ECOCARDIOGRAFIA 2015
XVII Congresso Nazionale SIEC
Hotel Royal Continental
Napoli, 16-18 Aprile 2015

Stenosi aortica a basso flusso e a basso gradiente

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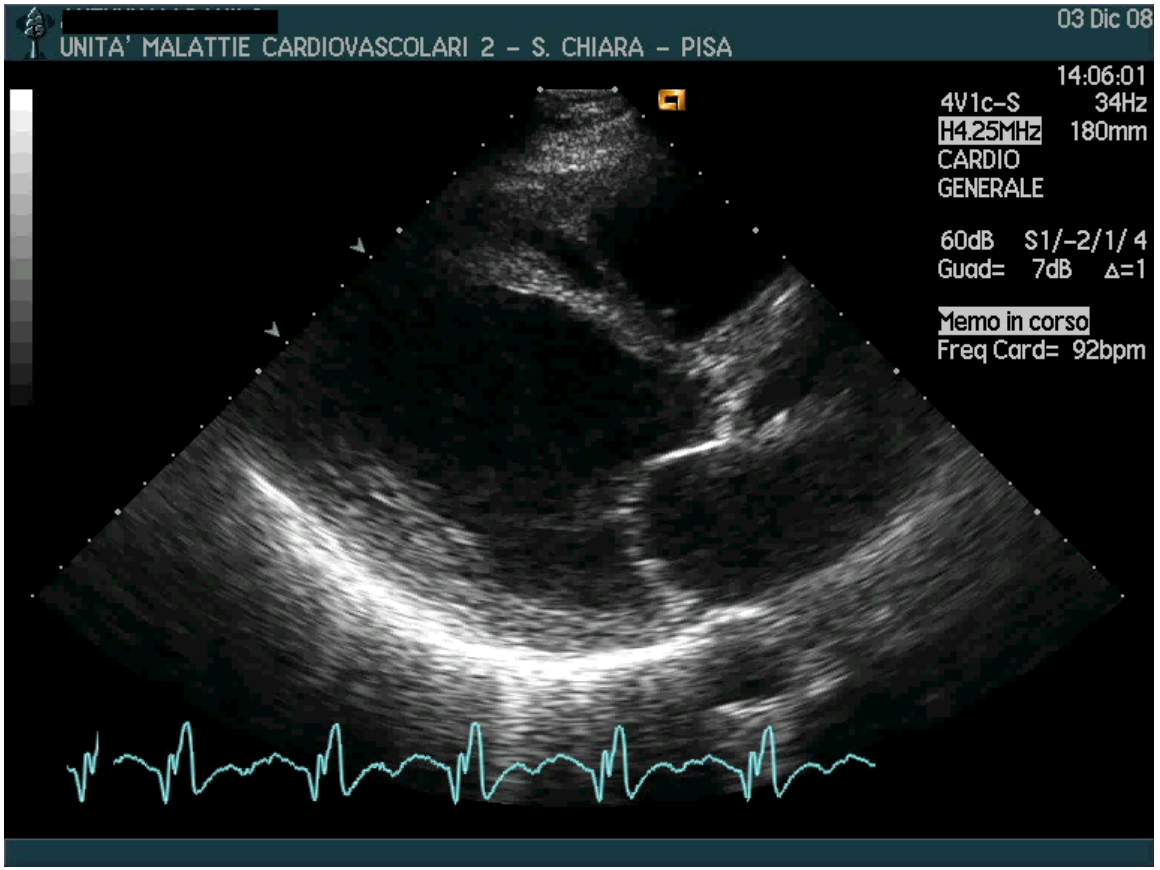
Azienda Ospedaliero Universitaria Pisana

Dipartimento Cardiotoracico

UO Malattie Cardiovascolari I

Maschio , 80 aa , storia di CMPD e valvulopatia mitralica . NYHA III

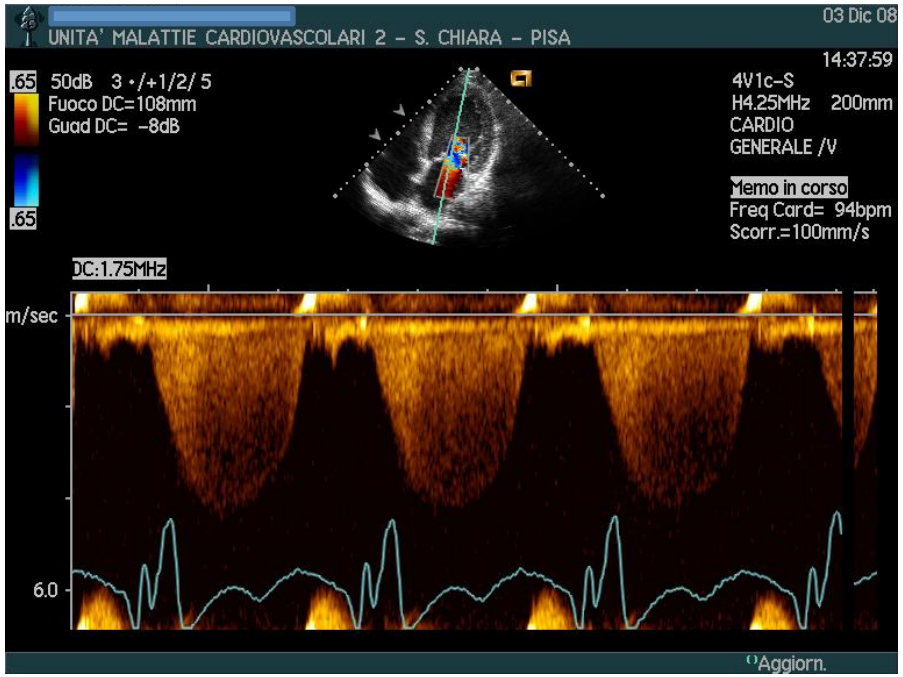


FE=25%

VTD=227 ml

AVA = 1 cm2

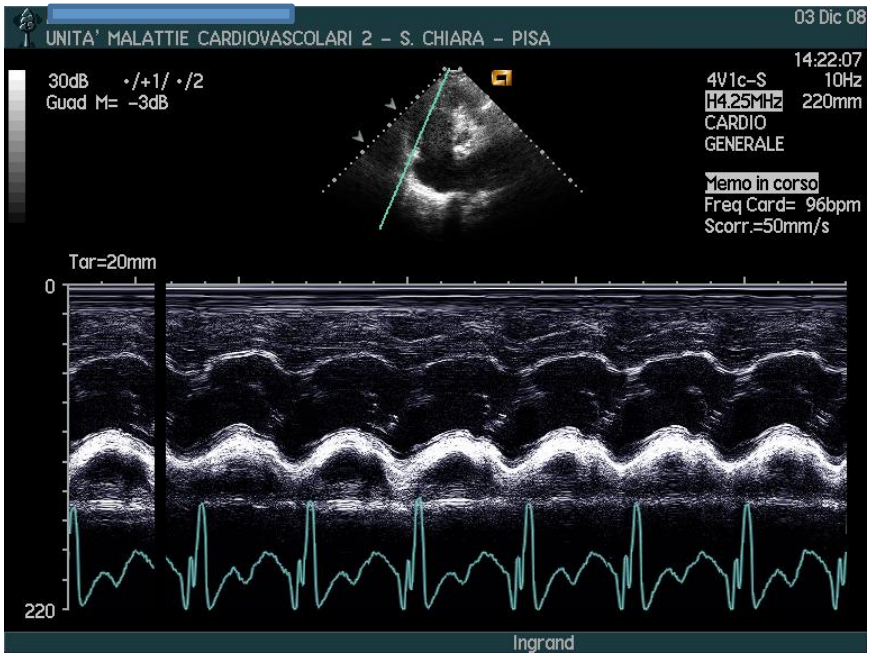
Gradiente Ao max =36 mmHg
Gradiente Ao Medio= 20 mmhg

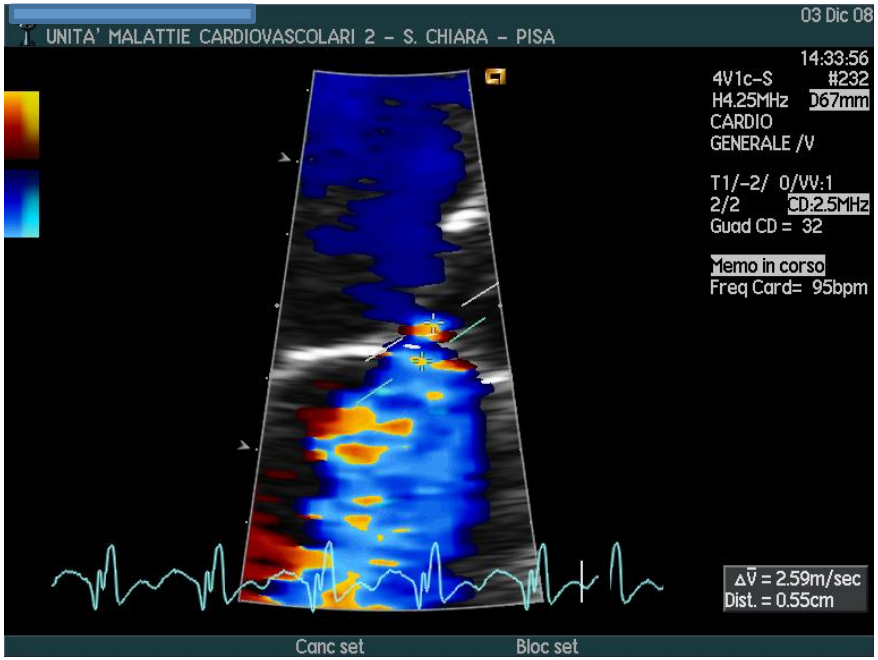


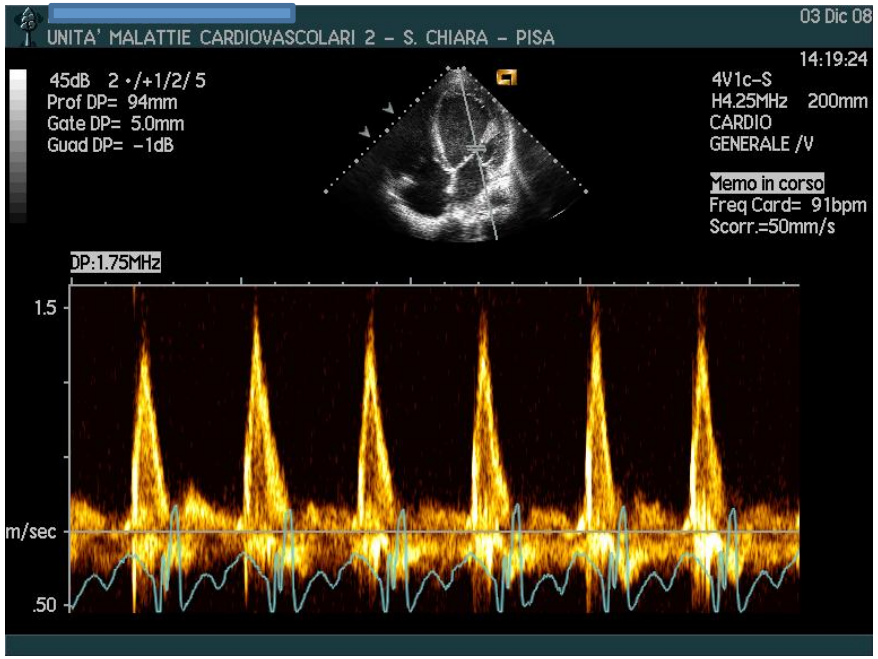
DP/Dt : 485 mmHg/sec

I.M. : VC=6 mm

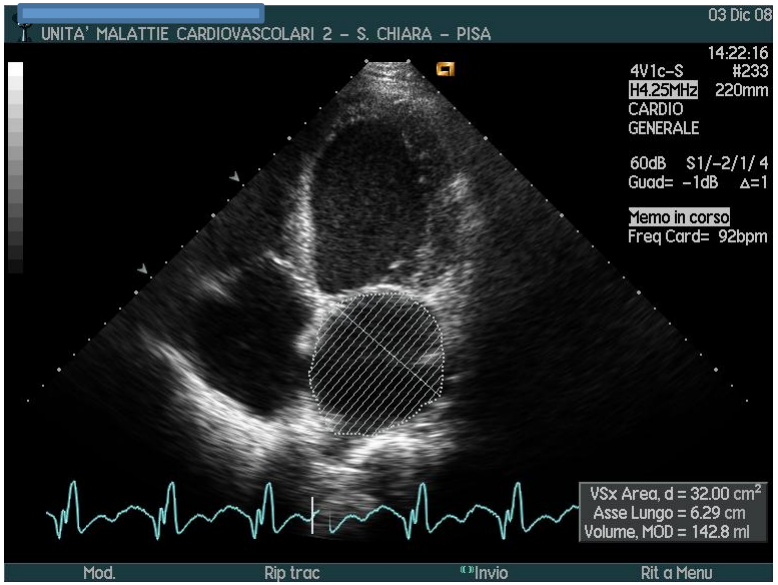
TAPSE :24

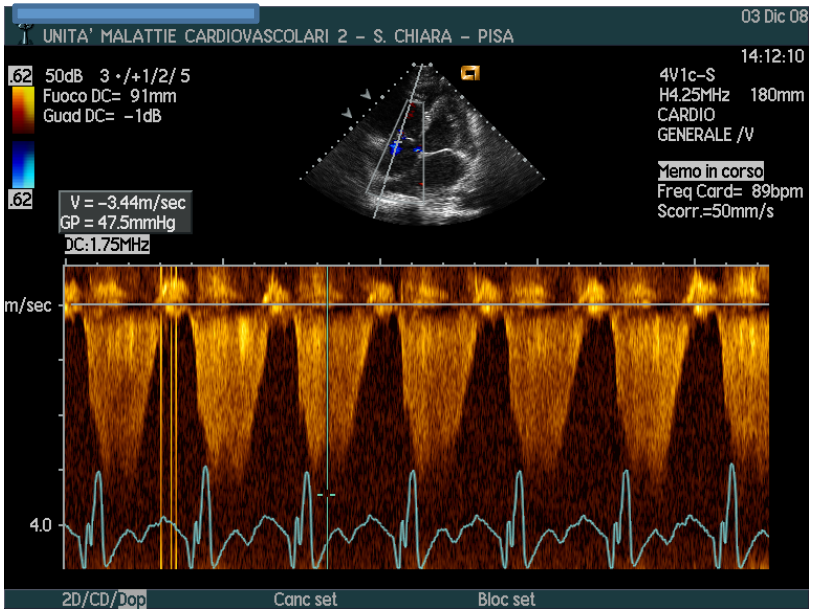


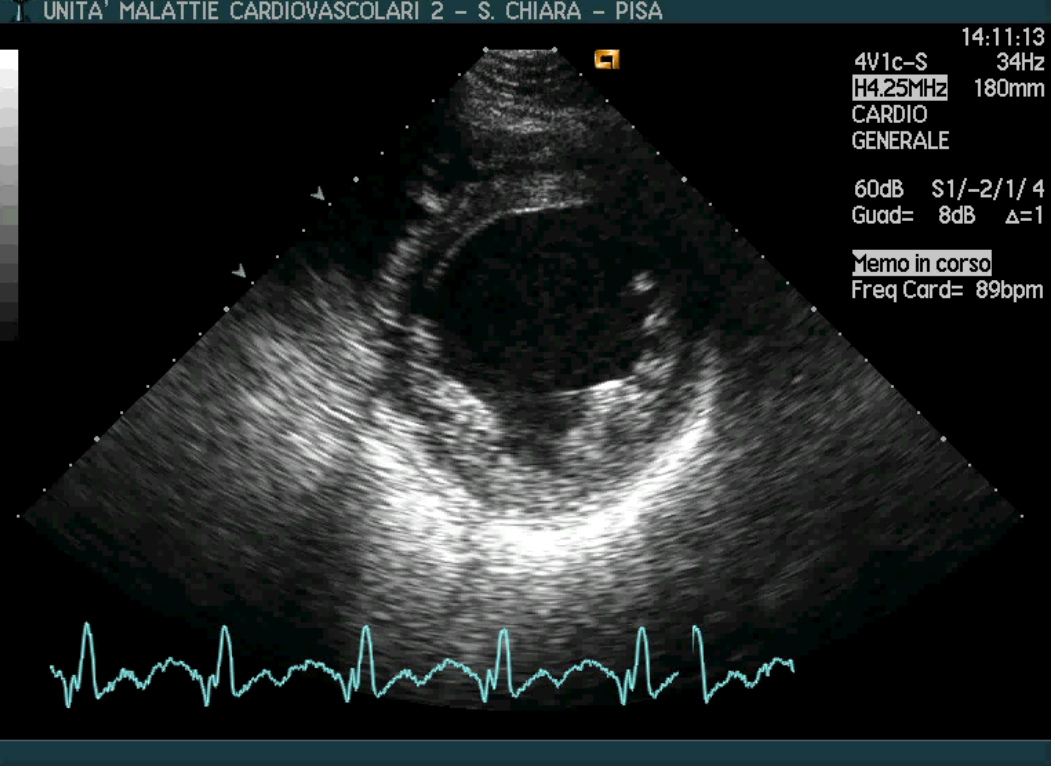




AS= 142 ml
Flusso mitralico restrittivo
PASP= 57 mmHg
TAPSE = 24 mm

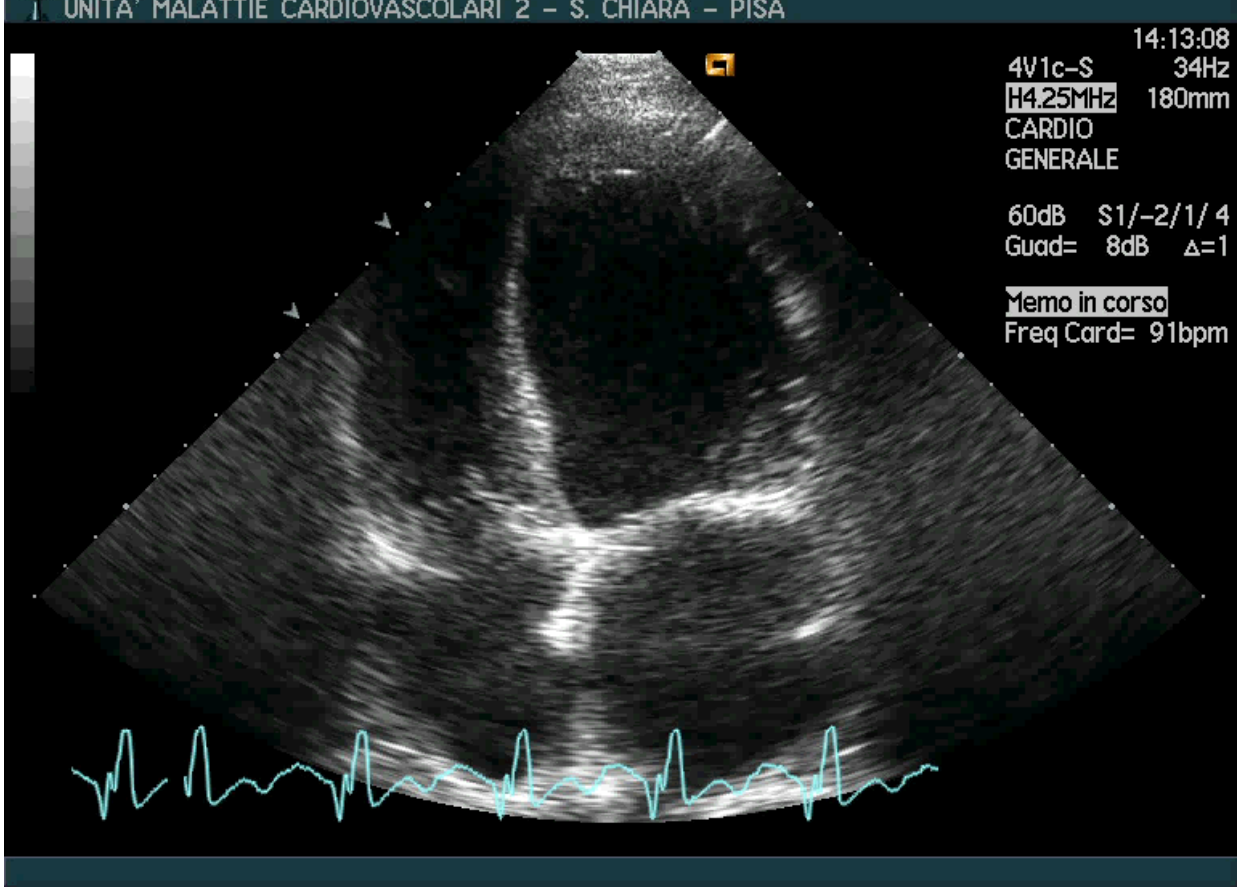






ECG: BBs
FC: 89 b/min

Impianto di ICD BIV



Otto mesi dopo impianto di ICD CRT il Paziente rimane con:

- Classe funzionale avanzata (NYHA II,
- Insufficienza mitralica Moderata
- Pressione polmonare aumentata : PASP = 48 mmHg

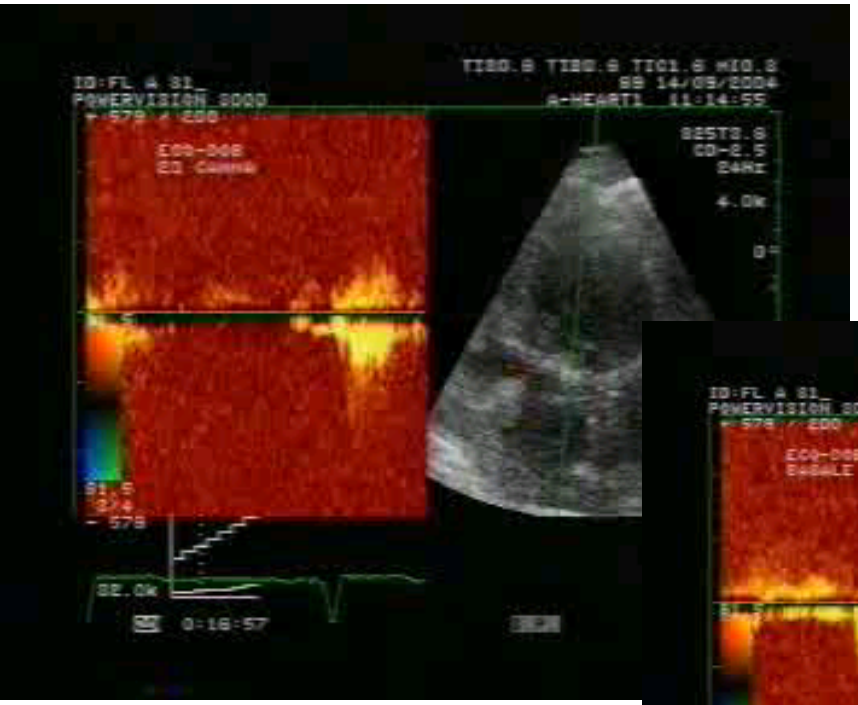
Valvulopatia aortica invariata

Rivalutazione

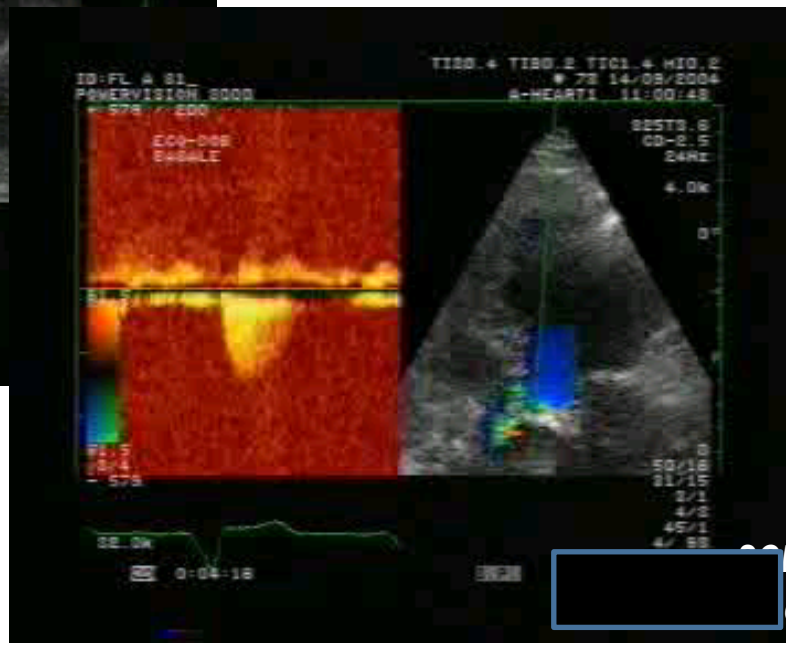
DOBUTAMINA

FE=25% > 30%

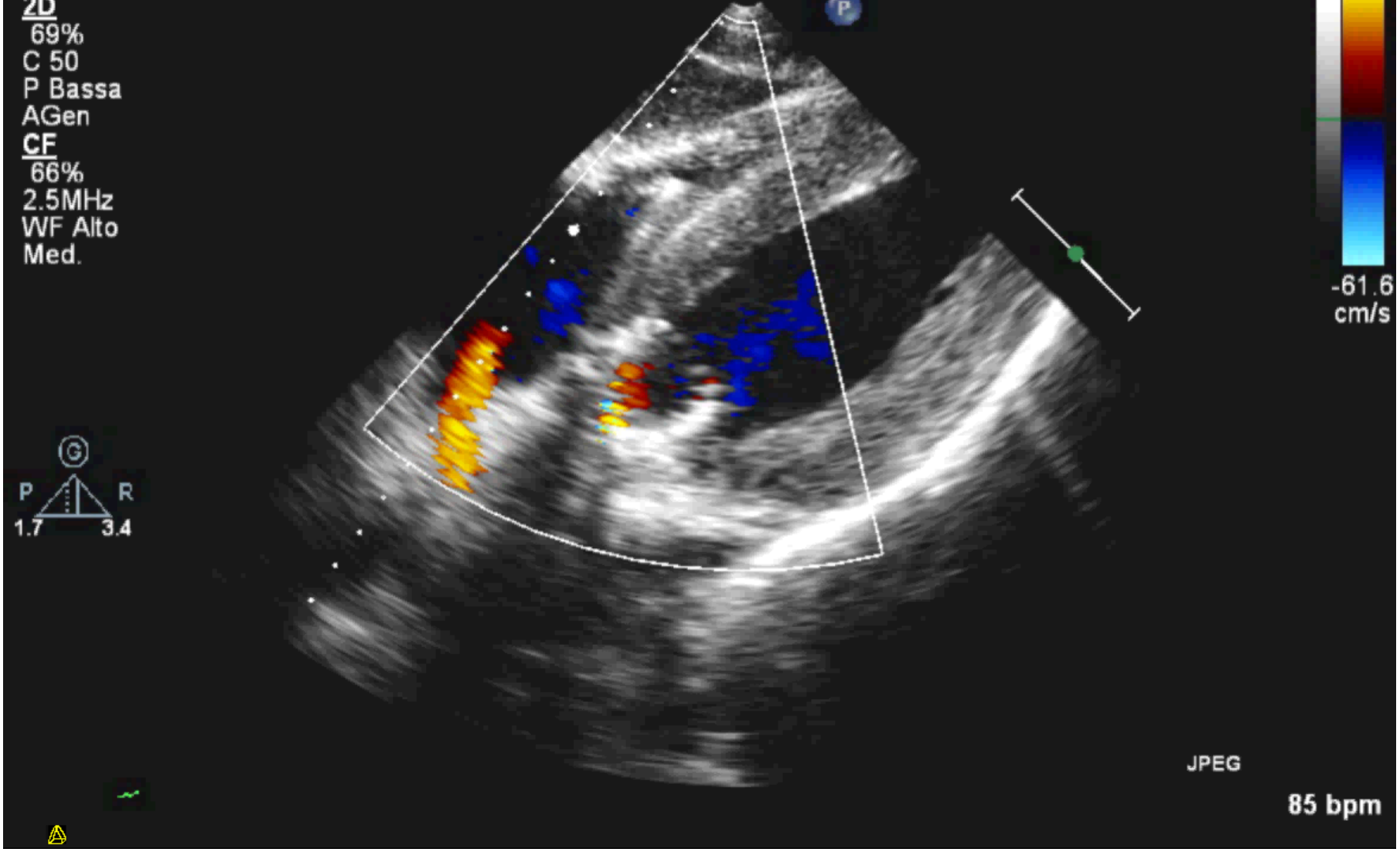
AVA = 0.9 cm2
Gradiente max =48 mmHg
Gradiente Medio =26 mmhg



BASE

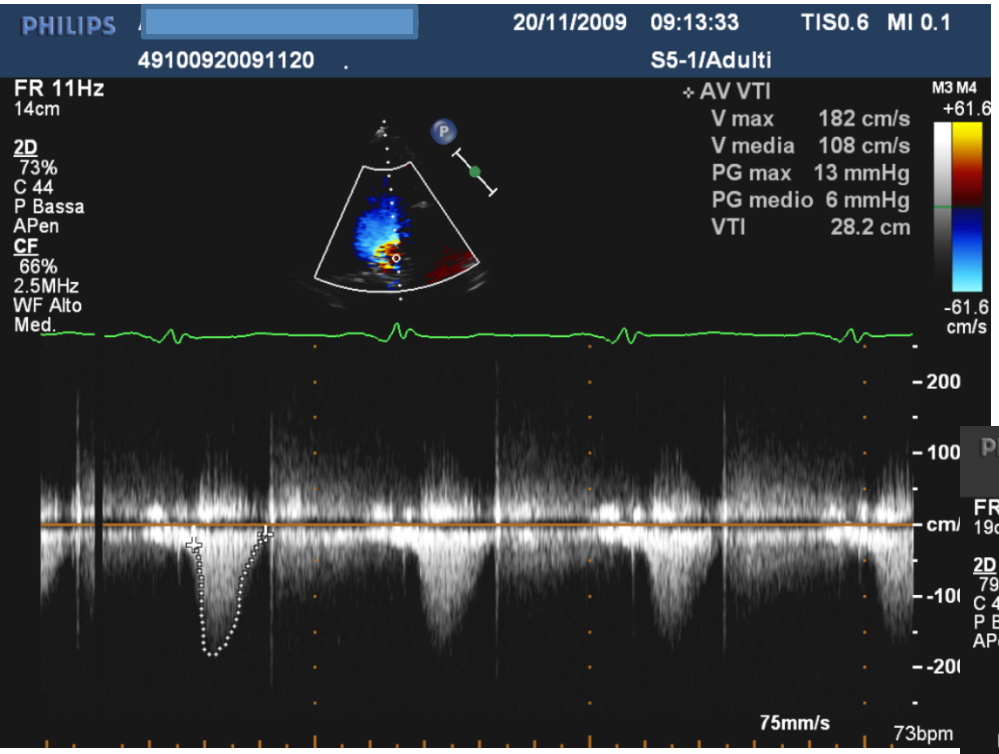


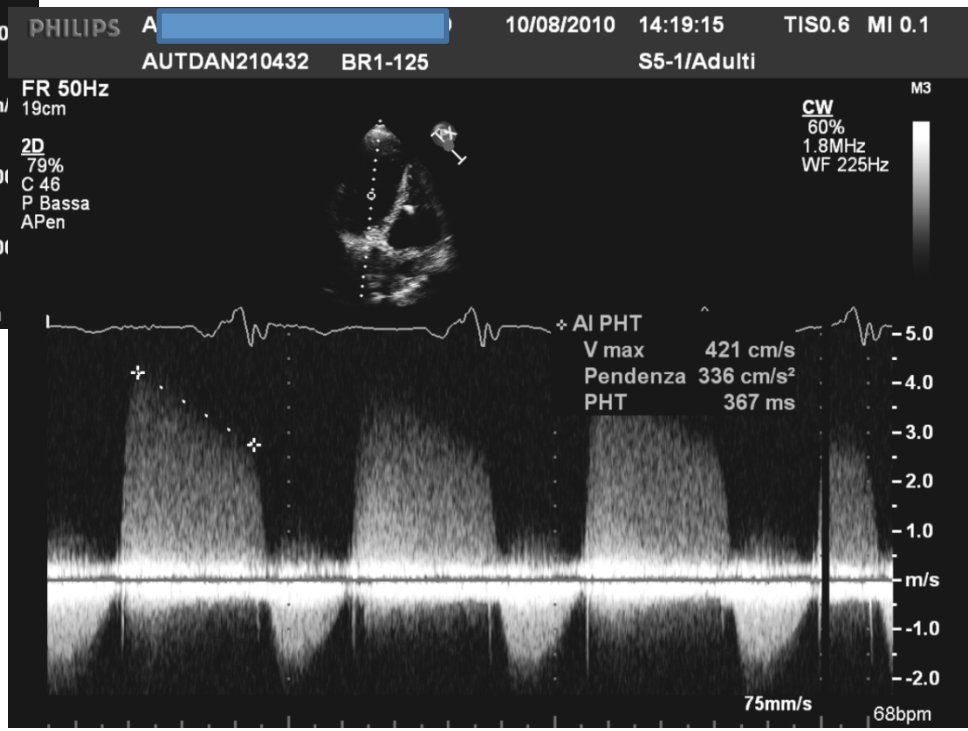
20 gamma/Kg/min

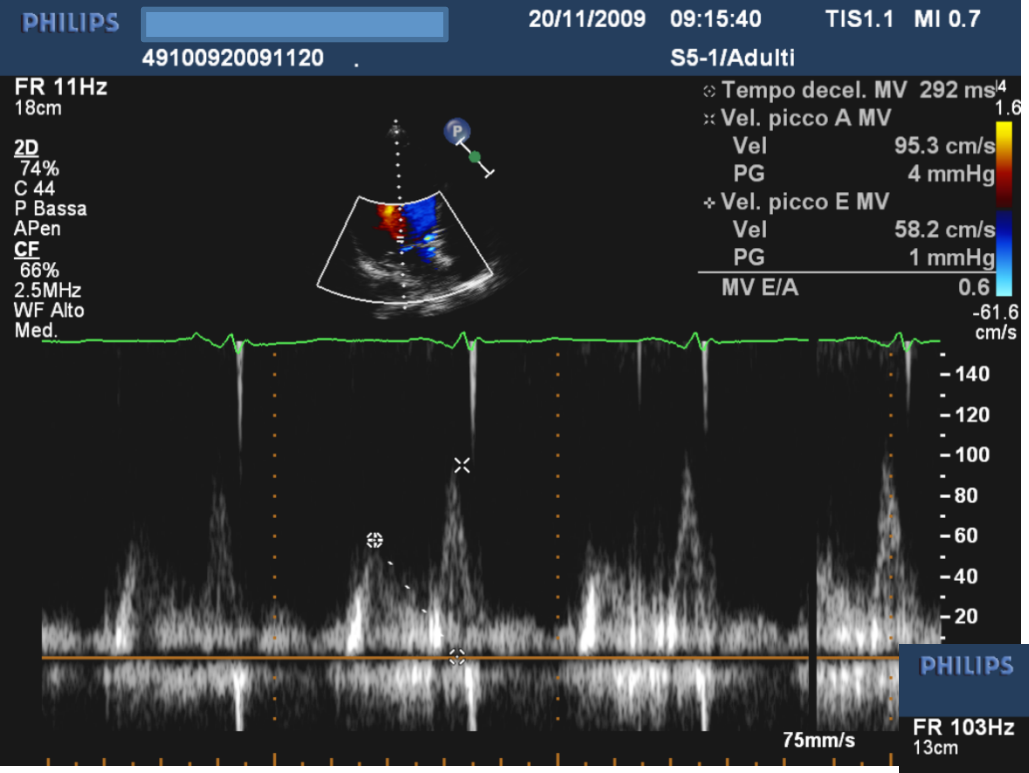


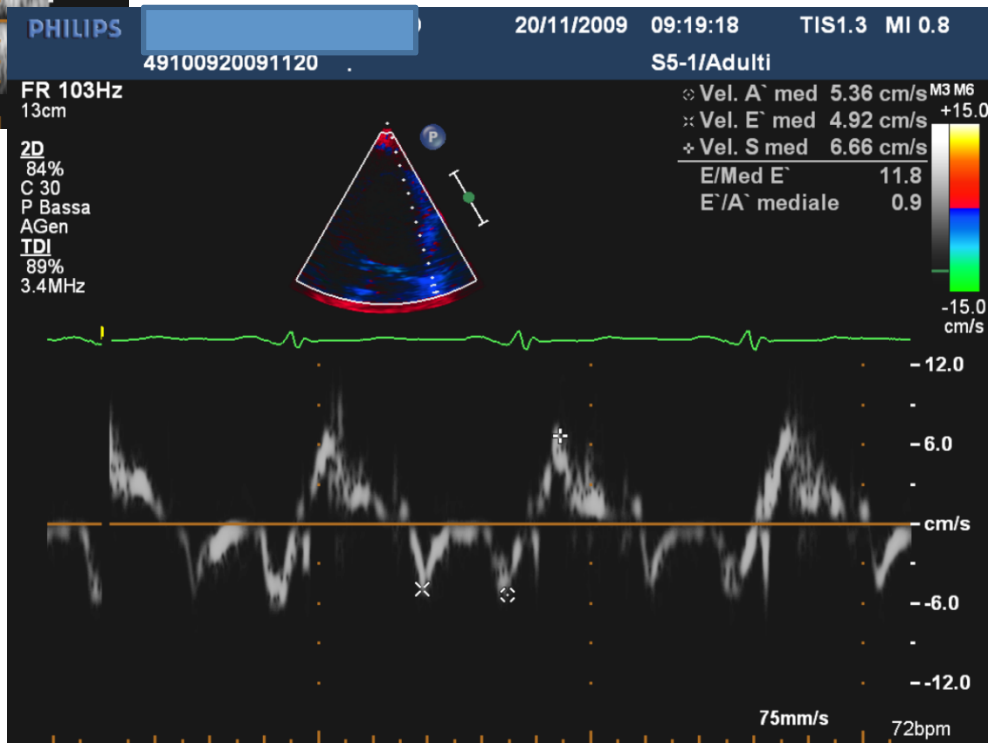
Novembre 2009

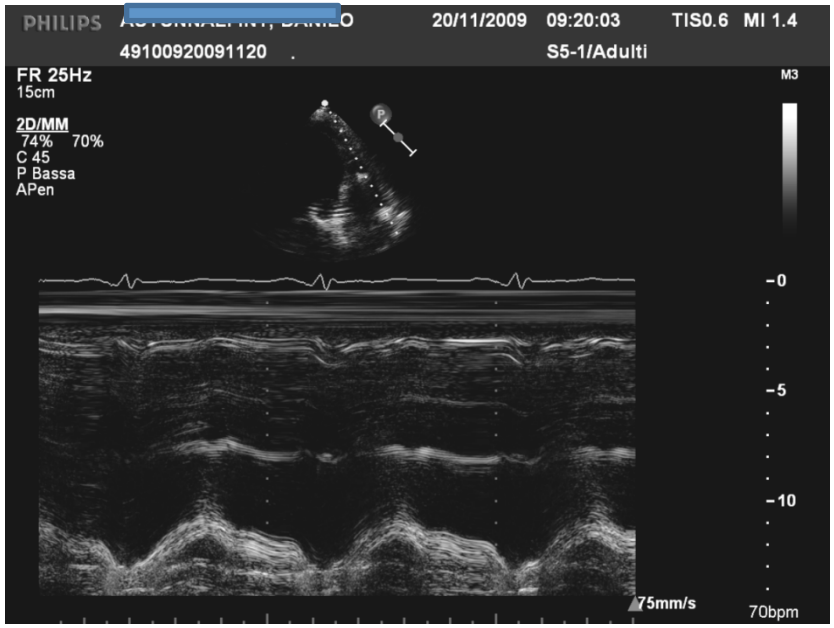
Esegue TAVI con residua insufficienza periprotesica aortica di entità lieve – moderata


PHILIPS
20/11/2009 09:13:33 TIS0.6 MI 0.1
49100920091120
S5-1/Adulti
FR 11Hz
14cm
2D
73%
C 44
P Bassa
APen
CF
66%
2.5MHz
WF Alto
Med.
AV VTI
V max 182 cm/s
V media 108 cm/s
PG max 13 mmHg
PG medio 6 mmHg
VTI 28.2 cm
M3 M4
+61.6
-61.6
cm/s
200
100
cm/
-100
-200
75mm/s
73bpm


PHILIPS
10/08/2010 14:19:15 TIS0.6 MI 0.1
AUTDAN210432 BR1-125
S5-1/Adulti
FR 50Hz
19cm
2D
79%
C 46
P Bassa
APen
CW
60%
1.8MHz
WF 225Hz
M3
AI PHT
V max 421 cm/s
Pendenza 336 cm/s²
PHT 367 ms
5.0
4.0
3.0
2.0
1.0
m/s
-1.0
-2.0
75mm/s
68bpm


PHILIPS
20/11/2009 09:15:40 TIS1.1 MI 0.7
49100920091120 .
S5-1/Adulti
FR 11Hz
18cm
2D
74%
C 44
P Bassa
APen
CF
66%
2.5MHz
WF Alto
Med.
Tempo decel. MV 292 ms
Vel. picco A MV
Vel 95.3 cm/s
PG 4 mmHg
Vel. picco E MV
Vel 58.2 cm/s
PG 1 mmHg
MV E/A 0.6
1.6
-61.6
cm/s
140
120
100
80
60
40
20
75mm/s


PHILIPS
20/11/2009 09:19:18 TIS1.3 MI 0.8
49100920091120 .
S5-1/Adulti
FR 103Hz
13cm
2D
84%
C 30
P Bassa
AGen
TDI
89%
3.4MHz
Vel. A` med 5.36 cm/s
Vel. E` med 4.92 cm/s
Vel. S med 6.66 cm/s
E/Med E` 11.8
E`/A` mediale 0.9
M3 M6
+15.0
-15.0
cm/s
12.0
6.0
cm/s
-6.0
-12.0
75mm/s
72bpm


PHILIPS
20/11/2009 09:20:03 TIS0.6 MI 1.4
49100920091120 .
S5-1/Adulti
FR 25Hz
15cm
2D/MM
74% 70%
C 45
P Bassa
APen
M3
0
5
10
75mm/s
70bpm

Febbraio 2015 potatura degli ulivi

ACC/AHA 2006 Guidelines for the Management of Patients With Valvular Heart Disease: Executive Summary

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease)

Developed in Collaboration With the Society of Cardiovascular Anesthesiologists

Endorsed by the Society for Cardiovascular Angiography and Interventions and the Society of Thoracic Surgeons

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5. Low-Flow/Low-Gradient Aortic Stenosis

Class IIa

1. **Dobutamine stress echocardiography is reasonable to evaluate patients with low-flow/low-gradient AS and LV dysfunction.** ***(Level of Evidence: B)***
2. **Cardiac catheterization for hemodynamic measurements with infusion of dobutamine can be useful for evaluation of patients with low-flow/low-gradient AS and LV dysfunction.** ***(Level of Evidence: C)***

Patients with severe AS and low cardiac output often present with a relatively low transvalvular pressure gradient (i.e., mean gradient less than 30 mm Hg). Such patients can

6. Indications for Aortic Valve Replacement

Class I

1. AVR is indicated for symptomatic patients with severe AS.* *(Level of Evidence: B)*
2. AVR is indicated for patients with severe AS* undergoing coronary artery bypass graft surgery (CABG). *(Level of Evidence: C)*
3. AVR is indicated for patients with severe AS* undergoing surgery on the aorta or other heart valves. *(Level of Evidence: C)*
4. AVR is recommended for patients with severe AS* and LV systolic dysfunction (ejection fraction less than 0.50). *(Level of Evidence: C)*

Class IIa

AVR is reasonable for patients with moderate AS* undergoing CABG or surgery on the aorta or other heart valves (see Section X-D). *(Level of Evidence: B)*

Class IIb

1. AVR may be considered for asymptomatic patients with severe AS* and abnormal response to exercise (e.g., development of symptoms or asymptomatic hypotension). *(Level of Evidence: C)*
2. AVR may be considered for adults with severe asymptomatic AS* if there is a high likelihood of rapid progression (age, calcification, and CAD) or if surgery might be delayed at the time of symptom onset. *(Level of Evidence: C)*
3. AVR may be considered in patients undergoing CABG who have mild AS* when there is evidence, such as moderate to severe valve calcification, that progression may be rapid. *(Level of Evidence: C)*
4. AVR may be considered for asymptomatic patients with extremely severe AS (aortic valve area less than 0.6 cm^2, mean gradient greater than 60 mm Hg, and jet velocity greater than 5.0 m per second) when the patient's expected operative mortality is 1.0% or less. *(Level of Evidence: C)*

Class III

AVR is not useful for the prevention of sudden death in asymptomatic patients with AS who have none of

Table 8. Stages of Valvular AS

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
A	At risk of AS	• Bicuspid aortic valve (or other congenital valve anomaly) • Aortic valve sclerosis	• Aortic V_{max} <2 m/s	• None	• None
B	Progressive AS	• Mild-to-moderate leaflet calcification of a bicuspid or trileaflet valve with some reduction in systolic motion or • Rheumatic valve changes with commissural fusion	• Mild AS: Aortic V_{max} 2.0–2.9 m/s or mean ΔP <20 mm Hg • Moderate AS: Aortic V_{max} 3.0–3.9 m/s or mean ΔP 20–39 mm Hg	• Early LV diastolic dysfunction may be present • Normal LVEF	• None
C: Asymptomatic severe AS					
C1	Asymptomatic severe AS	• Severe leaflet calcification or congenital stenosis with severely reduced leaflet opening	• Aortic V_{max} ≥4 m/s or mean ΔP ≥40 mm Hg • AVA typically is ≤1.0 cm^2 (or AVAi ≤0.6 cm^2/m^2) • Very severe AS is an aortic V_{max} ≥5 m/s or mean ΔP ≥60 mm Hg	• LV diastolic dysfunction • Mild LV hypertrophy • Normal LVEF	• None: Exercise testing is reasonable to confirm symptom status
C2	Asymptomatic severe AS with LV dysfunction	• Severe leaflet calcification or congenital stenosis with severely reduced leaflet opening	• Aortic V_{max} ≥4 m/s or mean ΔP ≥40 mm Hg • AVA typically ≤1.0 cm^2 (or AVAi ≤0.6 cm^2/m^2)	• LVEF <50%	• None
D: Symptomatic severe AS					
D1	Symptomatic severe high-gradient AS	• Severe leaflet calcification or congenital stenosis with severely reduced leaflet opening	• Aortic V_{max} ≥4 m/s or mean ΔP ≥40 mm Hg • AVA typically ≤1.0 cm^2 (or AVAi ≤0.6 cm^2/m^2) but may be larger with mixed AS/AR	• LV diastolic dysfunction • LV hypertrophy • Pulmonary hypertension may be present	• Exertional dyspnea or decreased exercise tolerance • Exertional angina • Exertional syncope or presyncope
D2	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	• LV diastolic dysfunction • LV hypertrophy • LVEF <50%	• HF • Angina • Syncope or presyncope
D3	Symptomatic severe low-gradient AS with normal LVEF or paradoxical low-flow severe AS	• 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)	• Increased LV relative wall thickness • Small LV chamber with low stroke volume • Restrictive diastolic filling • LVEF ≥50%	• HF • Angina • Syncope or presyncope

Indications for aortic valve replacement in symptomatic aortic stenosis

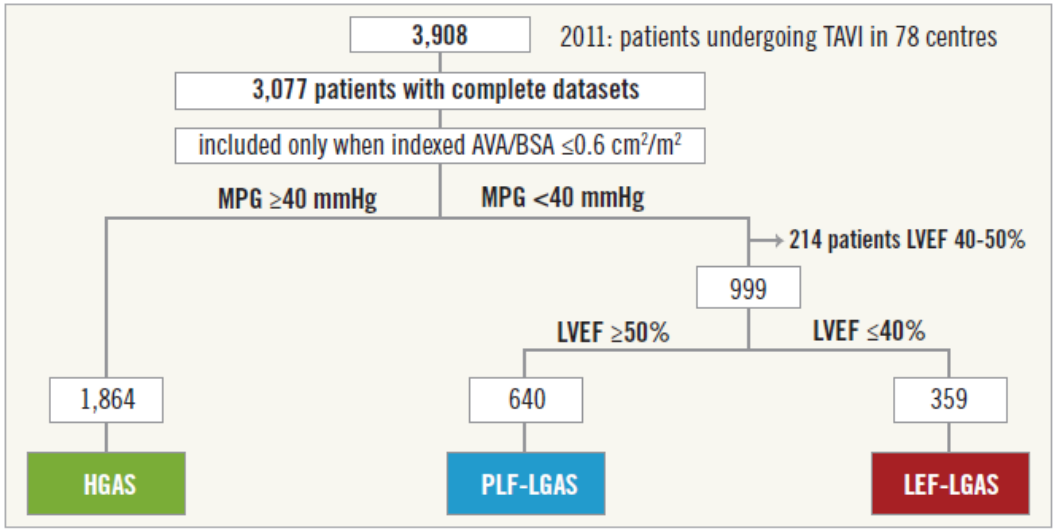
	Class	Level
AVR is indicated in patients with severe AS and any symptoms related to AS.	I	B
AVR is indicated in patients with severe AS undergoing CABG, surgery of the ascending aorta or another valve.	I	C
AVR should be considered in patients with moderate AS undergoing CABG, surgery of the ascending aorta or another valve.	IIa	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 symptomatic patients with low flow, low gradient (< 40 mmHg) AS with normal EF only after careful confirmation of severe AS.	IIa	C
AVR should be considered in symptomatic patients with severe AS, low flow, low gradient with reduced EF, and evidence of flow reserve.	IIa	C
AVR may be considered in symptomatic patients with severe AS low flow, low gradient, and LV dysfunction without flow reserve.	IIb	C

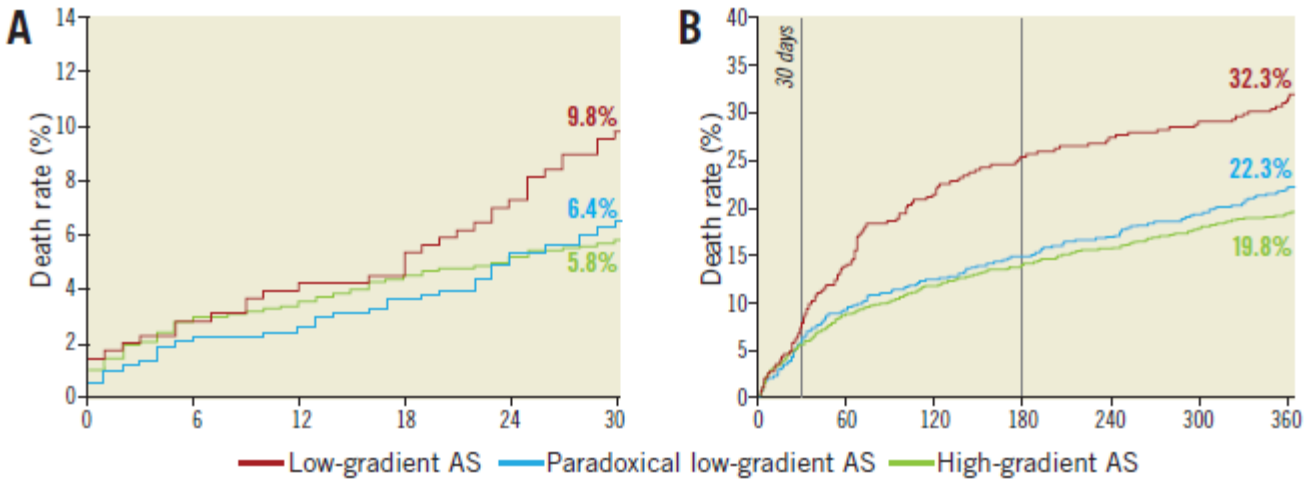
Paradoxical low-flow, low-gradient AS[¶]			
ESC/EACTS 2012	AVR should be considered in symptomatic patients with low-flow, low-gradient (<40 mmHg) AS with normal LVEF only after careful confirmation of severe AS.	IIa	C
ACC/AHA 2014	AVR is reasonable in symptomatic patients who have low-flow, low-gradient severe AS who are normotensive and have an LVEF ≥50% if clinical, haemodynamic and anatomic data support valve obstruction as the most likely cause of symptoms.	IIa	C

EuroIntervention 2014;10:850-859

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[3], MD; Christian W. Hamm[2], MD; on behalf of the GARY Executive Board





Cum.events Numbers at risk	Day 0	Day 30	Day 180	Day 365
Low-gradient AS	5 359	35 322	90 261	113 237
Paradoxical low-gradient AS	3 640	41 596	94 532	140 483
High-gradient AS	18 1,864	108 1,748	259 1,562	359 1,459

Log-rank test *p*-values (GH: <0.001)	Paradoxical low-gradient AS	High-gradient AS
Low-gradient AS	<0.001	<0.001
Paradoxical low-gradient AS		0.175

GARY Registry , Eurointerventions, 2014

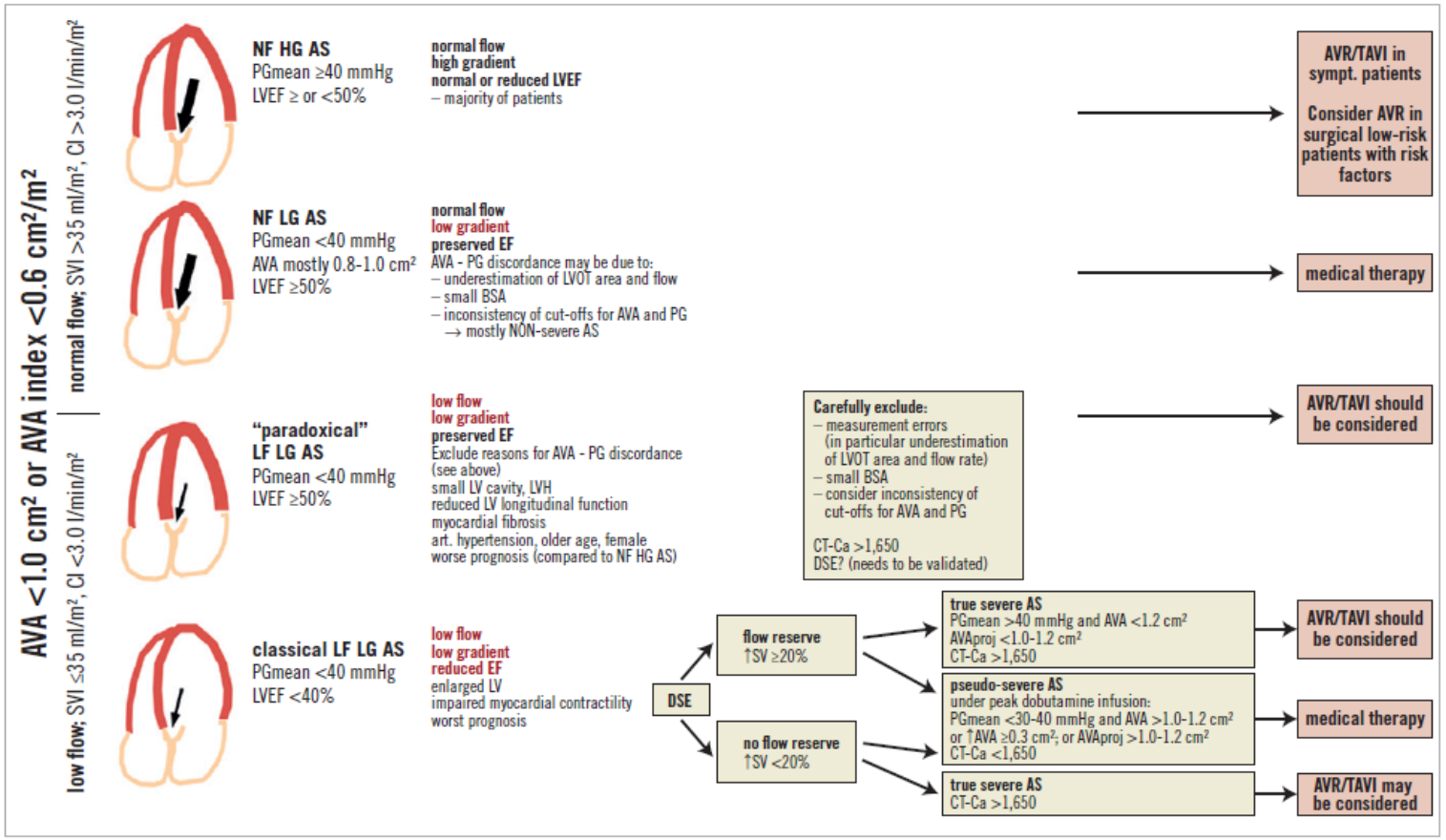
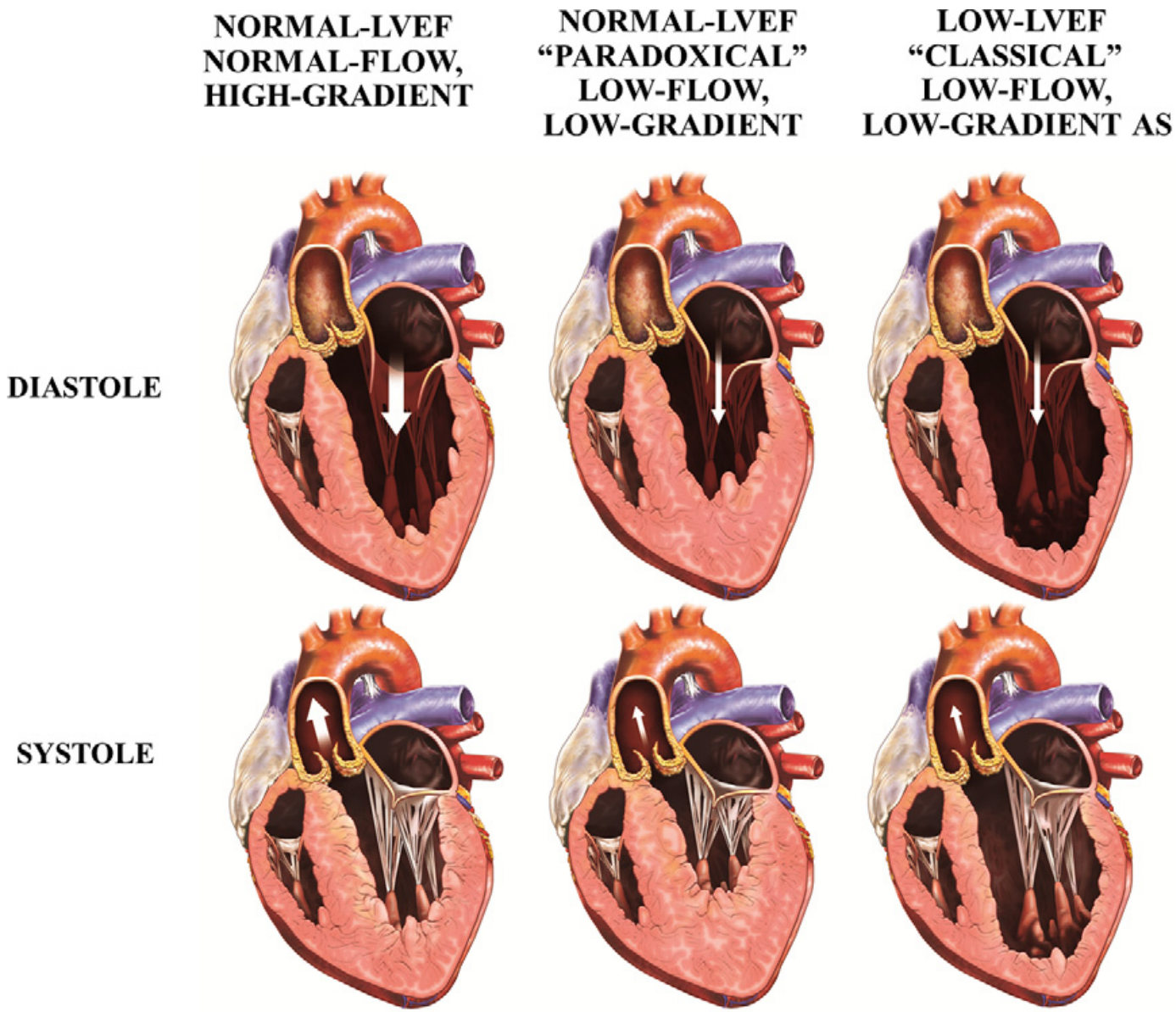


Figure 1. *Classification of patients with aortic stenosis (AS) and aortic valve area (AVA) <1.0 cm² (AVA index <0.6 cm²/m²) depending on pressure gradient level (low gradient [LG] vs. high gradient [HG]), flow state (normal flow [NF]; low flow [LF]) and left ventricular ejection fraction (LVEF). The subgroup of patients with low flow, high gradient was not taken into account due to limited study data. AVAproj: projected aortic valve area; BSA: body surface area; CI: cardiac index; CT-Ca: computed tomography calcium score; DSE: dobutamine stress echocardiography; PG: pressure gradient; LVH: left ventricular hypertrophy; LVOT: left ventricular outflow tract; SVI: stroke volume index*

Orwat S. Eurointervention , 2013

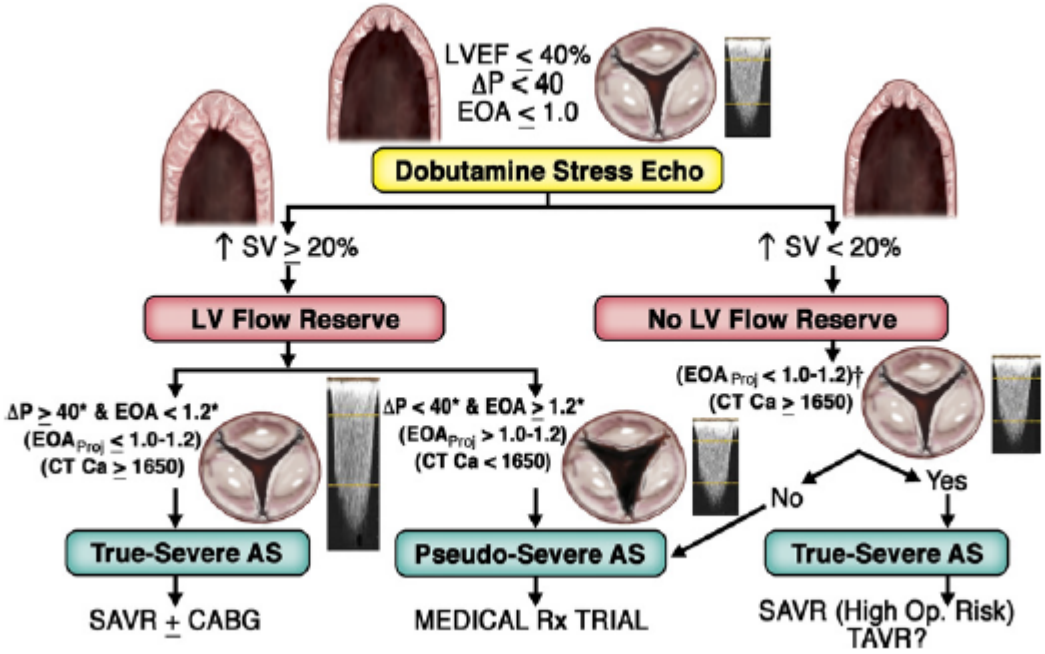


Pibarot P, JACC 2011

STENOSI AORTICA
con disfunzione ventricolare sinistra

For such patients I recommend
hemodynamic manipulation
in the cath or echo lab
to help determine which patients
are more likely to benefit from surgery

Carabello, N Engl J Med 2002



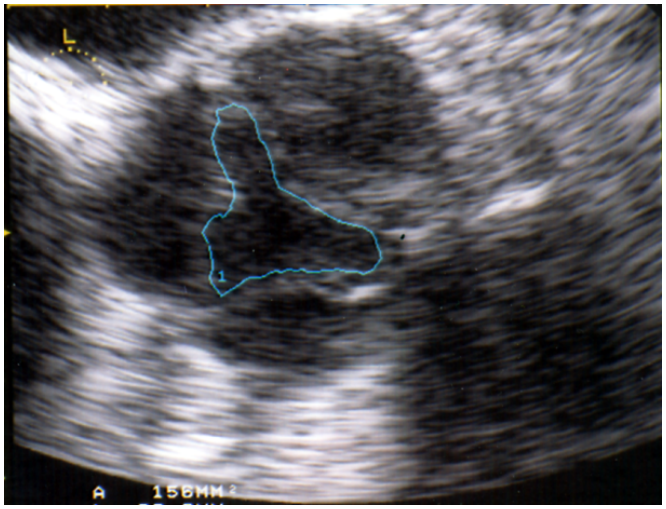
Pibarot , Dumesmil JACC , 2012

Stenosi aortica a basso gradiente e ridotta FE: quali altre indagini in assenza di riserva contrattile?

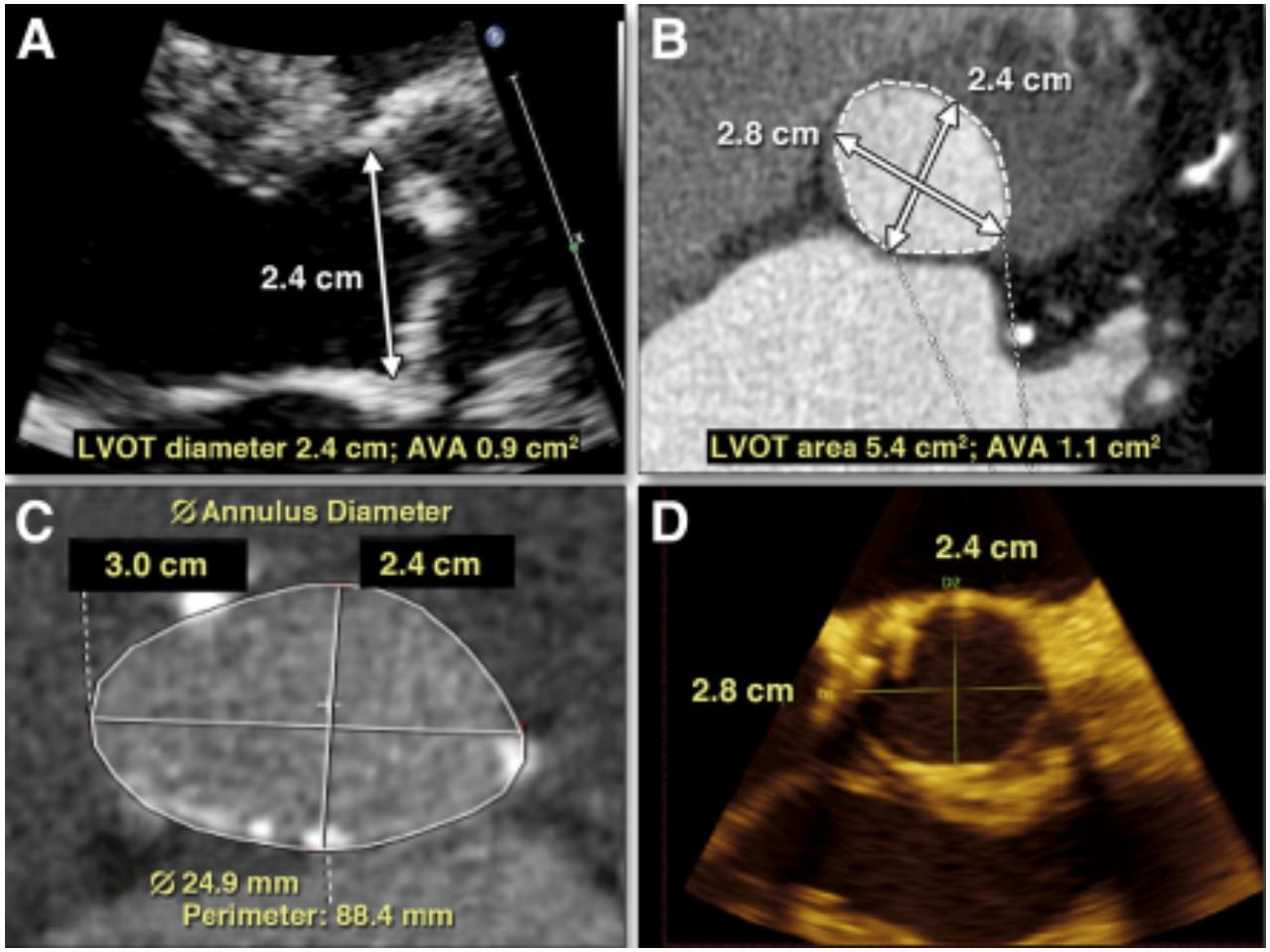
- **Morfologia ecocardiografica della valvola** (TEE con planimetria)
- **Calcium score (> 1.651) (multislice CT scan)**
- **Risonanza magnetica (AVA)**

Area valvolare: gli errori

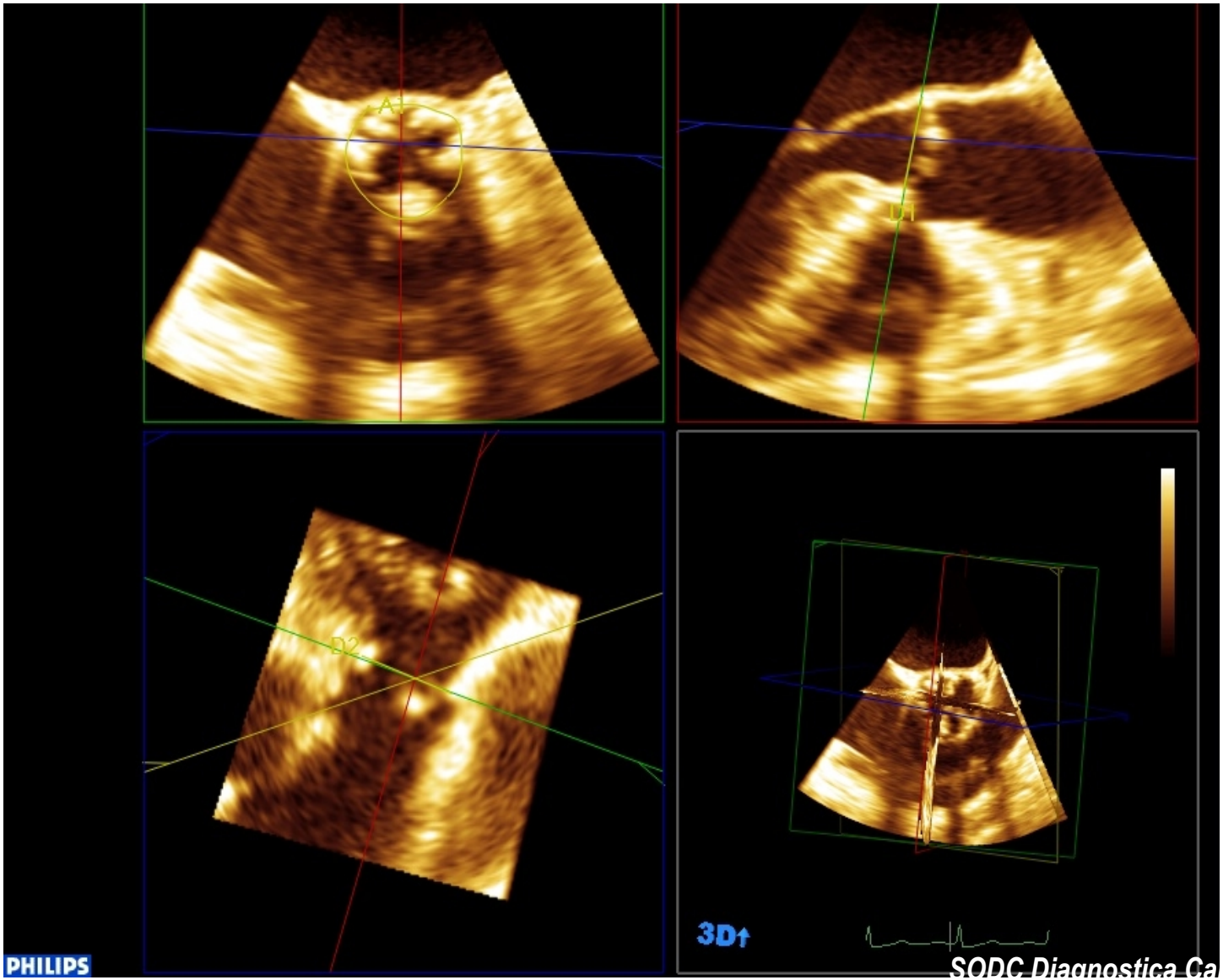
- In sala di cateterismo
  - Termo diluizione
  - Misura del gradiente
- In laboratorio di Eco
  - Area del tratto di efflusso
  - Gittata sistolica
  - TEE con manipolazione emodinamica (Dob , NtrPr)



Stenosi Aortica: Valutazione del TEVSn

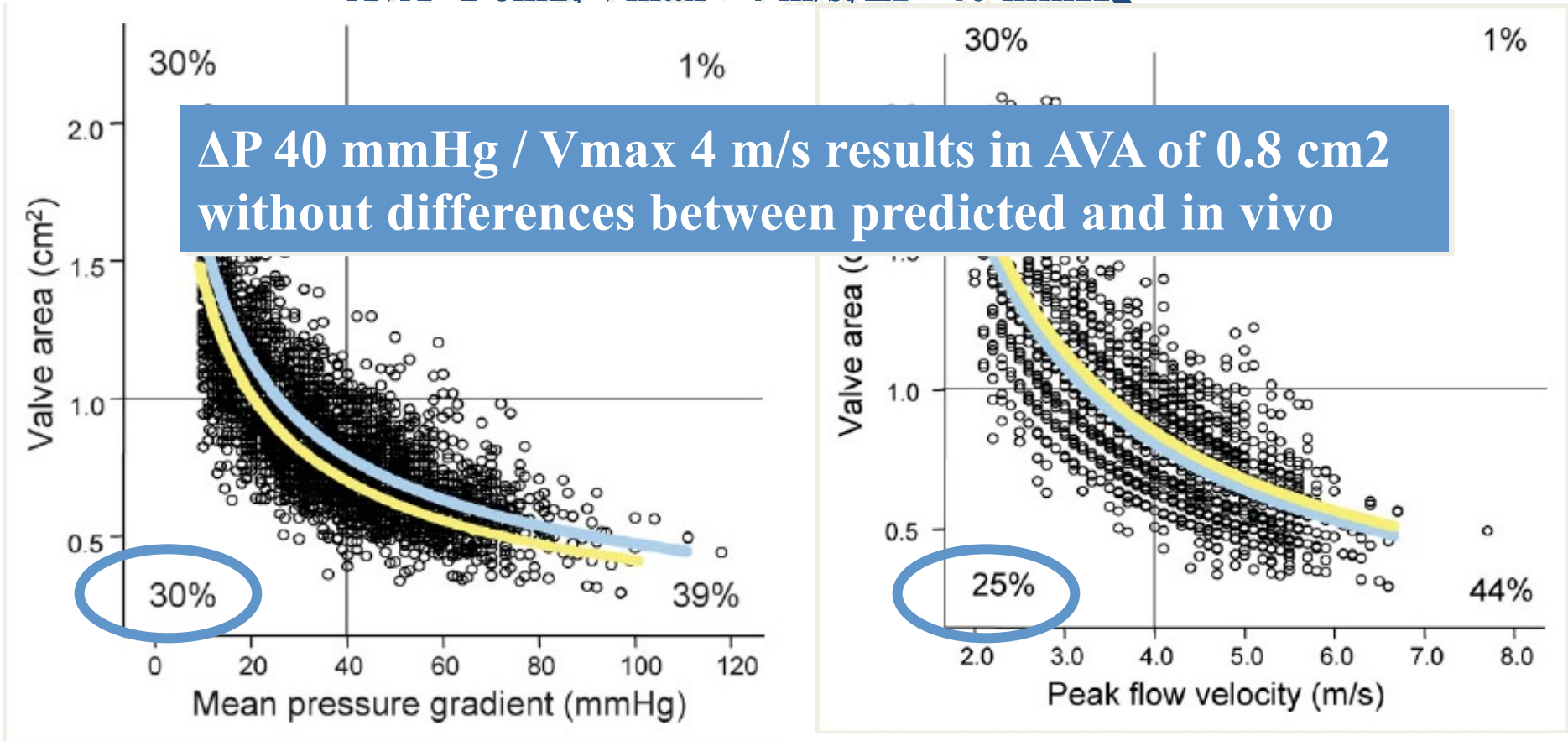


Stenosi Aortica: Valutazione Eco TE 3D



Inconsistencies of echocardiographic criteria for the grading of aortic valve stenosis

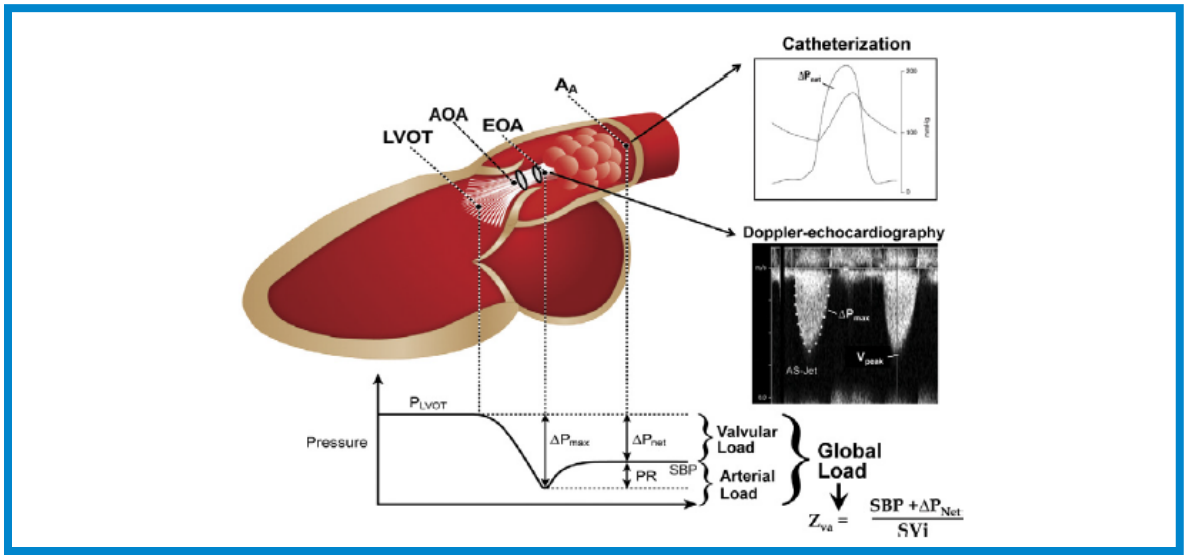
AVA<1 cm2, Vmax >4 m/s, ΔP>40 mmHg



ΔP 40 mmHg / Vmax 4 m/s results in AVA of 0.8 cm2 without differences between predicted and in vivo

Minners et al. European Heart Journal (2008) 29, 1043–1048

Errori di valutazione del Gradiente
"Recupero di pressione "



Pibarot , Dumesmil JACC , 2012

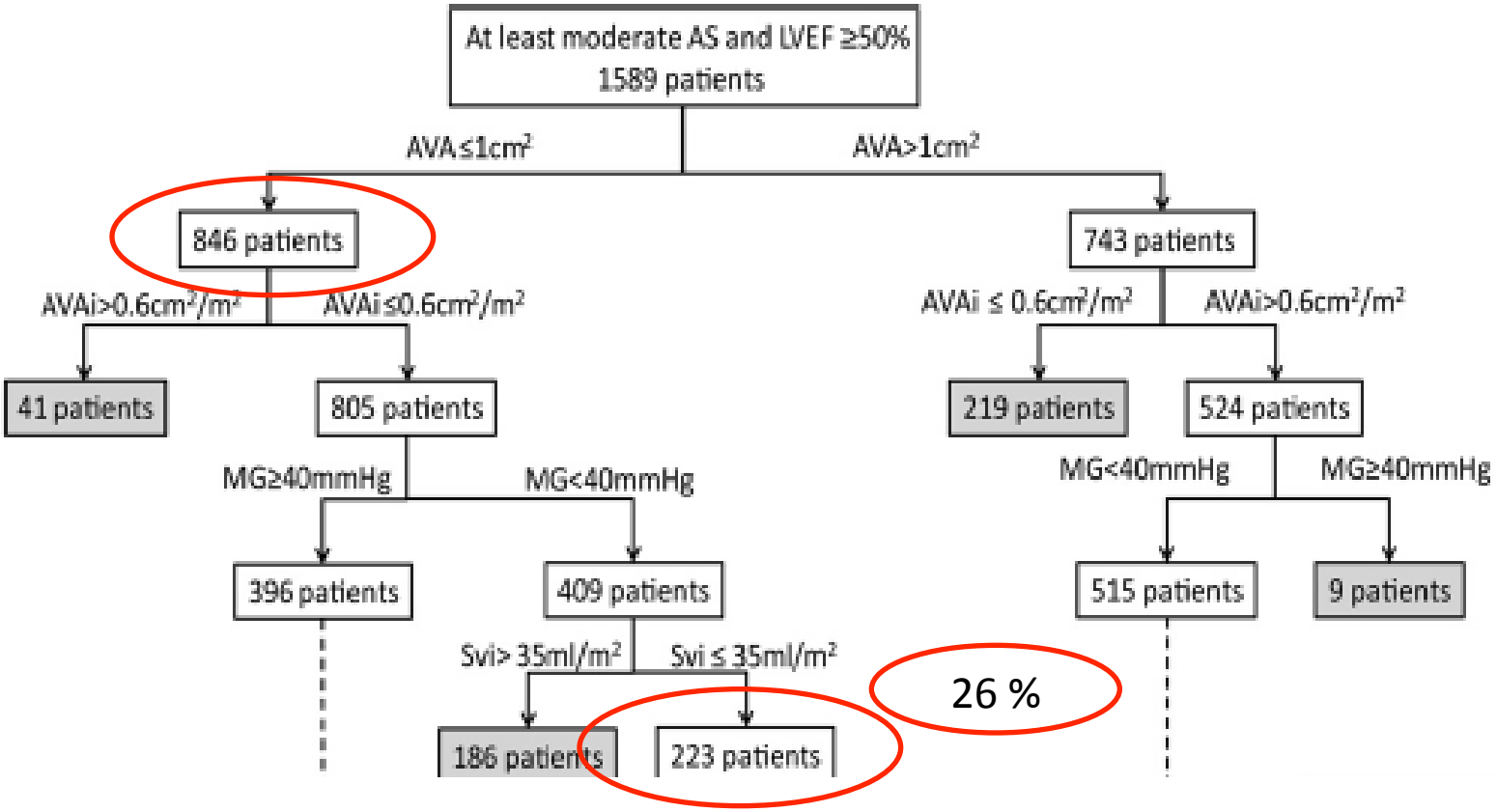
Il recupero di pressione è minore in presenza di alcuni elementi come

- **Dilatazione dell'aorta ascendente**
- **Flusso trans valvolare eccentrico**
- **Morfologia cupoliforme della stenosi**

A PARITA' DI GRADIENTE SARA' <u>MAGGIORE IL PESO EMODINAMICO</u>

Stenosi aortica severa paradossa:

Le dimensioni del problema



Clavel MA et al. JACC 2012

Paradoxical Low-Flow, Low-Gradient severe aortic stenosis
Possibili cause

- **Errori di Misura**
  - **Velocità**
  - **Stroke volume**
  - **Area valvolare**
- Taglia corporea piccola (Indicizzazione)
- Limiti del valore di cut-off per AVA
- Una vera diversa popolazione ?

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STENOSI AORTICA

Quale Area Valvolare ?

- Area Anatomica (gold standard del passato)
- Area Doppler: inferiore all' area anatomica secondo un coeff. di contrazione variabile in base alla morfologia della stenosi e alla reologia del liquido
- Area sec. Gorlin: inferiore all' area anatomica, ma parzialmente corretta (costante di Gorlin 44.3)
- Area Doppler < Area sec. Gorlin
- Area Doppler = sistematica sottostima

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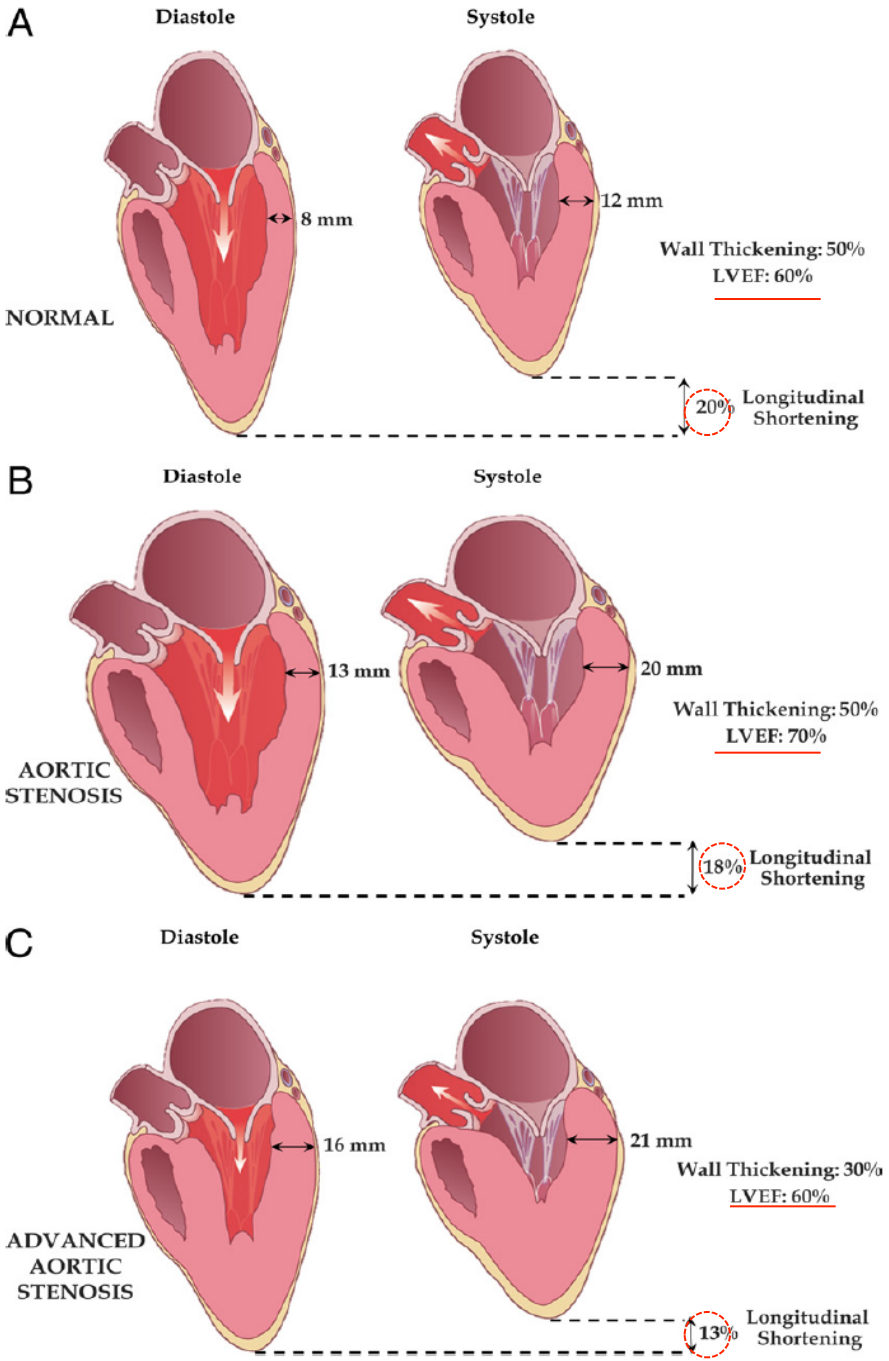
Paradoxical Low-Flow, Low-Gradient severe aortic stenosis despite preserved Ejection Fraction

Sottogruppo di p con SAO severa (AV < 0.6 cm^2/m^2; MG < 40 mmHg; FE > 50%,) con le seguenti caratteristiche:

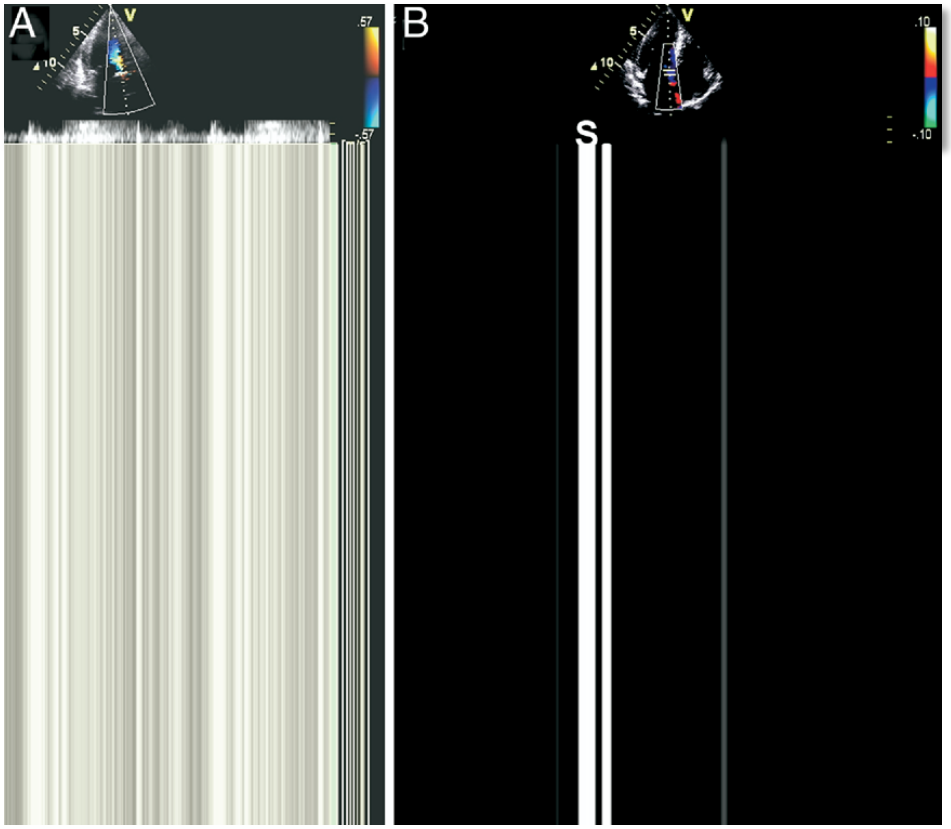
- Età più avanzata
- Sesso prevalentemente femminile
- Maggiore afterload globale del VS
- Più evidente rimodellamento concentrico del VS
- Segni di intrinseca disfunzione miocardica (ridotto mid-wall fractional shortening, ridotto strain longitudinale)
- Fibrillazione atriale , insufficienza / stenosi mitralica
- Ridotto stroke volume (bassi gradienti) (< 35 ml/m^2)

Superiorità dell'Accorciamento Longitudinale sulla Frazione d'Eiezione del VS per identificare la disfunzione sistolica nella Stenosi Aortica



da: Pibarot P, Dumesnil JG , JACC 2012

Longitudinal Left Ventricular Mechanics (Tissue Doppler, Speckle Tracking, Strain) in Asymptomatic Severe Aortic Stenosis

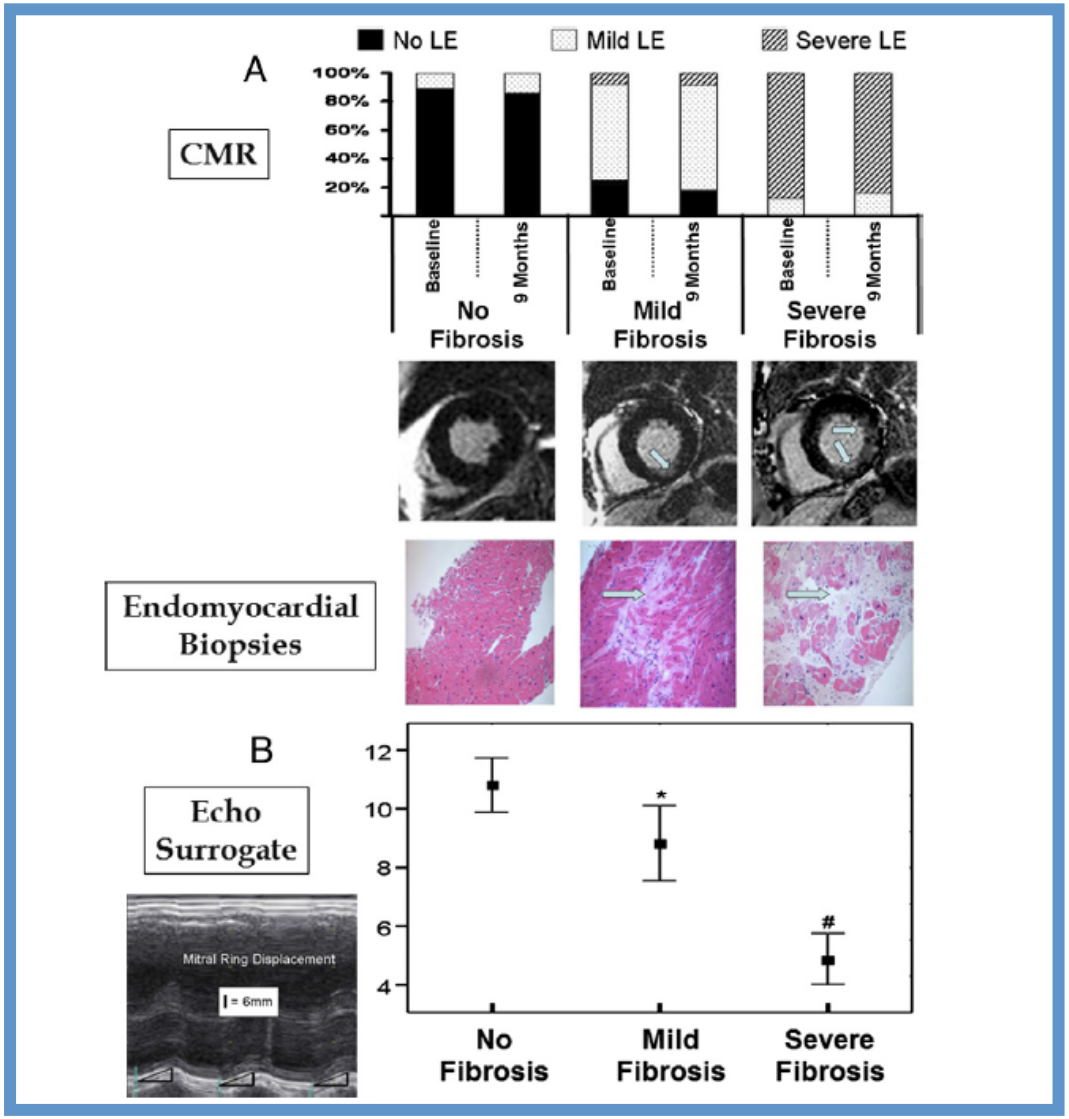


TDI

LS < 15%

Tissue Doppler and speckle track imaging might be therefore potentially useful in optimizing the timing of AVR before the onset of global LV dysfunction and symptoms in patients with severe AS. However, this requires future investigation

Dal-Bianco JP et al, J Am Coll Cardiol 2008



Pibarot , Dumesnil JACC 2012

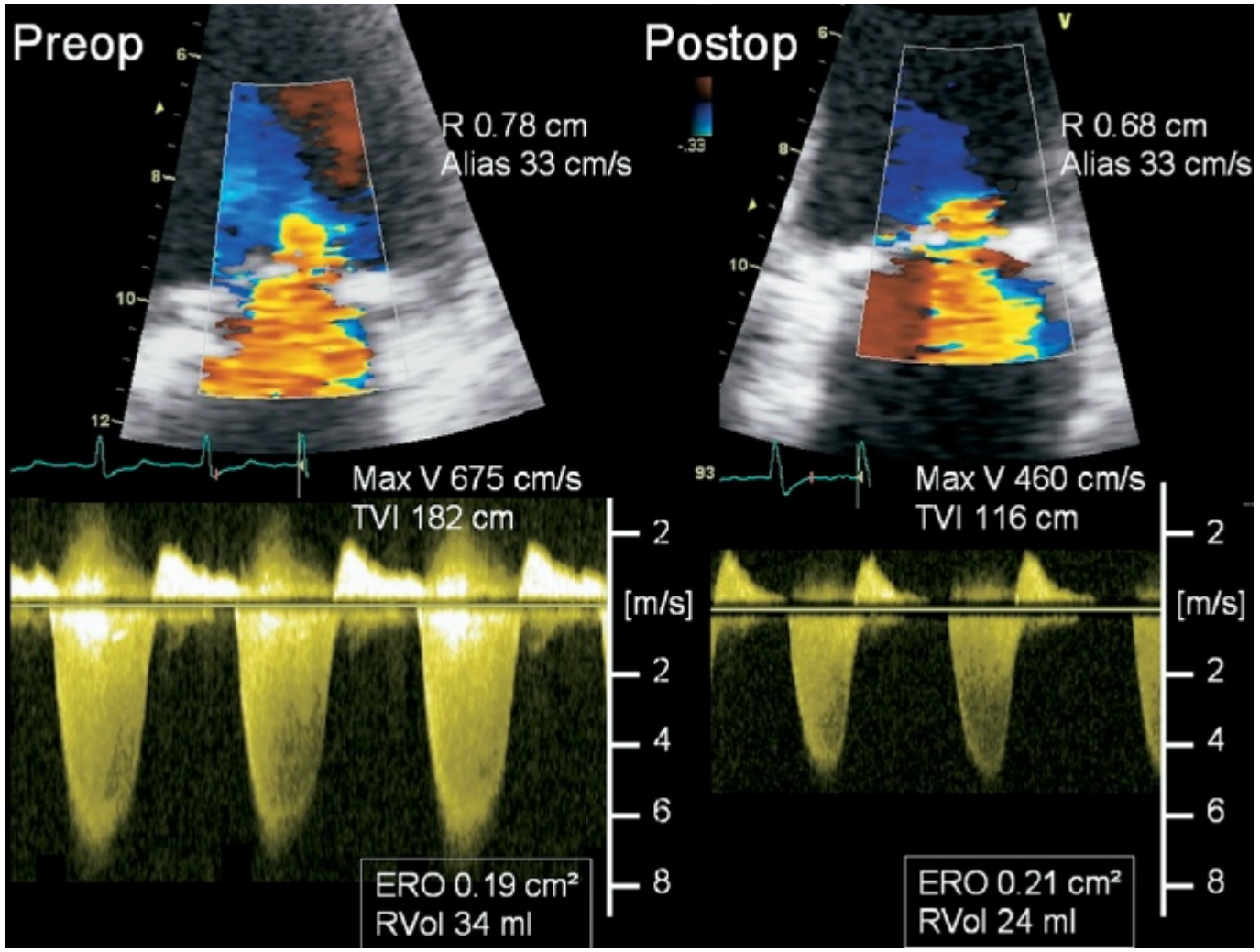
- Impedenza aortica

La valutazione dell'impedenza valvolare-arteriosa (ZVA index = gradiente medio+pressione arteriosa sistolica/gettata sistolica indicizzata per la superficie corporea) rappresenta un ulteriore elemento per stimare il peso emodinamico

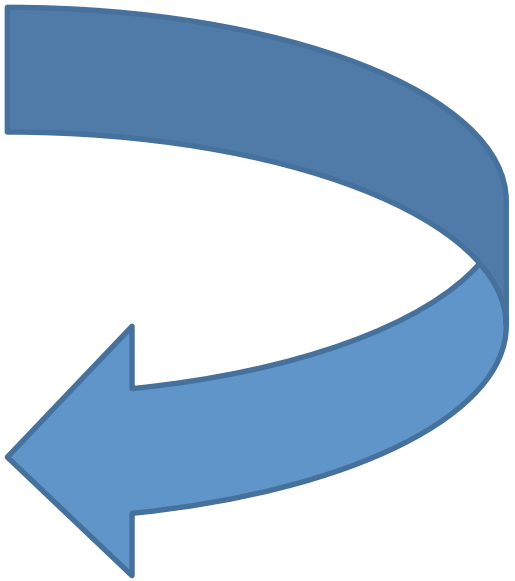
$$Z_{va} = \frac{SBP + \Delta P_{Net}}{SVi}$$

- **Ogni paziente deve avere un controllo attento dei valori pressori con pressione sistolica inferiore a 140 mmhg.**
- **Raggiunto questo risultato si deve rivalutare attentamente il gradiente transvalvolare ed il CO**
- **Valori di Zva > 4,5 mmhg/ml/m2 indicano una stenosi aortica significativa**

Severe Aortic stenosis and Moderate Mitral regurgitation



Ungar P et al., Am J Cardiol 2006

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GRAZIE !