Insufficienza aortica

La fisiopatologia, i metodi di valutazione della gravità del rigurgito, la funzione ventricolare sinistra ed il timing operatorio nelle fasce di età avanzate

M. Cecconi

Insufficienza aortica

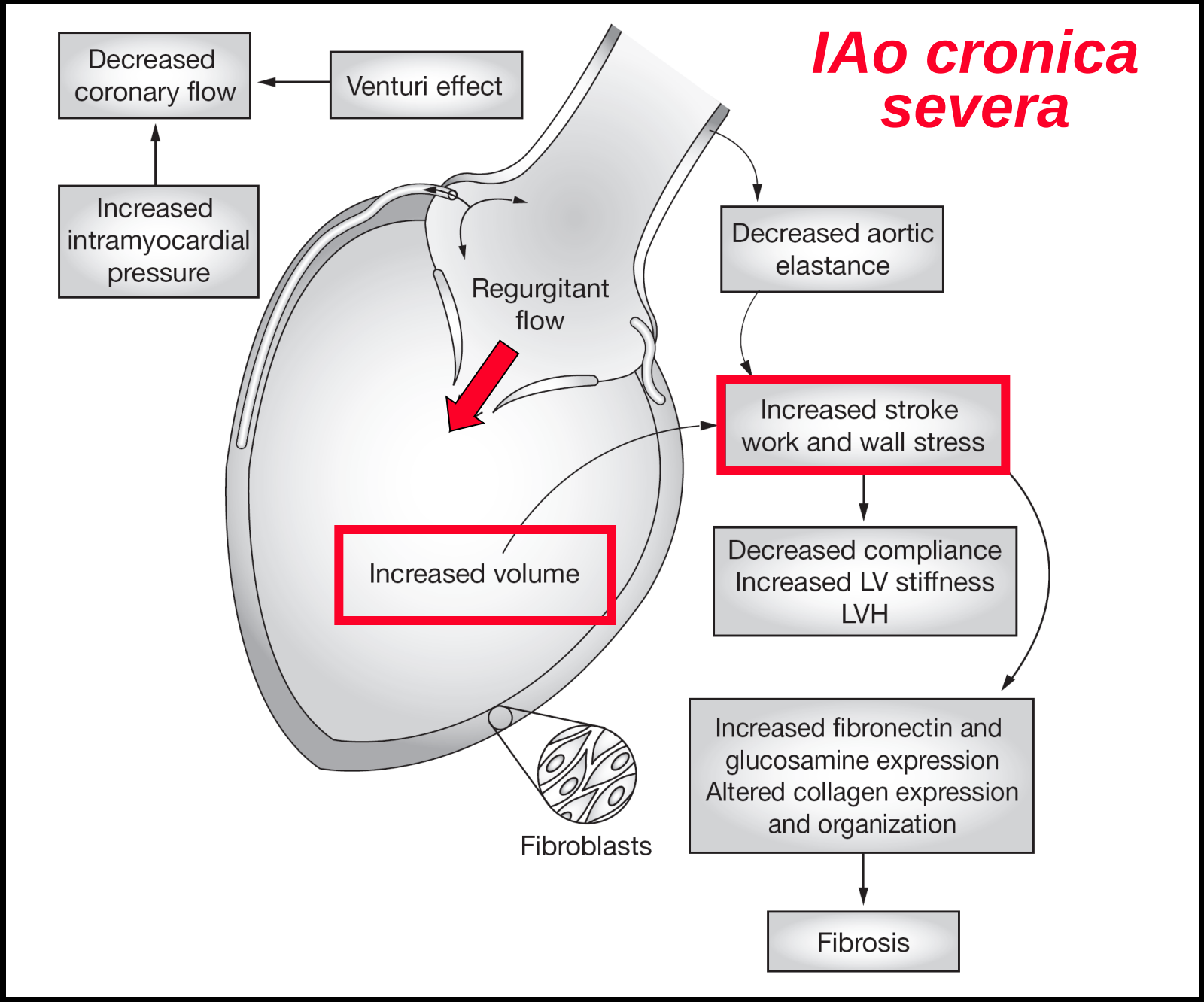
- *Fisiopatologia*

  Gravità del rigurgito

  Funzione ventricolare sinistra

  Timing chirurgico

IAo cronica severa

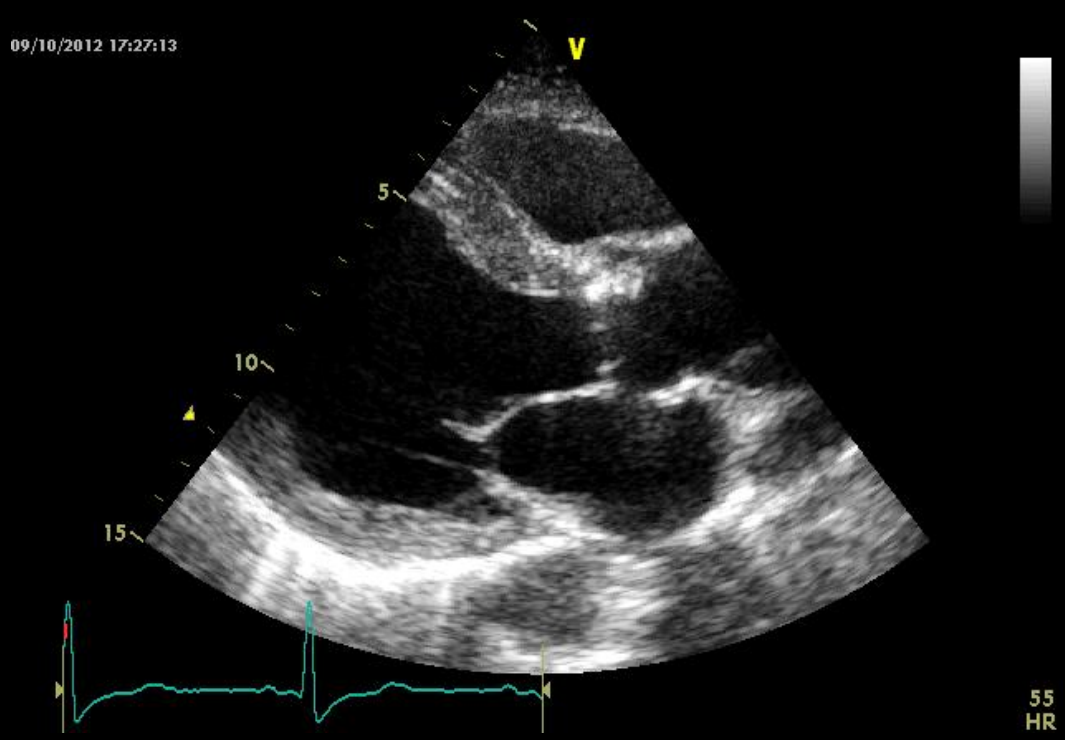


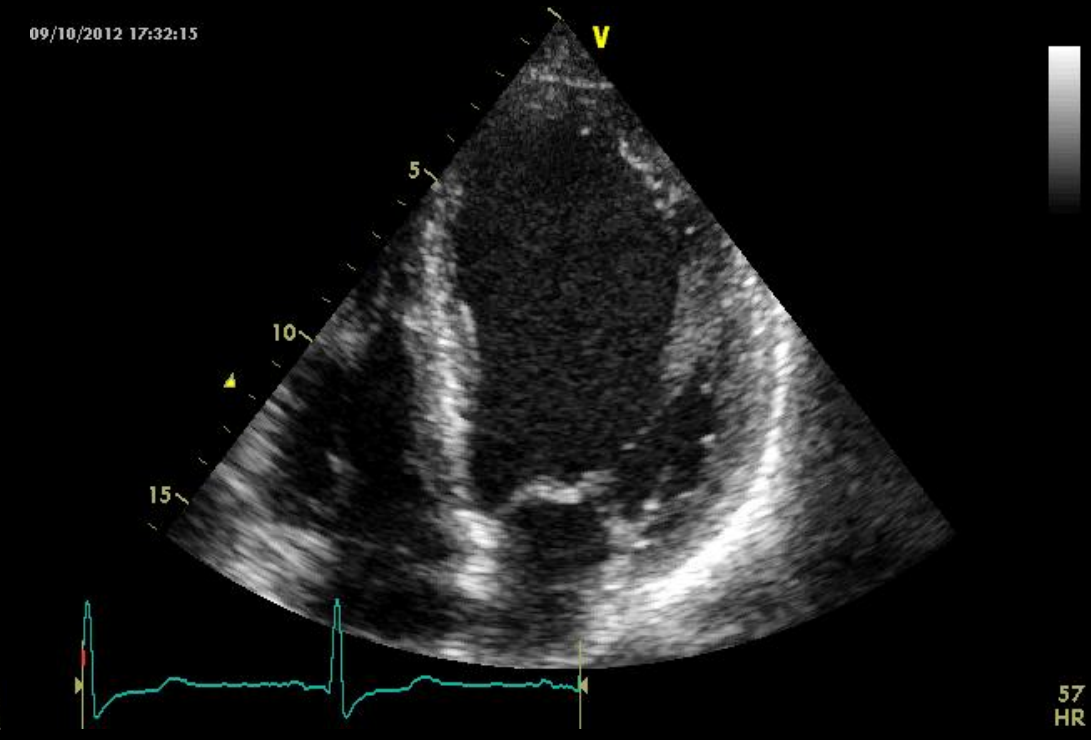
Goldbarg SH, Halperin JL. Nat Clin Pract Cardiovasc Med 2008; 5: 269-79

Fisiopatologia (1)

- ***Incremento del volume telediastolico e dello stress di parete del VS***
- ***Aumentato precarico e postcarico del ventricolo sinistro***
- ***Sovraccarico di volume e di pressione del ventricolo sinistro***

Dilatazione / ipertrofia del VS





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Fisiopatologia (2)

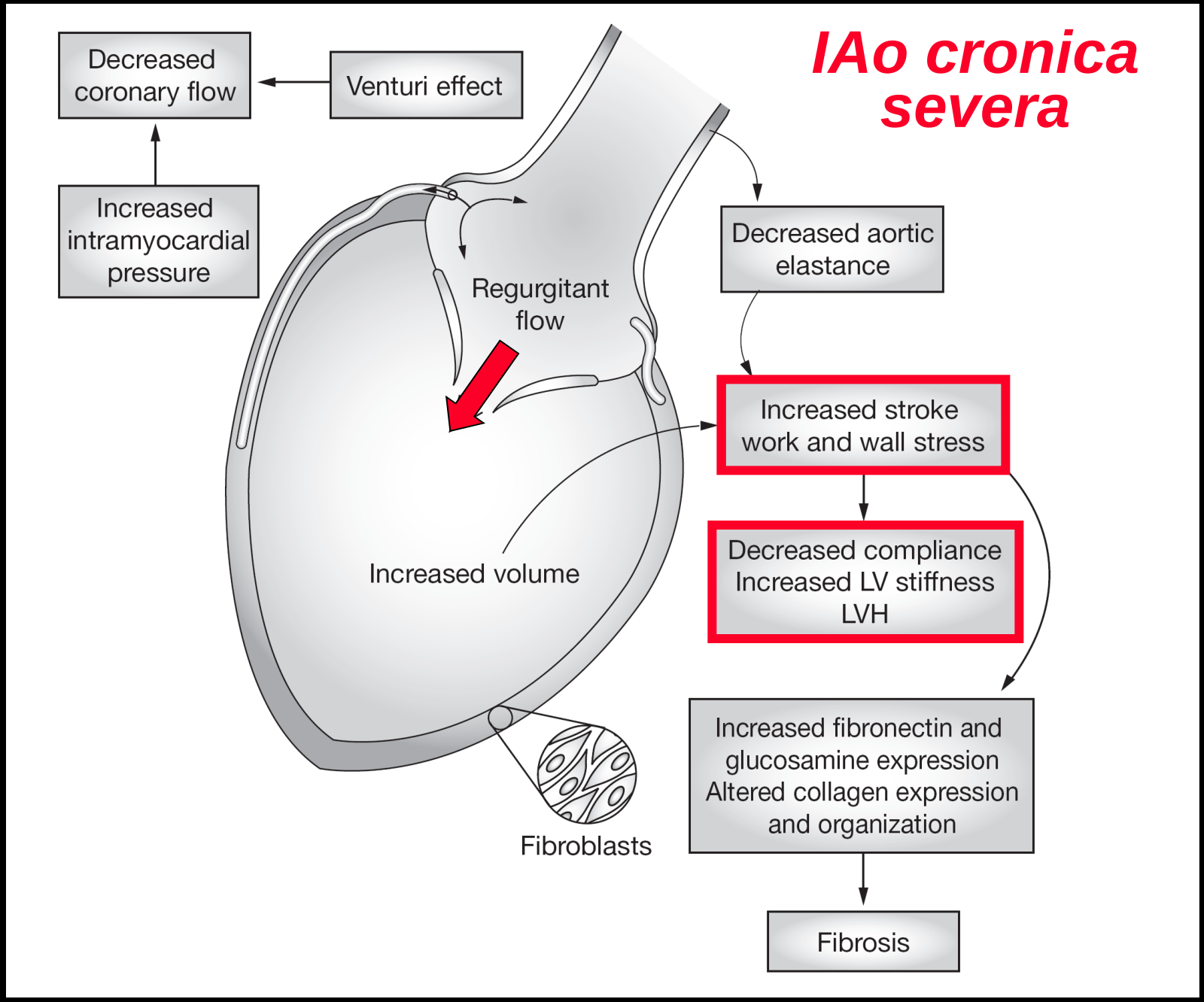
- ***Combinazione dilatazione/ipertrofia (remodeling "efficiente" del VS)***
- ***Incremento dello stroke volume***
- ***Mantenimento di un' adeguata gittata sistolica e di una normale frazione d' eiezione del VS in assenza di significativo incremento delle pressioni di riempimento (incremento della compliance ventricolare)***

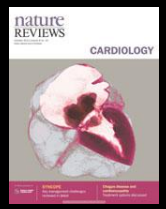
Fisiopatologia (3)

"Compenso funzionale" bilancio tra:

- ***Eccesso di postcarico***
- ***Riserva di precarico***
- ***Ipertrofia ventricolare sinistra***

IAo cronica severa





Goldbarg SH, Halperin JL. Nat Clin Pract Cardiovasc Med 2008; 5: 269-79

Fisiopatologia (4)

Progressione della malattia

Progressivo incremento del volume telediastolico del VS non più adeguatamente compensato dall' incremento dello spessore parietale

↓

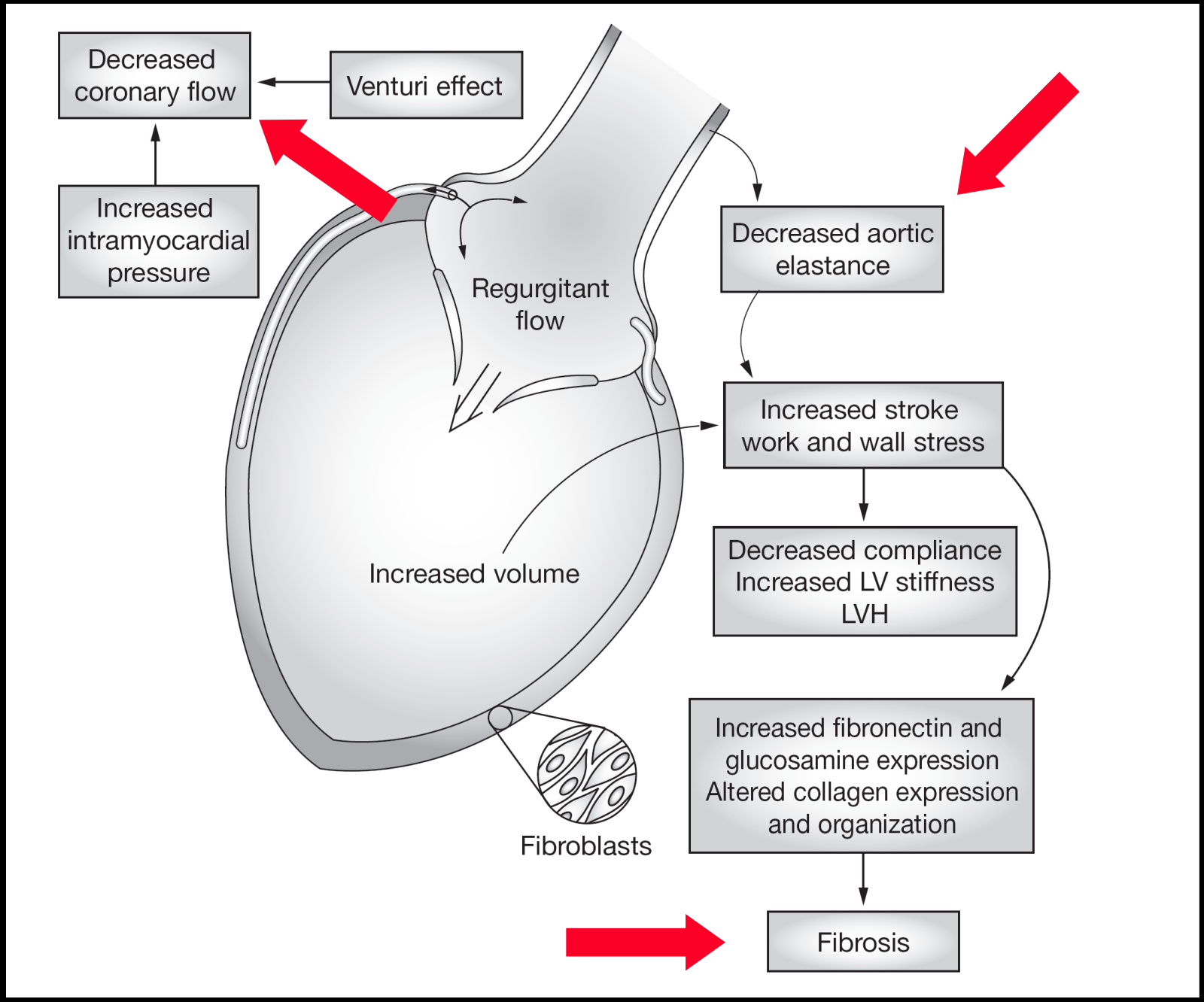
Incremento dello stress parietale

↓

Afterload mismatch

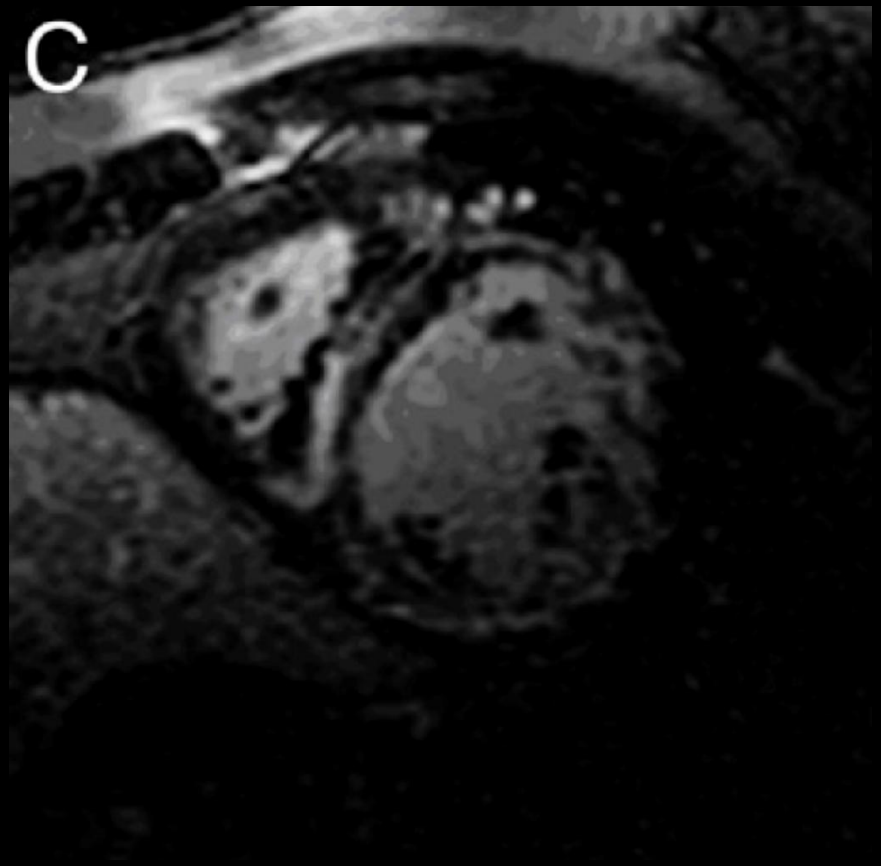
↓

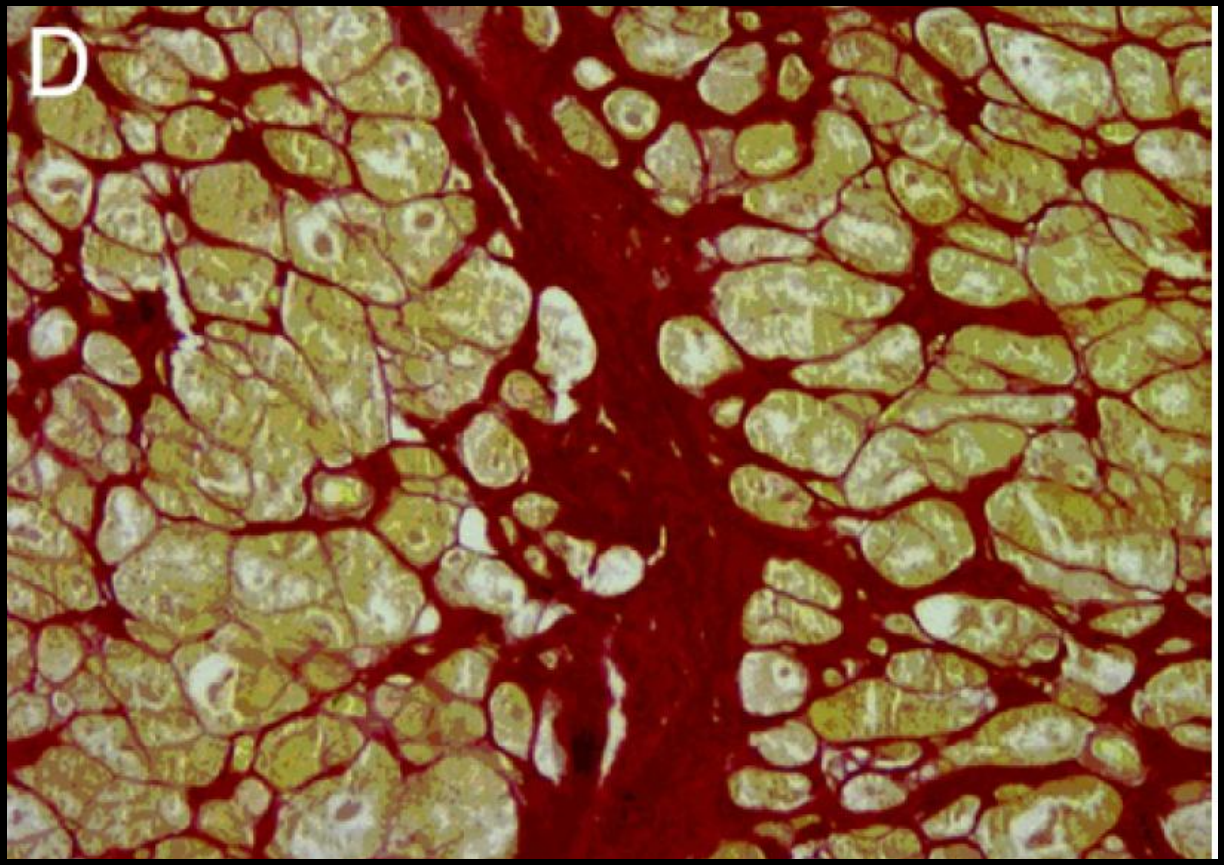
Disfunzione sistolica del VS



Goldbarg SH, Halperin JL. Nat Clin Pract Cardiovasc Med 2008; 5: 269-79

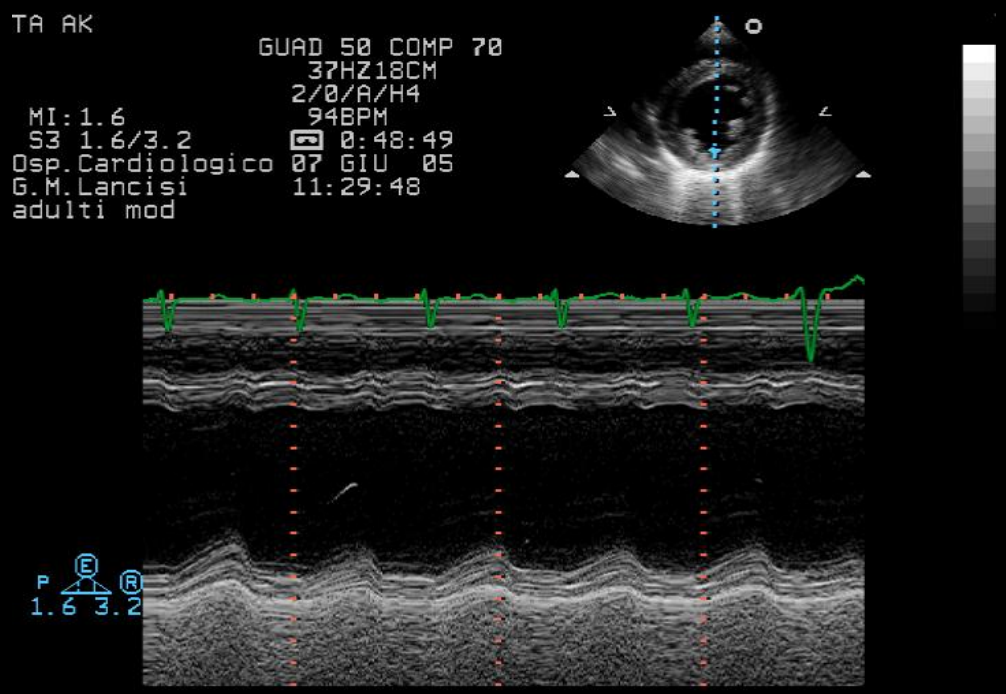
Myocardial fibrosis

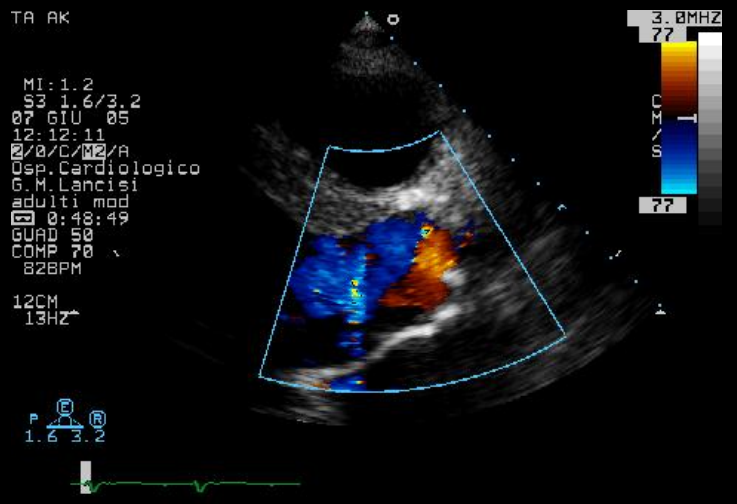


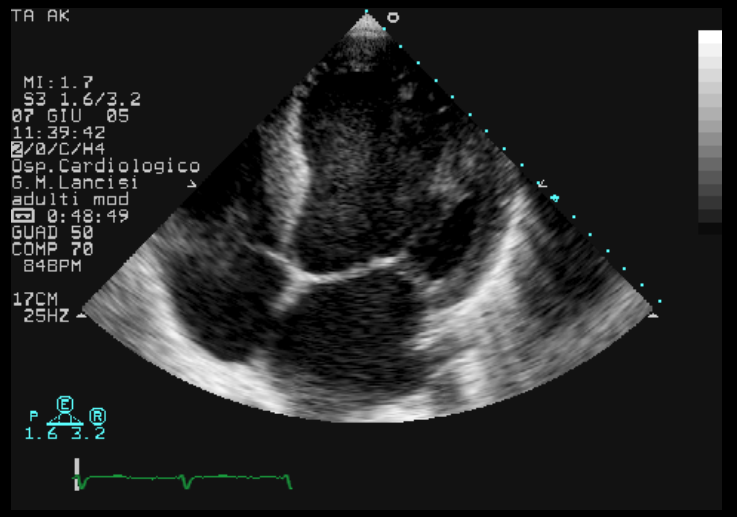


Azevedo CF et al. J Am Coll Cardiol 2010; 56: 278-87

Disfunzione VS







Relazione DVS-sintomi

TABLE 1. Baseline Characteristics of 450 Patients Who Underwent AVR for AR With Baseline EF Measurement

	LoEF EF <35%	MedE EF 35%–50%	NI EF EF ≥50%	*P*
No.	43	134	273	...
Female sex, %	19	23	22	0.82
Age, y	58±14	58±15	56±16	0.22
Associated CABG, %	21	25	21	0.63
CAD, %	22	31	23	0.12
CCS class III–IV, %	16	6	9	0.60
Atrial fibrillation, %	23	16	14	0.28
Hypertension, %	35	31	34	0.78
Creatinine, %	1.16±0.26	1.17±0.37	1.24±0.64	0.43
Diabetes, %	16	6	2	0.0002
NYHA class III–IV, %	58	49	29	<0.0001

A large proportion of patients had no symptoms in the LoEF group (28 %) similar to the MedEF (30 %, p = 0.85) or NlEF group (37 %, p = 0.31).

Chaliki HP et al.: Circulation 2002; 106: 2687-93

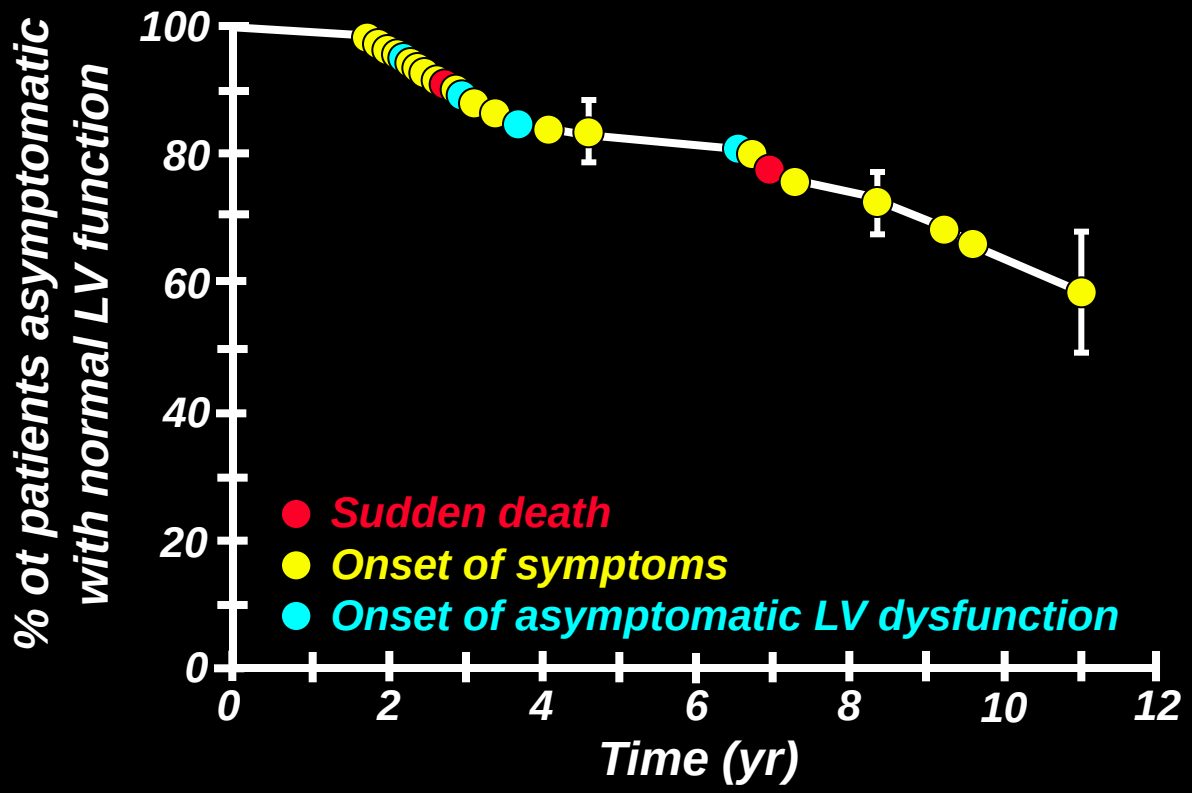
Natural history of asymptomatic AR

Study	Number of patients	Mean FU (yr)	Progression to symptoms, death or LV dysfunction rate/yr (%)	Progression to asymptomatic LV dysfunction rate/yr (%)	Mortality (number of patients)
Bonow (1983, 1991)	104	8.0	3.8	0.5	2
Scognamiglio (1986)	30	4.7	2.1	2.1	0
Siemienczuk (1989)	50	3.7	4.0	0.5	0
Scognamiglio (1994)	74	6.0	5.7	3.4	0
Tornos (1995)	101	4.6	3.0	1.3	0
Ishii (1996)	27	14.2	3.6	--	0
Borer (1998)	104	7.3	6.2	0.9	4
Tarasoutchi (2003)	72	10.0	4.7	0.1	0
Evangelista (2005)	31	7.0	3.6	--	1
	593	**6.6**	**4.3**	**1.2**	**0.18 %/y**

Età media: 39 anni

Natural history of asymptomatic AR

104 patients (mean age: 36 years)



Mean FU: 8 years

Sudden death: 2

Symptoms: 19

Asymptomatic LVD: 4

At 11 years 58 ± 9 % of the patients were alive and asymptomatic with normal LV function

Bonow RO et al. Circulation 1991; 84: 1625-1635

Mortality and morbidity of AR

- 246 pazienti con insufficienza aortica III/IV - IV/IV
- 192 maschi (78 %); età media: **56 ± 19 anni**
- "Conservative management" (1985-1994)
- Follow-up medio : 7 ± 3 anni

Entro 10 anni: morte o necessità di chirurgia **nel 75 % dei pazienti** ed eventi cardiovascolari* nell' 83 % dei pazienti.

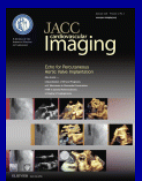
* morte CV, chirurgia, scompenso, dissezione aortica, tromboembolia, fibrillazione atriale, endocardite

Dujardin KS et al.: Circulation 1999; 99: 1851-7

Indicazione chirurgica

81 pazienti (età media: 60 a.)

Sintomi:	**38**
Disfunzione o dilatazione VS:	**17**
Aneurisma aortico:	**11**
Endocardite infettiva:	**3**
Preferenza medico/paz:	**11**
Dissezione aortica:	**1**



Detaint D et al. J Am Coll Cardiol Img. 2008; 1: 1-11

Insufficienza aortica

Fisiopatologia

- ***Gravità del rigurgito***

Funzione ventricolare sinistra

Timing chirurgico

Gravità dell' insufficienza aortica

- **Valutazione poliparametrica**
  - *Integrazione di parametri:*
    - *Qualitativi*
    - *Semiquantitativi*
    - *Quantitativi*

Almeno 2 parametri concordanti !

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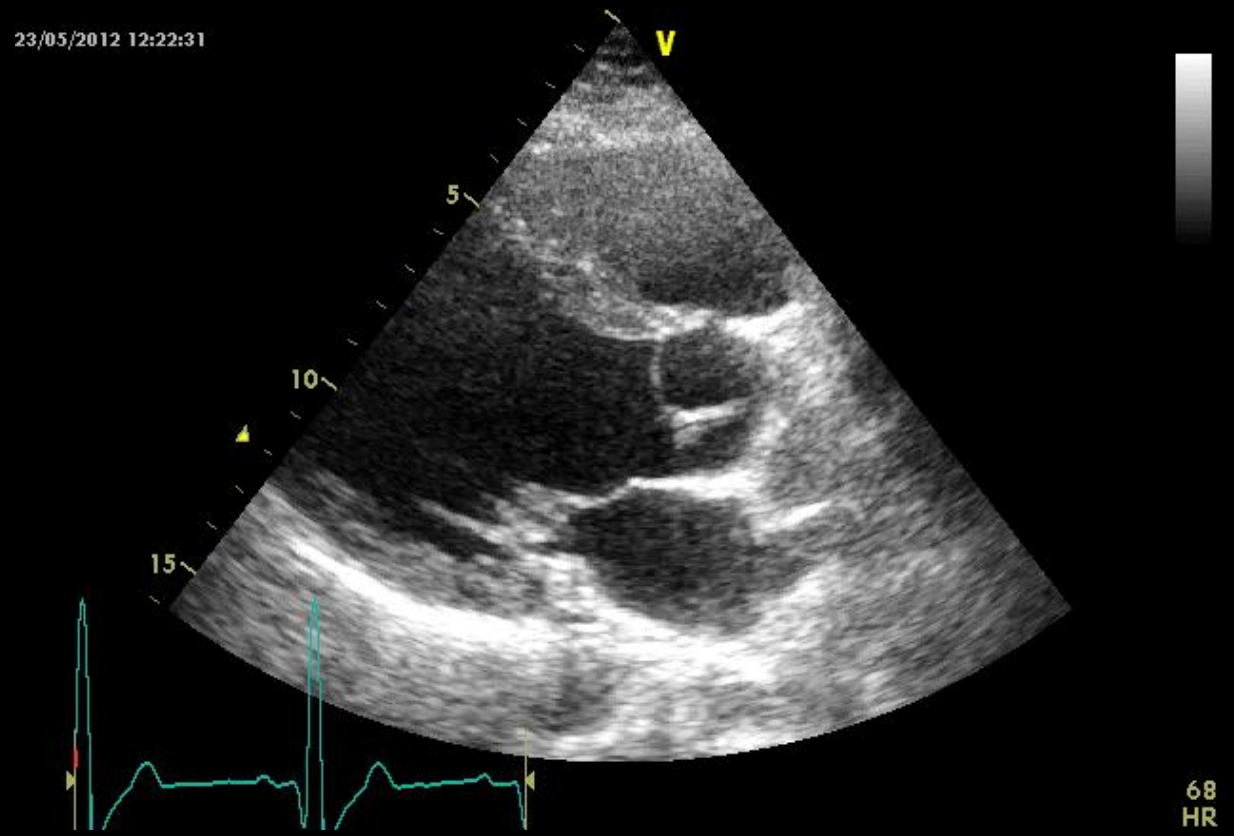
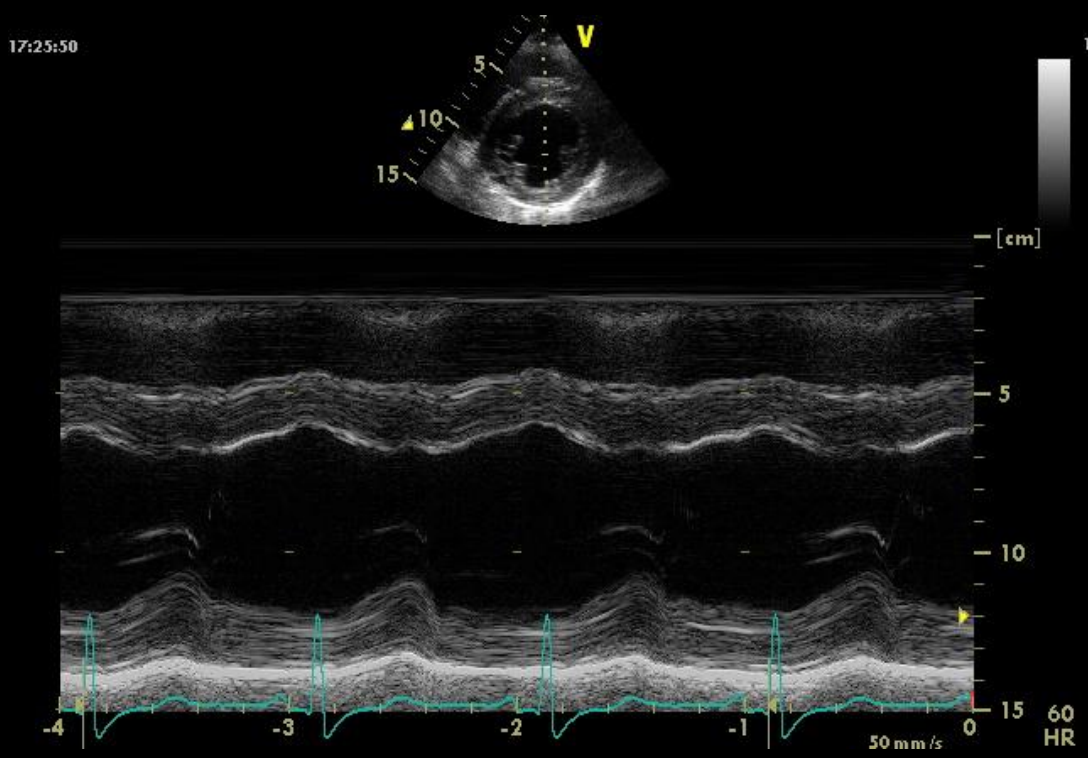
Insufficienza aortica severa

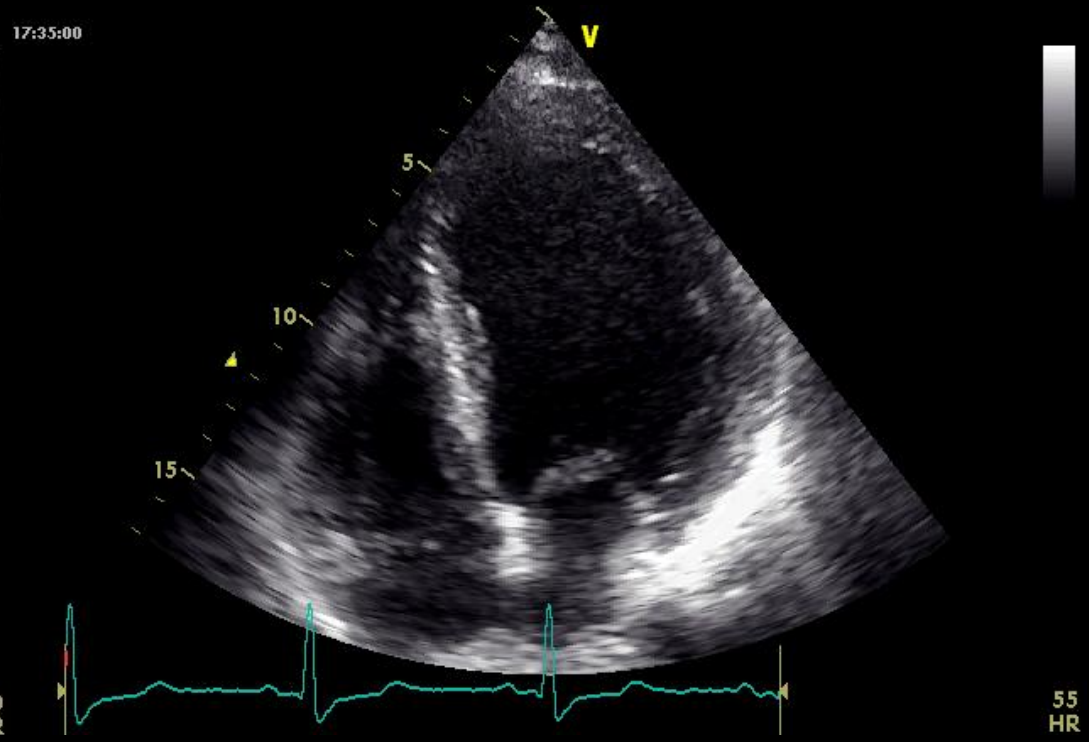
Difetto di coaptazione visualizzabile con ECO 2D



Insufficienza aortica cronica severa

Dilatazione del ventricolo sinistro





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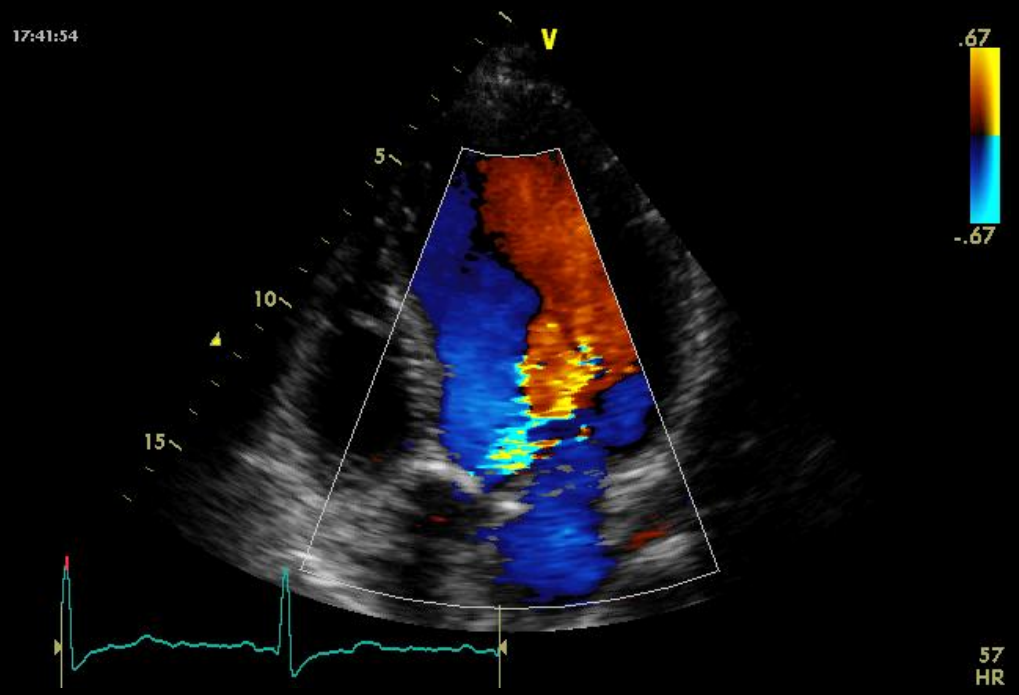
Estensione del jet

Parametro non raccomandato per la quantificazione

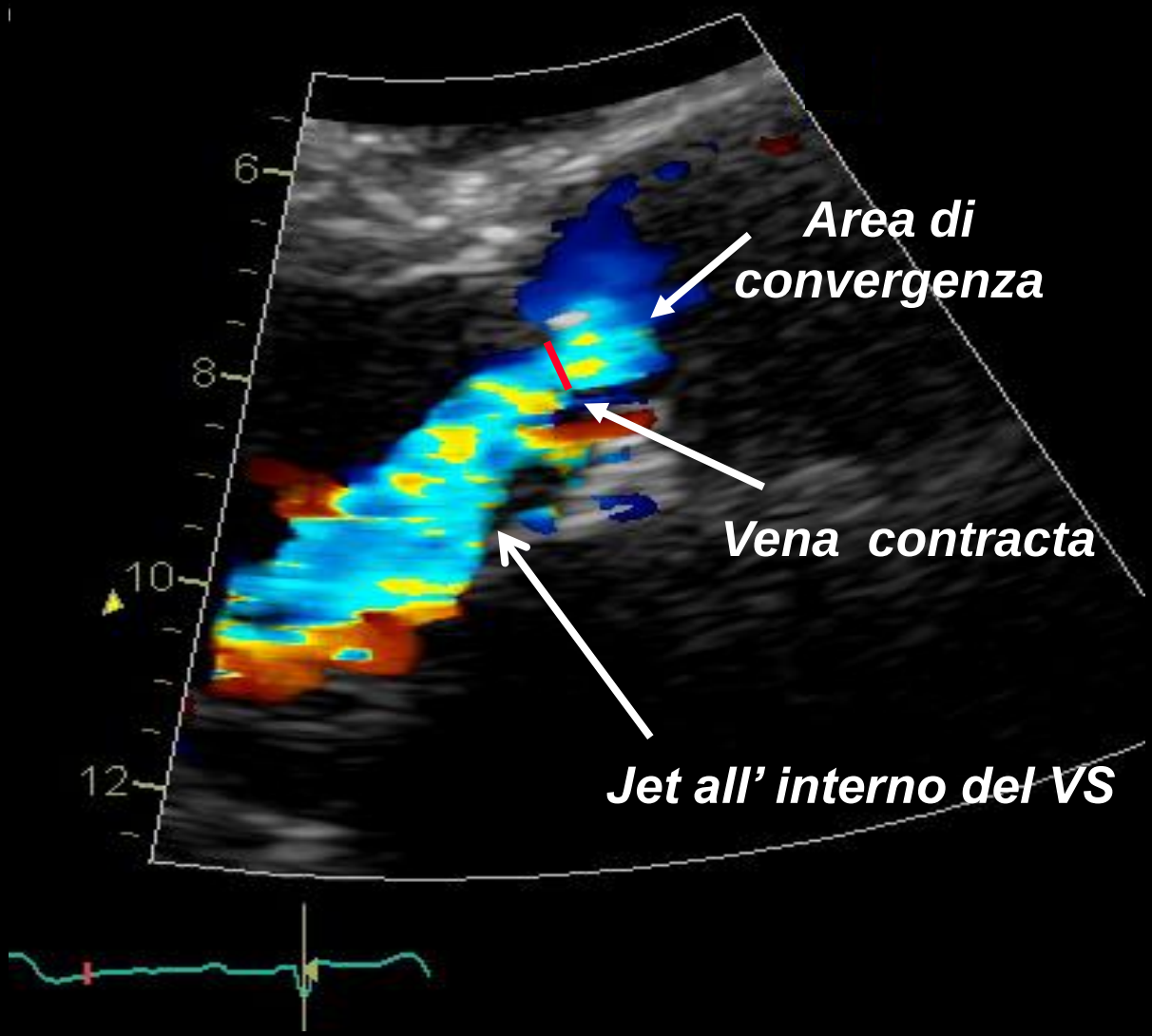


- *Valutazione visiva iniziale*
- *Debole correlazione con la gravità dell' lAo*

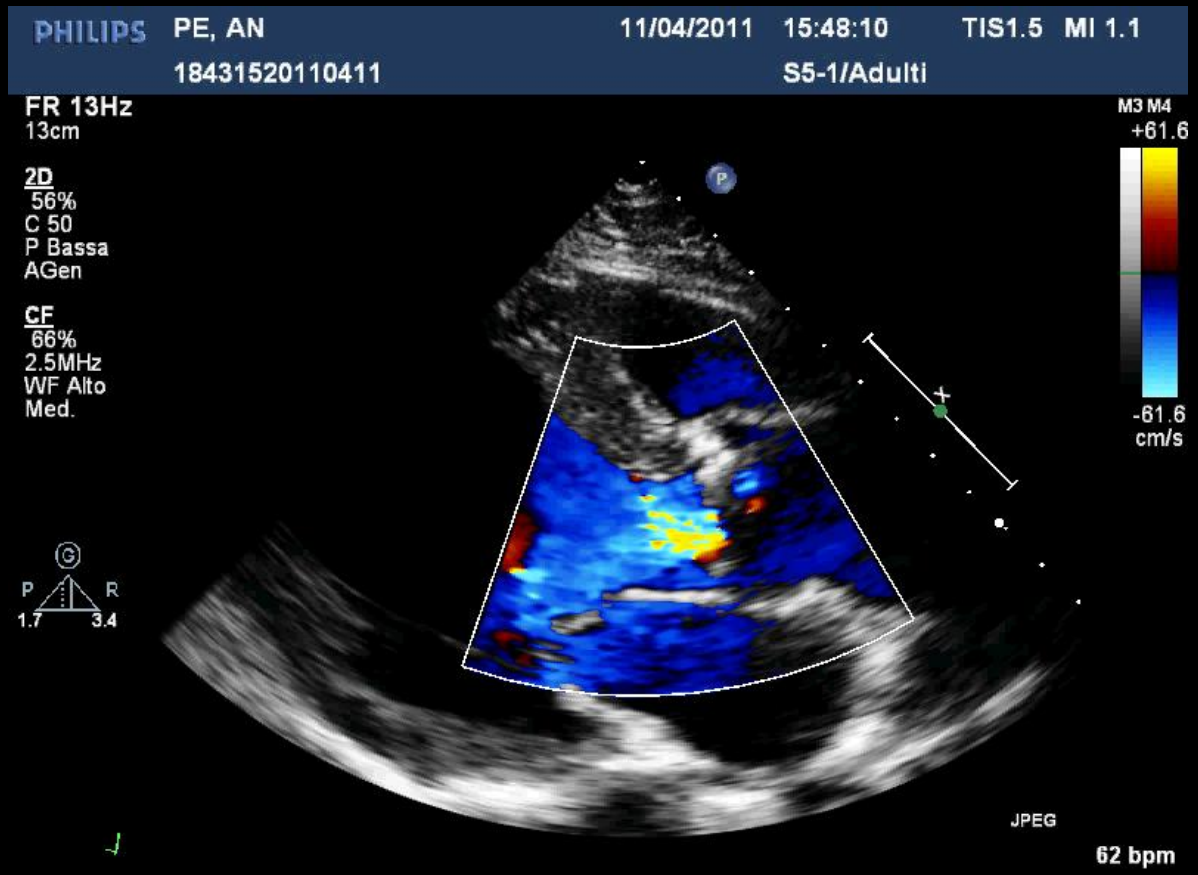
Limiti:

- Fattori tecnici (gain, PRF)
- Jet eccentrici
- Fattori emodinamici (gradiente ventricolo-aortico, compliance del VS)

Analisi del jet



Ampiezza del jet



Perry GJ et al. J Am Coll Cardiol 1987; 9: 952-9

Ampiezza del jet

< 0.25

Insufficienza aortica lieve

ZONA GRIGIA

≥ 0.65

Insufficienza aortica severa

Ampiezza del jet

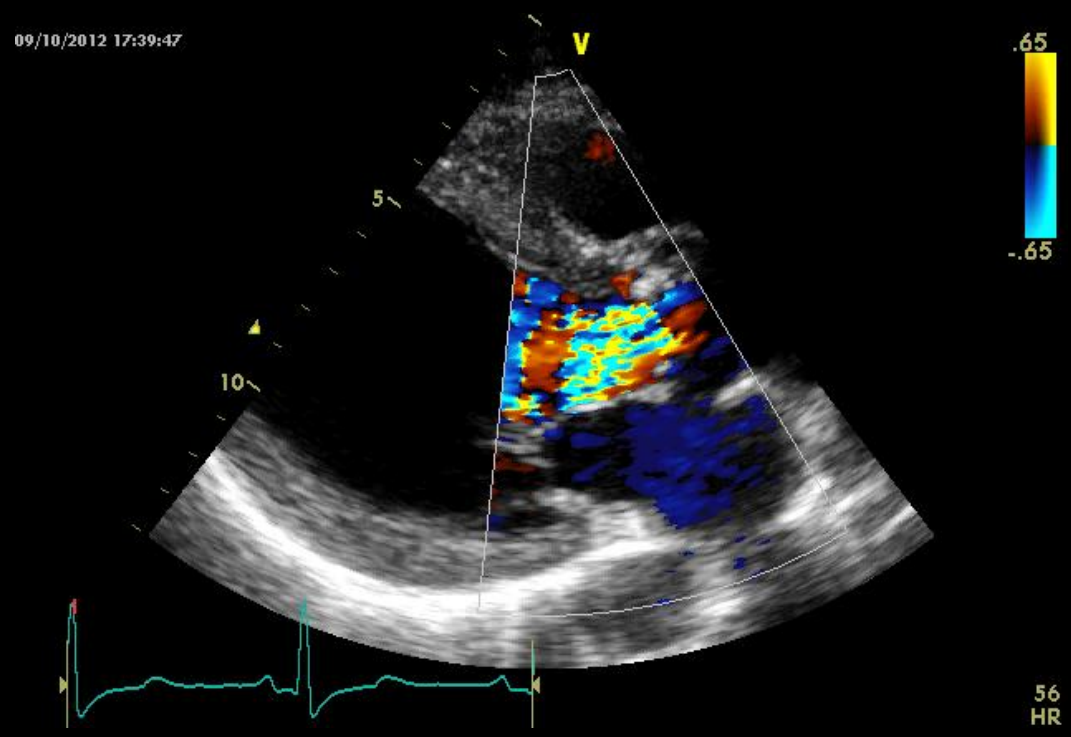
Vantaggi:

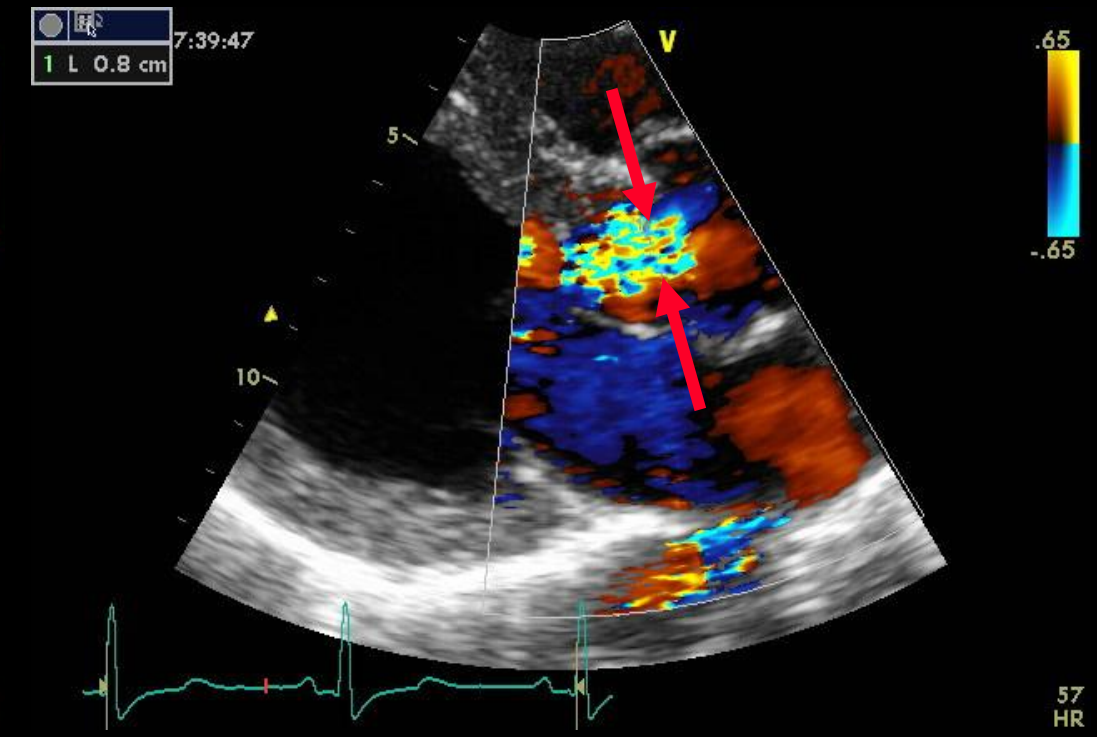
- Parametro semplice
- Rapido screening della gravità
- Specificità dei cut-off di IAo severa e lieve

Limiti:

- Ampia zona grigia
- Jet eccentrici
- Orifizio di rigurgito irregolare

Vena contracta





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Tribouilloy CM et al. Circulation 2000; 102: 558-64

Vena contracta

< 3 mm	3-6 mm	> 6 mm
↓	↓	↓
Insufficienza aortica lieve	Insufficienza aortica moderata ?	Insufficienza aortica severa

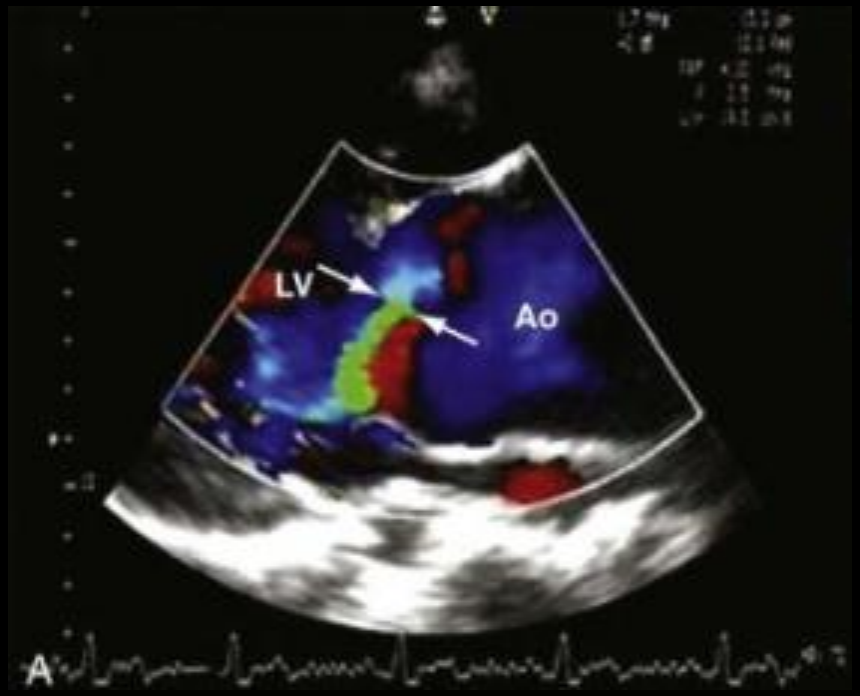
Vena contracta

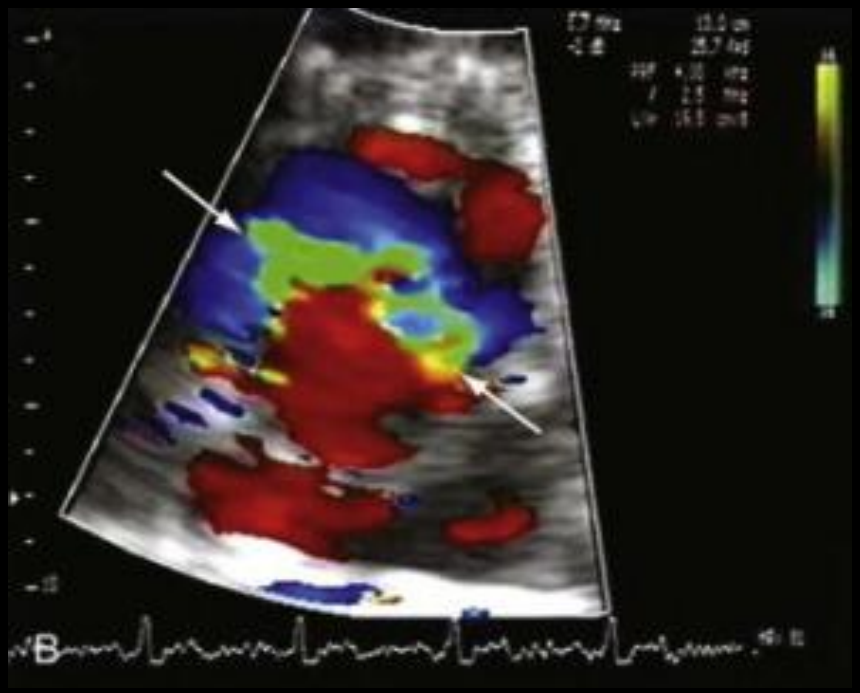
Limiti

- *Valori intermedi richiedono l'utilizzazione di altri metodi diagnostici*
- *Piccolo valore numerico (errore %)*
- *Assunzione di orifizio circolare*
- *Jet multipli*
- *Jet marcatamente eccentrici*

Vena contracta

Orifizio di rigurgito irregolare





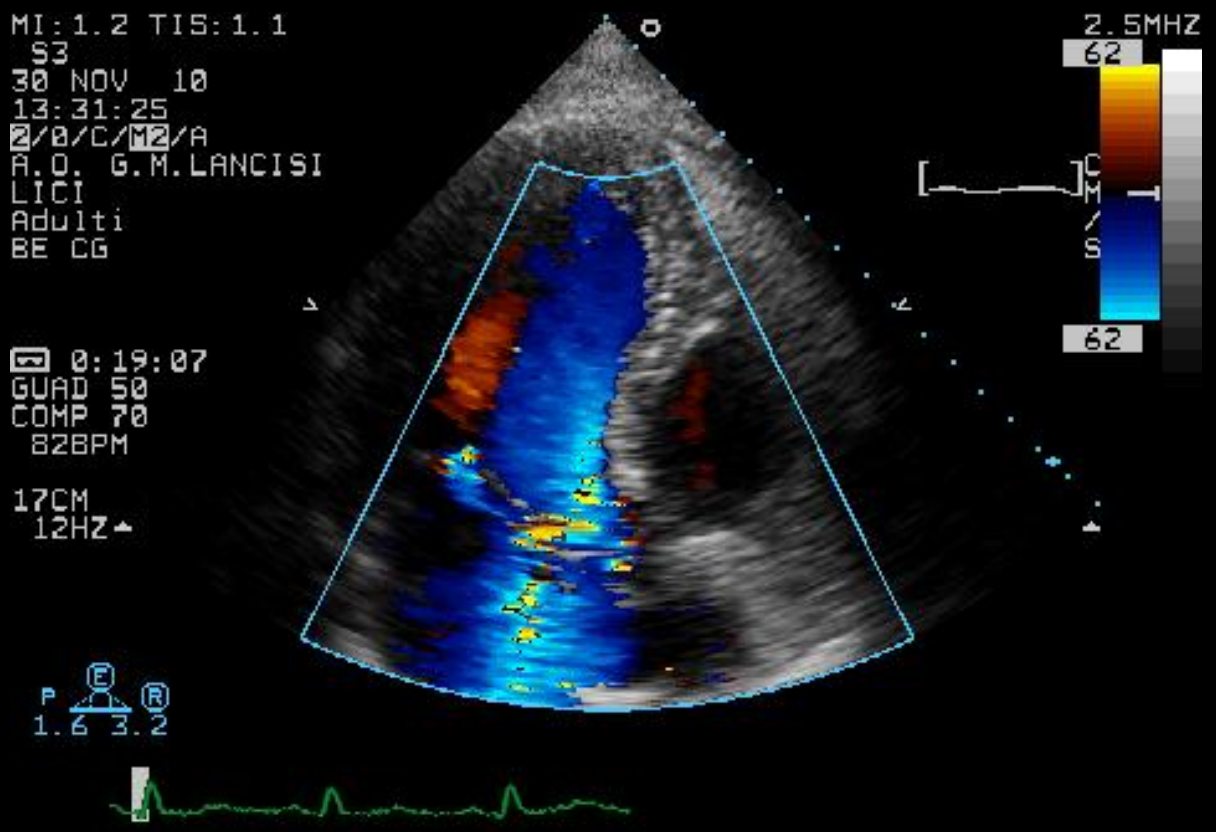
Evangelista A, Tornos P. In Otto C: The practice of clinical echocardiography, 2012

Vena contracta

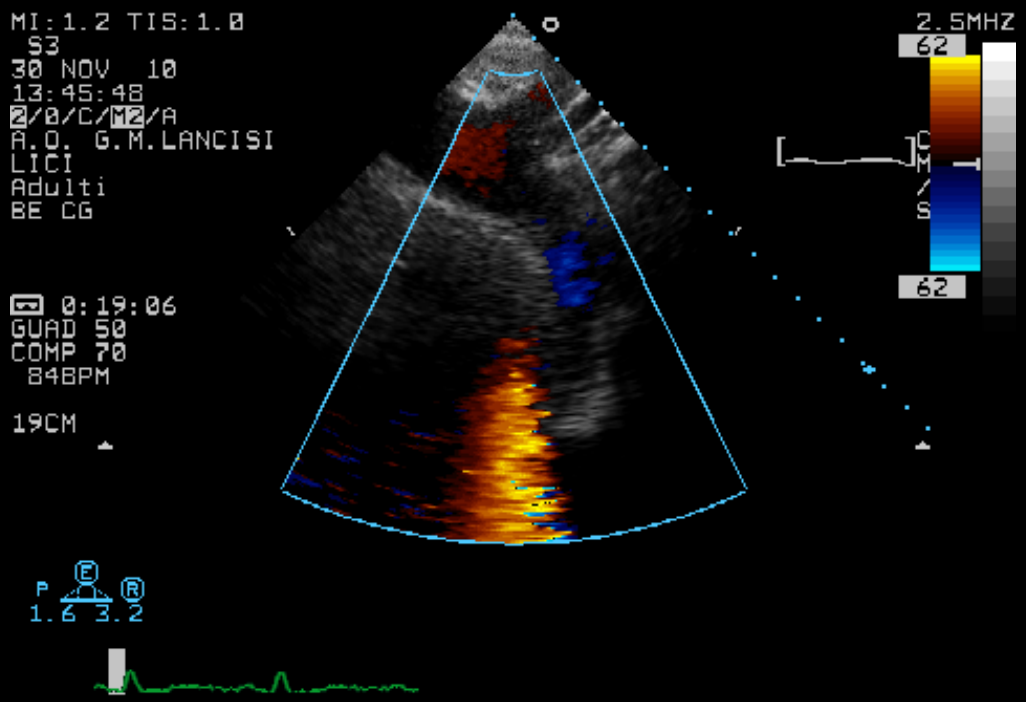
Vantaggi

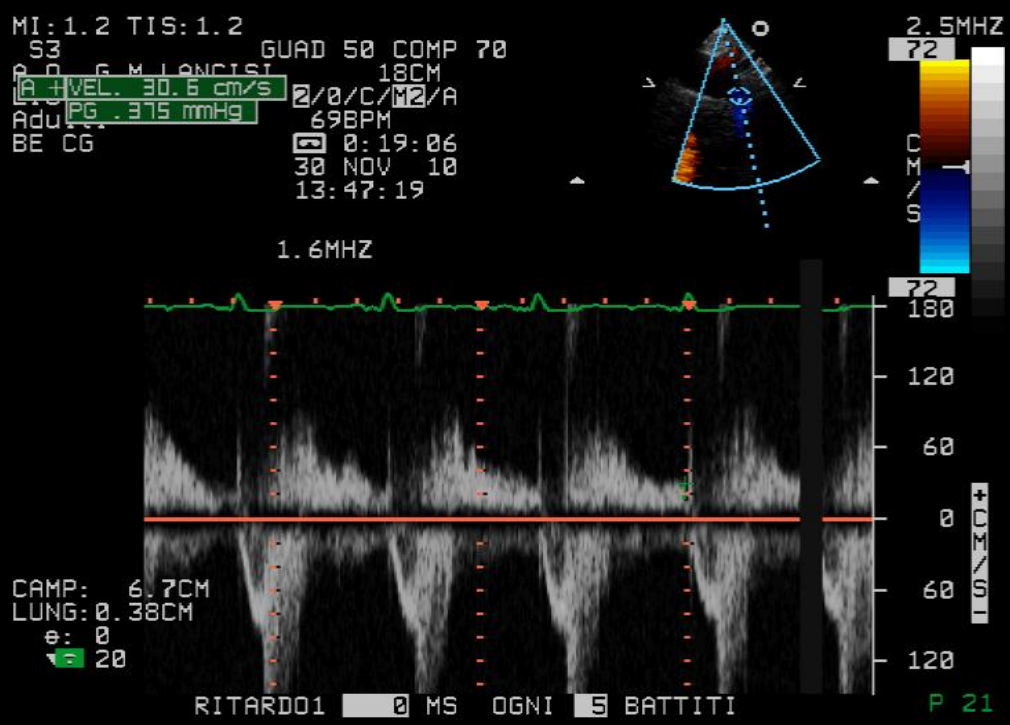
- *Parametro semplice e riproducibile*
- *Specificità dei cut-off di IAo severa e lieve*
- *Migliore capacità discriminante rispetto agli altri parametri semiquantitativi*
- *Correlazione con la valutazione quantitativa*
- *Scarsamente influenzata da fattori emodinamici*

Jet multipli



Inversione diastolica

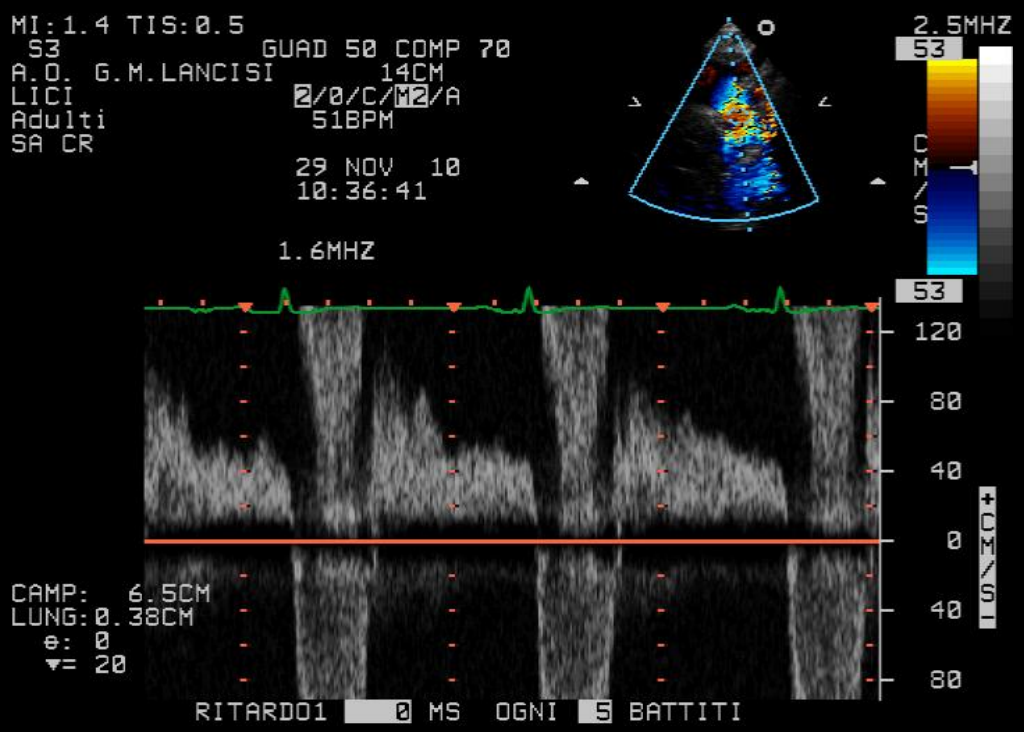




Touche T et al. Circulation 1985; 72: 819-24

Tribouilloy C et al. Br Heart J 1991; 65: 37-40

Inversione diastolica

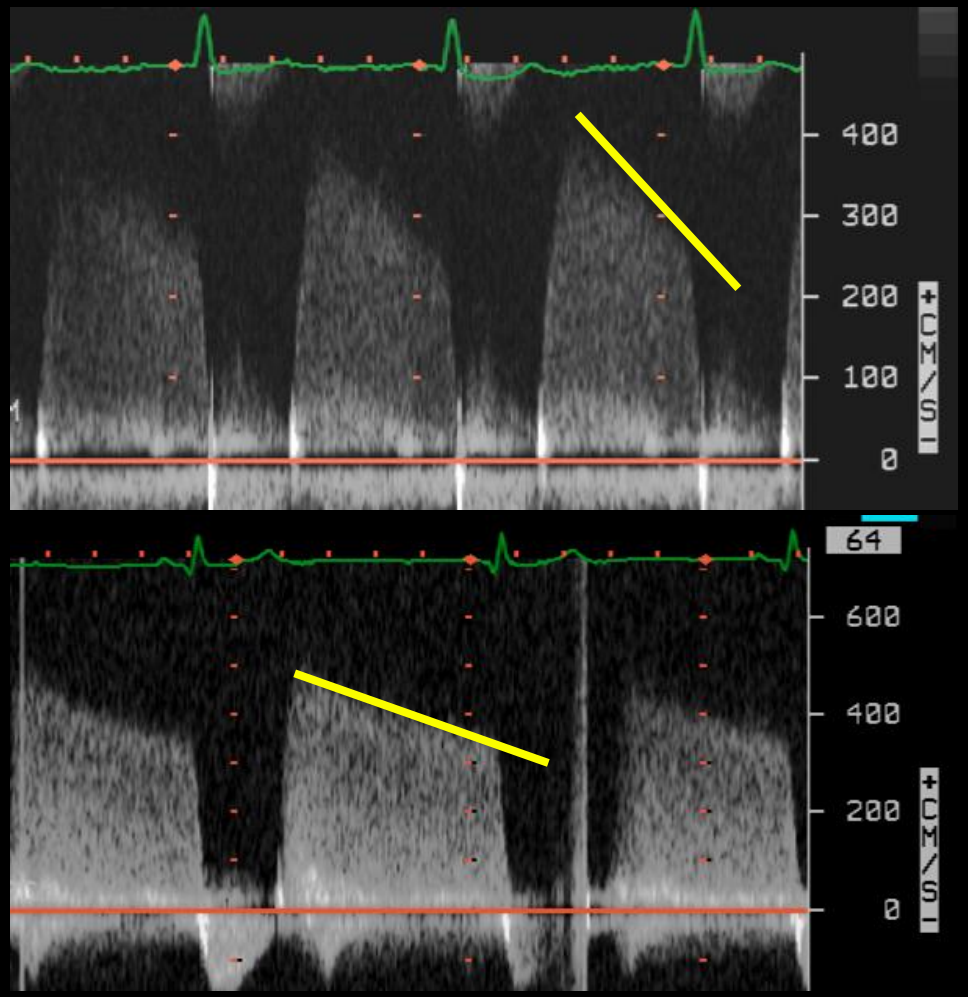


Inversione olodiastolica del flusso in aorta discendente prossimale con velocità telediastolica > 20 cm/sec: elevata specificità per insufficienza aortica severa

- *Compliance aortica*
- *Frequenza cardiaca*
- *Insufficienza aortica acuta*

Lancellotti P et al. Eur J Echocardiogr 2010; 11: 223-44

Pressure half-time



PHT > 500 ms: IAo lieve
PHT < 200 ms: IAo severa

Bassa capacità discriminante

PHT < 200 ms: elevata specificità per IAo severa (spesso acuta)

- ***Influenzato da tutti i fattori che interferiscono con il gradiente Ao-VS***
- ***Jet eccentrici***

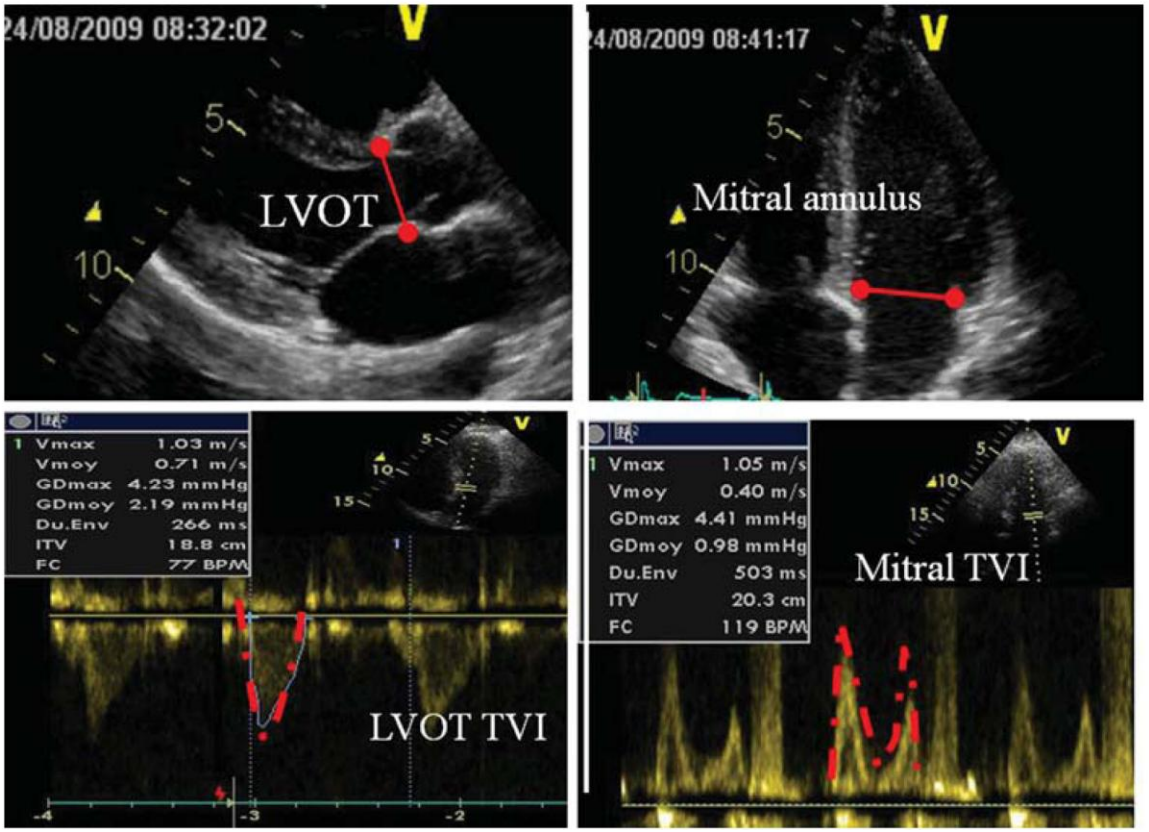
Accuratezza dei metodi semiquantitativi

Threshold	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC
PHT ≤ 200 msec					
Overall	12	100	100	52	0.73
Tricuspid valve	13	100	100	55	0.74
Bicuspid valve	10	100	100	40	0.72
DFR ≥ 18 cm/sec					
Overall	45	87	79	60	0.77
Tricuspid valve	38	85	69	61	0.74
Bicuspid valve	62	100	100	53	0.86
VC ≥ 6 mm					
Overall	81	83	78	85	0.89
Tricuspid valve	83	83	75	88	0.88
Bicuspid valve	78	81	86	72	0.89

Messika-Zeitoun D et al. J Am Soc Echocardiogr 2011; 24: 1246-52 (mod)

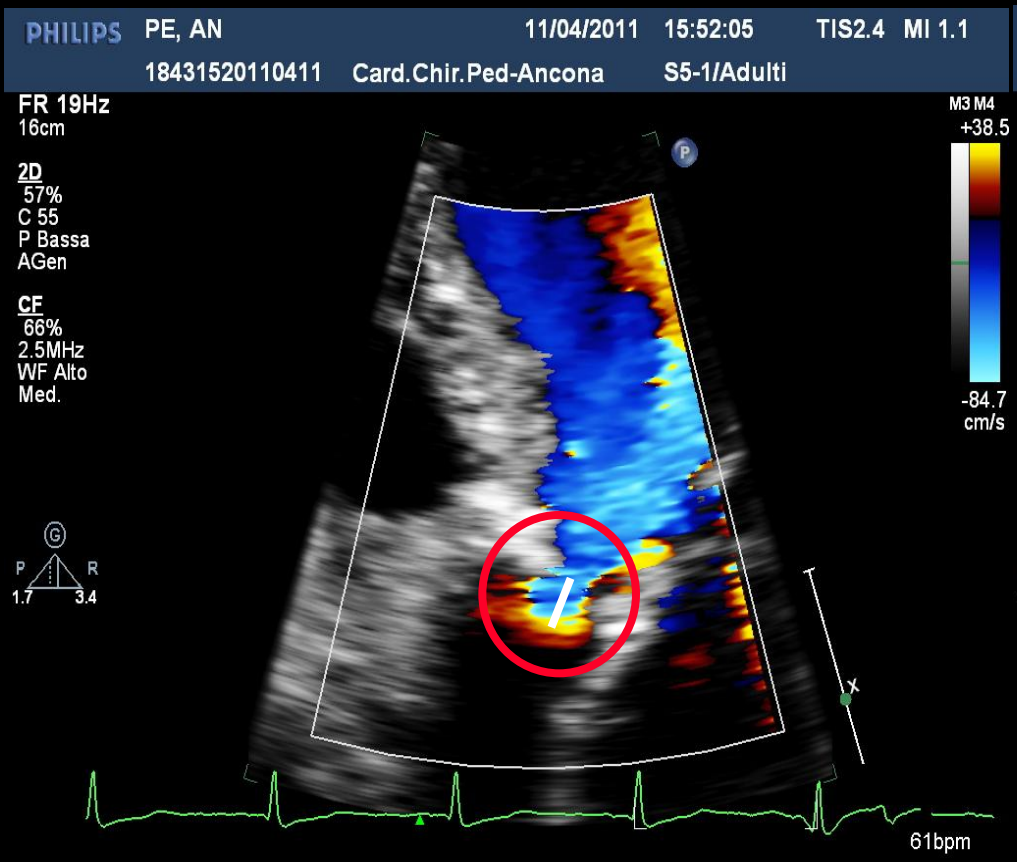
Valutazione quantitativa

Metodo 2D - Doppler



Lancellotti P et al. Eur J Echocardiogr 2010; 11: 223-44

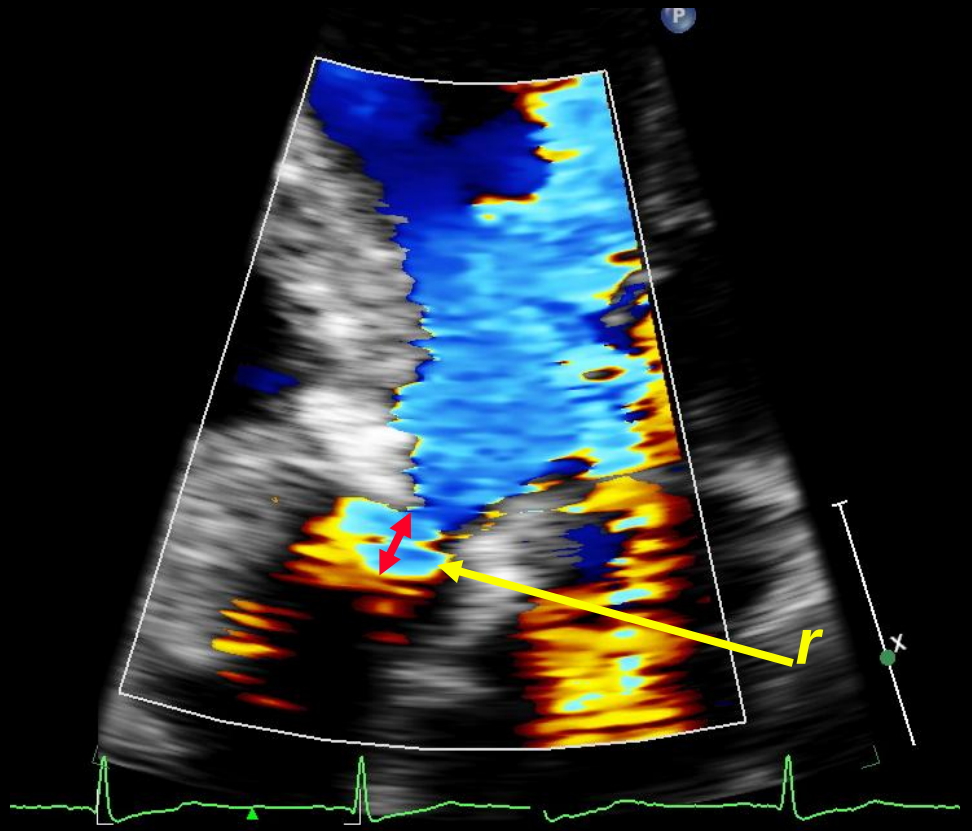
Metodo PISA

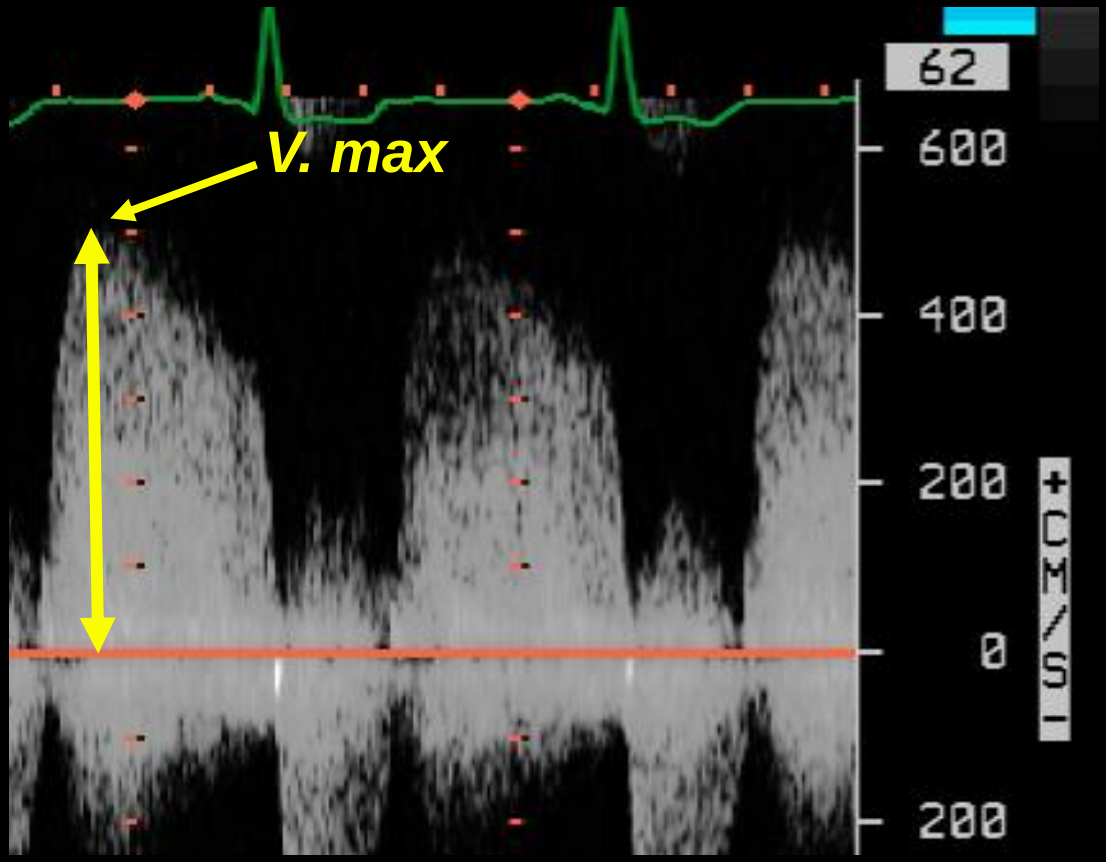


Tribouilloy CM et al. J Am Coll Cardiol 1998; 32: 1032-9

Pouleur AC et al. Am J Cardiol 2008; 102: 475-480

Metodo PISA





$EROA = 2 \pi r^2 \times Va / Vmax$ ≥ 30 mm^2

$VR = EROA \times TVI$ ≥ 60 ml/b

European Association of Echocardiography recommendations for the assessment of valvular regurgitation. Part 1: aortic and pulmonary regurgitation (native valve disease)

When feasible, the PISA method is highly recommended to quantify the severity of AR. It can be used in both central and eccentric jets. In eccentric AR jets, we recommend to use the parasternal long-axis view to evaluate the flow convergence zone. An EROA $\geq$30 mm^2 or an R Vol $\geq$60 mL indicates severe AR.

Lancellotti P et al. Eur J Echocardiogr 2010; 11: 223-44

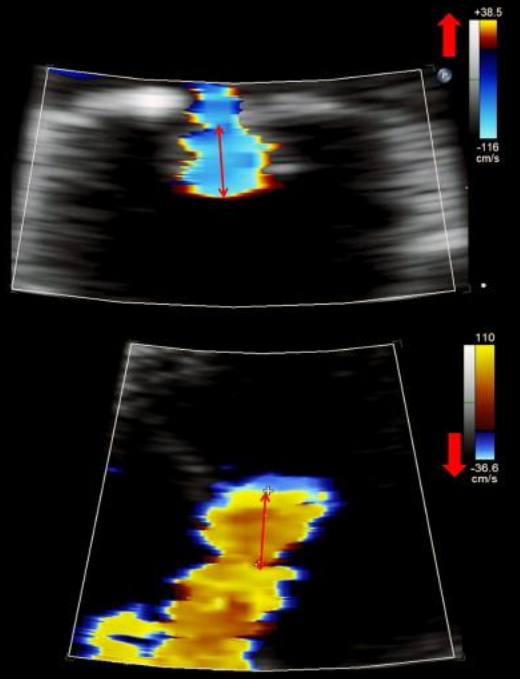
Metodo PISA

- *Stima quantitativa (validazione con RM)*
- *Significato prognostico*
- *Utilizzabile nei jet eccentrici*
- *Non influenzato dalla frequenza cardiaca*
- *Scarsa influenza dei fattori emodinamici*

Metodo PISA

Limiti

- Fattibilità subottimale
- Variabilità interosservatore
- Errore elevato al quadrato
- Jet multipli
- Jet marcatamente eccentrici
- Orifizio rigurgitante non circolare
- Estese calcificazioni valvolari
- Aneurisma della radice aortica (angolo ottuso)

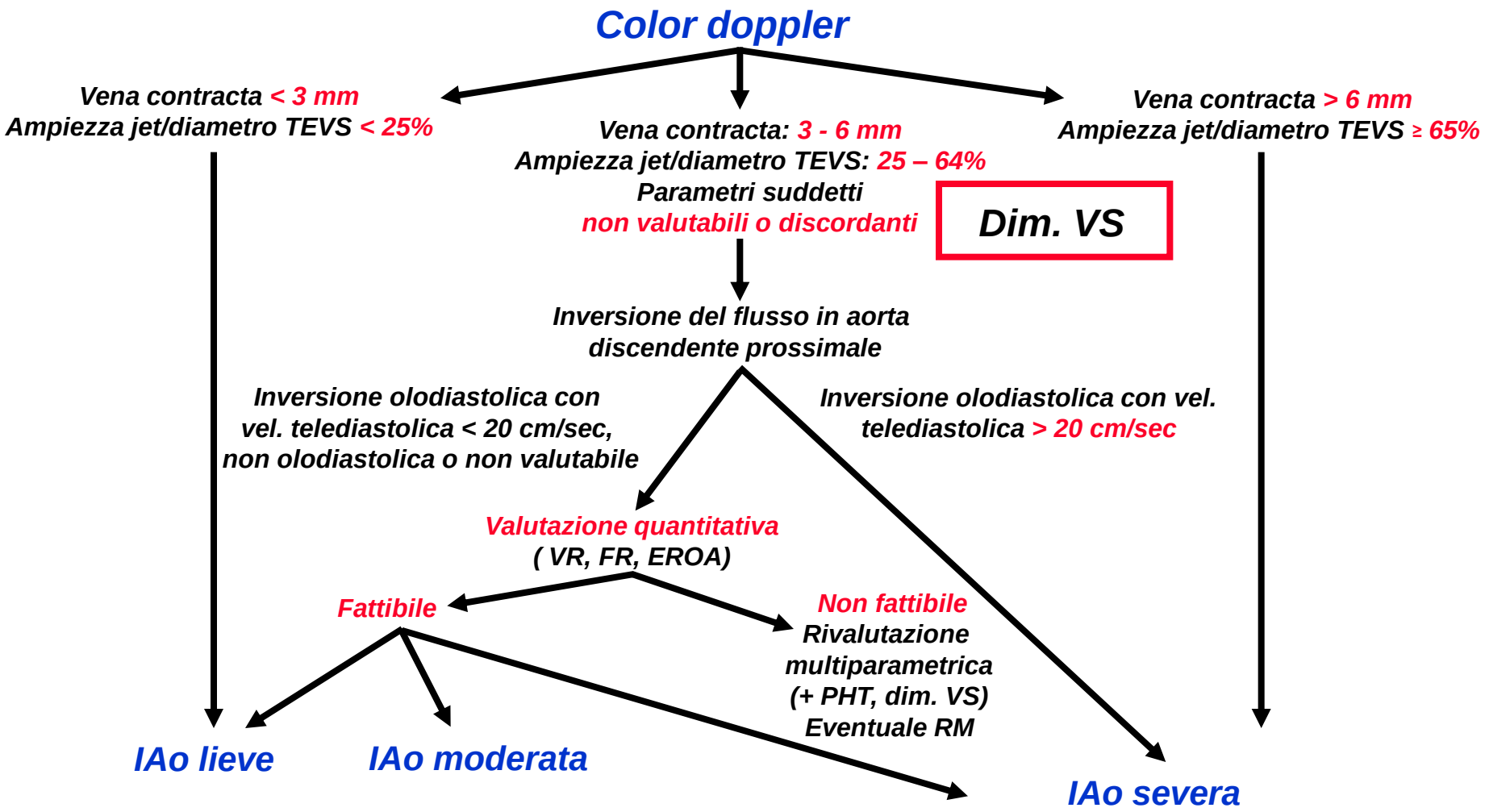


Gravità del rigurgito

Parametri	Grado di Insufficienza			
	Lieve	**Moderato**		**Severo**
Diametri e volumi del VS *	Normali	Normali o lievemente aumentati		Aumentati
Morfologia valvolare **	Normale/alterata	Normale/alterata		Alterata
Ampiezza della VC (mm)	< 3.0	3 ÷ 6		> 6
Ampiezza Jet / Diametro TEVS (%) ***	< 25	25÷64		≥ 65
Inversione del flusso in Ao discendente prossimale	Breve (solo in protodiastole) o assente	Intermedia o olodiastolica con v. telediastolica < 20 cm/ sec		Olodiastolica con v. telediastolica > 20 cm/ sec
Intensità del segnale	Incompleta o debole	Densa		Densa
PHT (msec)	> 500	500 ÷ 200		< 200
Area Jet/Area TEVS (%)	< 5	5÷59		≥ 60
VR (ml/b)	< 30	30÷44	45÷59	≥ 60
FR (%)	< 30	30÷40	40÷49	≥ 50
EROA (mm^2)	< 10	10÷19	20÷29	≥ 30

Linee guida SIEC, 2011

Flow chart



Linee guida SIEC, 2011 (mod)

Color me variable: the irreproducible nature of color flow Doppler in aortic regurgitation

***Always measure the blood pressure at the time of the echocardiogram** and, if possibile, throughout the examination. Post and update blood pressure with patient data so that it is accessible to the reader who is interpreting the digital loop or video clip.*

Schiller NB. Am Heart J 2002; 144: 5-7

Insufficienza aortica

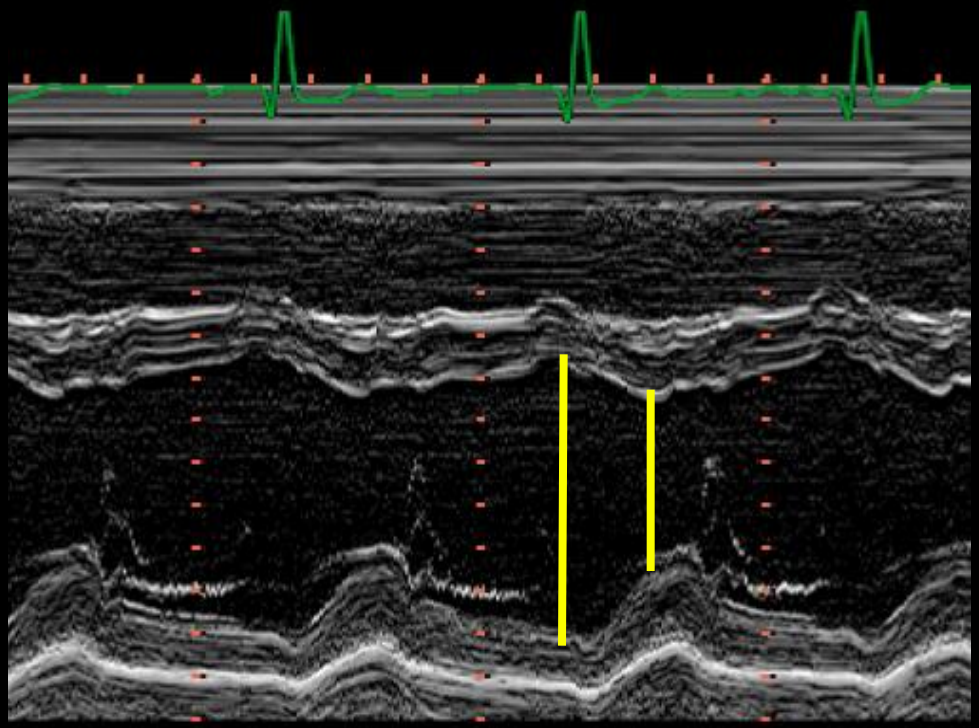
Fisiopatologia

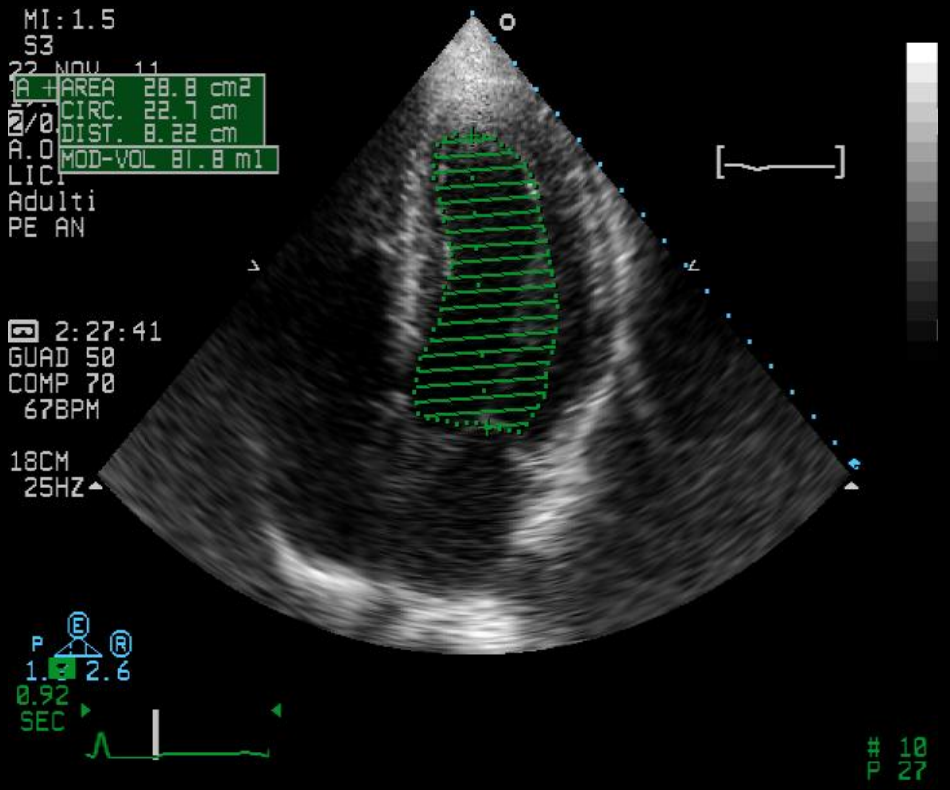
Gravità del rigurgito

- ***Funzione ventricolare sinistra***

Timing chirurgico

Impatto sul ventricolo sinistro





- *Diametri e volumi del VS*
- *Frazione d' eiezione del VS*

Mortality in subgroups of patients

	Event rates		Linearized yearly	p vs
	5 y	10 y	rate (%/y)	expected
EF < 55 %	20 ± 9	47 ± 13	5.8	0.03
EF ≥ 55 %	10 ± 4	17 ± 5	2.0	0.81

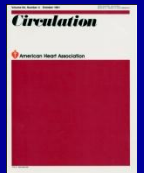
Independent predictor of survival

Excess mortality rate compared with expected rate was observed with EF < 50 % (at 10 years, 74 ± 10 %, p < 0.001) and with EF of 50 to 55 % (at 10 years, 35 ± 12 % , p = 0.039)

Dujardin KS et al.: Circulation 1999; 99: 1851-7

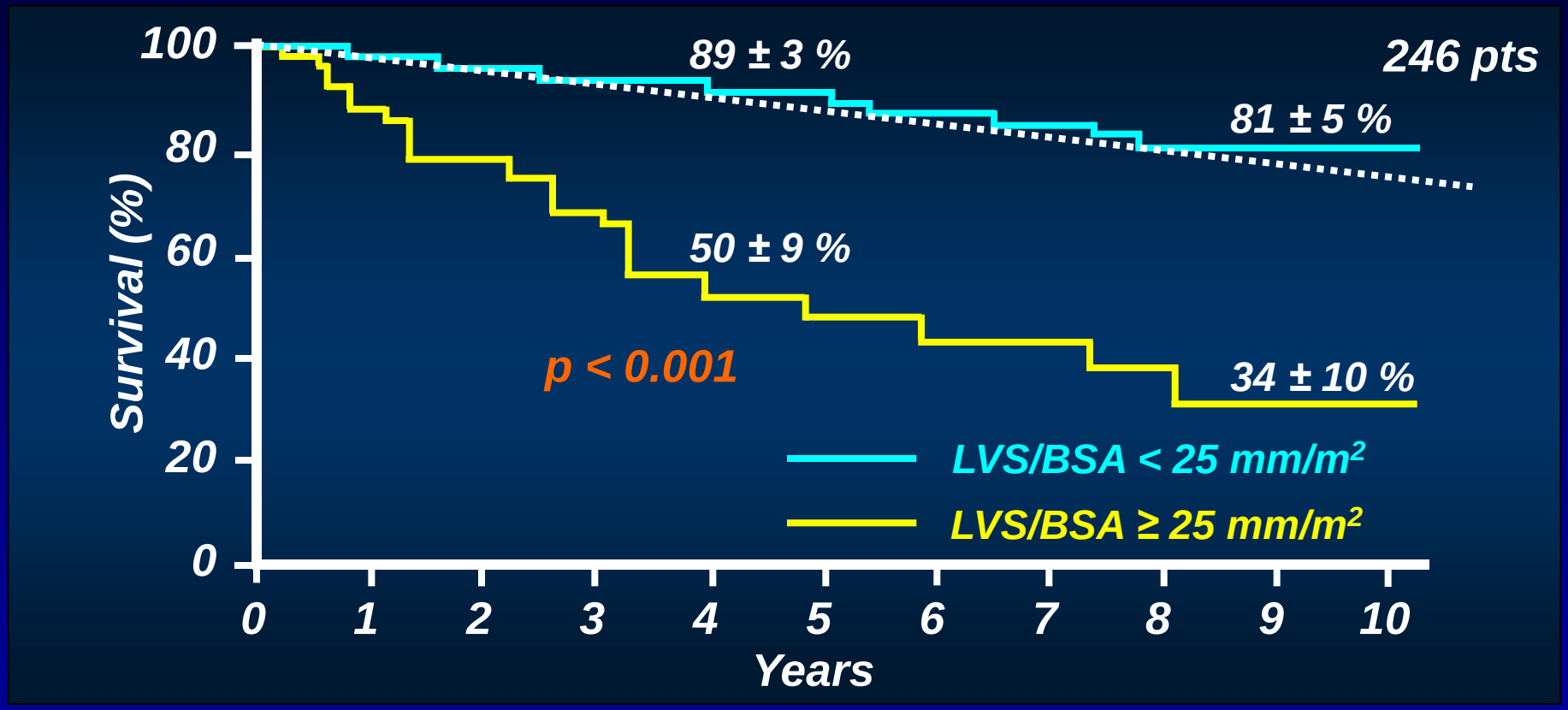
Risk stratification based on LV dimension

Variable	Value	Likelihood of death, symptoms, or LV dysfunction
LV end-systolic dimension	> 50 mm	19 % per year
	40-49 mm	6 % per year
	< 40 mm	0 % per year
LV end-diastolic dimension	≥ 70 mm	10 % per year
	< 70 mm	2 % per year



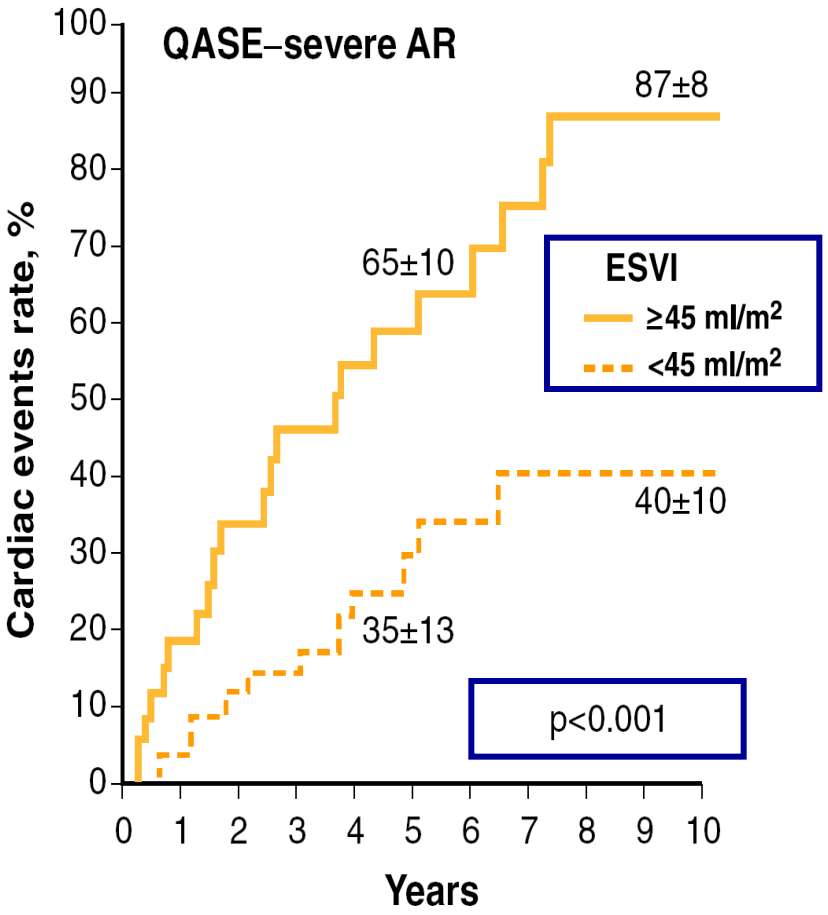
Bonow RO et al. Circulation 1991; 84: 1625-1635

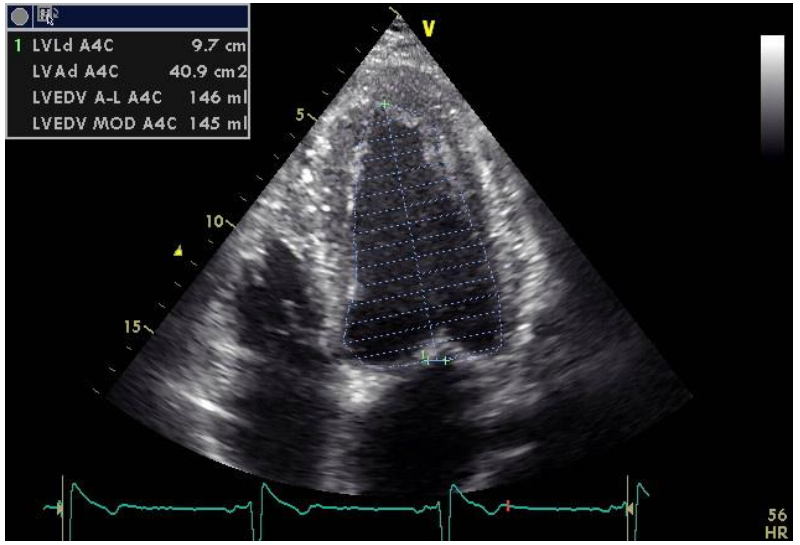
DTSVS indicizzato



Dujardin KS et al.: Circulation 1999; 99: 1851-7

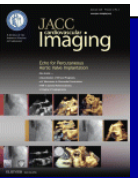
VTSVS indicizzato



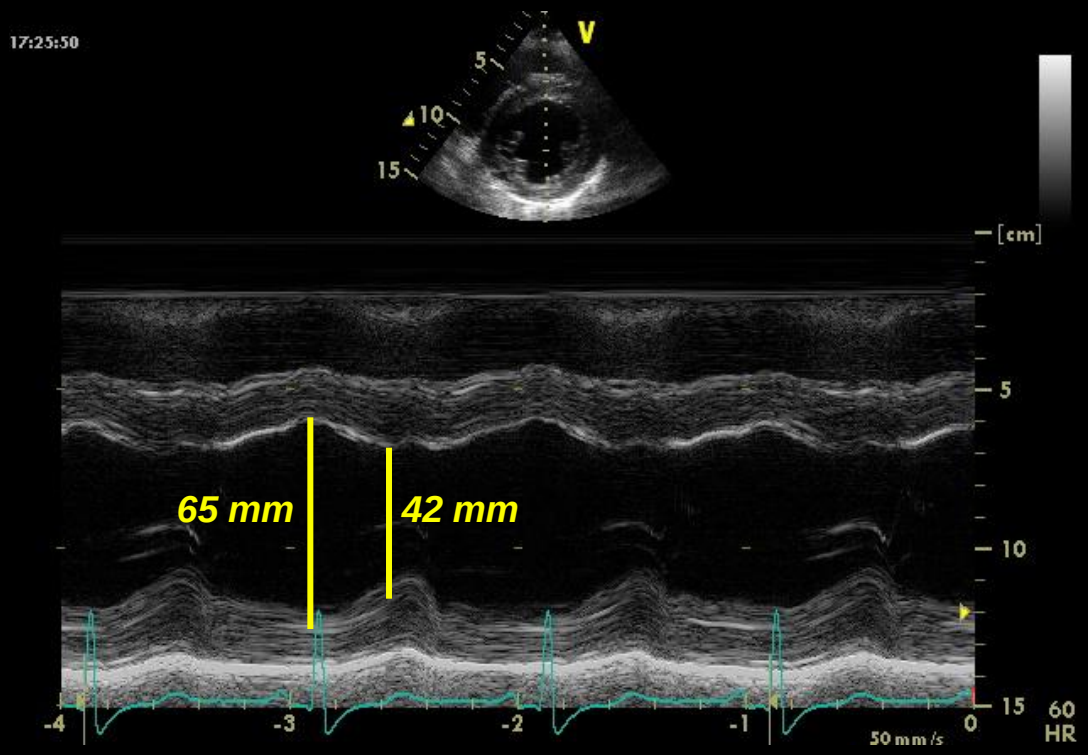


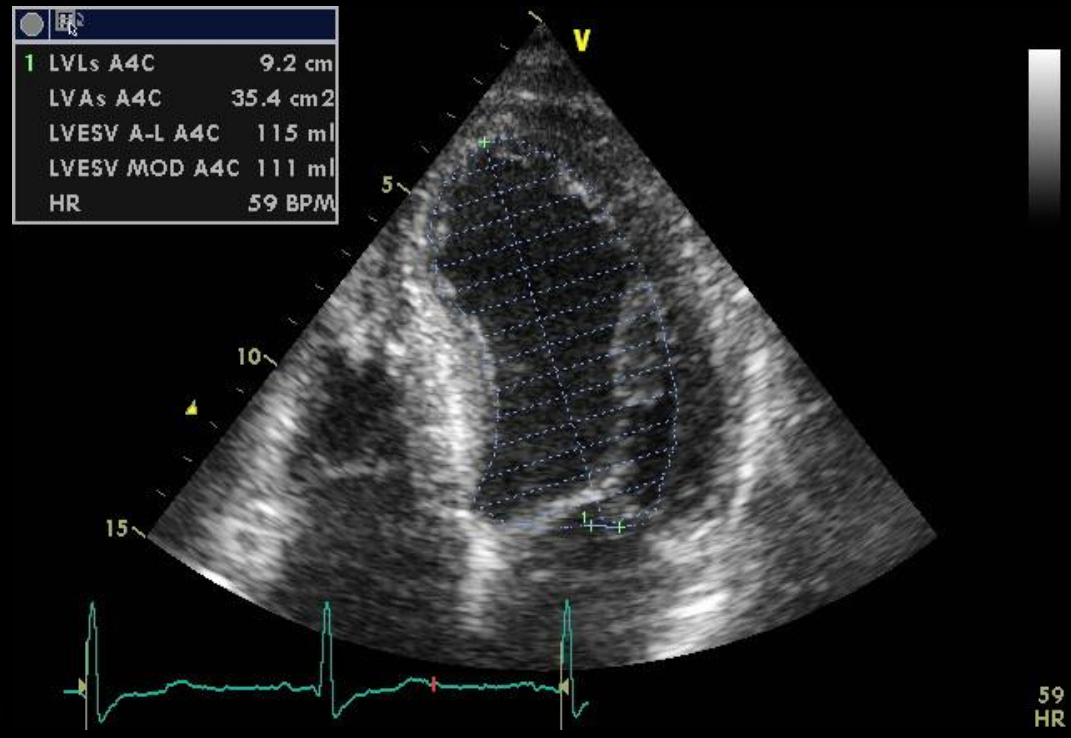
Cardiac events:

- cardiac death
- congestive heart failure
- new atrial fibrillation



Detaint D et al. J Am Coll Cardiol Img. 2008; 1: 1-11 (mod.)





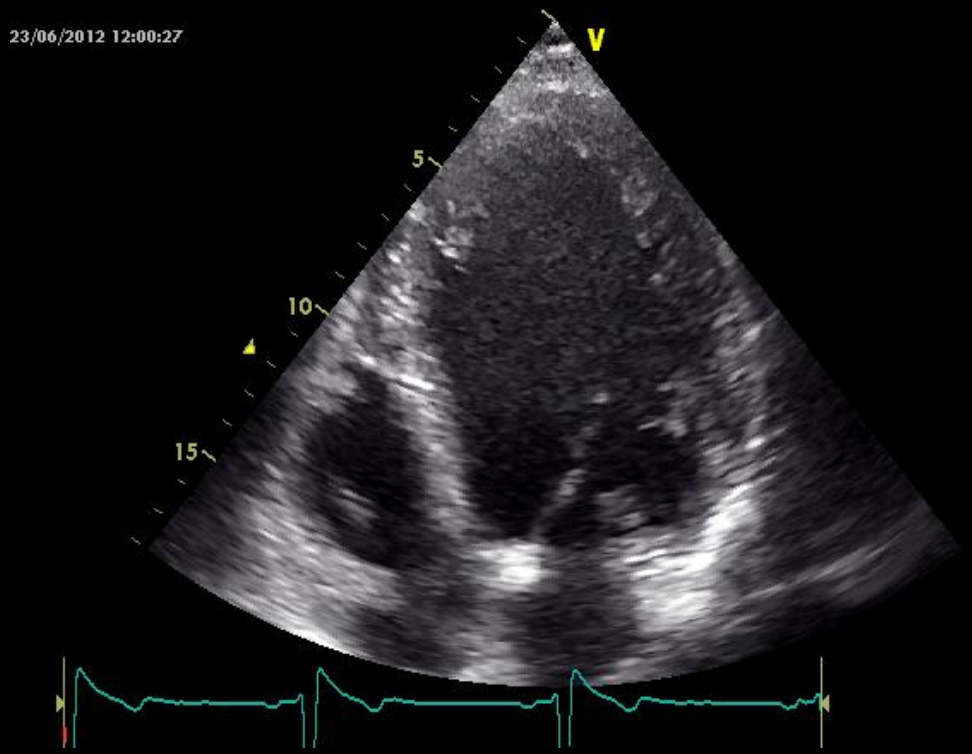
DTSVS = 22 mm/m²

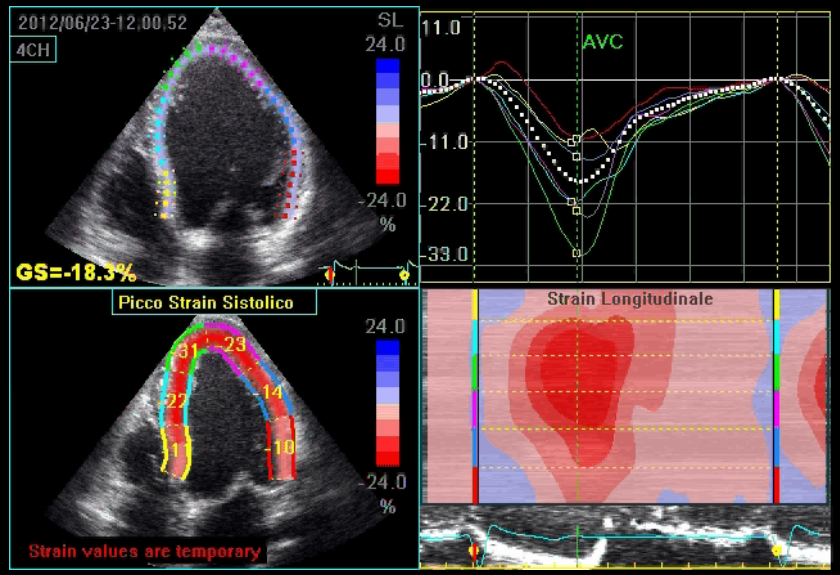
VTSVS = 57 ml/m²

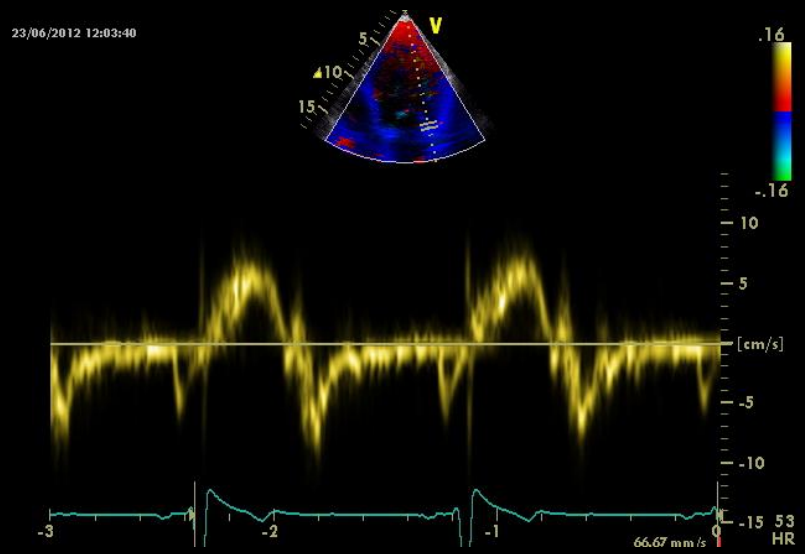
VTDVS > 45 ml/m²: indicazione chirurgica

Detaint D et al. J Am Coll Cardiol Img. 2008; 1: 1-11

Funzione sistolica longitudinale

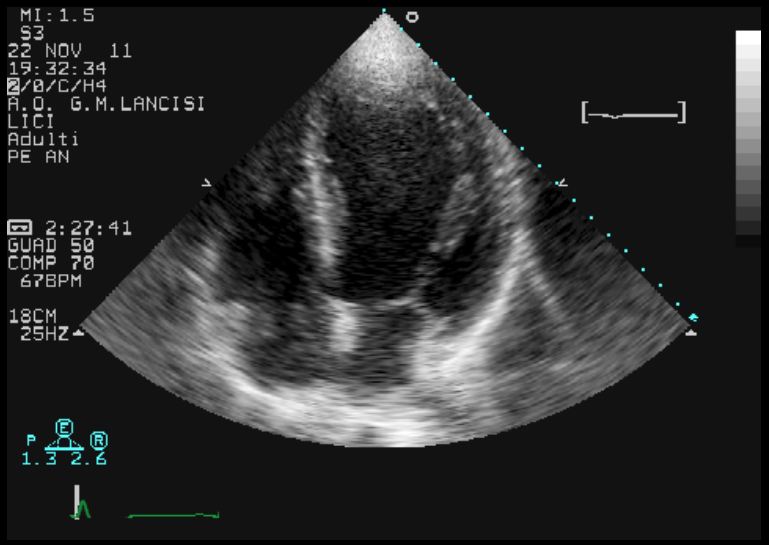


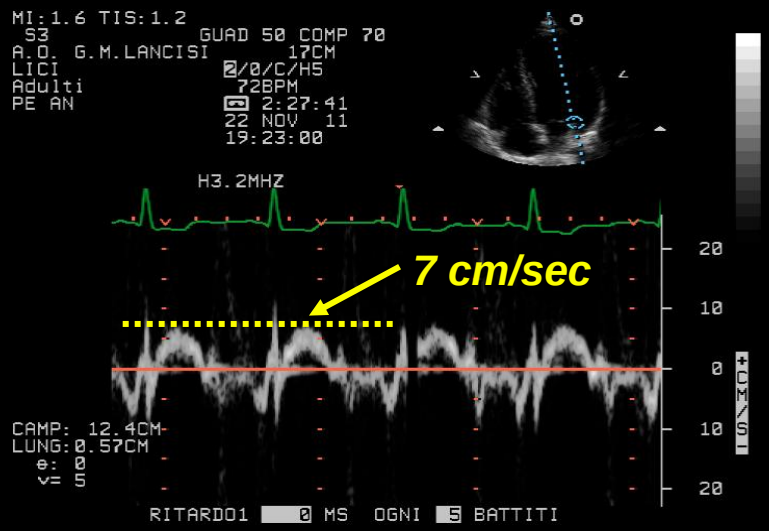




56
HR

Funzione sistolica longitudinale





Velocità sistolica annulus laterale

< 6.25 cm/sec

Predittivo di chirurgia entro 1 anno

(sens: 97 %; spec: 83 %)

Paraskevaidis IA et al. AJC 2007; 100: 1677-82

Strain longitudinale

Strain sistolico longitudinale globale significativamente inferiore nei pazienti con IAo severa e normale FE (- 17.5 ± 3.1 % vs - 22.1 ± 1.8 % p < 0.01)

Smedsrud MK et al. J Am Soc Echocardiogr 2011; 24: 1253-9

Table 3. Association Between Echocardiography and Outcome

Baseline Measurement	Outcome During Conservative Management (n = 33)				Outcome After Surgery (n = 29)			
	Stable (n = 25)	Progression (n = 8)	OR (95% CI)	p Value	Good (n = 18)	Impaired (n = 11)	OR (95% CI)	p Value
Conventional echocardiography								
LVEF (%)	58.7 ± 5.4	57.6 ± 3.6	1.3 (0.6–3.0)	0.57	53.9 ± 9.8	45.2 ± 11.8	2.3 (1.1–6.1)	0.04
LVEDVI (ml/m^2)	58.9 ± 16.4	64.9 ± 21.1	1.4 (0.6–3.5)	0.39	92.2 ± 24.8	119.7 ± 33.4	3.0 (1.2–10.7)	0.01
LVESVI (ml/m^2)	24.2 ± 7.1	27.8 ± 10.2	1.6 (0.7–4.0)	0.26	43.6 ± 18.8	67.5 ± 27.7	3.2 (1.3–10.5)	0.01
Speckle tracking								
ε_{sys} (%)	−19.0 ± 2.6	−16.3 ± 3.3	3.2 (1.2–13.8)	0.02	−15.6 ± 2.3	−11.5 ± 4.3	3.7 (1.4–14.4)	0.006
SR_{sys} (s^{-1})	−1.19 ± 0.17	−1.04 ± 0.14	3.3 (1.2–13.4)	0.02	−1.01 ± 0.17	−0.88 ± 0.19	2.6 (1.0–9.0)	0.04
SR_{dia} (s^{-1})	1.60 ± 0.30	1.20 ± 0.34	4.6 (1.6–18.8)	0.002	1.33 ± 0.36	0.98 ± 0.21	4.0 (1.4–16.3)	0.005
Tissue Doppler								
LD_{sys} (mm)	11.2 ± 1.8	10.7 ± 2.1	1.4 (0.6–3.3)	0.45	11.2 ± 2.4	8.9 ± 2.5	2.8 (1.2–8.0)	0.02
s′ (cm/s)	6.0 ± 1.1	5.5 ± 0.6	1.9 (0.8–5.4)	0.14	5.8 ± 0.8	4.9 ± 1.2	2.9 (1.2–9.4)	0.02
e′ (cm/s)	−6.5 ± 2.1	−5.9 ± 1.8	1.4 (0.6–3.4)	0.46	−6.2 ± 2.4	−5.0 ± 2.0	1.8 (0.8–4.9)	0.17

Data are expressed as mean ± SD.
CI = confidence interval; OR = odds ratio associated with 1 SD of worsening in predictive measure; other abbreviations as in Table 2.

Strain predittivo di progressione della malattia (sintomi, incremento del volume VS > 15 %, riduzione della frazione d' eiezione > 10 %)

Olsen NT et al. J Am Coll Cardiol Img 2011; 4: 223-30

Insufficienza aortica

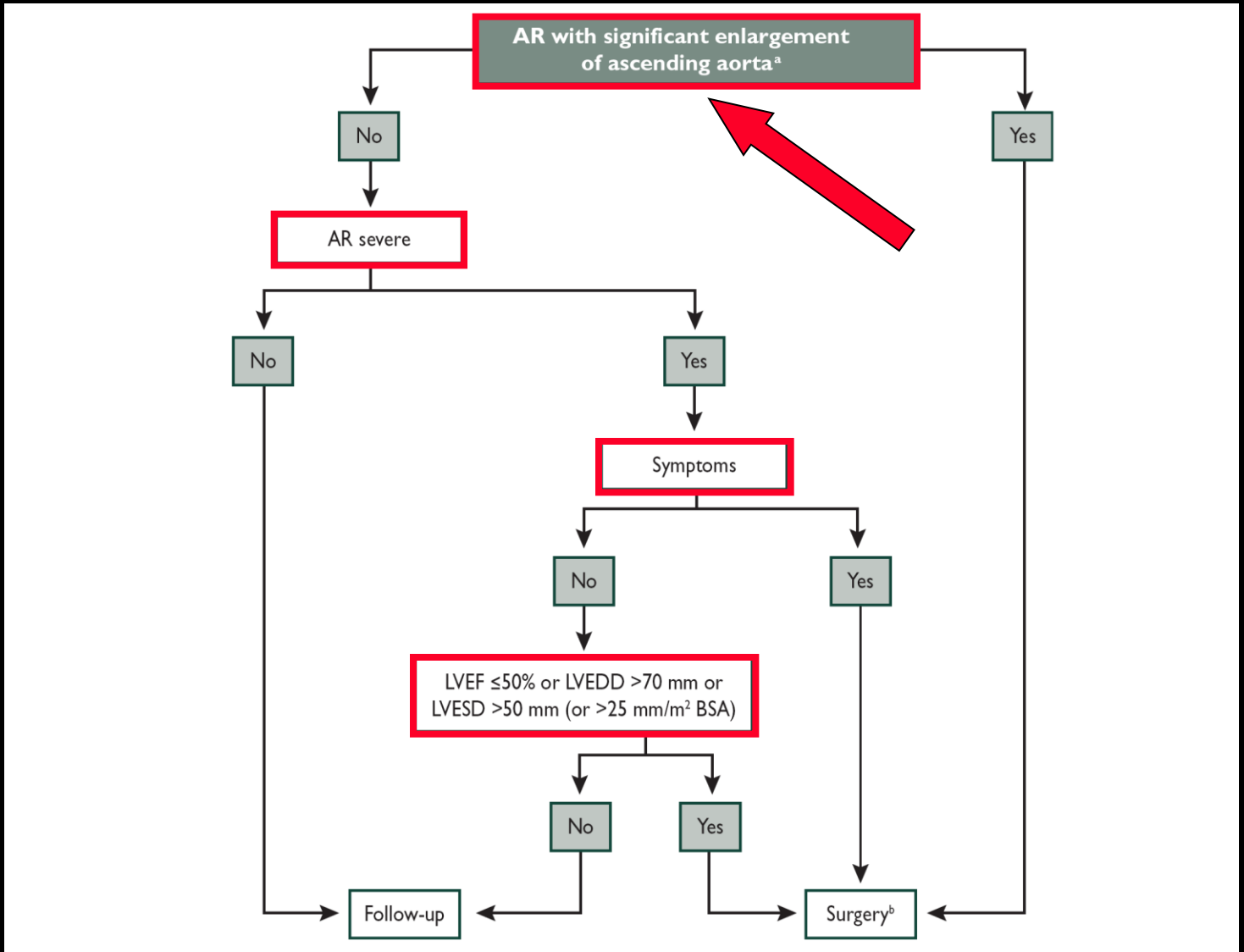
Fisiopatologia

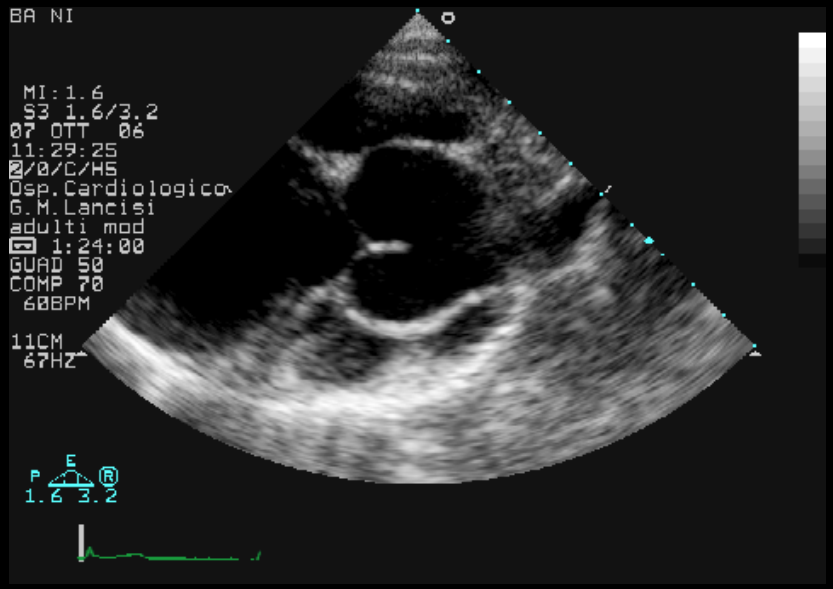
Gravità del rigurgito

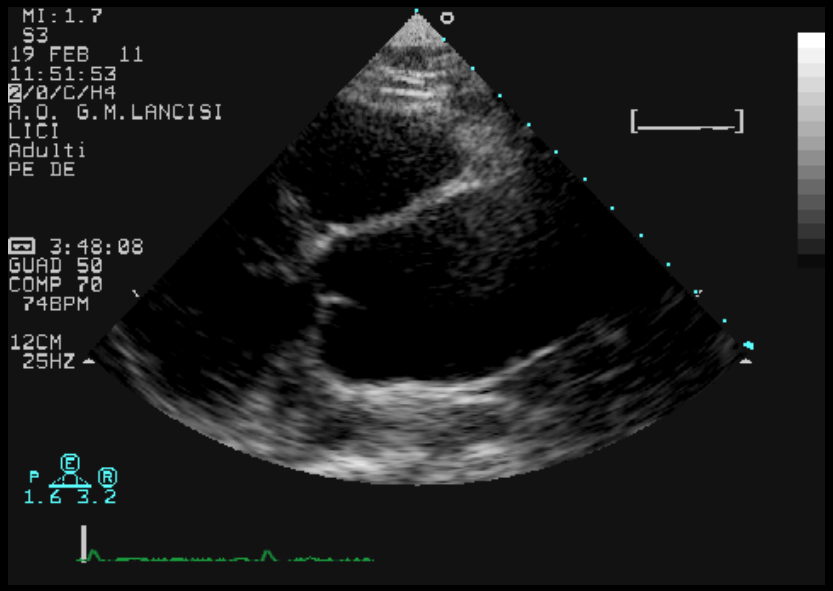
Funzione ventricolare sinistra

- ***Timing chirurgico***

Guidelines on the management of valvular heart disease (version 2012)




BA NI
MI:1.6
S3 1.6/3.2
07 OTT 06
11:29:25
2/0/C/H5
Osp.Cardiologico
G.M.Lancisi
adulti mod
1:24:00
GUAD 50
COMP 70
60BPM
11CM
67HZ
1.6 3.2


MI:1.7
S3
19 FEB 11
11:51:53
2/0/C/H4
A.O. G.M.LANCISI
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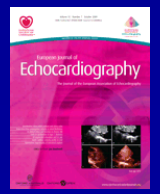
3:48:08
GUAD 50
COMP 70
74BPM
12CM
25HZ
1.6 3.2

Echocardiography in aortic diseases: EAE recommendations for clinical practice

Arturo Evangelista[1]*, Frank A. Flachskampf[2], Raimund Erbel[3], Francesco Antonini-Canterin[4], Charalambos Vlachopoulos[5], Guido Rocchi[6], Rosa Sicari[7], Petros Nihoyannopoulos[8], and Jose Zamorano[9] on behalf of the European Association of Echocardiography

Recommendation

TTE permits adequate assessment of several aortic segments, particularly the aortic root and proximal ascending aorta. All scanning planes should be used to obtain information on most aortic segments. However, if inconclusive information or abnormalities are present, another imaging modality is required to either complete or add diagnostic information.



Evangelista A et al. : Eur J Echocardiogr 2010; 11: 645-658

Dimensioni aortiche

- ***Ecocardiografia transtoracica bidimensionale***
- ***Misurazione in telediastole utilizzando la sezione che consente di visualizzare la dimensione massima del segmento in esame***
- ***Utilizzazione di sezioni ecocardiografiche non convenzionali (parasternale sinistra alta, parasternali destre)***
- ***Asse perpendicolare all' asse lungo del vaso***
- ***Può essere utilizzata sia la misurazione "leading edge to leading edge" che quella "inner edge to inner edge" (specificare)***
- ***Indicizzazione delle dimensioni aortiche (SC, altezza)***

TC e RM

Classe I

La RM o la TC sono indicate quando non é possibile ottenere con l'ecocardiografia un'adeguata valutazione della radice aortica e dell'aorta ascendente (livello di evidenza C)

Classe IIa

La RM o la TC sono consigliate, per una più completa valutazione, nei pazienti con dilatazione della radice aortica e/o dell'aorta ascendente ed indicazione o possibile indicazione alla chirurgia dell'aorta (livello di evidenza B)

Linee guida SIEC 2009, 2011

Table 8 Indications for surgery in (A) severe aortic regurgitation and (B) aortic root disease (whatever the severity of aortic regurgitation)

	Class [a]	Level [b]	Ref [c]
A. Indications for surgery in severe aortic regurgitation			
Surgery is indicated in symptomatic patients.	I	B	59
Surgery is indicated in asymptomatic patients with resting LVEF ≤50%.	I	B	71
Surgery is indicated in patients undergoing CABG or surgery of ascending aorta, or on another valve.	I	C	
Surgery should be considered in asymptomatic patients with resting EF >50% with severe LV dilatation: LVEDD >70 mm, or LVESD >50 mm or LVESD >25 mm/m^2 BSA.[d]	IIa	C	
B. Indications for surgery in aortic root disease (whatever the severity of AR)			
Surgery is indicated in patients who have aortic root disease with maximal ascending aortic diameter[e] ≥50 mm for patients with Marfan syndrome.	I	C	

[f]Family history of aortic dissection and/or aortic size increase >2 mm/year (on repeated measurements using the same imaging technique, measured at the same aorta level with side-by-side comparison and confirmed by another technique), severe AR or mitral regurgitation, desire of pregnancy.

[g]Coarctation of the aorta, systemic hypertension, family history of dissection or increase in aortic diameter >2 mm/year (on repeated measurements using the same imaging technique, measured at the same aorta level with side-by-side comparison and confirmed by another technique).

Guidelines on the management of valvular heart disease (version 2012)

Table 8 Indications for surgery in (A) severe aortic regurgitation and (B) aortic root disease (whatever the severity of aortic regurgitation)

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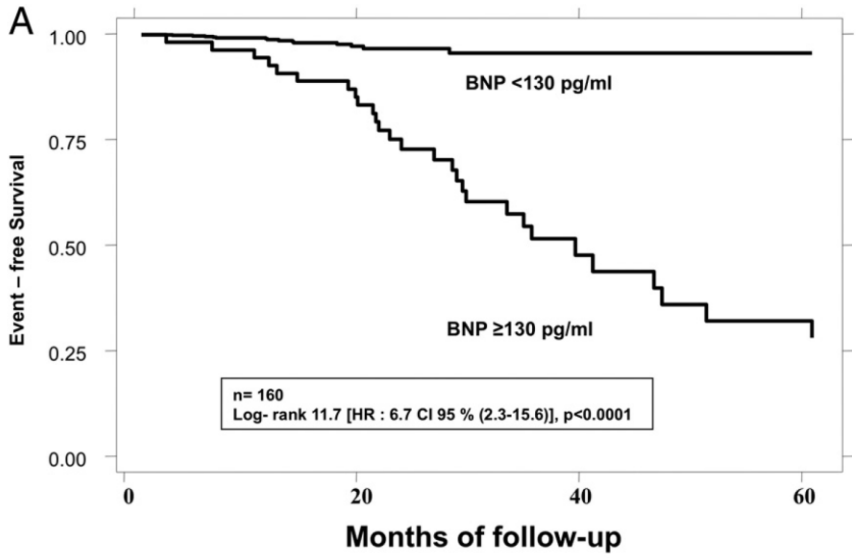
Surgery is indicated in patients who have aortic root disease with maximal ascending aortic diameter[e] ≥50 mm for patients with Marfan syndrome.			
Surgery should be considered in patients who have aortic root disease with maximal ascending aortic diameter: ≥45 mm for patients with Marfan syndrome with risk factors[f] ≥50 mm for patients with bicuspid valve with risk factors[g] ≥55 mm for other patients	IIa	C	

VTSVS ≥ 45 ml/m²

Peptidi natriuretici

294 pazienti asintomatici; FEVS > 55 %



DVS, sintomi, morte

Endpoint	OR (95% CI)	p Value
BNP ≥130 pg/ml	6.9 (2.52–17.57)	0.0001
ESD/BSA ≥24 mm/m^2	3.4 (1.88–11.9)	0.01
EROA ≥50 mm^2	4.3 (2.4–12.4)	0.001
EDD ≥35 mm/m^2	2.1 (0.88–13.7)	0.09

Pizarro R et al. J Am Coll Cardiol 2011; 58: 1705-14

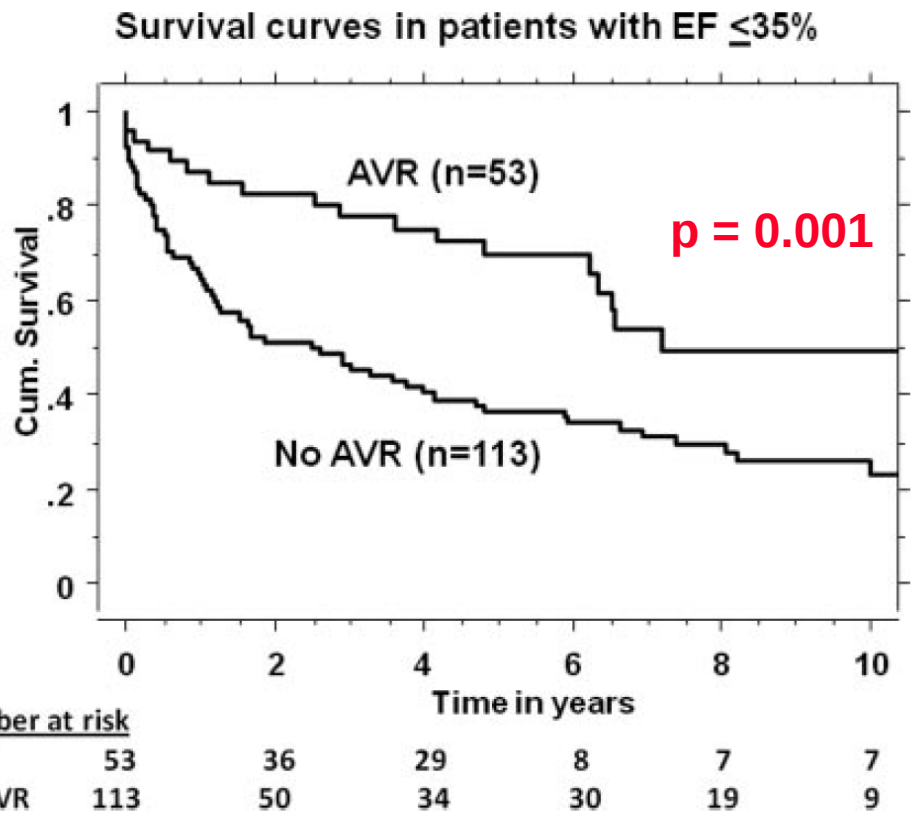
Insufficienza aortica severa

Età dei pazienti

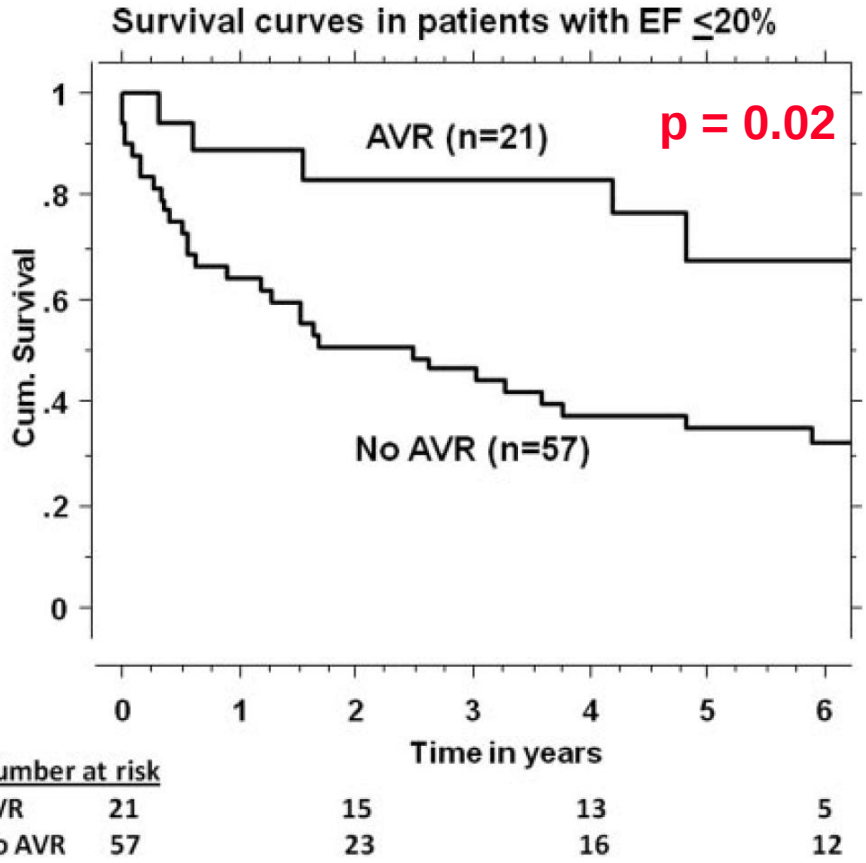
	n. pz	Età
Dujardin et al. (1999)	246	56 ± 19
Corti et al. (2001)	125	44 ± 13
Chukwuemeka et al. (2006)	72	59 ± 12
Detaint et al. (2008)	93	58 ± 18
Kamath et al. (2009)*	166*	65 ± 16*
Turk et al. (2010)	123	60 ± 17
Olsen et al. (2011)	64	57 ± 13

*FEVS ≤ 35 %

Disfunzione ventricolare sinistra

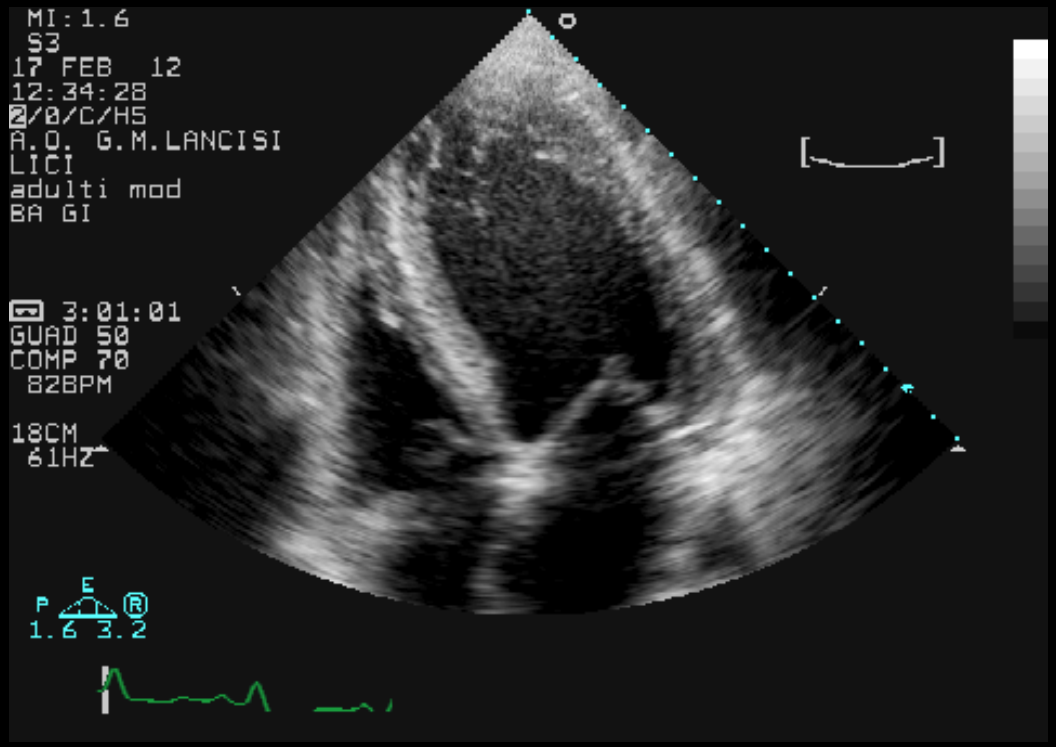


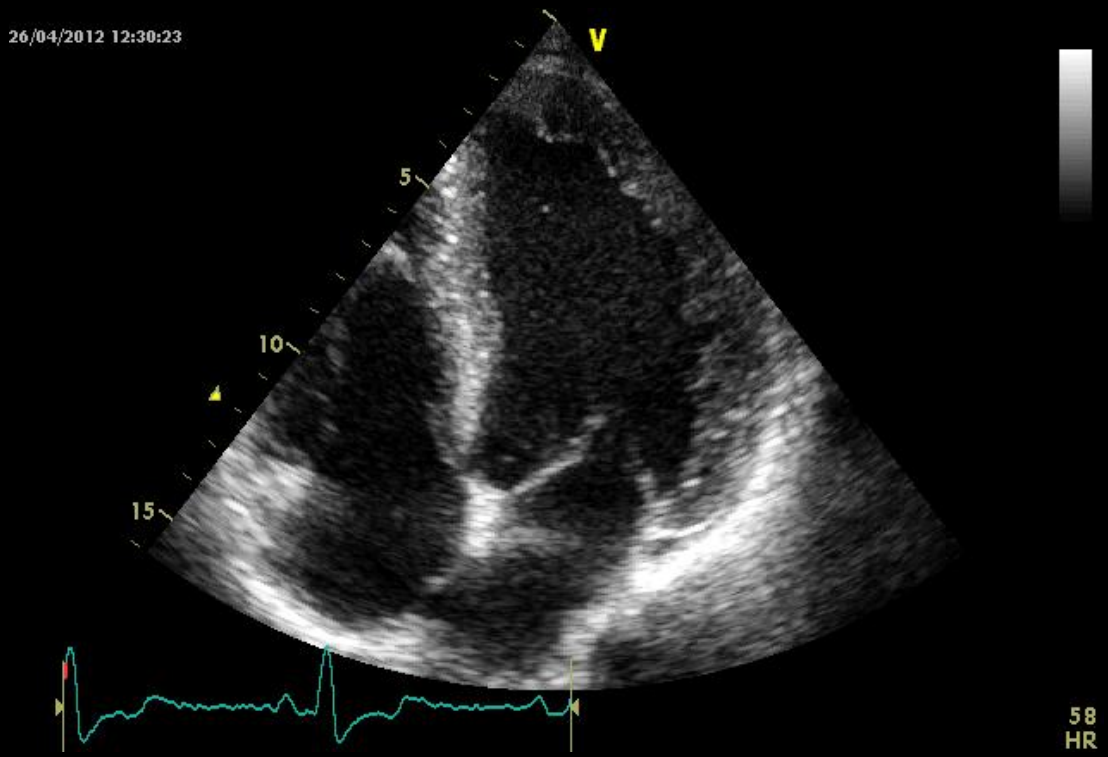
Number at risk						
AVR	53	36	29	8	7	7
No AVR	113	50	34	30	19	9



Number at risk				
AVR	21	15	13	5
No AVR	57	23	16	12

Kamath AR et al. Circulation 2009; 120 [suppl 1]: S 134-S 138

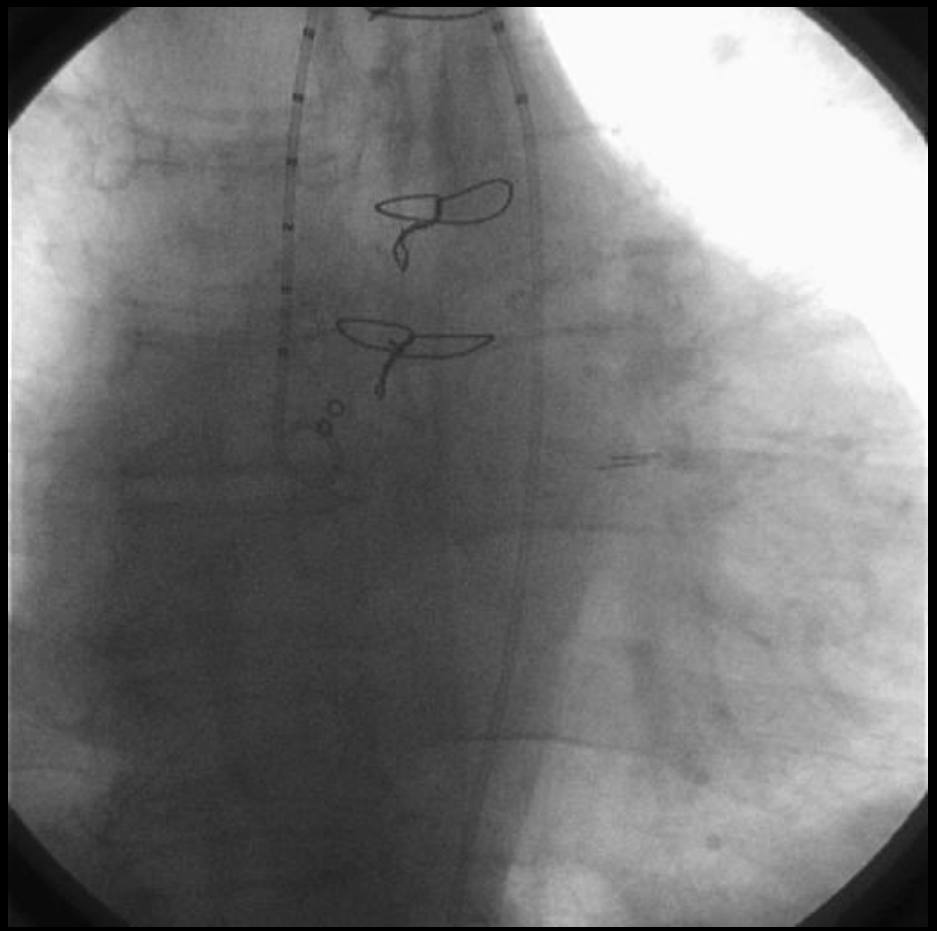


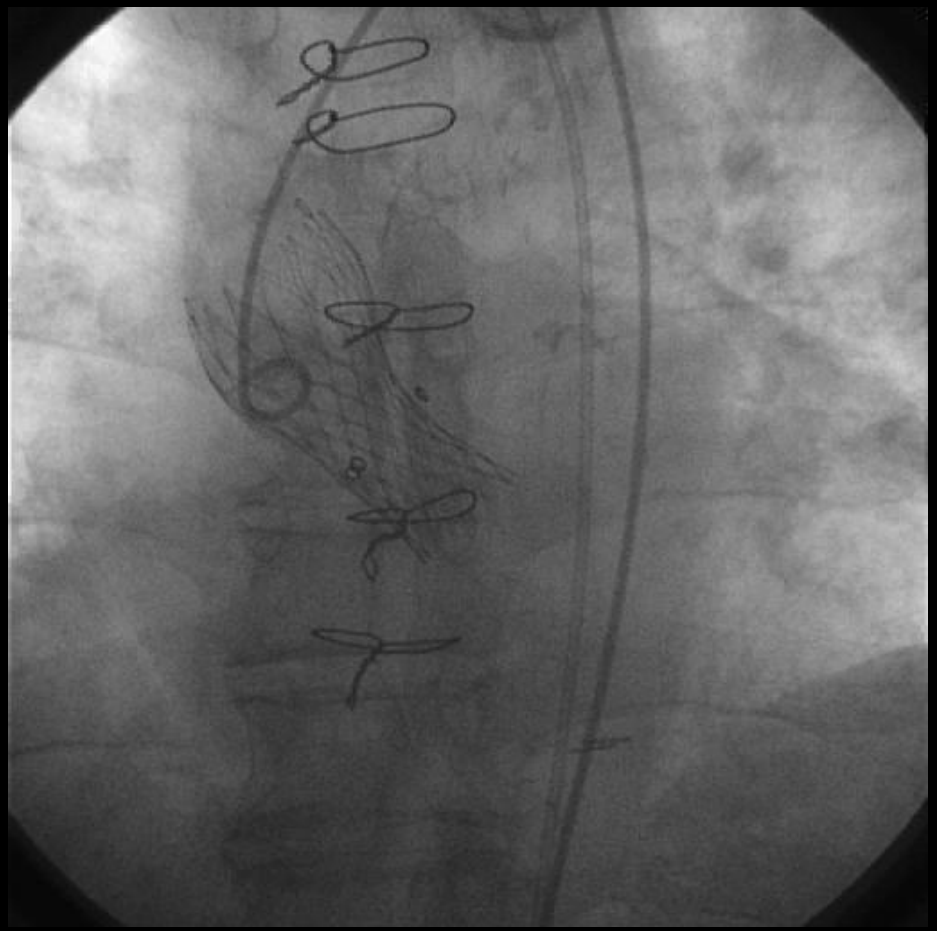


17 febbraio 2012

26 aprile 2012

Insufficienza aortica - TAVI





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Ancona

Cortesia del dr. T. Piva