutazione quantitativa (area)





# Other Techniques

- **Exercise testing**
  - Objective assessment if equivocal or no symptoms.
  - Prognosis in asymptomatic AS.
- **Stress echocardiography**
  - Low dose dobutamine echocardiography in AS with low gradient and LV dysfunction.
  - Exercise echocardiography may provide additional information in AS, MR, MS.
- **Magnetic resonance imaging**
  - To assess regurgitation/LV function if echocardiography is inadequate.
  - As a reference method for evaluation of RV.
- **Multislice CT**
  - For imaging of thoracic aorta.
  - For work-up before TAVI.
- **Cardiac catheterisation (to evaluate valve function)**
  - Only if non-invasive findings inconsistent or discordant with clinical assessment.



# ESC/EACTS Guidelines for the Management of Valvular Heart Disease

	Aortic stenosis	Mitral stenosis	Tricuspid stenosis
Valve area (cm <sup>2</sup> )	< 1.0	< 1.0	–
Indexed valve area (cm <sup>2</sup> /m <sup>2</sup> BSA)	< 0.6	–	–
Mean gradient (mmHg)	> 40	> 10	≥ 5
Maximum jet velocity (m/s)	> 4.0	–	–
Velocity ratio	< 0.25	–	–

Adapted from Baumgartner, EAE/ASE recommendations. *Eur J Echocardiogr.* 2010;10:1-25

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 &  
European Journal of Cardio-Thoracic Surgery 2012 -  
doi:10.1093/ejcts/ezs455).

**DISCORDANZA = DIFFICILE  
STRATIFICAZIONE PROGNOSTICA  
NELLA STENOSI AORTICA  
ASINTOMATICA**

## Inconsistencies of echocardiographic criteria for the grading of aortic valve stenosis

Jan Minners\*, Martin Allgeier, Christa Gohlke-Baerwald, Robert Kienzle, Franz-Josef Neumann, and Nikolaus Jander

Percentage of patients diagnosed with severe aortic stenosis according to which echocardiographic criterion was used

Guidelines/ recommendations	Parameter	Patients with severe stenosis
AHA/ACC <sup>3</sup>	AVA <1.0 cm <sup>2</sup>	69%
ESC <sup>2</sup>	AVA/BSA <0.6 cm <sup>2</sup>	76%
Otto <sup>4</sup>	V <sub>max</sub> >4.0 m/s	45%
AHA/ACC <sup>3</sup>	ΔP <sub>mn</sub> >40 mmHg	40%

AVA, aortic valve area; BSA, body surface area; V<sub>max</sub>, peak flow velocity; ΔP<sub>mn</sub>, mean pressure gradient.

Severe stenosis?

Am Heart J. 1998



Valvular aortic stenosis: which measure of severity is best?

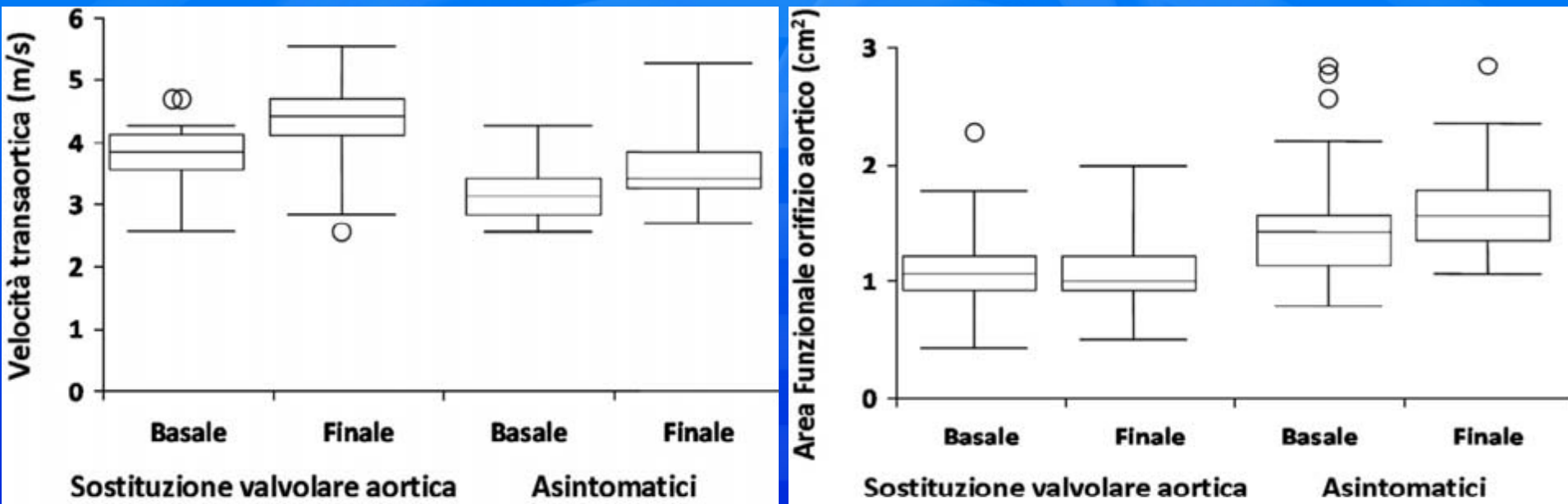
*“In my opinion, rather than Catherine M. Otto pursuing an elusive anatomic or hemodynamic standard, we should use clinical outcome as the reference standard for aortic stenosis severity “*

*Catherine M. Otto*





## Variabilità delle aree valvolari e della velocità transaortica massima al momento in cui i pazienti con stenosi valvolare aortica diventano sintomatici



Otto CM, Burwash IG, Legget ME, et al. Circulation 1997; 95: 2262-70.

# PROFILO EPIDEMIOLOGICO



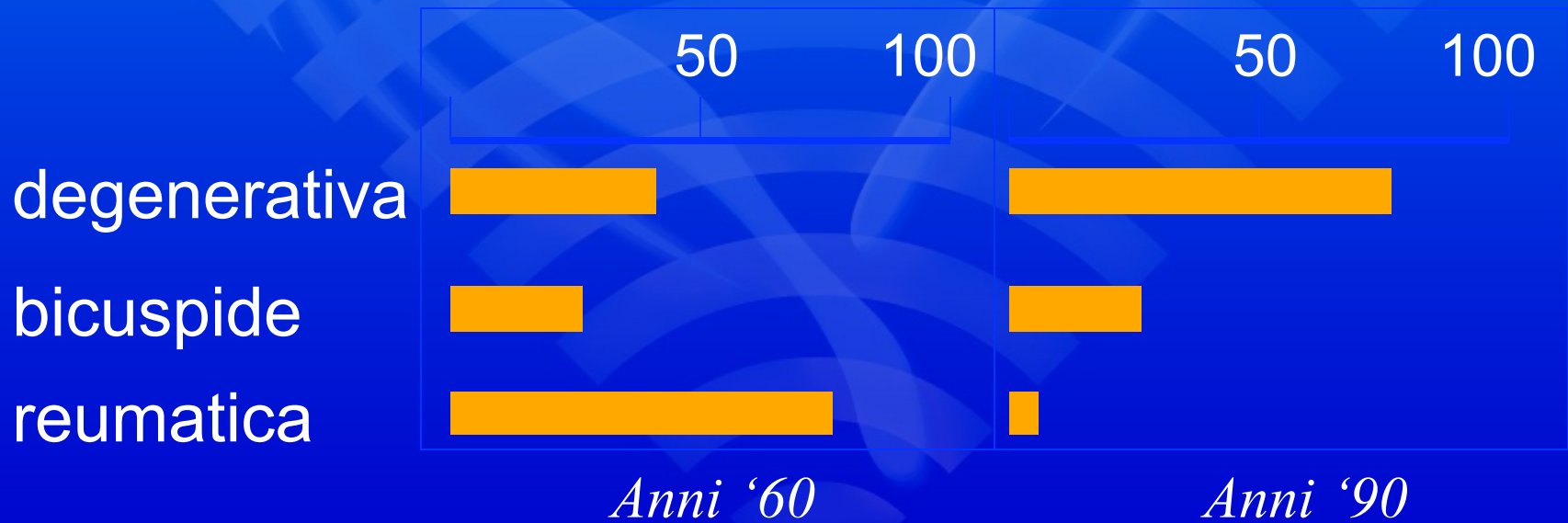
reumatica



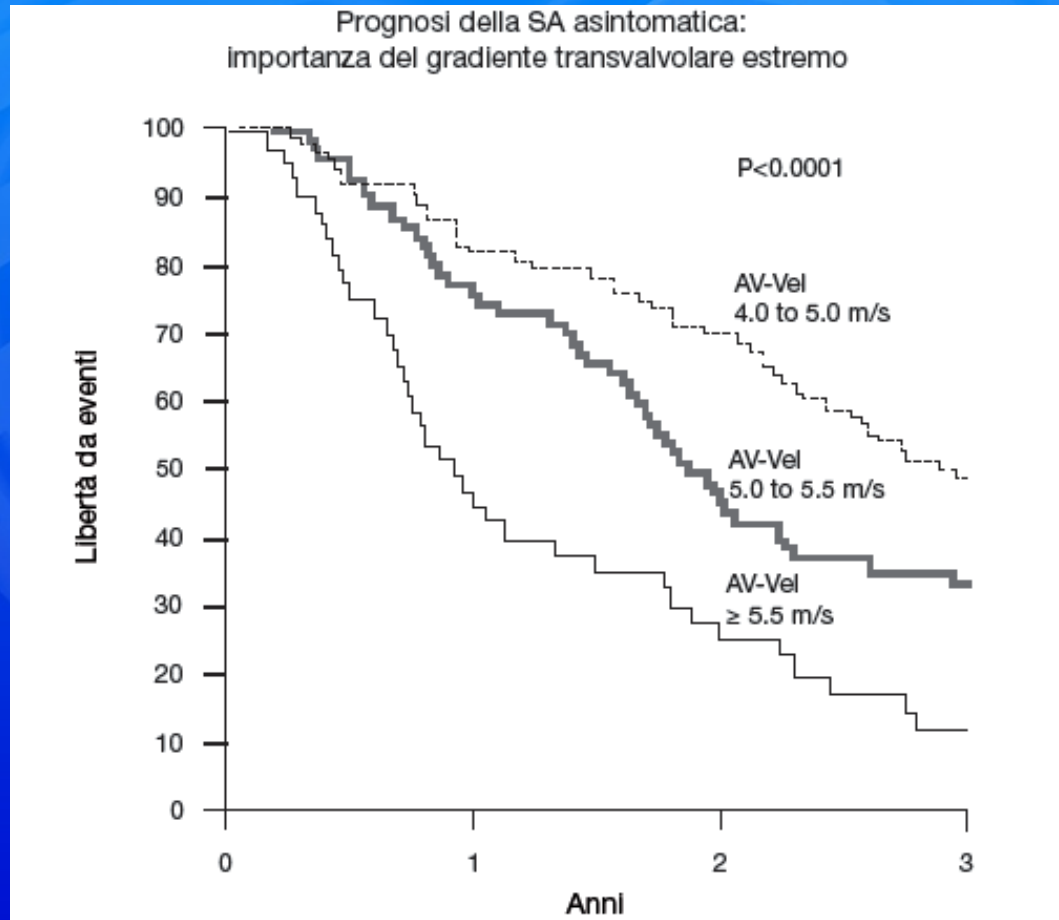
degenerativa



bicuspide



# Prognosi della SA asintomatica secondo valori di velocità

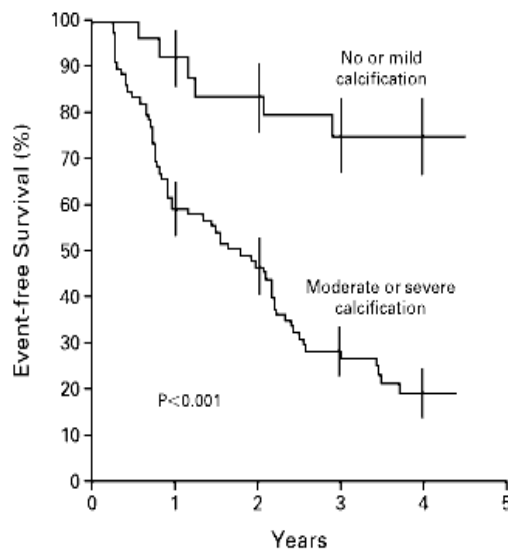


*Rosenhek R, Zilberszac R, Schemper M, Czerny M, et al  
Circulation 2010; 121:151-156*

# NUOVI CONCETTI NELLA STRATIFICAZIONE PROGNOSTICA DELLA SA ASINTOMATICA

- La velocità  $>5.5$  m/sec è da considerarsi indicativa di SA estrema e codifica un elevato rischio di eventi a breve termine indipendentemente dai valori di area valvolare.

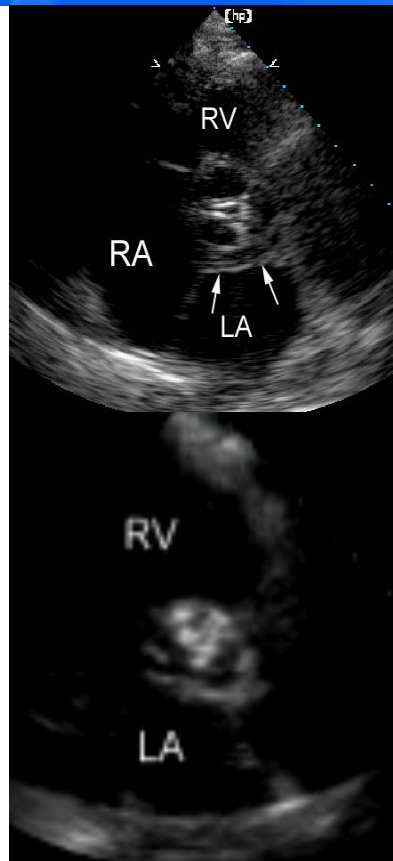
## - Calcificazioni Aortiche



No. OF PATIENTS AT RISK

No or mild calcification	25	23	20	17	9
Moderate or severe calcification	101	48	38	21	7

**Rosenhek. N Eng J Med 2000;  
343: 611-7**





# Stratificazione del rischio mediante ECO Doppler

ECHO  
Multiparametrico



# Variabilità dei gradienti pressori

Ansietà

Esercizio Fisico

Anemia

Ipertiroidismo

Insufficienza Aortica

Funzione ventricolare sinistra depressa

Concomitante insufficienza mitralica

Sedazione

Ipovolemia



Stroke volume



Stroke volume

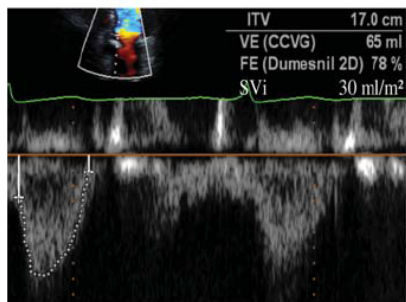


IDENTIFICAZIONE DI  
CONDIZIONI DI  
BASSO FLUSSO  
( $<35$  ML/M<sup>2</sup>)

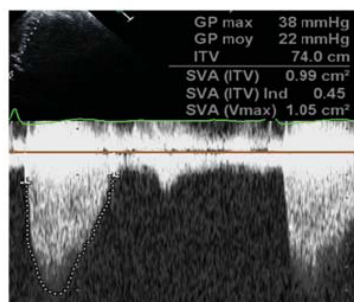
# Paradoxical low flow and/or low gradient severe aortic stenosis despite preserved left ventricular ejection fraction: implications for diagnosis and treatment

Jean G. Dumesnil<sup>1\*</sup>, Philippe Pibarot<sup>1\*</sup>, and Blaise Carabello<sup>2</sup>

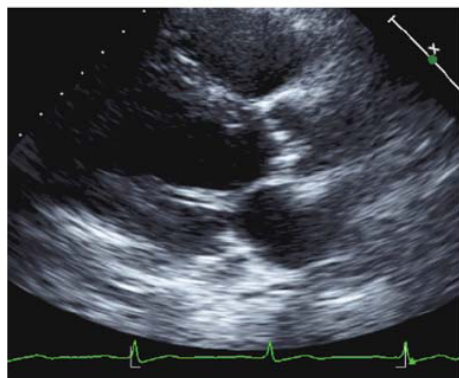
A PW Doppler



B CW Doppler



C Two-D Echocardiogram



D Cardiac Catheterization



“Il paradosso”



European Heart Journal (2010) 31, 281–289





# Paradoxical Low-Flow, Low-Gradient Aortic Stenosis

Adding New Pieces to the Puzzle\*

Philippe Pibarot, DVM, PhD,  
Jean G. Dumesnil, MD

JACC Vol. 58, No. 4, 2011  
July 19, 2011:413-5

**Table 1** Typical Characteristics of the 3 Main Entities of Severe Aortic Stenosis

	Severe AS		
	Normal-Flow, High-Gradient	Preserved LVEF (Paradoxical), Low-Flow, Low-Gradient	Reduced LVEF, Low-Flow, Low-Gradient
Aortic valve area, cm <sup>2</sup>	≤1.0	≤1.0	≤1.0
Indexed aortic valve area, cm <sup>2</sup> /m <sup>2</sup>	<0.6	<0.6	<0.6
Mean gradient, mm Hg	>40	<40	<40
Z <sub>va</sub> , mm Hg·ml <sup>-1</sup> ·m <sup>2</sup>	>4.5	>4.5	>4.5
LV end-diastolic diameter, mm	45-55	<47	>50
Relative wall thickness	>0.43	>0.50	0.35-0.55
LVEF, %	>50	>50	<50
Mitral ring displacement, mm	5-15	<8	<8
Global longitudinal strain, %	14-20	<14	<14
Stroke volume index, ml/m <sup>2</sup>	>35	<35	<35
Mean flow rate, ml/s	>200	<200	<200
Myocardial fibrosis	+	++	+++
CT valve calcium score, AU	>1,650	>1,650	>1,650
Plasma NT-proBNP, pg/ml	<1,500	>1,500	>1,500



$Z_{VA}$  index\_

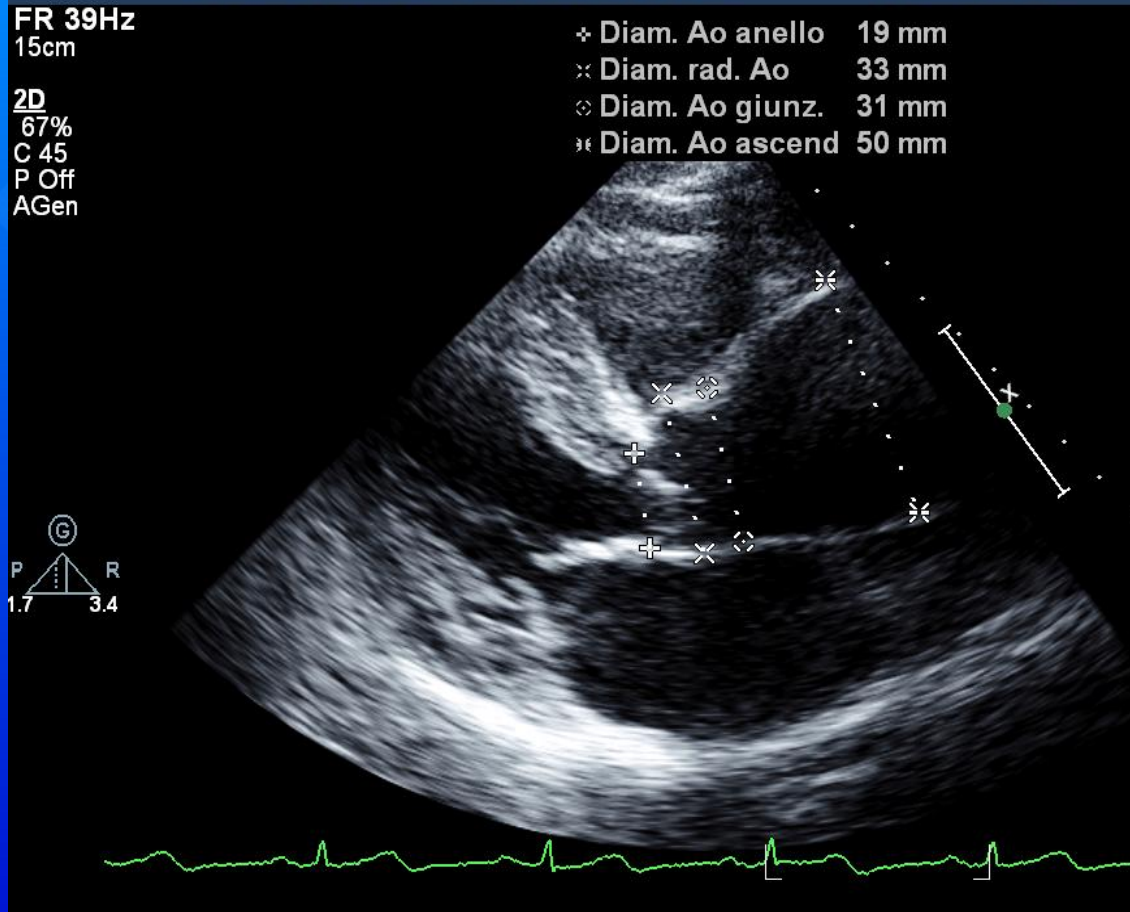
$$Z_{va} = \frac{SAP + MG_{net}}{SV_i}$$

PA systolic + Mean gradient  
Stroke volume index ml/m<sup>2</sup>

- > 4,5 mmHg/ml/m<sup>2</sup>: Severe AS
- < 4,5 mmHg/ml/m<sup>2</sup>: Non severe AS



# Dimensioni



*Garcia D, Pibarot P, Dumesnil, Sakr F, Durand LG.*

Assesment of aortic valve stenosis severity: a new index based on the energy loss concept. *Circulation* 2000

$$ELI = EOA \times Aa/Aa - EOA/BSA$$

(EOA= area aortica effettiva sec Eq di continuit ;

Aa: area aorta ascendente ad 1 cm dal piano valvolare; BSA superficie corporea)



# Nuovi concetti nella stratificazione prognostica della SA asintomatica

Normalizzare il gradiente per le condizioni di flusso e di impedenza vascolare



Definire in maniera più accurata l'entità della stenosi aortica

Caratterizzare un profilo prognostico differenziato

fenomeno di recupero di pressione a valle della stenosi

dimensioni aortiche

eccentricità del jet

DIFFERENTE DISPENDIO ENERGETICO DEL VENTRICOLO SX

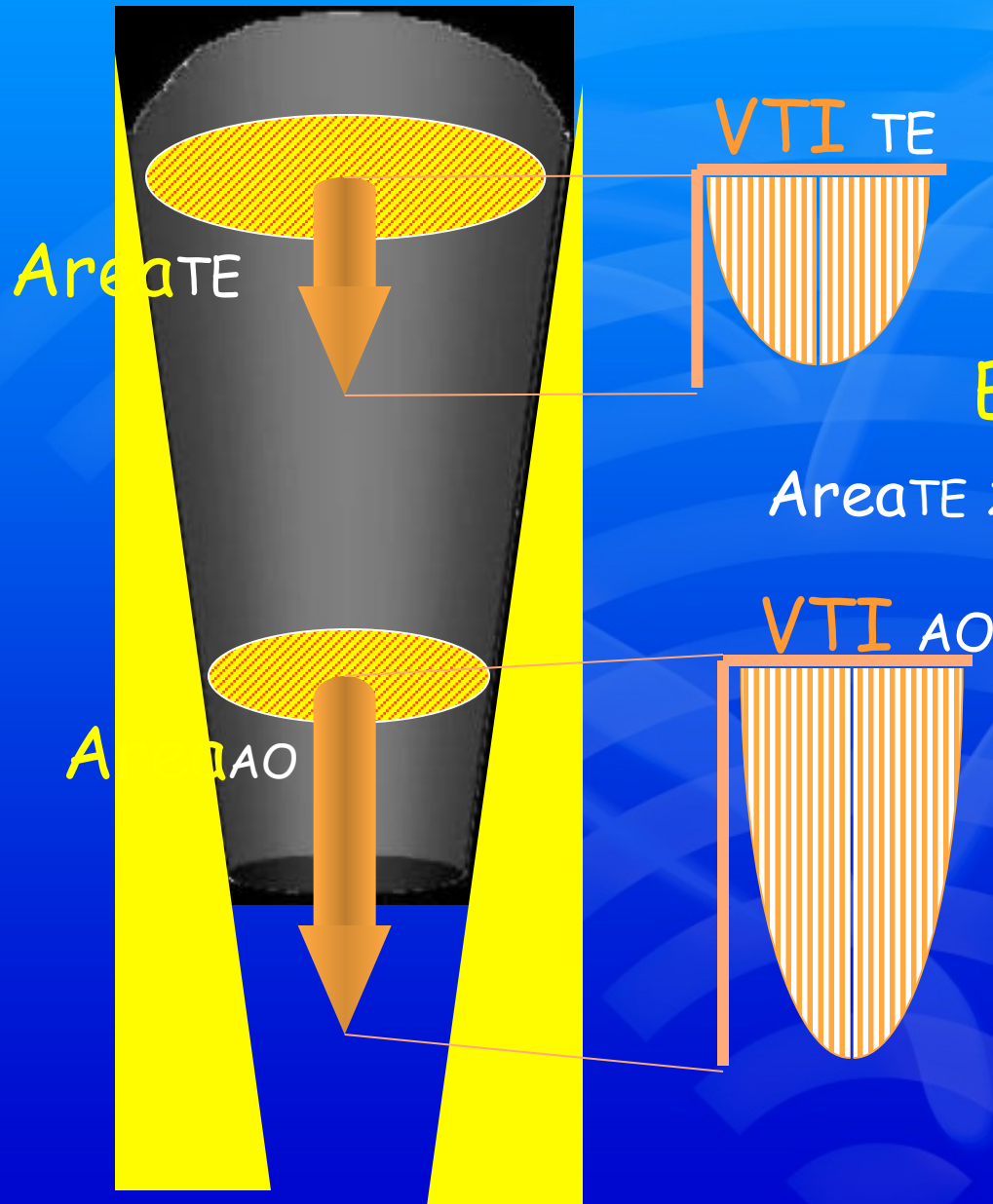


Valore *Gradiente Transvalvolare*





# Calcolo dell'area valvolare



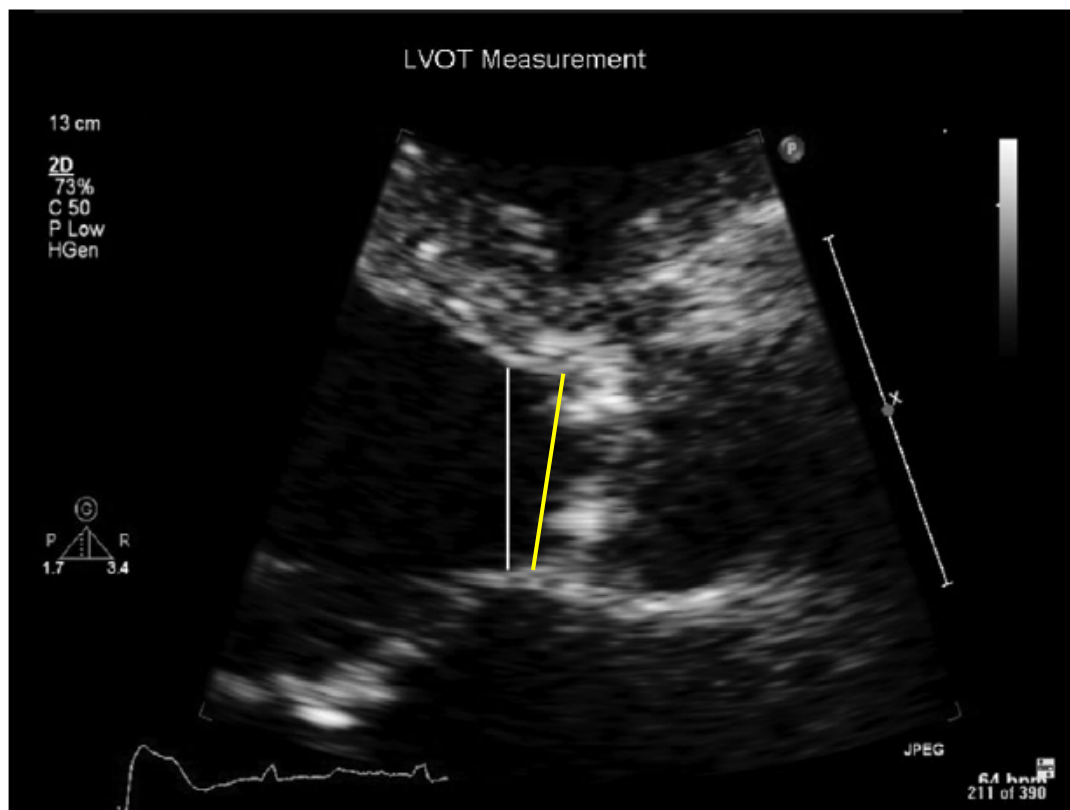
Equazione di continuità

$$Area_{TE} \times VTI_{TE} = Area_{AO} \times VTI_{AO}$$

Area valvolare  
aortica

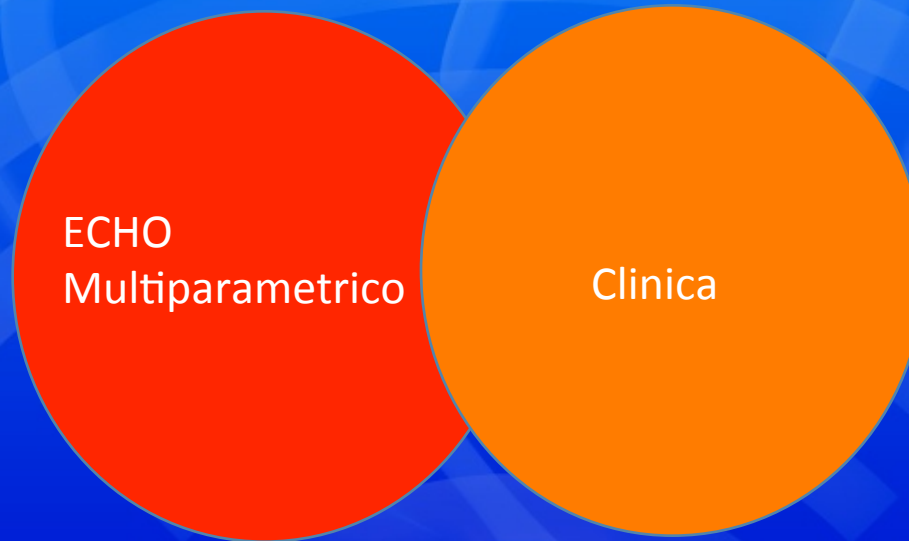
$$\frac{Area_{TE} \times VTI_{TE}}$$

$$VTI_{AO}$$



**Figure 5** Left ventricular outflow tract diameter is measured in the parasternal long-axis view in mid-systole from the white-black interface of the septal endocardium to the anterior mitral leaflet, parallel to the aortic valve plane and within 0.5–1.0 cm of the valve orifice.

# Stratificazione prognostica mediante test da sforzo





# ABSOLUTE AND RELATIVE CONTRAINDICATIONS FOR EXERCISE TEST

		Sheffield (1984)	Froelicher (1982,1983)	Ellestad (1980)	Jones/Campbell (1982)
<b>Absolute</b>					
1	Acute MI or recent ECG change	X	X	X	X
2	Unstable angina	X	X	X	X
3	Acute myocarditis, pericarditis, and/or endocarditis	X	X	X	X
4	Known ominous CAD pattern	X			
5	Severe aortic stenosis	X	X		
6	Congestive heart failure	X		X <sup>b</sup>	X
7	Severe hypertension	X			X
8	Significant cardiac arrhythmias <sup>a</sup>	X	X	X	
9	Heart block > 1°	X		X	
10	Acute systemic illness or serious noncardiac disorder	X	X	X	X
11	Unwillingness to sign consent	X			
12	Severe LV dysfunction		X		
13	Acute PE, pulmonary infarct or edema		X		X
14	Severe physical handicap		X		
<b>Relative</b>					
1	Known left main disease or equivalent	X	X	X	
2	Severe hypertension	X	X	X	
3	Moderate aortic, valvular, or myocardial heart diseases		X	X	X
4	Cardiomyopathy, hypertrophic obstructive	X		X	
5	Ventricular conducting defects		X		
6	Tachy/bradyarrhythmias < serious		X		X
7	Noncardiac disease < serious (i.e., diabetes, epilepsy, etc.)		X		X
8	Drug effect or electrolyte abnormality		X		X
9	Fixed rate artificial pacemaker		X		
10	Psychiatric disorder/inability to cooperate		X		
11	Recent MI < 4 weeks				X
12	Resting ECG abnormality			X	X





# Stratificazione prognostica mediante test da sforzo

## CRITERI DI ANORMALE RISPOSTA ALLO SFORZO

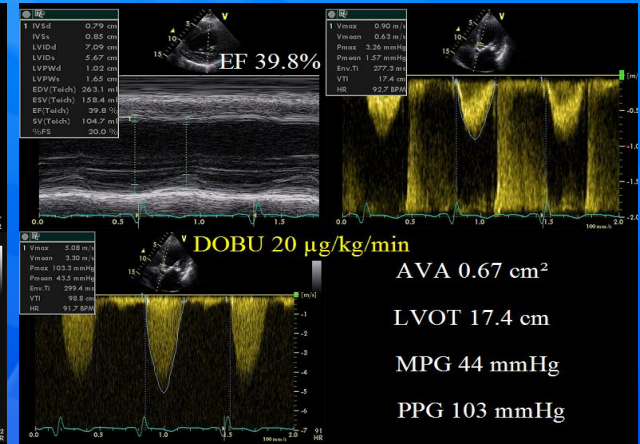
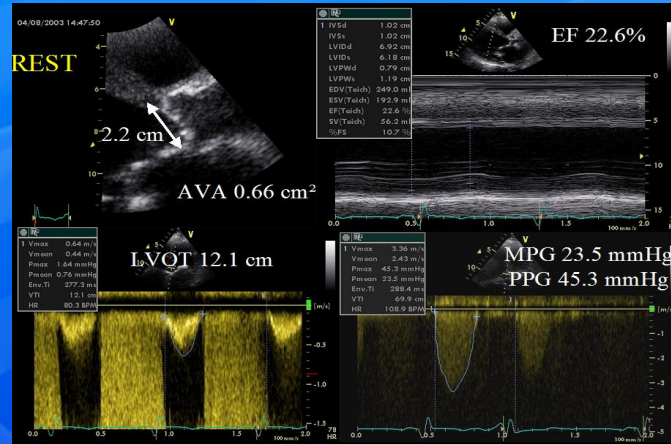
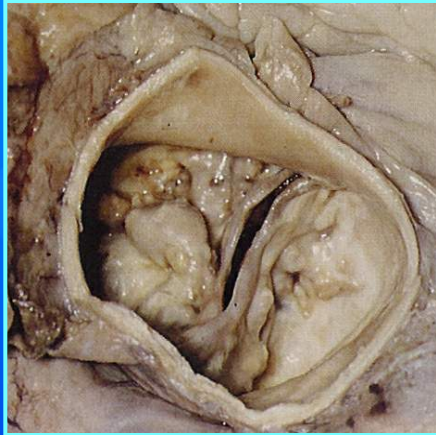
1) sviluppo di sintomi

2) riduzione o mancato incremento ( $< 20$  mm Hg) della pressione arteriosa basale

3) ridotta capacità funzionale ( $< 80\%$ )

4) sottoslivellamento ST di almeno 2 mm

# STRESS ECHO in Aortic Stenosis with low gradient



## Low-gradient AS

- mean gradient < 25 - 30 mm Hg
- calculated AVA < 1.0 cm<sup>2</sup>
- dobutamine-responsiveness :  
contractile reserve → ↑ SV ≥ 20%

## Operative mortality

5% ( 3 of 64 pts) if CR ↑

32% (10 of 35 pts) if CR ↓

Monin et al , Circ 2003



# Exercise-test

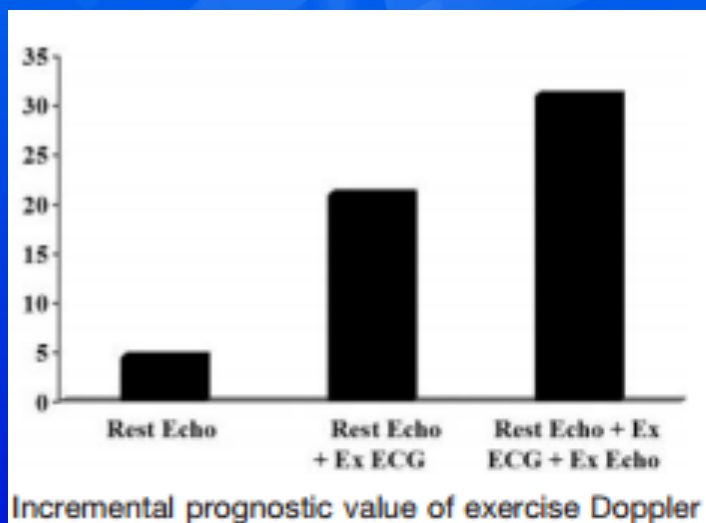




## Prognostic Importance of Quantitative Exercise Doppler Echocardiography in Asymptomatic Valvular Aortic Stenosis

Patrizio Lancellotti, Florence Lebois, Marc Simon, Christophe Tombeux, Christophe Chauvel and Luc A. Pierard

*Circulation.* 2005;112:I-377-I-382



**TABLE 3. Multivariate Predictors of Events**

Categorical Variables	$\chi^2$	<i>P</i> Value
Mean aortic pressure gradient diff $\geq 18$ mm Hg	10	0.015
Abnormal exercise test	9.1	0.0026
Aortic valve area $< 0.75$ cm	8.7	0.0031

Diff indicates difference between exercise and rest.

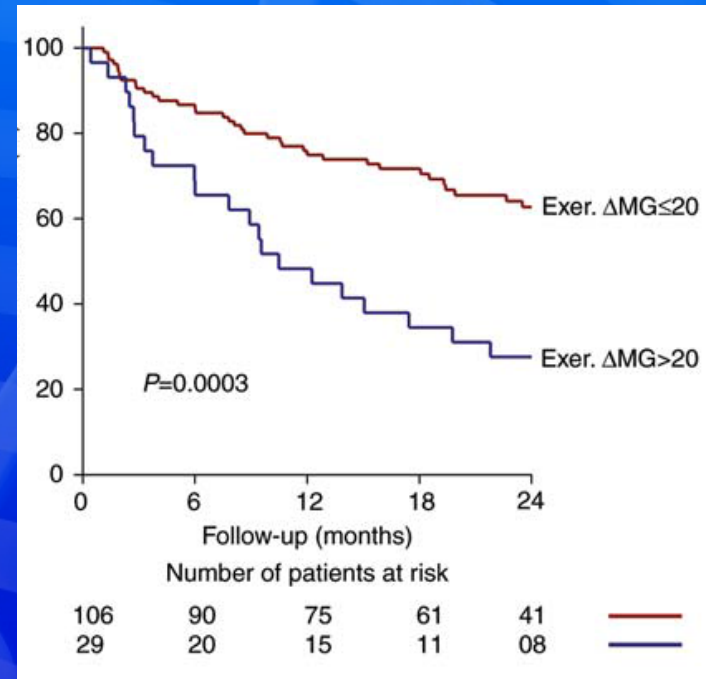
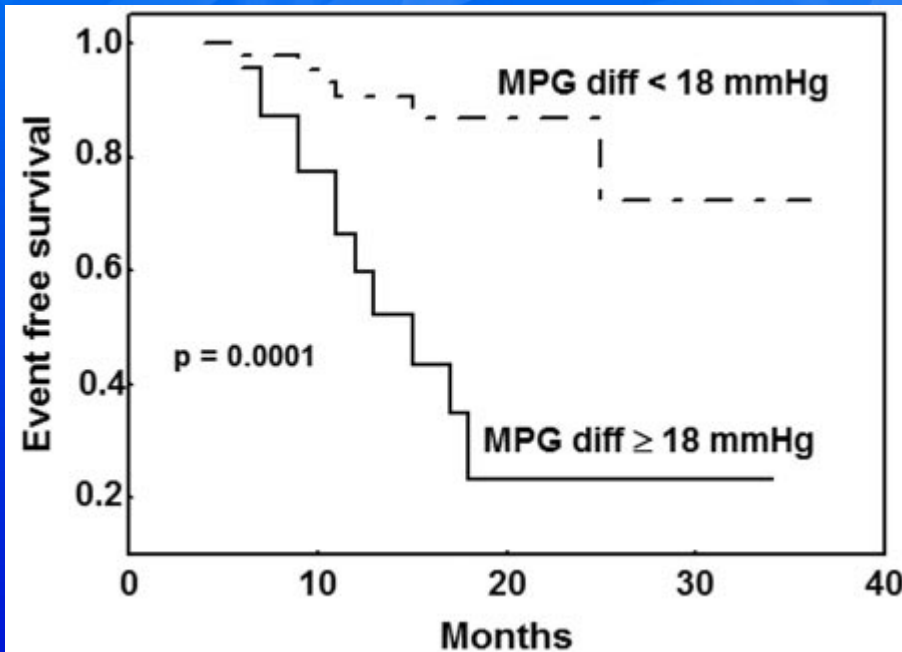
Exercise Doppler echocardiographic findings provided incremental prognostic value over resting echocardiographic and exercise electrocardiographic parameters.



# Exercise-induced increase in transvalvular gradient

69 Pts, age 66±12 Yrs

186 Pts, age 64±15 Yrs

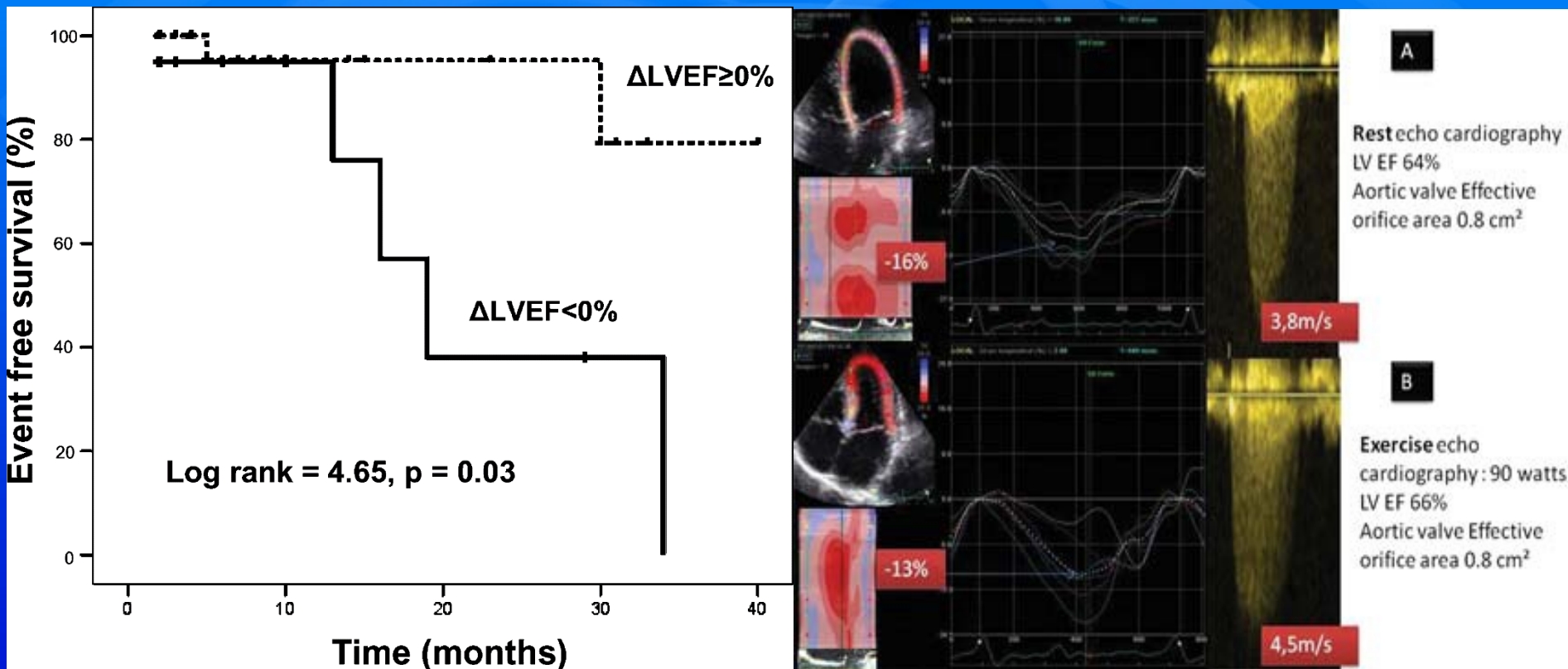


Lancellotti P et al.  
Circulation 2005;112(9 Suppl):I377–I382

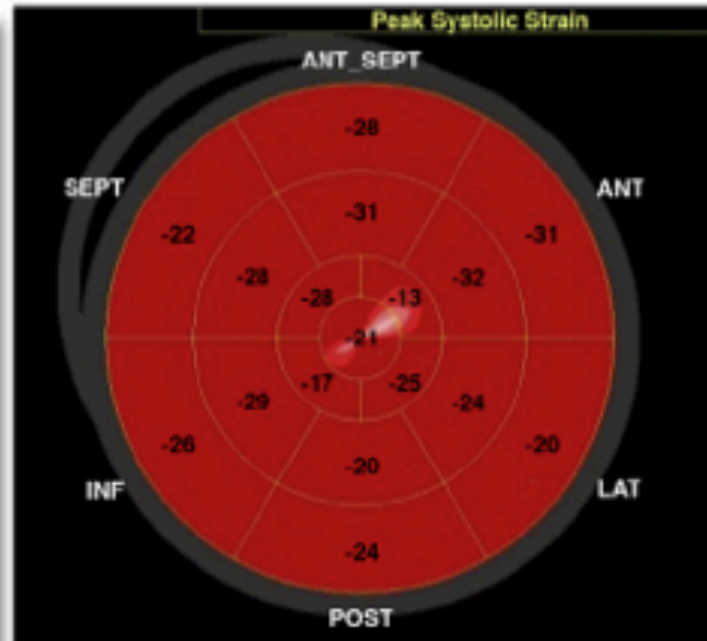
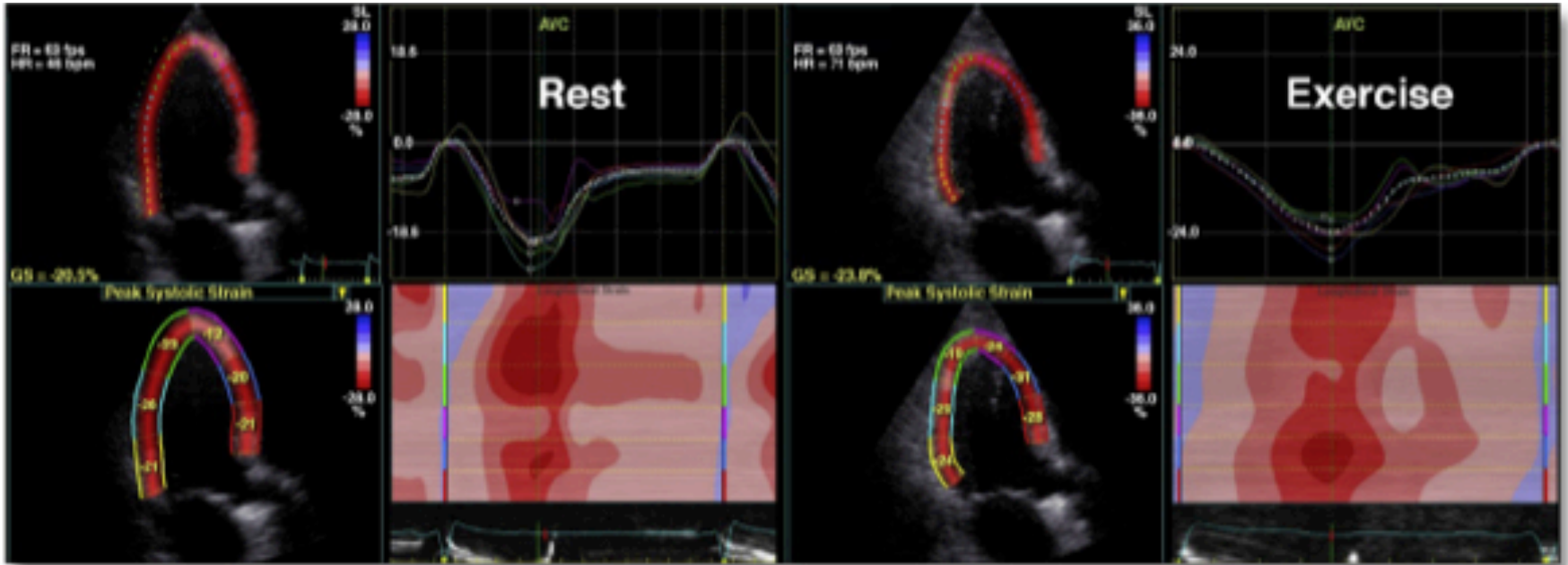
Maréchaux S et al.  
Eur Heart J 2010;31:1390–1397



# Ex-induced changes in LV systolic function

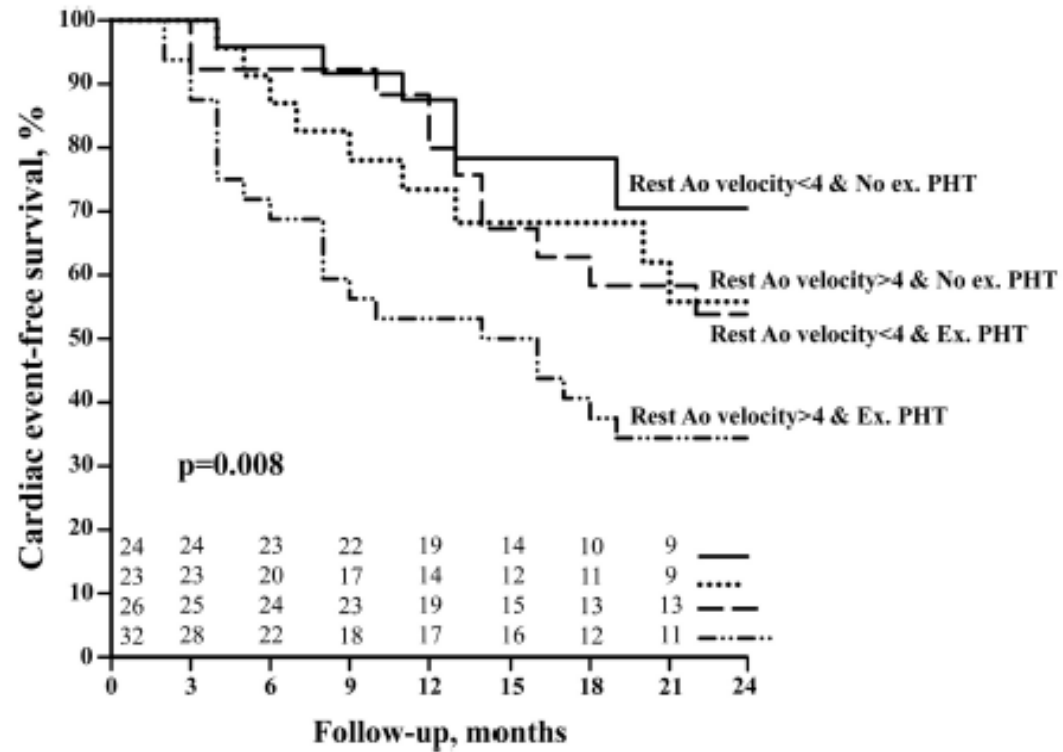
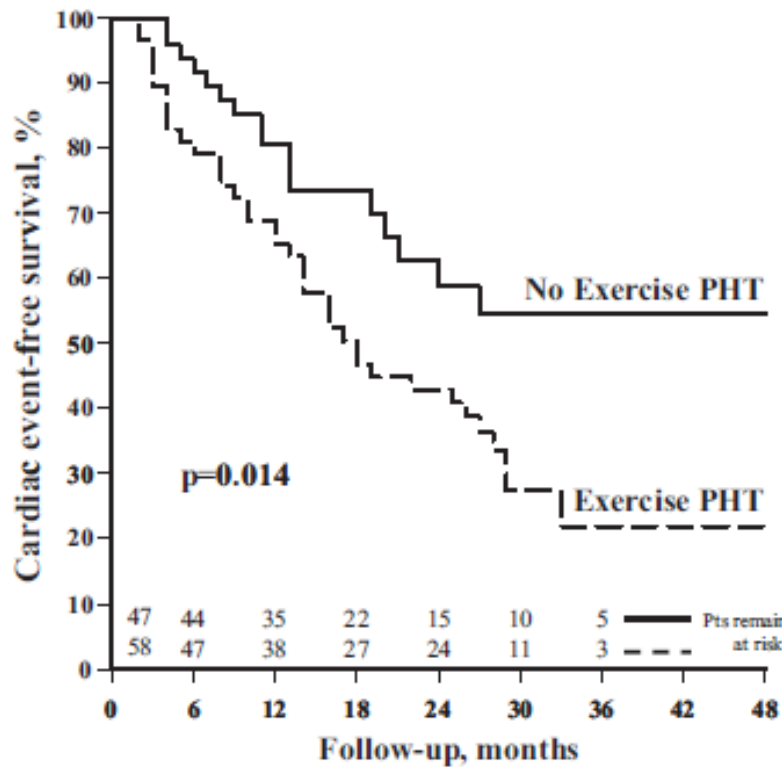


# Presence of LV Contractile Reserve in an Asymptomatic Patient With Severe Aortic Stenosis Using LVEF and GLS (Using 2D Speckle Tracking)



# Exercise-induced PH

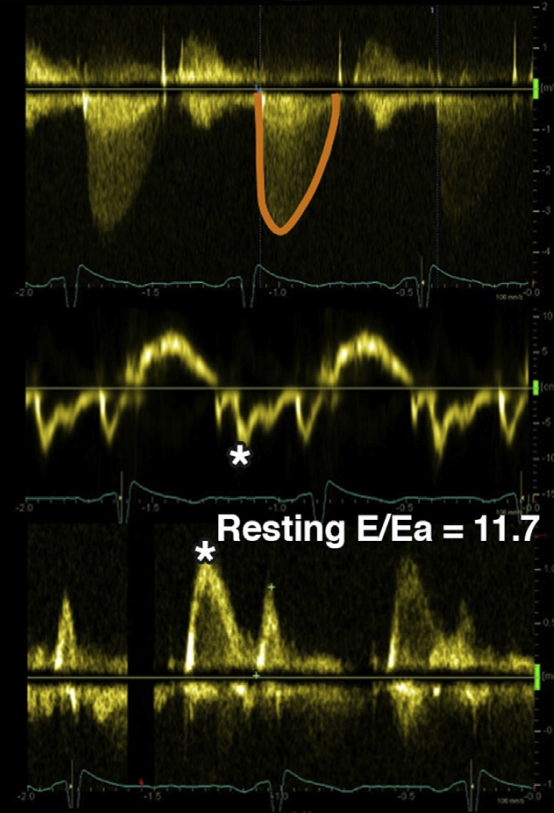
105 Pts, age 71±9 Yrs





**Resting MPG = 30 mm Hg**

AV VTI 78.94 cm  
AV Env.TI 299.88 ms  
HR 86.13 BPM

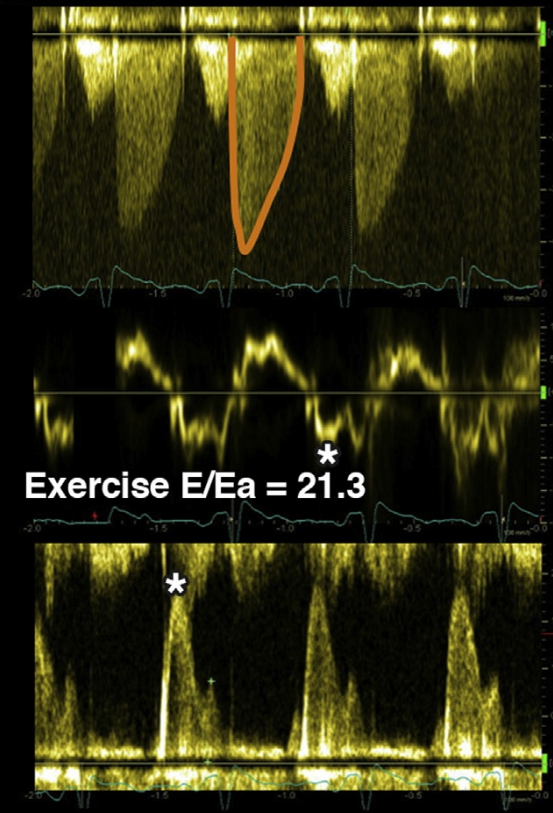


**Resting E/Ea = 11.7**

TR Vmax 2.98 m/s  
TR maxPG 35.44 mmHg

**Exercise MPG = 41 mm Hg**

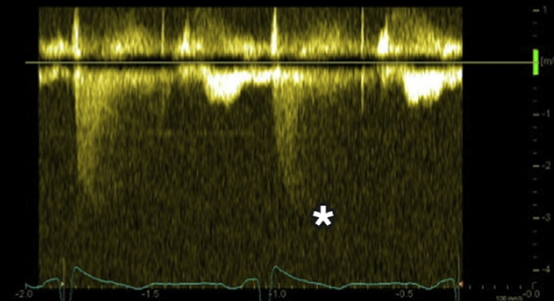
AV VTI 82.03 cm  
AV Env.TI 265.28 ms  
HR 128.76 BPM



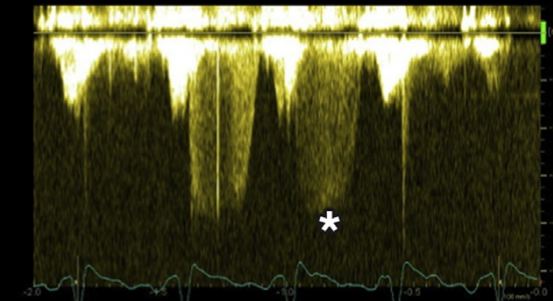
**Exercise E/Ea = 21.3**

TR Vmax 3.97 m/s  
TR maxPG 63.15 mmHg

**Resting TTPG = 35 mm Hg**



**Exercise TTPG = 63 mm Hg**



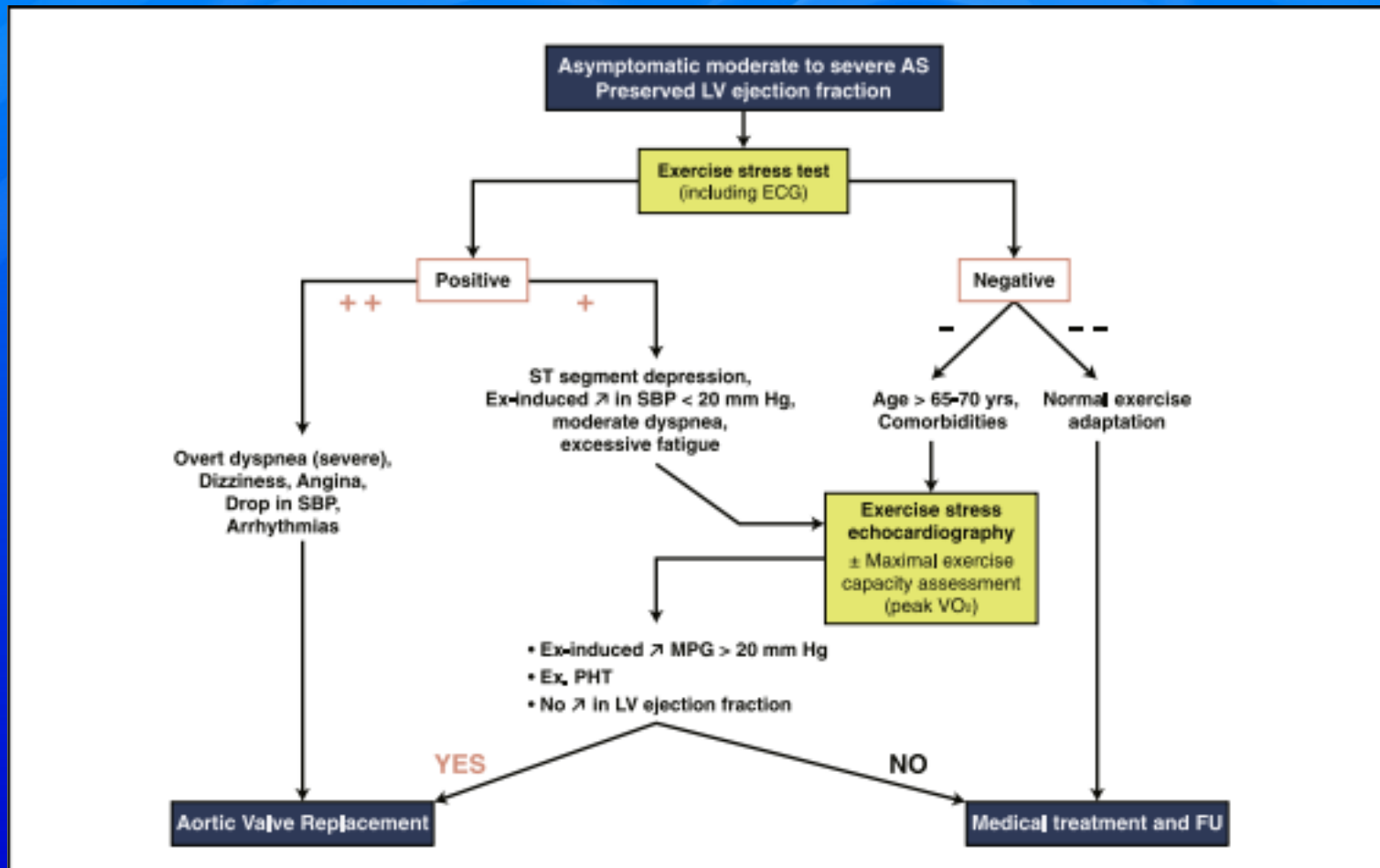
STATE-OF-THE-ART PAPER

# Exercise Testing in Asymptomatic Severe Aortic Stenosis

Julien Magne, PhD, Patrizio Lancellotti, MD, PhD, Luc A. Piérard, MD, PhD  
*Liège, Belgium*

“Exercise stress echocardiography may further unmask a subset of asymptomatic patients (i.e., without exercise stress test abnormalities) who are at high risk of reduced cardiac event free survival. In these patients, early surgery could be beneficial, whereas regular follow-up seems more appropriate in patients without echocardiographic abnormalities during exercise. ”

# DECISIONAL ALGORITHM FOR MANAGEMENT OF ASYMPTOMATIC PATIENTS WITH PRESERVED LV EJECTION FRACTION



# Contraindications that should be strictly respected

- Truly symptomatic severe VHD
- Clear indication for surgery
- Physical or mental disability to adequately perform an exercise stress test
- High BP (systolic arterial pressure >200 mm Hg or diastolic arterial pressure >110 mm Hg)
- Uncontrolled or symptomatic arrhythmias
- Systemic illness





## ESC Working Group on Valvular Heart Disease Position Paper—heart valve clinics: organization, structure, and experiences

**Patrizio Lancellotti<sup>1,2\*</sup>, Raphael Rosenhek<sup>3</sup>, Philippe Pibarot<sup>4</sup>, Bernard Iung<sup>5</sup>,  
Catherine M. Otto<sup>6</sup>, Pilar Tornos<sup>7</sup>, Erwan Donal<sup>8</sup>, Bernard Prendergast<sup>9</sup>,  
Julien Magne<sup>1,2</sup>, Giovanni La Canna<sup>10</sup>, Luc A. Piérard<sup>1,2</sup>, and Gerald Maurer<sup>3</sup>**

<sup>1</sup>GIGA Cardiovascular Sciences, Heart Valve Clinic, University of Liège Hospital, Liège, Belgium; <sup>2</sup>Department of Cardiology, University Hospital CHU Sart Tilman, Liège B-4000, Belgium; <sup>3</sup>Department of Cardiology, Medical University of Vienna, Vienna, Austria; <sup>4</sup>Institut Universitaire de Cardiologie et de Pneumologie de Québec/Québec Heart and Lung Institute, Laval University, Québec City, Québec, Canada; <sup>5</sup>Cardiology Department, University Paris Diderot, Bichat Hospital, Paris, France; <sup>6</sup>Heart Valve Clinic, University of Washington School of Medicine, Seattle, WA, USA; <sup>7</sup>Hospital General Universitario Vall d'Hebron, Barcelona, Spain; <sup>8</sup>Service de Cardiologie, CHU RENNES, CIC-IT 804 and LTSI, INSERM U 1099, Université Rennes-1, Rennes, France; <sup>9</sup>Oxford University Hospitals NHS Trust, Oxford, UK; and <sup>10</sup>San Raffaele Hospital, Milan, Italy

Received 15 June 2012; revised 29 October 2012; accepted 28 November 2012; online publish-ahead-of-print 4 January 2013

### Background

With an increasing prevalence of patients with valvular heart disease (VHD), a dedicated management approach is needed. The challenges in management, diagnosis, and prognosis include the identification and classification of patients with VHD, the timing of intervention, and the choice of treatment. This paper reviews the current state of the art in the management of patients with VHD, with a focus on the organization, structure, and experiences of heart valve clinics.

- ❑ In aortic stenosis, the occurrence of exercise-limiting symptoms during an exercise stress test is a strong indication in favour of aortic valve replacement in young (<70 years) and physically active patients.
- ❑ In some experienced centres, stress echocardiography (exercise or dobutamine) can be useful for equivocal cases (e.g. moderate mitral stenosis or aortic stenosis with symptoms, low-flow low-gradient aortic stenosis)

# ECOCARDIOGRAFIA TEE

## Riserva di apertura valvolare

La valutazione dell'area valvolare planimetrica (APA) mediana (TEE), di base e durante stress con dobutamina, consente di obiettivare una riserva di apertura valvolare che è correlata con:

- grado residuo di elasticità delle cuspidi aortiche
- reclutamento contrattile del ventricolo sx

Il test di riserva valvolare aortica può pertanto rivelarsi di utilità clinica per una stratificazione prognostica nei pazienti asintomatici nonostante una SA giudicata di grado severo in condizioni basali.





*Cosa cercare:*

*Elementi di Prognosi sfavorevole*

- Velocità  $> 5.5$  m/sec (Gradiente  $> 100$  mmHg) o rapida EVOLUZIONE
- Estesa calcificazione dei lembi/fusione commissure
- Assenza di riserva valvolare (Eco-TEE con dobutamina/Nitroprussiato di Na)
- **Eco sforzo** (sintomi/ipertensione polmonare, extrasistolia ventricolare, ipotensione arteriosa sistemica, incremento del Grad  $> 20$  mm Hg)
- Dilatazione aorta ascendente con o senza bicuspidia
  - Indice ZVA  $> 4.5$
- Ipertensione arteriosa incontrollabile
  - Ipertrofia Miocardica
  - Ridotto strain ventricolare ( $< 15\%$ )