La diagnostica nella cardiopatia ischemica cronica. Ecocardiogramma da sforzo o ecostress farmacologico? Quali sono i criteri di scelta?

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Cardiopatia ischemica cronica

Pazienti con ECG basalmente alterato

Pazienti con comorbidità (es vasculoptie)

Vitalità miocardica

Territorio ischemico

Stress echocardiography, stress single-photon-emission computed tomography and electron beam computed tomography for the assessment of coronary artery disease: A meta-analysis of diagnostic performance

Majanka H. Heijenbrok-Kal, PhD,[a,b] Kirsten E. Fleischmann, MD, MPH,[c] and M.G. Myriam Hunink, MD, PhD
Rotterdam, The Netherlands; San Francisco, CA; and Boston, MA

American Heart Journal
Volume 154, Number 3

Table II. Pooled sensitivity, specificity, and log of the diagnostic odds ratio and corresponding 95% confidence intervals per type of test using a random effects meta-analysis

Test	No. of studies	Sensitivity % (95% CI)	Specificity % (95% CI)	lnDOR (95% CI)
Exercise echo	55	82.7 (80.2-85.2)	84.0 (80.4-87.6)*	3.0 (2.7-3.3)
Adenosine echo	11	79.2 (72.1-86.3)	91.5 (87.3-95.7)	3.0 (2.5-3.5)
Dipyridamole echo	58	71.9 (68.6-75.2)	94.6 (92.9-96.3)*	3.0 (2.8-3.2)
Dobutamine echo	102	81.0 (79.1-82.9)	84.1 (82.0-86.1)*	2.9 (2.7-3.0)
Combined echo	226	79.1 (77.6-80.5)	87.1 (85.7-88.5)*	2.9 (2.8-3.0)
Exercise SPECT	48	88.1 (85.8-90.3)†	68.8 (62.8-74.8)	2.7 (2.6-3.0)
Adenosine SPECT	14	90.5 (89.0-91.9)‡	81.0 (73.5-88.6)	3.4 (3.0-3.8)**
Dipyridamole SPECT	23	90.4 (87.3-93.5)‡	75.4 (66.2-84.6)	2.7 (2.3-3.1)
Dobutamine SPECT	16	83.6 (78.4-88.8)	75.1 (71.1-79.0)	2.5 (2.1-2.9)
Combined SPECT	103	88.1 (86.6-89.6)‡	73.0 (69.1-76.9)	2.8 (2.6-3.0)
EBCT	21	93.1 (90.7-95.6)‡	54.5 (45.3-63.8)‡	2.6 (2.2-3.0)

CI, Confidence interval; *lnDOR*, natural logarithm of the diagnostic odds ratio.
*Nonoverlapping confidence intervals indicating a statistically higher specificity than the corresponding SPECT test.
**Nonoverlapping confidence intervals indicating a statistically higher lnDOR than exercise and dobutamine SPECT and EBCT.
†Nonoverlapping confidence intervals indicating a statistically higher sensitivity than the corresponding echocardiography test.
‡Nonoverlapping confidence intervals indicating a statistically higher sensitivity than all other tests, except for adenosine and dipyridamole SPECT and a statistically lower specificity than all other tests except for exercise SPECT.

Valutazione prognostica

J Am Coll Cardiol. 2007 Jan 16;49(2):227-37. Epub 2006 Dec 29.

The prognostic value of normal exercise myocardial perfusion imaging and exercise echocardiography: a meta-analysis.

Metz LD, Beattie M, Hom R, Redberg RF, Grady D, Fleischmann KE.

Department of Medicine, New York University School of Medicine, New York, New York, USA.

Metaanalisi (articoli dal ’90 al ’05)

9000 pazienti

Eco stress negativo bassissima incidenza di eventi (<1% anno nei successivi 4-5 anni, rischio annuale del 0,4-0,9% l’anno) Metz et Al, JACC 2007

Eco stress positivo: 10-30% di eventi spontanei o perioperatori nei successivi anni.

Stress Echo Risk Titration of a Negative Test

1-year risk (hard events)	Very low (<0.5% year)	Low (1–3% year)
Stress	Maximal	Submaximal
Resting EF	>50%	<40%
Anti-ischaemic therapy	Off	On
CFR	>2.0	<2.0

CFR, coronary flow reserve.

European Journal of Echocardiography. 2008 Jul;9(4):415-37

Stress Echo Risk Titration of a Positive Test

1-year risk (hard events)	Intermediate (1–3% year)	High (>10% year)
Dose/workload	High	Low
Resting EF	>50%	<40%
Anti-ischaemic therapy	Off	On
Coronary territory	LCx/RCA	LAD
Peak WMSI	Low	High
Recovery	Fast	Slow
Positivity or baseline dyssynergy	Homozonal	Heterozonal
CFR	>2.0	<2.0

LAD, left anterior descending artery; LCx, left circumflex; RCA, right coronary artery.

European Journal of Echocardiography. 2008 Jul;9(4):415-37

ECHO stress

- Esercizio fisico
- treadmill
- cyclette (in ortostatismo, supina)
- esercizio isometrico
- Farmacologico
- dobutamina
- dipiridamolo
- adenosina
- ergonovina
- arbutamina
- Altri
- atrial pacing
- cold pressor test
- stress mentale
- iperventilazione

Vantaggi dei test farmacologici

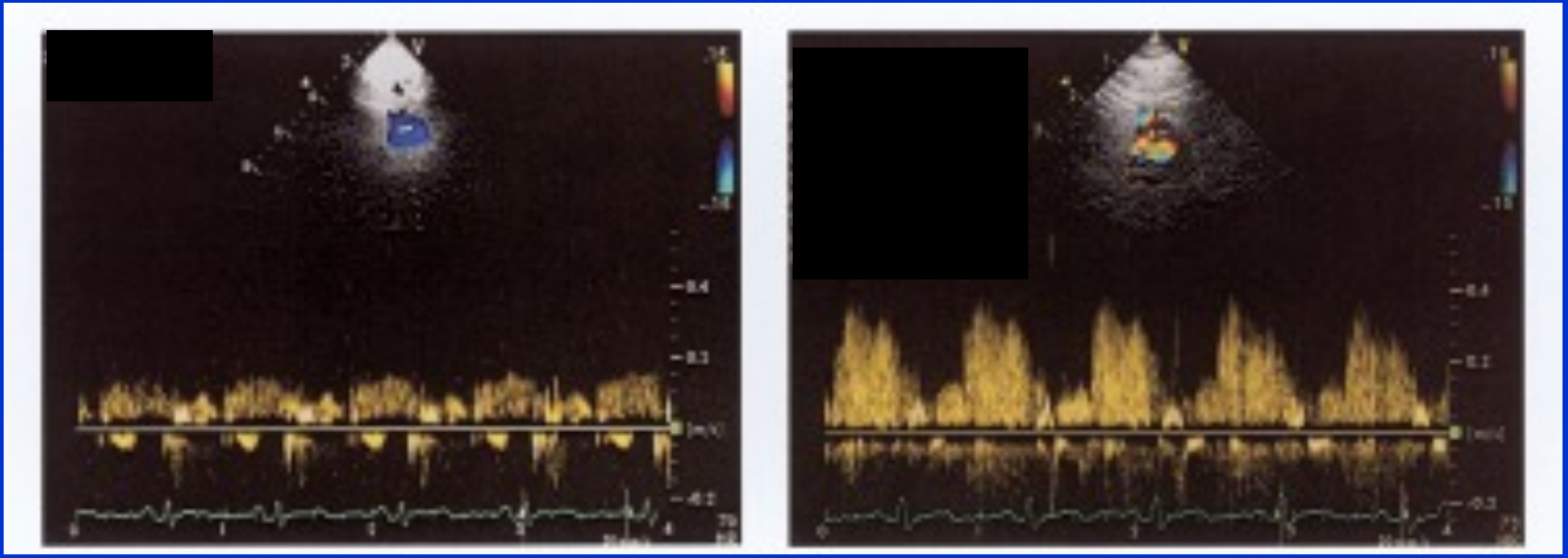
- -organizzativi (non necessitano di laboratorio dedicato con ergometro)
- -qualità delle immagini (nessuna interferenza del respiro né del movimento; possibilità di monitorare le immagini per l'intera durata dell'esame)
- -possibiltà di valutare la riserva di flusso coronarico (quando si usano vasodilatatori)
- -facilità nell'applicare nuove metodiche

Vantaggi dei test farmacologici

- -organizzativi (non necessitano di laboratorio dedicato con ergometro)
- -possibiltà di valutare la riserva di flusso coronarico
- -possibilità di applicare nuove metodiche
- -qualità delle immagini (nessuna interferenza del respiro né del movimento)

Eco stress con vasodilatatori

Basale **Dipiridamolo**



Valutazione prognostica

Potere prognostico addizionale combinando la valutazione della riserva di flusso coronarico e le modificazioni della cinetica durante test al dipiridamolo (Cortigiani, JACC 2007; Rigo, Eur Heart J 2007)

In 460 pts con echo dipiridamolo negativo per alterazioni della cinetica regionale, lo studio della riserva di flusso coronarica su IVA permetteva di identificare pattern prognostici diversi: riserva di flusso ridotta, in particolare su IVA, forte capacità predittiva di eventi maggiori.

Cortigiani et Al, Heart 2009.

Valutazione della riserva di flusso coronarico

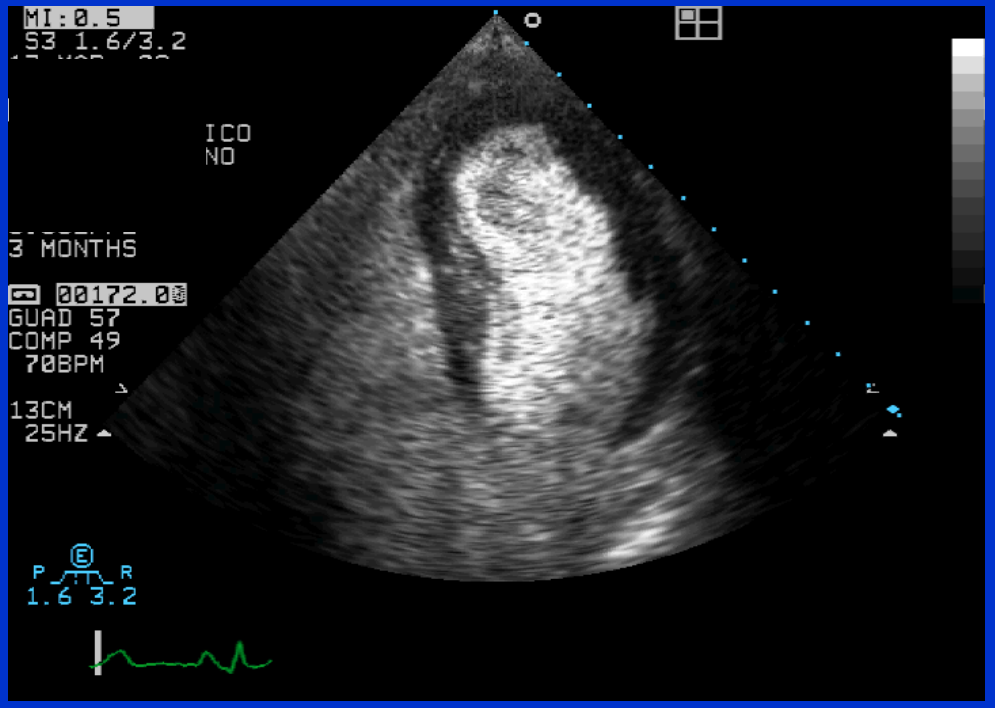
- **Valutazione limitata alla IVA**
- **Impossibilità a distinguere la componente legata al macro- e al microcircolo**
- **Valutazione di flusso e di cinetica (la alterazione della cinetica parietale è più efficiente per identificare la presenza di stenosi coronarica significativa, la normalità della riserva di flusso coronarico è più efficace nell'escluderla).**

Vantaggi dei test farmacologici

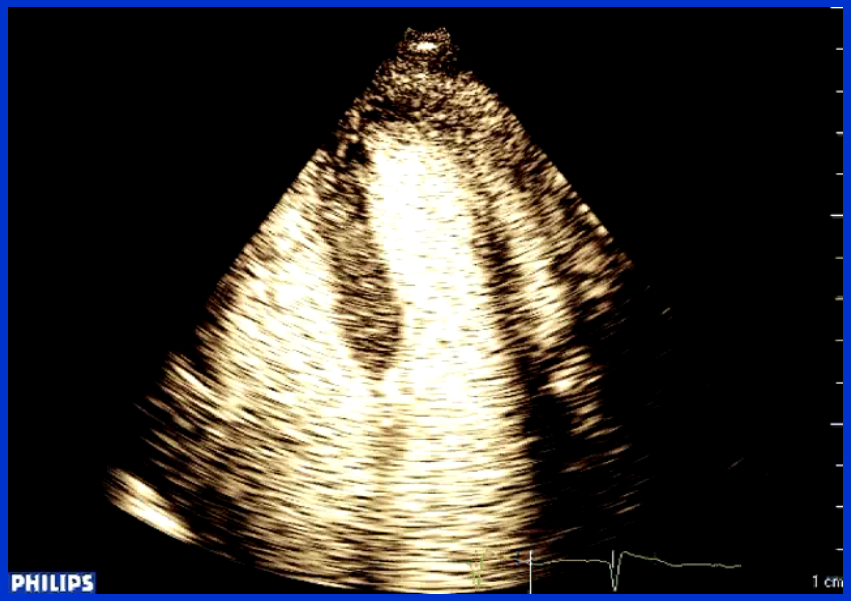
- -organizzativi (non necessitano di laboratorio dedicato con ergometro)
- --possibilità di valutare la riserva di flusso coronarico (quando si usano vasodilatatori)
- -possibilità di applicare nuove metodiche
- qualità delle immagini (nessuna interferenza del respiro né del movimento; possibilità di monitorare le immagini per l'intera durata dell'esame)

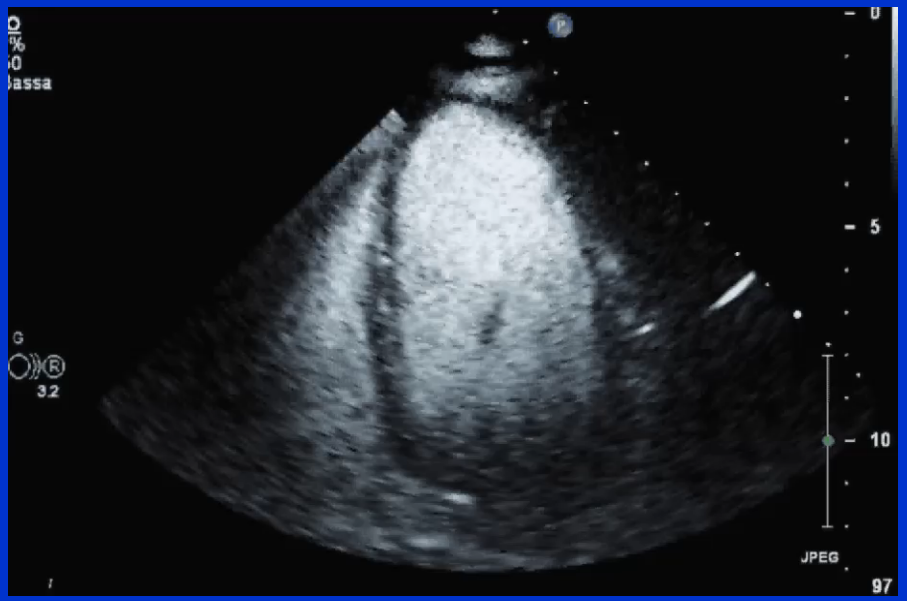
Nuove tecnologie applicate a stress Echo: Ecocontrasto

- Migliore visualizzazione dell'endocardio con opacizzazione di LV (nei pazienti con finestra ecocardiografica di scarsa qualità)



Valutazione della perfusione





Incremental value of contrast myocardial perfusion to detect intermediate versus severe coronary artery stenosis during stress-echocardiography

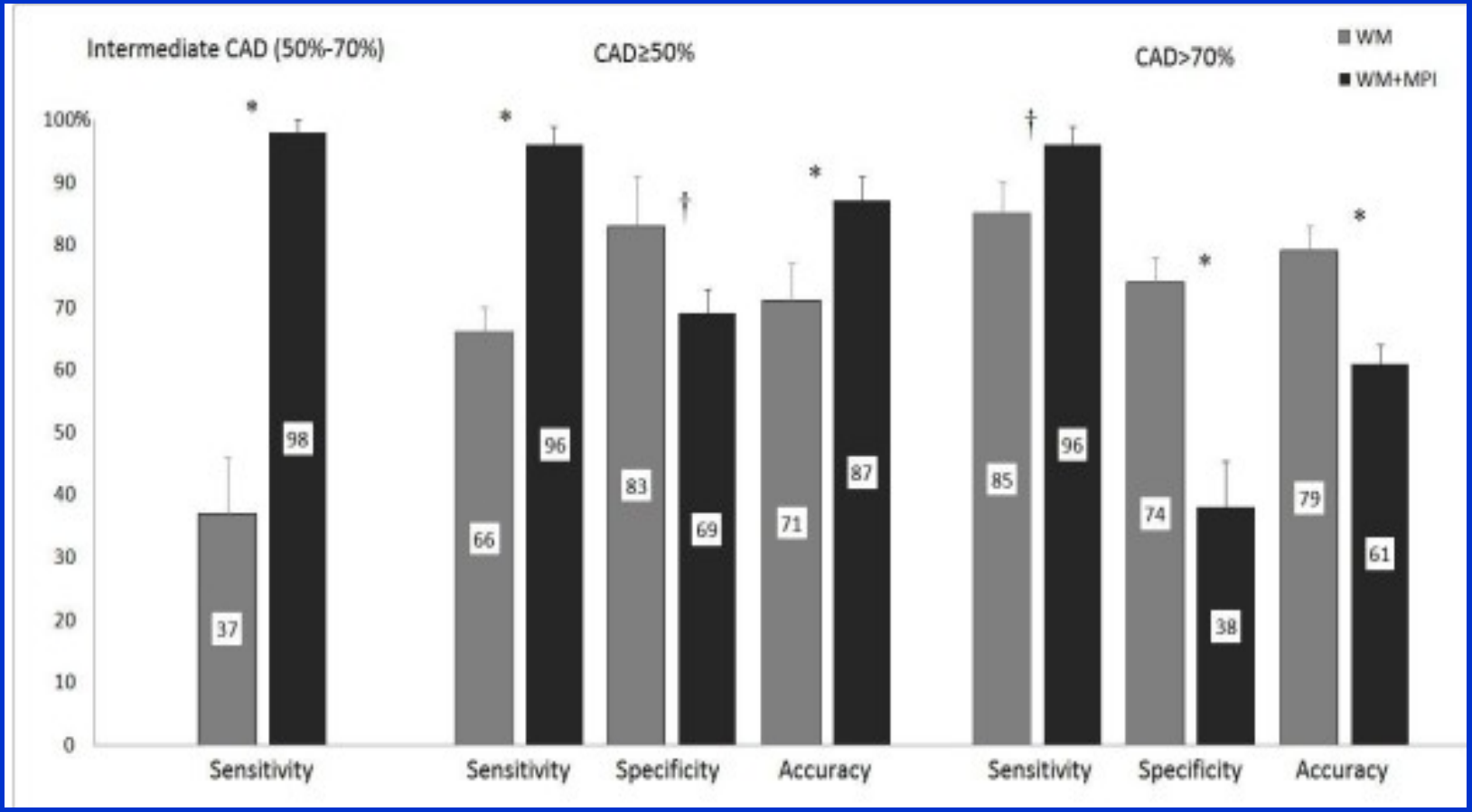
Nicola Gaibazzi[1*], **Fausto Rigo**[2*], **Angelo Squeri**[1*], **Fabrizio Ugo**[1*] and **Claudio Reverberi**[1*]

1 Cardiology Division, Azienda Ospedaliero-Universitaria di Parma, Parma, Italy

2 Cardiology Division, Umberto I° Hospital, Mestre-Venice, Italy

author email corresponding author email * Contributed equally

Cardiovascular Ultrasound 2010, **8**:16 doi:10.1186/1476-7120-8-16



J Am Coll Cardiol. 2004 Dec 7;44(11):2185-91.

Comparative accuracy of real-time myocardial contrast perfusion imaging and wall motion analysis during dobutamine stress echocardiography for the diagnosis of coronary artery disease.

Elhendy A, O'Leary EL, Xie F, McGrain AC, Anderson JR, Porter TR.

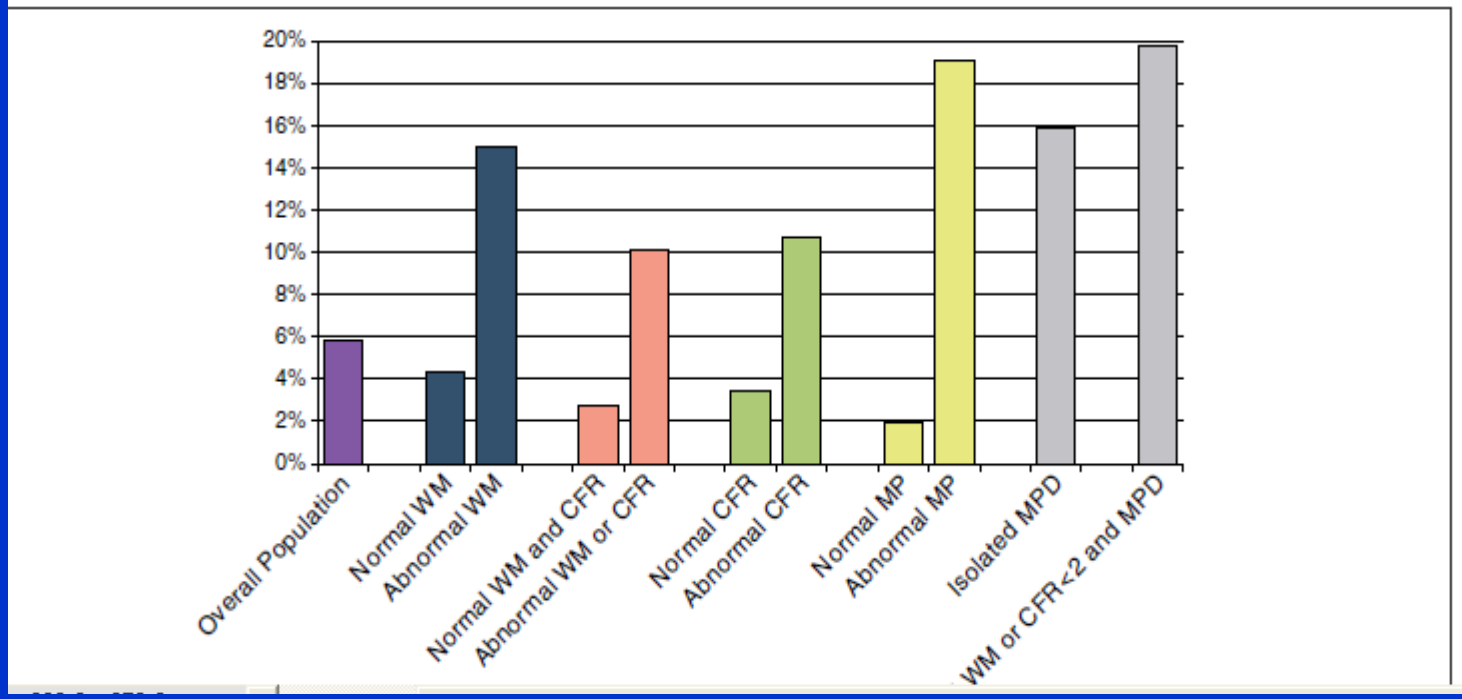
Department of Internal Medicine, Section of Cardiology, University of Nebraska Medical Center, Omaha, Nebraska, USA.

Sensitivity of MCE was higher than that of WMA at maximal stress (91% vs. 70%; p = 0.001) and at intermediate stress (84% vs. 20%; p = 0.0001). Specificity was lower for MCE compared with WMA (51% vs. 74%; p = 0.01). Overall accuracy was higher for MCE than for WMA (81% vs. 71%; p = 0.01). Sensitivity for detection of CAD based on abnormalities in >/=2 vascular regions was higher for

MCE than for WMA (67% vs. 28%; p < 0.01).

Selezione e zoom

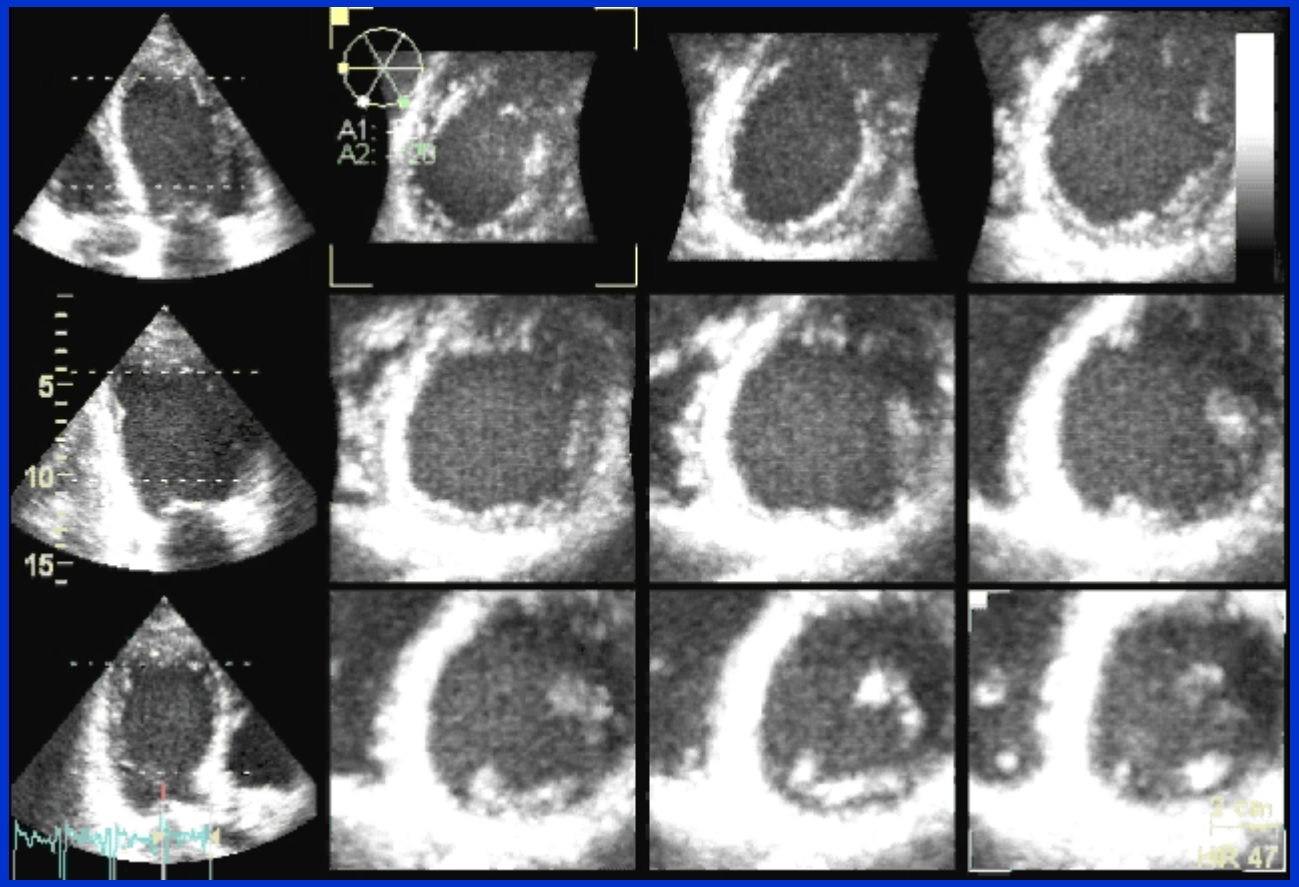
CC: CARDIOVASCULAR IMAGING, VOL. 6, NO. 1, 2013
JANUARY 2013:1–12



interobserver agreement : 80% per la perfusione

95% per le alterazioni della cinetica parietale

Ecocardiografia tridimensionale



High Volume-Rate Three-Dimensional Stress Echocardiography to Assess Inducible Myocardial Ischemia: A Feasibility Study

Luigi P. Badano, MD, Denisa Muraru, MD, Fausto Rigo, MD, Lorenzo Del Mestre, RS, Davide Ermacora, MD, Pasquale Gianfagna, MD, and Alessandro Proclemer, MD, *Udine and Mestre-Venice, Italy; Bucharest, Romania*

(J Am Soc Echocardiogr 2010;23:628-35.)

Table 3 Sensitivity and specificity of 3DE and 2DE for the detection of coronary artery disease

	Sensitivity (%)			Specificity (%)		
Coronary artery territory	3DE	2DE	*P*	3DE	2DE	*P*
All	80	78	NS	87	91	NS
Left anterior descending	87	78	.011	90	93	NS
Right	82	77	NS	85	88	NS
Left circumflex	65	63	NS	94	92	NS

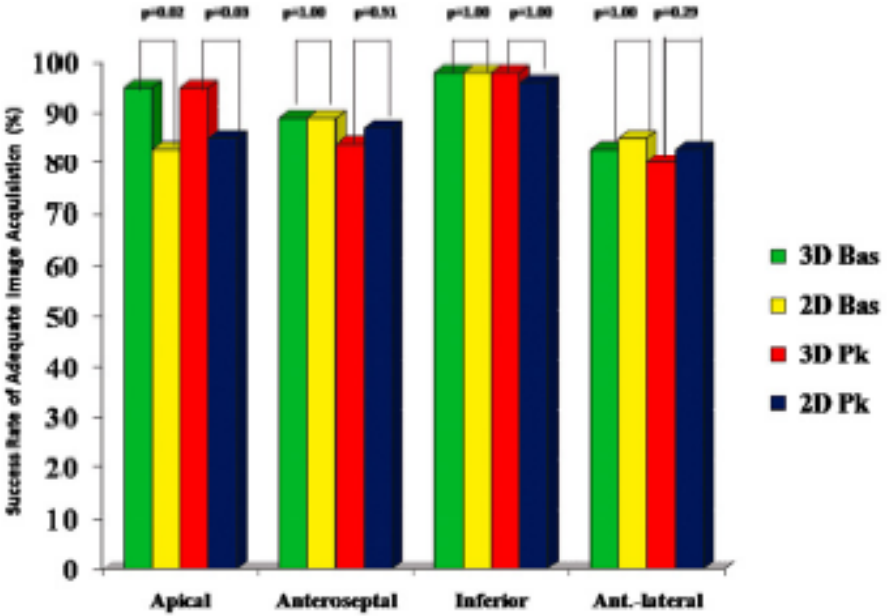
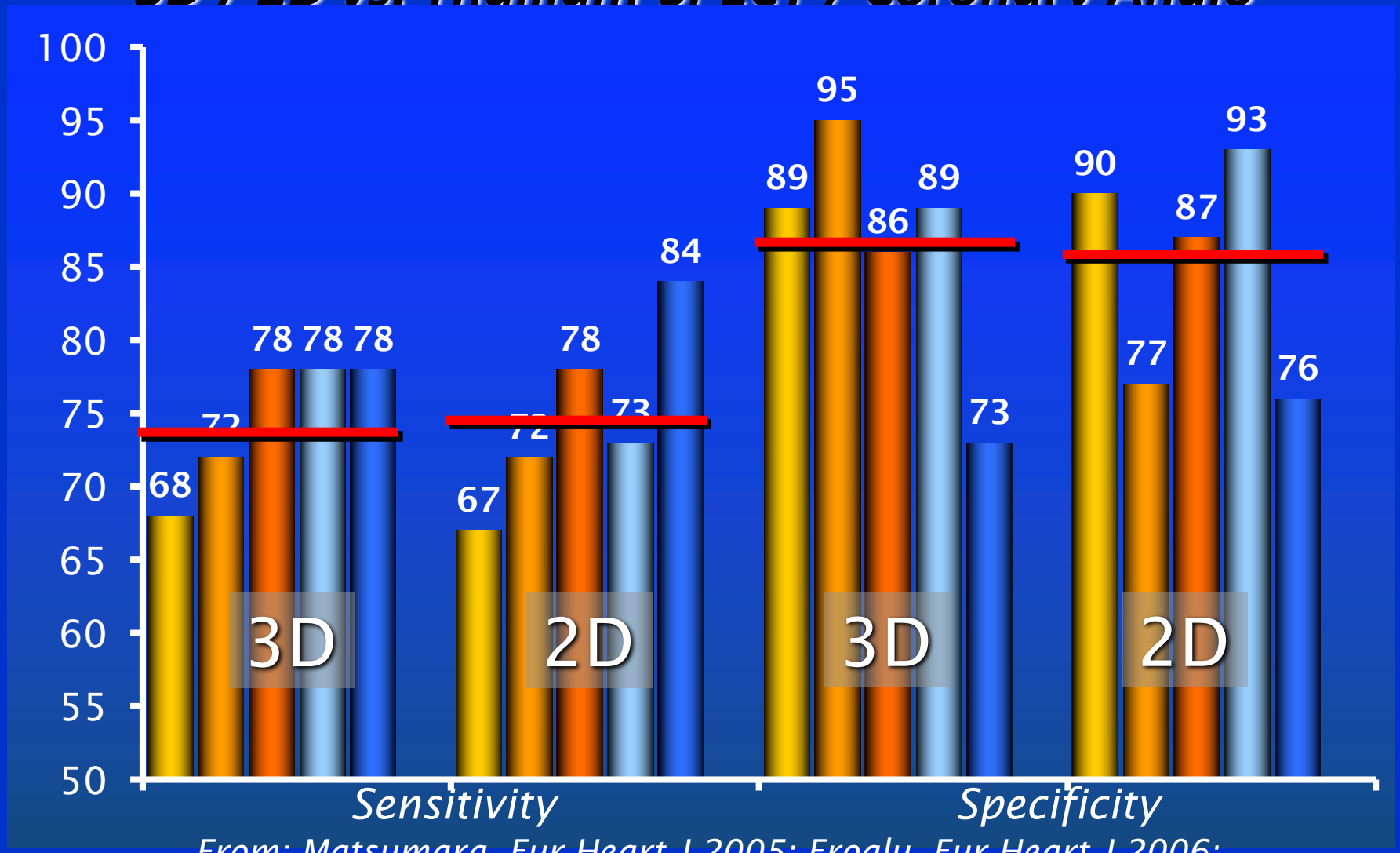


Figure 4 Success rate of adequate LV segment visualization at baseline (Bas) and during peak stress (Pk) using 3DE and 2DE in 4 left ventricular regions. The only significant difference could be detected in the apical region.

Accuracy of Stress Echo

3D / 2D vs. Thallium-SPECT / Coronary Angio



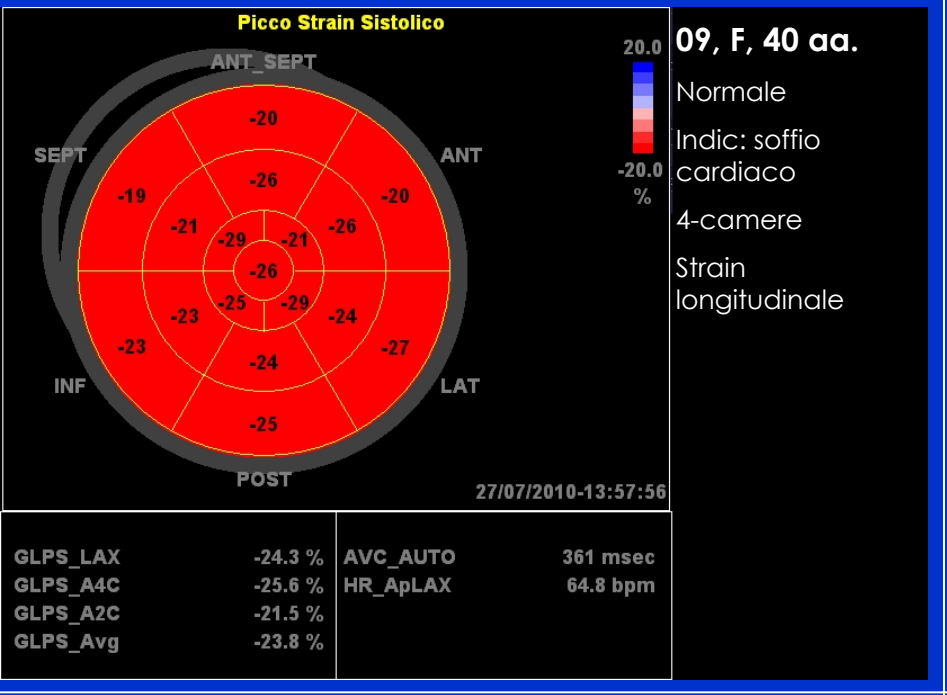
From: Matsumara, Eur Heart J 2005; Eroglu, Eur Heart J 2006; Peteiro, JASE 2007; Aggeli Heart 2007; Yoshitani, JASE 2009

Strain percentuale dell'accorciamento delle fibre miocardiche relativo alla sua dimensione originale
Strain rate è la sua derivata temporale

Speckle tracking permette la valutazione della deformazione ventricolare nelle 3 direzioni (longitudinale, circonferenziale, radiale)

Ischemia inizia nello strato subendocardico, la funzione longitudinale dipende soprattutto dalle fibre subendocardiche

I parametri di deformazione longitudinali potrebbero essere più accurati e precoci nell'evidenziare ischemia anche durante i test provocativi



09, F, 40 aa.

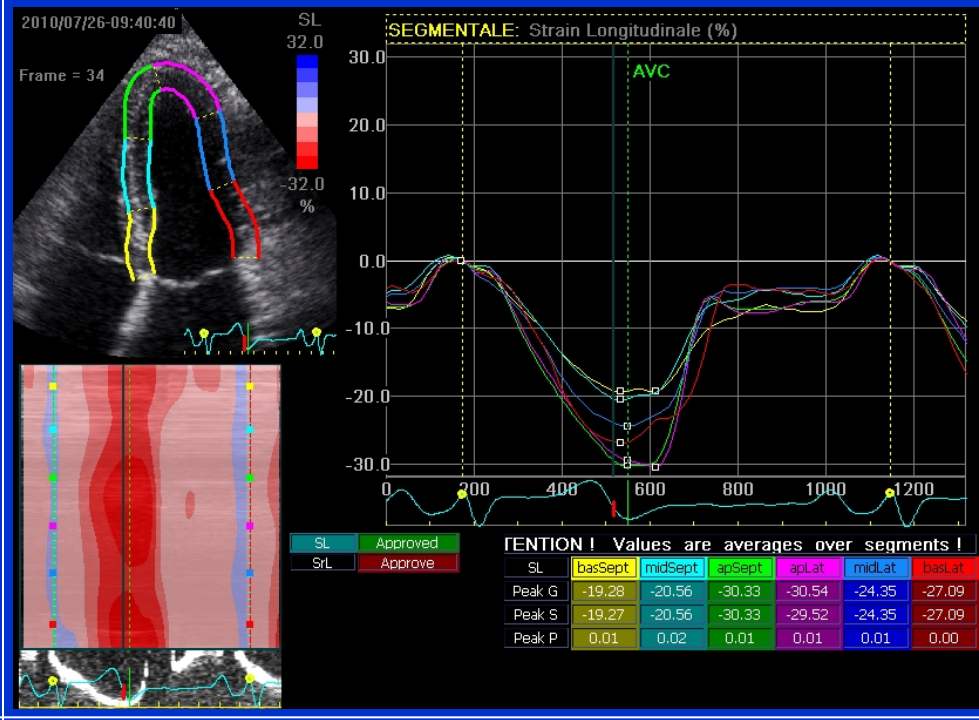
Normale

Indic: soffio cardiaco

4-camere

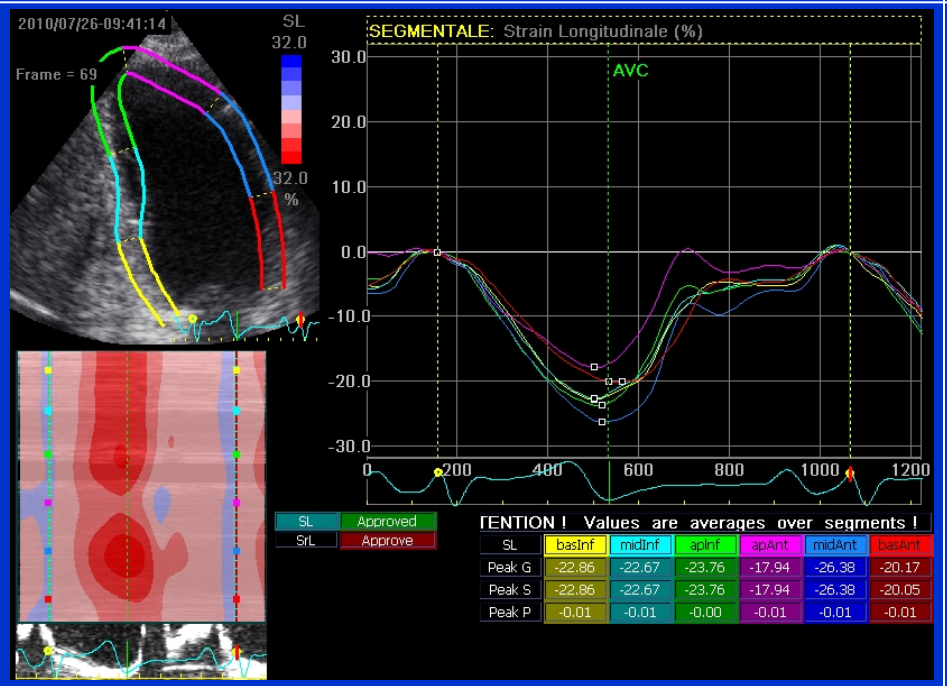
Strain longitudinale

GLPS_LAX	-24.3 %	AVC_AUTO	361 msec
GLPS_A4C	-25.6 %	HR_ApLAX	64.8 bpm
GLPS_A2C	-21.5 %		
GLPS_Avg	-23.8 %		



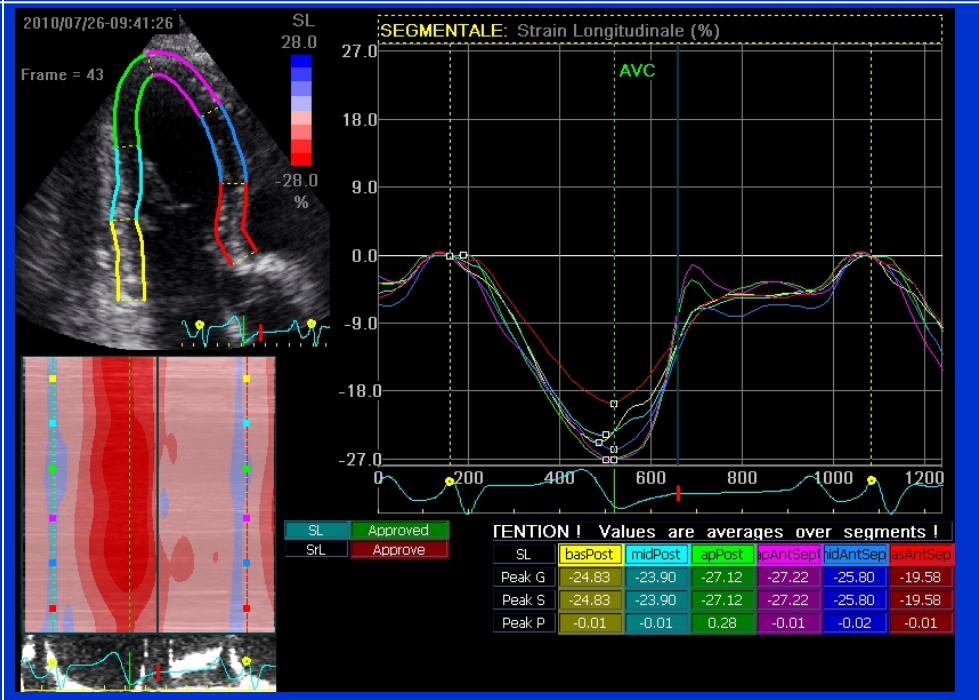
ATTENTION ! Values are averages over segments !

SL	basSept	midSept	apSept	apLat	midLat	basLat
Peak G	-19.28	-20.56	-30.33	-30.54	-24.35	-27.09
Peak S	-19.27	-20.56	-30.33	-29.52	-24.35	-27.09
Peak P	0.01	0.02	0.01	0.01	0.01	0.00



ATTENTION ! Values are averages over segments !

SL	basInf	midInf	apInf	apAnt	midAnt	basAnt
Peak G	-22.86	-22.67	-23.76	-17.94	-26.38	-20.17
Peak S	-22.86	-22.67	-23.76	-17.94	-26.38	-20.05
Peak P	-0.01	-0.01	-0.00	-0.01	-0.01	-0.01



ATTENTION ! Values are averages over segments !

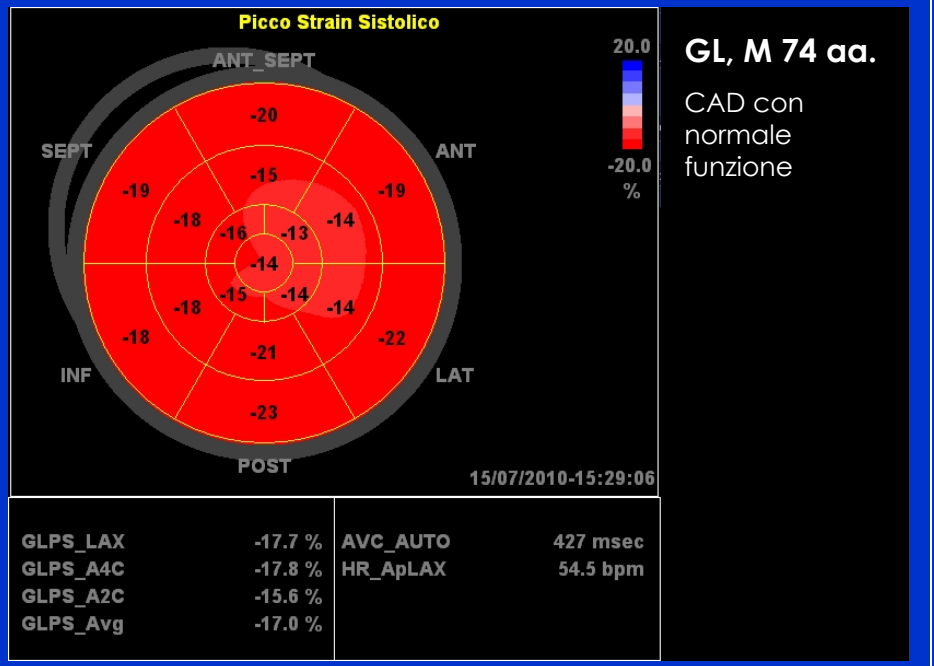
SL	basPost	midPost	apPost	apAntSept	midAntSep	basAntSep
Peak G	-24.83	-23.90	-27.12	-27.22	-25.80	-19.58
Peak S	-24.83	-23.90	-27.12	-27.22	-25.80	-19.58
Peak P	-0.01	-0.01	0.28	-0.01	-0.02	-0.01

Parametro accurati per ischemia: strain e strain rate sono ridotti in caso di ischemia

PSS (post sistolic shortening, ispessimento miocardico dopo la chiusura della valvola aortica), parametro molto precoce e sensibile per la diagnosi di ischemia acuta.

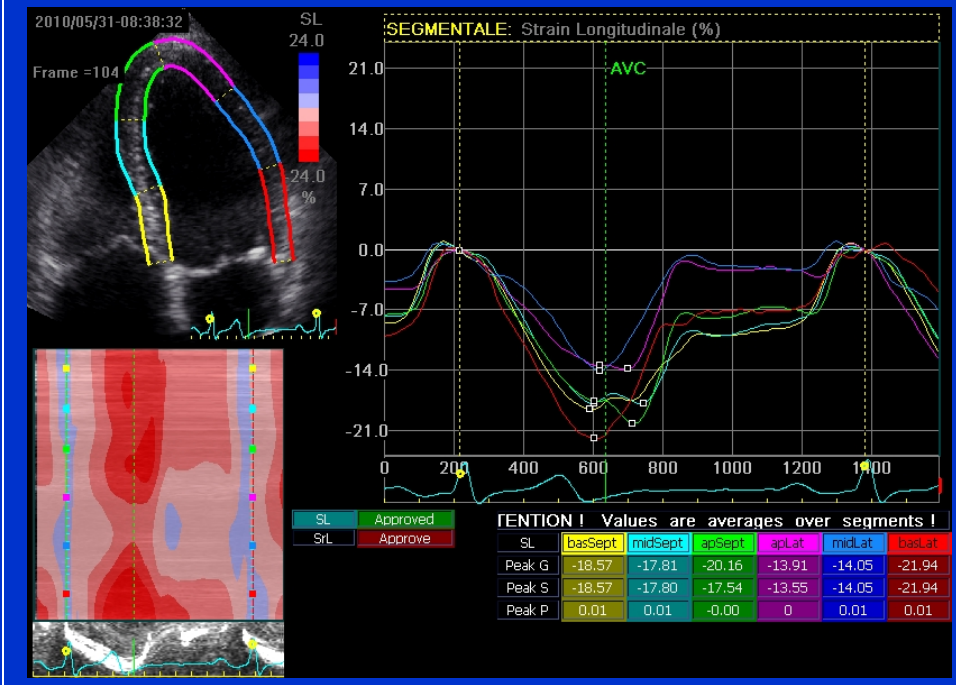
Patologico se: compare >90 msec dopo la chiusura della valvola aortica

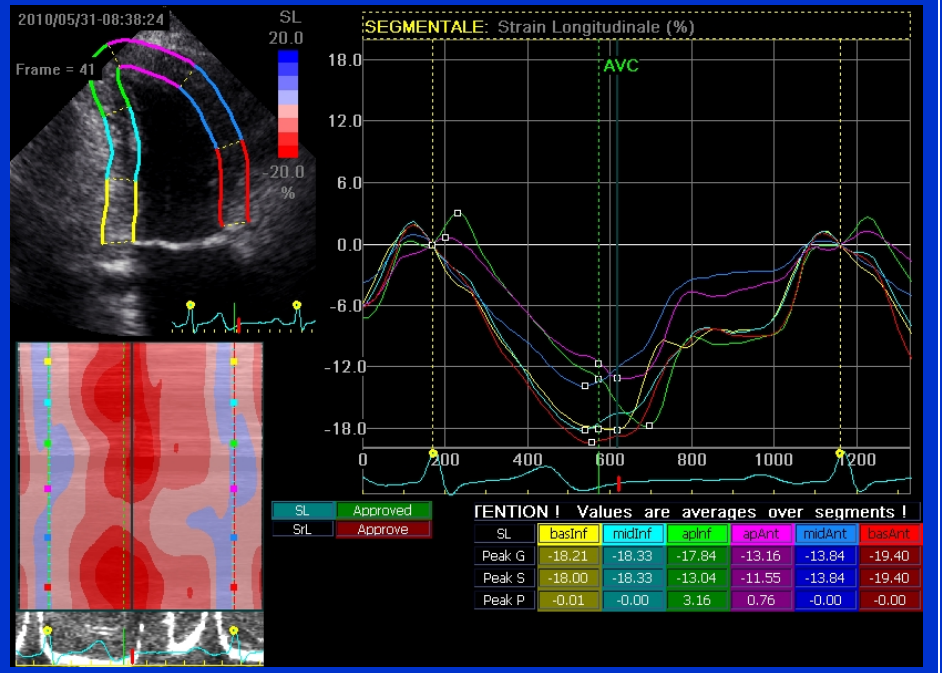
Durante test provocativi, l'incremento di strain e strain rate è ridotto nei segmenti ischemici
PSS è identificato nel 100% dei segmenti ischemici al picco dello stress

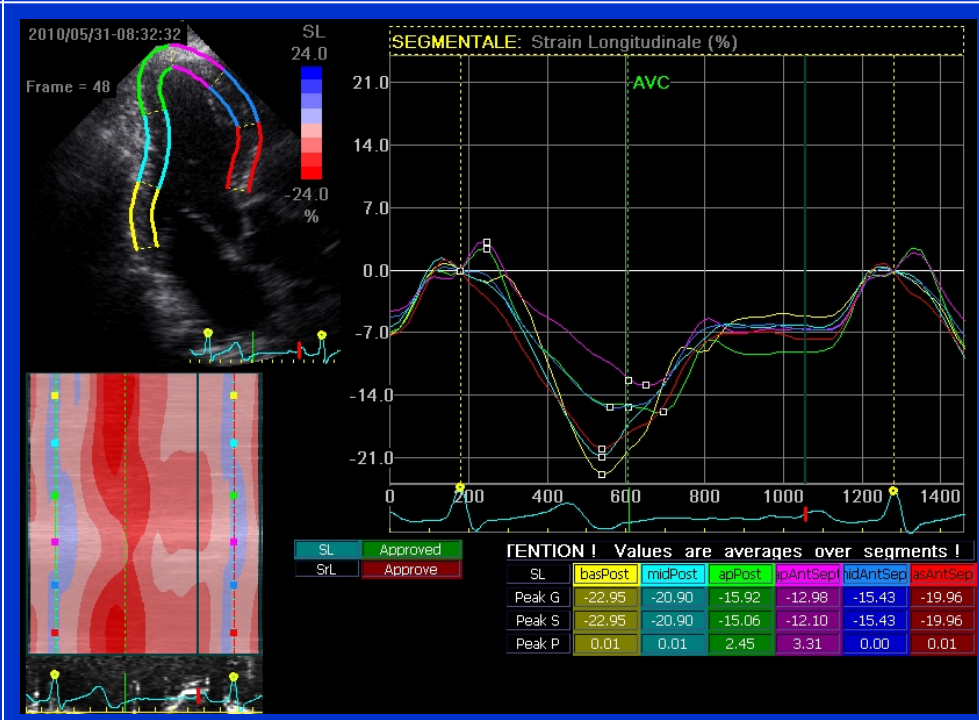


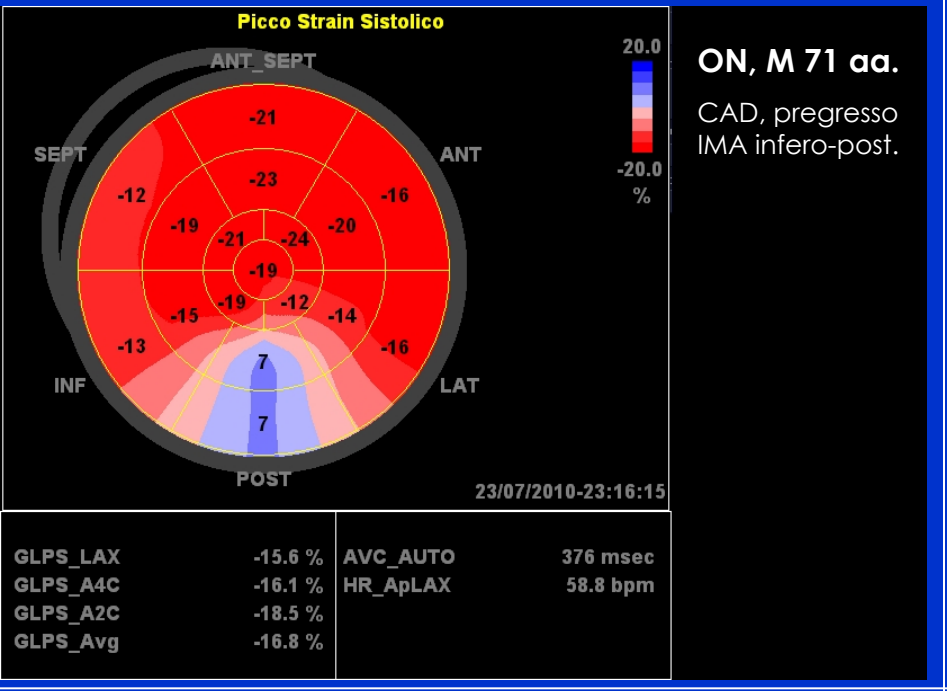
GL, M 74 aa.

CAD con normale funzione





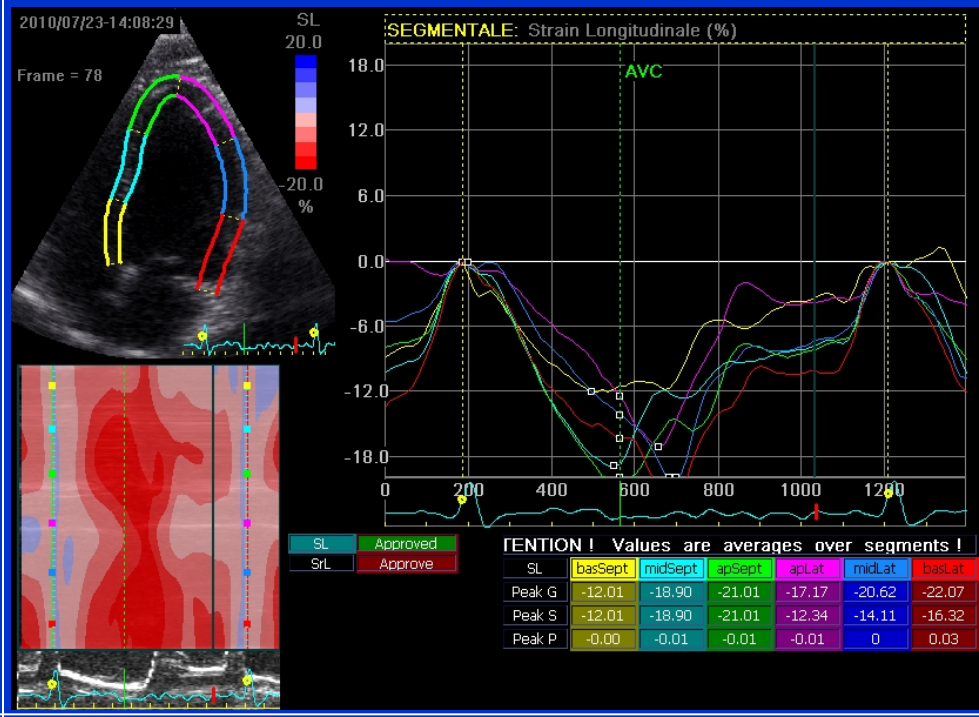




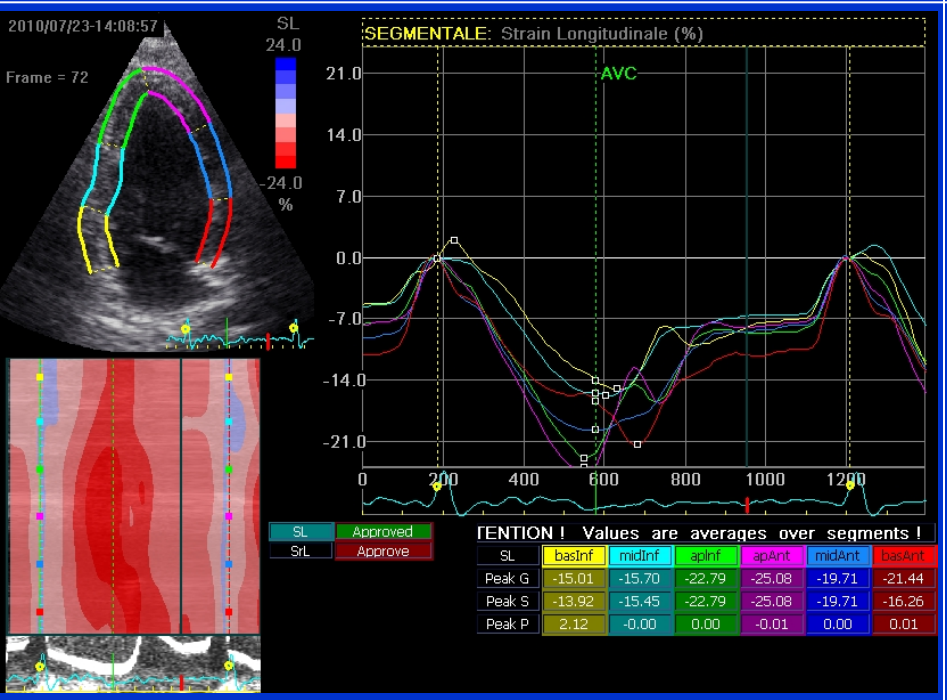
ON, M 71 aa.

CAD, pregresso IMA infero-post.

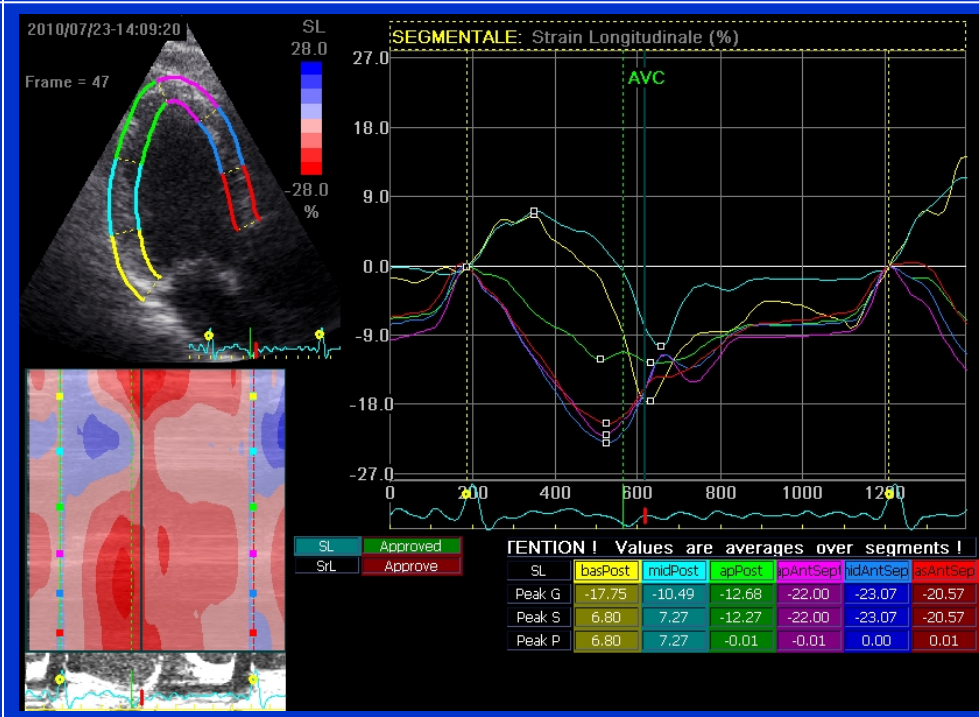
GLPS_LAX	-15.6 %	AVC_AUTO	376 msec
GLPS_A4C	-16.1 %	HR_ApLAX	58.8 bpm
GLPS_A2C	-18.5 %		
GLPS_Avg	-16.8 %		



SL	basSept	midSept	apSept	apLat	midLat	basLat
Peak G	-12.01	-18.90	-21.01	-17.17	-20.62	-22.07
Peak S	-12.01	-18.90	-21.01	-12.34	-14.11	-16.32
Peak P	-0.00	-0.01	-0.01	-0.01	0	0.03



SL	basInf	midInf	apInf	apAnt	midAnt	basAnt
Peak G	-15.01	-15.70	-22.79	-25.08	-19.71	-21.44
Peak S	-13.92	-15.45	-22.79	-25.08	-19.71	-16.26
Peak P	2.12	-0.00	0.00	-0.01	0.00	0.01



SL	basPost	midPost	apPost	apAntSept	midAntSep	basAntSep
Peak G	-17.75	-10.49	-12.68	-22.00	-23.07	-20.57
Peak S	6.80	7.27	-12.27	-22.00	-23.07	-20.57
Peak P	6.80	7.27	-0.01	-0.01	0.00	0.01

PSS e PSI(rapporto tra PSS e massimo accorciamento) parametro migliore per identificare ischemia durante stress (sensibilità 82%, specificità 85%)

Alcuni studi hanno identificato segmenti «sentinella» su cui valutare i vari parametri

Utilità in associazione alla valutazione della cinetica parietale per identificare i segmenti vitali

Vantaggi dei test farmacologici

- -organizzativi (non necessitano di laboratorio dedicato con ergometro)
- -qualità delle immagini (nessuna interferenza del respiro né del movimento; possibilità di monitorare le immagini per l'intera durata dell'esame)
- -possibiltà di valutare la riserva di flusso coronarico (quando si usano vasodilatatori)
- -possibilità di utilizzare nuove metodiche

Lettoergometro

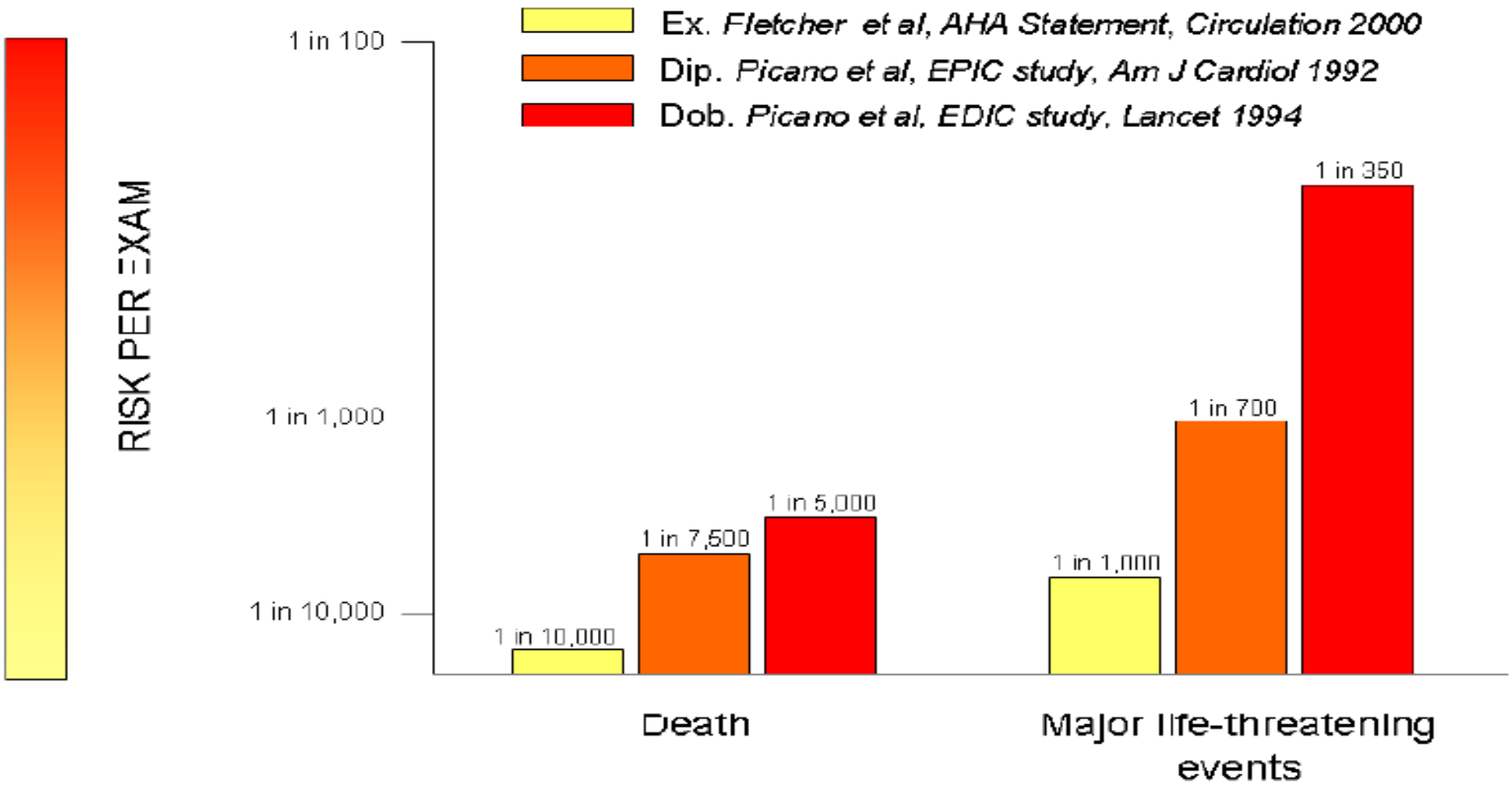
- Permette il monitoraggio continuo ecocardiografico

- Valutazione della cinetica durante e al picco dello sforzo (20% delle alterazioni della cinetica parietale regrediscono entro 1')

Vantaggi dell'ecocardiografia da sforzo

1) Fisiologica correlazione dell'ischemia con l'esercizio e significato ai diversi carichi
2) Possibilità di valutare meglio i sintomi lamentati dal paziente
3) Eventuale comparsa di aritmie durante l'esercizio
4) Semplicità di esecuzione, sicurezza

Acute risks of stress



European Journal of Echocardiography. 2008 Jul;9(4):415-37

Complication	Incidence	Incidence (range)	Mechanism	Treatment
Overall				
Mortality	<0.01%	0.00%–0.01%	VF, cardiac rupture	Per underlying cause
Mechanical complications				
Cardiac rupture	<0.01%	0.00%–0.01%	Rupture of akinetic or dyskinetic segments	Stop dobutamine, ± pericardiocentesis, ± surgery
Coronary spasm	0.14%	True incidence unknown	α1-receptor mediated vasoconstriction	Sublingual nitroglycerin (note beta-blocker would worsen spasm, consider long-term calcium channel blockade)
Thrombotic complications				
Myocardial infarction	0.02%	0.00%–0.1%	Plaque rupture, platelet aggregation	Stop dobutamine, coronary revascularization
Cerebrovascular accident	<0.01%	0.00%–0.1%	Embolism, shearing forces with increased BP	Stop dobutamine, MRI, neurology evaluation
Arrhythmia complications				
Asystole	<0.01%	0.00%–0.03%	Sinus node deceleration or arrest due to ischemia	Stop dobutamine, atropine bolus (0.5–2 mg), ± pacing
Ventricular fibrillation	0.04%	0.00%–0.18%	Underlying ischemia and/or scar	Stop dobutamine, initiate ACLS
Sustained ventricular tachycardia	0.15%	0.00%–0.78%	Effect on QTc, increased intracellular calcium which triggers automaticity	Stop dobutamine, administer IV beta-blockade (5–10 mg), administer IV procainamide or amiodarone, cardiovert if unstable
SVT	PAC 7.8% SVT 1.3% AF 0.9%	PAC (0.7%–27.8%) SVT (0.0%–7%) AFib (0.3%–2.2%)	More common in patients with decreased EF, increased left atrial size and pressure	Stop dobutamine, administer beta-blocker (5–10 mg), verapamil (10 mg) or digoxin (0.5 mg), cardioversion if unstable
Atrioventricular block	0.23%	0.03%–0.68%	Myocardial ischemia, Bezold–Jarisch reflex, latent abnormalities of His-Purkinje system	For Mobitz I, stop dobutamine and administer atropine For Mobitz II, stop dobutamine (atropine may worsen block); assess for myocardial ischemia (usually seen with wall motion abnormality)
Hypotension	1.7%	0.2%–7.6%	β2 agonist reduces SVR; inadequate increase in cardiac output to compensate for decrease in SVR	Stop dobutamine, Trendelenburg position, IV fluids, consider atropine
Hypertension	1.3%	0.2%–5.5%	More common in patients with a history of HTN or intermittent beta-blocker use	Stop dobutamine, administer IV beta-blockers or vasodilator as needed

Stress Echocardiography Expert Consensus Statement—Executive Summary

European Association of Echocardiography (EAE) (a registered branch of the ESC)

Rosa Sicari[1]*, Petros Nihoyannopoulos[2], Arturo Evangelista[3], Jaroslav Kasprzak[4], Patrizio Lancellotti[5], Don Poldermans[6], Jens-Uwe Voigt[7], and Jose Luis Zamorano[8] on behalf of the European Association of Echocardiography

[1]Institute of Clinical Physiology, Pisa, Italy; [2]Hammersmith Hospital, NIHLI, Imperial College, London, UK; [3]Hospital Vall d'Hebron, Barcelona, Spain; [4]Department of Cardiology, Medical University of Lodz, Lodz, Poland; [5]Department of Cardiology, University Hospital Sart Tilman, Liège, Belgium; [6]Erasmus Medical Center, Rotterdam, The Netherlands; [7]Catholic University, Leuven, Belgium; and [8]Instituto Cardiovascular, Hospital Clínico San Carlos, Madrid, Spain

DIPIRIDAMOLO

Author, year	Patients	Complications
Multicentre registry		
Picano *et al.*, 1992	10 451	1 cardiac death, 1 asystole, 2 AMI, 1 pulmonary oedema, 1 sustained VT
Varga *et al.*, 2006	24 599	19 (1 death)
Total	35 050	25

AMI, acute myocardial infarction; VT, ventricular tachycardia.

DOBUTAMINA e DIPIRIDAMOLO

	Dobutamine	Dipyridamole
% submaximal tests	10%	5%
Side effects	1/300 exams	1/1000
VT, VF	++	+
High grade AV block	+	++
Death	1/5000	1/10000

AV, arteriovenous; VF, ventricular fibrillation; VT, ventricular tachycardia.

Attrezzatura del laboratorio
Esperienza dell'operatore

Caratteristiche del paziente

Table 4. Stress echo: which test for which patient.

Pt characteristics	Exercise	Dipyridamole	Dobutamine
Inability to exercise	3	1	1
Contraindication to exercise	3	1	1
Positive EET in hypertensives, women, baseline ECG changes	1	2	2
Asthmatic patient	2	3	1
Under theophylline therapy	1	3	1
Severe hypertension	3	1	3
Well controlled hypertension	2	1	2
Relative hypotension	1	3	3
Ventricular ectopy	1	1	3
2nd–3rd degree atrioventricular block	1	3	2
Suboptimal acoustic window	3	1	2
Evaluation of anti-ischemic therapy efficacy	1	2	3
Unstable carotid disease	2	2	2
Permanent pacemaker		Pacemaker stress echo	

1: Especially indicated; 2: Relatively contraindicated; 3: Contraindicated.
ECG: Electrocardiogram; EET: Exercise-electrocardiography test.

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Ventricular ectopy	1	1	3
2nd–3rd degree atrioventricular block	1	3	2
Suboptimal acoustic window	3	1	2
Evaluation of anti-ischemic therapy efficacy	1	2	3
Unstable carotid disease	2	2	2
Permanent pacemaker		Pacemaker stress echo	

1: Especially indicated; 2: Relatively contraindicated; 3: Contraindicated.
ECG: Electrocardiogram; EET: Exercise-electrocardiography test.

Paziente	esercizio	dipiridamolo	dobutamina
Impossibilità ad eseguire esercizio	no	si	si
Controindicazione esercizio	no	si	si
Scarsa qualità della finestra acust	no	si	si
Asma	possibile	no	si
Assunzione di teofillinici	si	no	si
Blocco AV avanzato	si	no	possibile
Ipotensione	si	no	no
Aritmie ventricolari	si	si	no
Valutazione efficacia terapia	si	possibile	no
Valutazione vitalità			si

Ipertensione

nature publishing group

Non-Invasive Diagnostic Testing for Coronary Artery Disease in the Hypertensive Patient: Potential Advantages of a Risk Estimation-Based Algorithm

Diana Chin[1], Allegra Battistoni[1], Giuliano Tocci[2], Jasmine Passerini[1], Gianfranco Parati[3] and Massimo Volpe[1,2]

Table 1 | Comparison of non-invasive diagnostic tests for detection of coronary artery disease in hypertensive subjects

	Sensitivity	Specificity	PPV	NPV	Cost	Biological impact	Indications	Not recommended
EET	+++	++	+++	++++	+	0	Pts at **intermediate risk** of CAD	**In women, young pts, or unable to exercise, or with resting ECG abnormalities**
Dipyridamole echocardiography	++++	++++	++++	++++	++	+	Pts at **intermediate risk** of CAD **unable to exercise/ with positive EET** (especially women and >75 aa)/**with interfering abnormalities ECG (LVH, LBBB)**	In pts with **poor acoustic window**, or with **resting abnormal wall motion**; or with **contraindication to pharmacologic stressor agents**
Dobutamine echocardiography	++++	++++	++++	++++	++	+		
Exercise echocardiography	++++	++++	++++	++++	++	0		
MPS	++++	++	+++	++++	++++	++++	Pts at **intermediate risk** of CAD **unable to exercise/ with positive EET** (especially women and >75 aa)/ **with interfering abnormalities ECG (LVH, LBBB)**; asymptomatic pts at **high risk of CAD** or with a **strong familiarity** for CAD	In **young and women**; in pts with **contraindication to pharmacologic stressor agents**
CCT	++++	++++	++++	++++	+++	++++	Pts at **intermediate risk** of CAD **with positive EET pts and low/intermediate risk unable to exercise/ with interfering abnormalities ECG (LVH, LBBB);**	**Women or young pts or with serum creatinine >1,5 mg/dl**
CMR	n.a.	n.a.	n.a.	n.a.	++++	+	Pts at **intermediate risk** of CAD **unable to exercise/ with positive EET/with interfering abnormalities ECG (LVH, LBBB)**	**In claustrophobic pts, or with ferromagnetic objects, or with creatinine clearence <30 ml/min;** in pts with **contraindication to pharmacologic stressor**

- 2200 ipertesi, sottoposti ad eco dipiridamolo o dobutamina
- fattibilità
- Dobutamina
- ipertesi 88,8%
- normotesi 93,4%

- Dipiridamolo
- ipertesi 97%
- normotesi 97,5%

- Complicanze più frequenti con dobutamina negli ipertesi.

- Cortigiani et Al, J Hypertension 2002
-

DOI: 10.1111/j.1540-8175.2011.01623.x

Echocardiography

Intracranial Hemorrhage as a Complication of Dobutamine Stress Echocardiography: Case Report and Review of the Literature

Sachin P. Shah, M.D. and G. Muqtada Chaudhry, M.D.

Display Settings: Abstract

Send to:

BMJ Case Rep. 2014 Mar 18;2014. pii: bcr2013201891. doi: 10.1136/bcr-2013-201891.

Intraparenchymal haemorrhage and uncal herniation resulting from dobutamine stress echocardiography.

Bennin CL[1], Ramoutar V, Velarde G.

Author information

Ipertensione arteriosa

- 59 pazienti ipertesi
- 59 normotesi
- Sottoposti a coronarografia per dolore toracico
- Sottoposti ad ecocardiogramma da sforzo in assenza di terapia e, negli ipertesi, dopo normalizzazione dei valori di P.A. con nifedipina.
- CAD significativa (stenosi>50% in 22 ipertesi e 41 normotesi)

- Maltagliati et al, Hypertension, 2000

	ipertesi					
	WO		Nif		normotesi	
	Echo	ECG	Echo	ECG	Echo	ECG
Sensibilità	95%*	68%	91%*	45%	87%*	51%
Specificità	94%*	70%	100%	81%	72%	72%
Acc diagn	94%*	69%*	96%*	67%	83%*	57%

- Maltagliati et Al, Hypertension, 2000

2014 ESC/EACTS Guidelines on myocardial revascularization: the Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). Developed with the special contribution of the European Association of Percutaneous Cardiovascular Interventions (EAPCI).

Kolh P[1], Windecker S[2], Alfonso F[3], Collet JP[4], Cremer J[5], Falk V[6], Filippatos G[7], Hamm C[5], Head SJ[8], Jüni P[6], Kappetein AP[8], Kastrati A[5], Knuuti J[9], Landmesser U[6], Laufer G[10], Neumann FJ[5], Richter DJ[7], Schauerte P[5], Sousa Uva M[11], Stefanini GG[6], Taggart DP[12], Torracca L[13], Valgimigli M[13], Wijns W[14], Witkowski A[15]; European Society of Cardiology Committee for Practice Guidelines, Zamorano JL[3], Achenbach S[5], Baumgartner H[5], Bax JJ[8], Bueno H[3], Dean V[4], Deaton C[12], Erol Ç[16], Fagard R[14], Ferrari R[13], Hasdai D[17], Hoes AW[8], Kirchhof P[18], Knuuti J[9], Kolh P[14], Lancellotti P[14], Linhart A[19], Nihoyannopoulos P[12], Piepoli MF[13], Ponikowski P[15], Sirnes PA[20], Tamargo JL[3], Tendera M[15], Torbicki A[15], Wijns W[14], Windecker S[6]; EACTS Clinical Guidelines Committee, Sousa Uva M[11], Achenbach S[5], Pepper J[12], Anyanwu A[21], Badimon L[3], Bauersachs J[5], Baumbach A[12], Beygui F[4], Bonaros N[10], De Carlo M[13], Deaton C[12], Dobrev D[5], Dunning J[12], Eeckhout E[6], Gielen S[5], Hasdai D[17], Kirchhof P[22], Luckraz H[12], Mahrholdt H[5], Montalescot G[4], Paparella D[13], Rastan AJ[5], Sanmartin M[3], Sergeant P[14], Silber S[5], Tamargo J[3], ten Berg J[8], Thiele H[5], van Geuns RJ[8], Wagner HO[5], Wassmann S[5], Wendler O[12], Zamorano JL[3]; Task Force on Myocardial Revascularization of the European Society of Cardiology and the European Association for Cardio-Thoracic Surgery; European Association of Percutaneous Cardiovascular Interventions.

⊕ **Author information**

KEYWORDS: Acute coronary syndromes; Bare-metal stents; Coronary artery bypass grafting; Coronary artery disease; Drug-eluting stents; EuroSCORE; Guidelines; Heart Team; Medical therapy; Myocardial infarction; Myocardial ischaemia; Myocardial revascularization; Percutaneous

Rivascolarizzazione indicata nei pz con con scompenso si se vi è angina

Nei pazienti con vitalità, la rivascolarizzazione migliora la sopravvivenza, quando il miocardio vitale è>10%

European Journal of Echocardiography (2008) 9, 415–437
doi:10.1093/ejechocard/jen175

EUROPEAN SOCIETY OF CARDIOLOGY®

EAE GUIDELINES

Stress echocardiography expert consensus statement

European Association of Echocardiography (EAE) (a registered branch of the ESC)

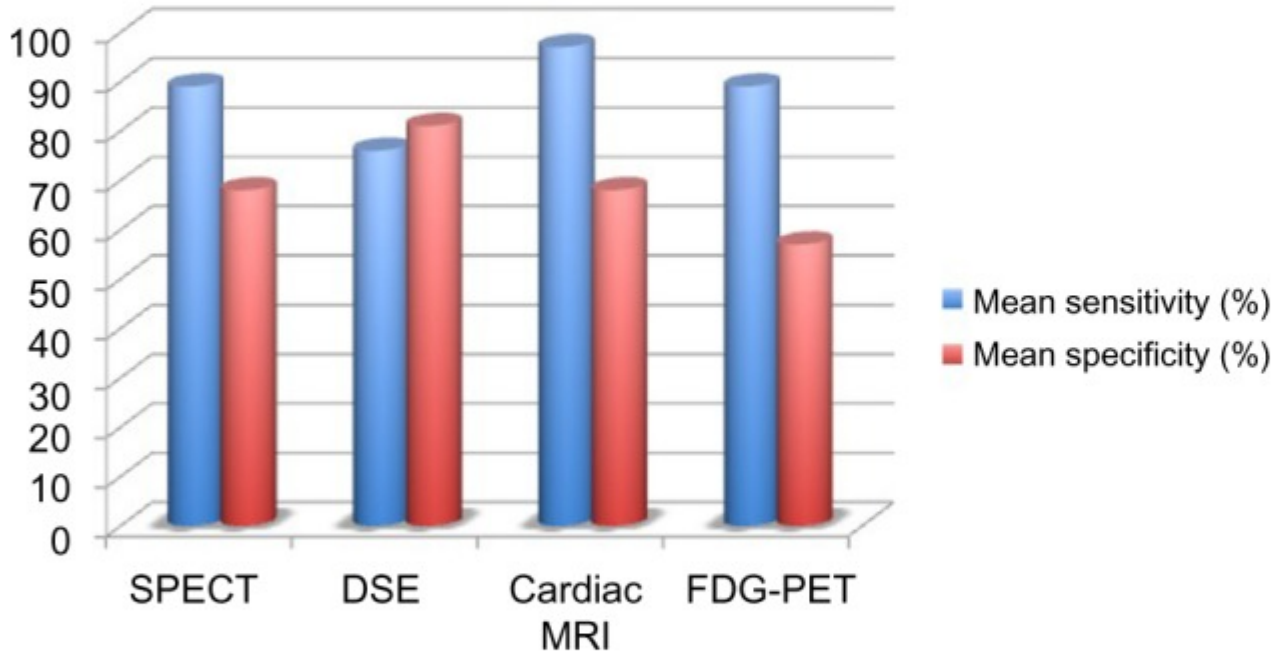
Rosa Sicari[1]*, Petros Nihoyannopoulos[2], Arturo Evangelista[3], Jaroslav Kasprzak[4], Patrizio Lancellotti[5], Don Poldermans[6], Jen-Uwe Voigt[7], and Jose Luis Zamorano[8] on behalf of the European Association of Echocardiography

- Ricerca della vitalità
- Dobutamina a basse dosi con step di 3’
- Dipiridamolo a basse dosi

Clinical Medicine Insights: Cardiology

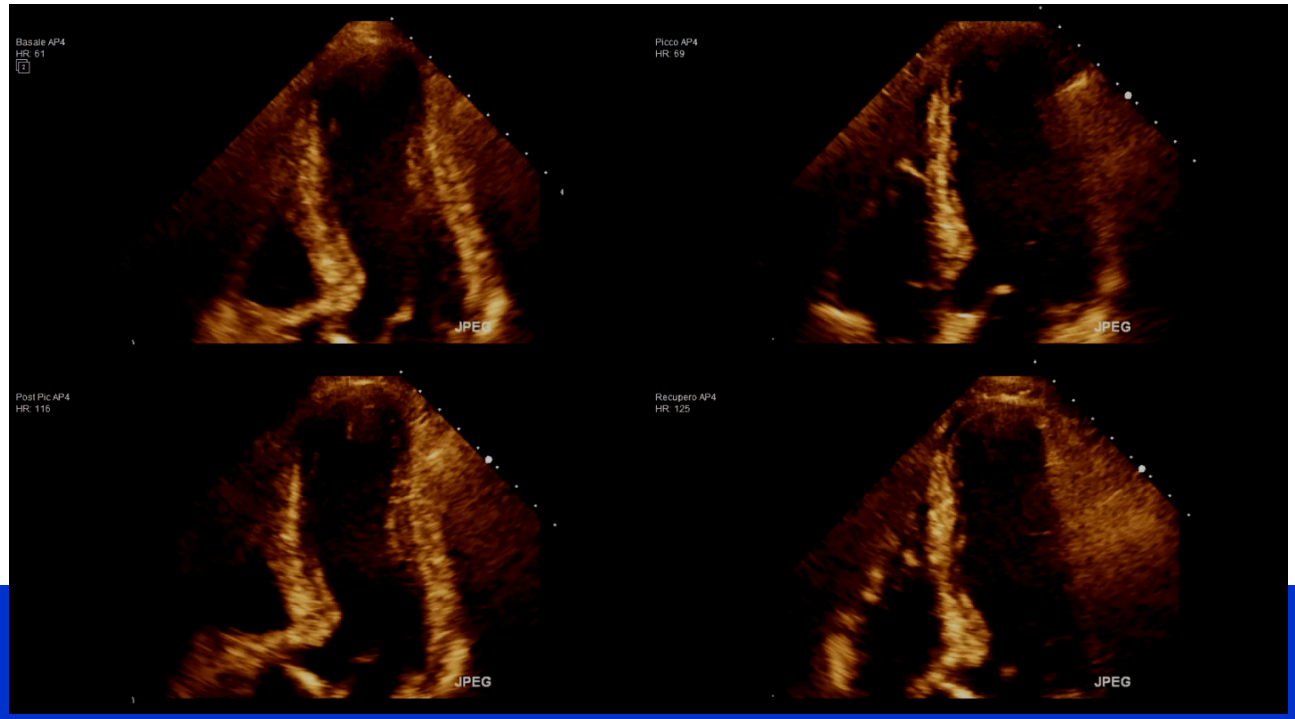
PMC full text: Clin Med Insights Cardiol. 2015; 9(Suppl 1): 105–109.
Published online 2015 Jun 28. doi: 10.4137/CMC.S18755

Figure 1



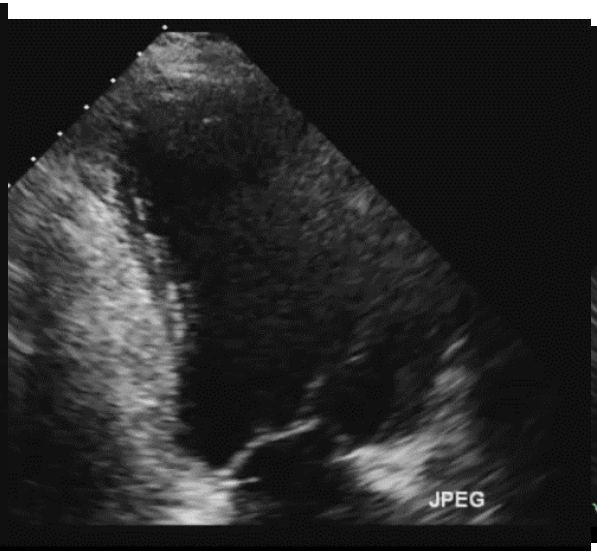
Protocollo dobutamina

- **Differenti possibili risposte:**
- **Risposta bifasica (iniziale miglioramento della cinetica seguito da peggioramento)**
- **Probabile vitalità ed ischemia**

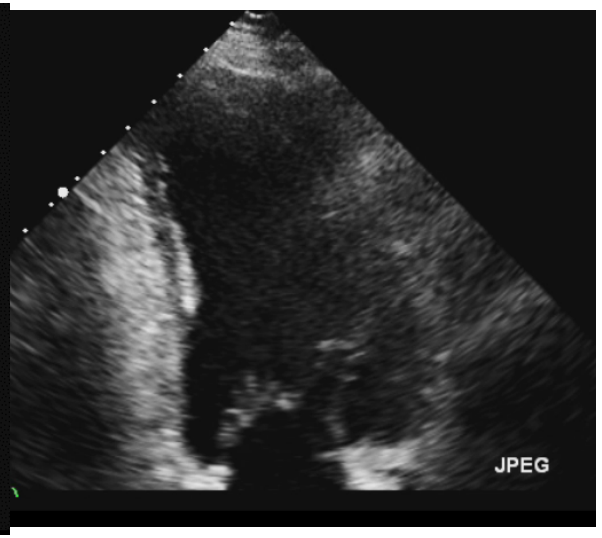


- **Marcato miglioramento**
- **Probabile espressione di necrosi subendocardica**

Basale 3 camere

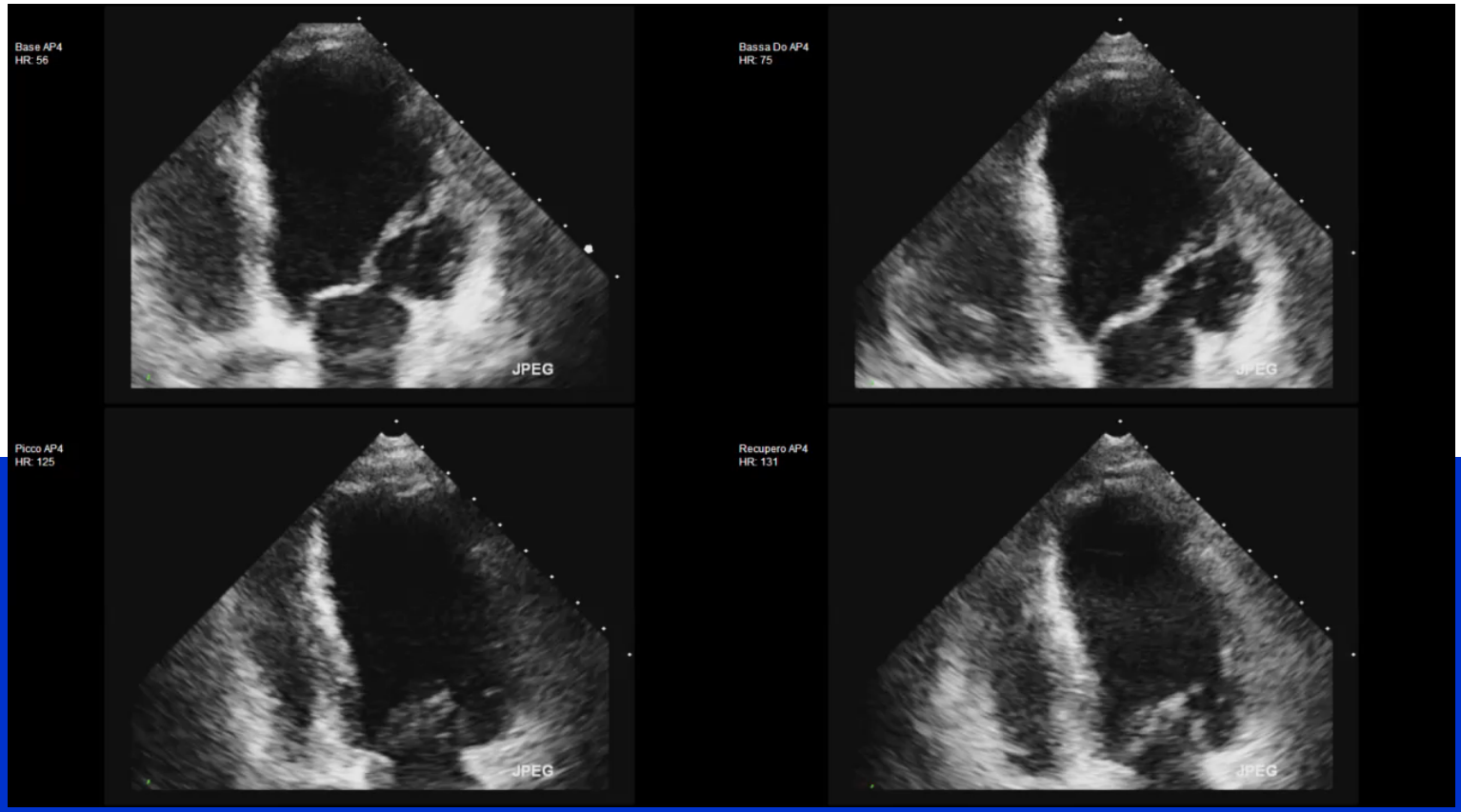


Bassa dose



Picco

- **Nessun miglioramento**
- **Espressione di presenza tessuto cicatriziale transmurale**



INTERVENTIONAL CARDIOLOGY AND SURGERY

Long term prognostic value of myocardial viability and ischaemia during dobutamine stress echocardiography in patients with ischaemic cardiomyopathy undergoing coronary revascularisation

V Rizzello, D Poldermans, A F L Schinkel, E Biagini, E Boersma, A Elhendy, F B Sozzi, A Maat, F Crea, J R T C Roelandt, J J Bax

Heart 2006;92:239–244. doi: 10.1136/hrt.2004.055798

5 segmenti vitali e/o incremento del WMS >25%

Circulation

Extensive Left Ventricular Remodeling Does Not Allow Viable Myocardium to Improve in Left Ventricular Ejection Fraction After Revascularization and Is Associated With Worse Long-Term Prognosis

Jeroen J. Bax, MD; Arend F.L. Schinkel, MD; Eric Boersma, MSc Abdou Elhendy, MD; Vittoria Rizzello, MD; Alexander Maat, MD; Jos R.T.C. Roelandt, MD; Ernst E. van der Wall, MD; Don Poldermans, MD

Background—Extensive left ventricular (LV) remodeling may not allow functional recovery after revascularization, despite the presence of viable myocardium.

Methods and Results—Seventy-nine consecutive patients with ischemic cardiomyopathy (left ventricle ejection fraction [LVEF] 29±7%) underwent surgical revascularization. Before revascularization, viability was assessed by metabolic imaging with F18-fluorodeoxyglucose and SPECT. LV volumes and LVEF were assessed by resting echocardiography. LVEF was re-assessed by echocardiography 8 to 12 months after revascularization. Three-year clinical follow-up (events: cardiac death, infarction, and hospitalization for heart failure) was also obtained. Forty-nine patients had substantial viability; 5 died before re-assessment of LVEF. Of the remaining 44 patients, 24 improved ≥5% in LVEF after revascularization, whereas 20 did not improve in LVEF. LV end-systolic volume was the only parameter that was significantly different between the groups (109±46 mL for the improvers versus 141±31 mL for the nonimprovers; $P<0.05$). The change in LVEF after revascularization was linearly related to the baseline LV end-systolic volume, with a higher LV end-systolic volume associated with a low likelihood of improvement in LVEF after revascularization. During the 3-year follow-up, the highest event-rate (67%) was observed in patients without viable myocardium with a large LV size, whereas the lowest event rate (5%) was observed in patients with viable myocardium and a small LV size. Intermediate event rates were observed in patients with viable myocardium and a large LV size (38%), and in patients without viable myocardium and a small LV size (24%).

Conclusion—Extensive LV remodeling prohibits improvement in LVEF after revascularization and affects long-term prognosis negatively, despite the presence of viability. (*Circulation*. 2004;110[suppl II]:II-18–II-22.)

Key Words: myocardial viability ■ hibernating myocardium ■ heart failure ■ left ventricle remodeling

Importanza del volume ventricolare

Pazienti con LV end-systolic volume >130 ml prognosi peggiore, minore probabilità di incremento di LVEF

Parametri di deformazione nella valutazione di vitalità
Diversi pattern, a seconda del substrato

-Stunning: a riposo ridotto strain e strain rate, presenza di PSS
Dopo dobutamina quasi completa normalizzaione della deformazione sistolica, scomparsa di PSS

-Miocardio Ibernato ed ischemia cronica: iniziale lieve aumento di Strain e strain rate, seguito da riduzione alle alte dosi, con incremento del PSS.

-Infarto non transmurale: riduzione dello strain e strain rate, presenza di PSS

-Infarto transmurale: nessuna deformazione a riposo e durante infusione di dobutamina, comparsa di discinesia

I parametri di deformazione incrementano la sensibilità nell'identificare la vitalità; specificità invariata.

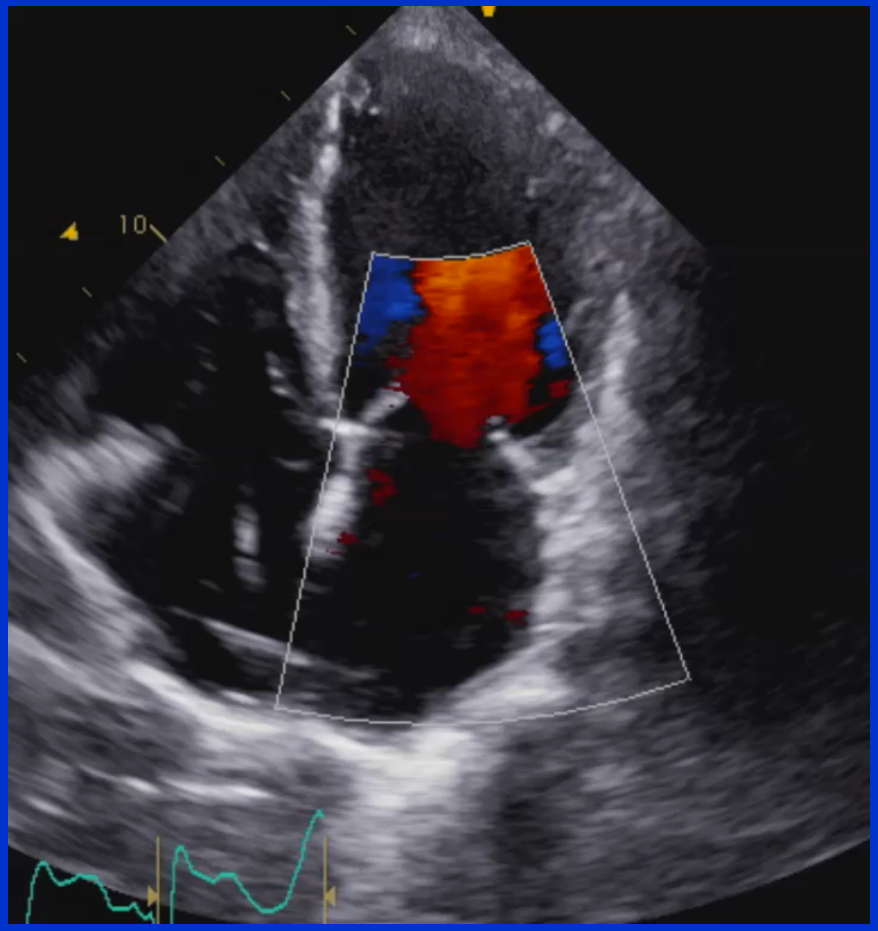
Lo strain circonferenziale basale e a bassa dose di dobutamina predice la ripresa funzionale indipendentemente dalla cinetica parietale; differenzia infarto subendocardico da quello transmurale.

Cardiopatia ischemica cronica

Insufficienza mitralica secondaria

Presente in circa il 50% dei pazienti dopo IMA

17% sviluppa moderata/severa insufficienza mitralica secondaria



LINEE GUIDA

Linee guida per il trattamento delle valvulopatie (versione 2012)

Task Force congiunta per il Trattamento delle Valvulopatie della Società Europea di Cardiologia (ESC) e dell'Associazione Europea di Chirurgia Cardiotoracica (EACTS)

Autori/Membri della Task Force

Alec Vahanian (Chairperson) (Francia), Ottavio Alfieri (Chairperson) (Italia), Felicita Andreotti (Italia), Manuel J. Antunes (Portogallo), Gonzalo Barón-Esquivias (Spagna), Helmut Baumgartner (Germania), Michael Andrew Borger (Germania), Thierry P. Carrel (Svizzera), Michele De Bonis (Italia), Arturo Evangelista (Spagna), Volkmar Falk (Svizzera), Bernard Iung (Francia), Patrizio Lancellotti (Belgio), Luc Pierard (Belgio), Susanna Price (UK), Hans-Joachim Schäfers (Germania), Gerhard Schuler (Germania), Janina Stepinska (Polonia), Karl Swedberg (Svezia), Johanna Takkenberg (Olanda), Ulrich Otto Von Oppell (UK), Stephan Windecker (Svizzera), Jose Luis Zamorano (Spagna), Marian Zembala (Polonia)

Importance of Ischemic and Viable Myocardium for Patients With Chronic Ischemic Mitral Regurgitation and Left Ventricular Dysfunction

Min Pu, MD, James D. Thomas, MD, Marc A. Gillinov, MD, Brian P. Griffin, MD, and Richard C. Brunken, MD

The objective of this investigation is to determine the importance of ischemic viable myocardium for clinical outcomes in patients with severe chronic ischemic mitral regurgitation and severe left ventricular dysfunction undergoing surgical correction of mitral regurgitation. The study included 54 patients with left ventricular ejection fraction of 27 ± 9%. Positron emission tomography was performed preoperatively for the identification of ischemic viable myocardium. The patients with a large amount of ischemic viable myocardium (≥5 segments) had significantly lower 6-month mortality rates than those with less viable myocardium (0 to 4 segments) after the surgery.
(Am J Cardiol 2003;92:862–864)

and mitral valve repair or replacement. The exclusion criteria were intrinsic mitral valve disease, moderate or severe aortic stenosis, and acute MR secondary to acute myocardial infarction. A total of 54 patients fulfilled the enrollment criteria. Dipyridamole stress and rubidium-82 perfusion at rest and F-18-2-fluoro-2-deoxyglucose metabolic PET images were acquired with a Posicam scanner (Positron, Houston, Texas). A reversible perfusion defect (ischemia) was defined by an improvement in relative tracer concentration of ≥15% from the stress to the images at rest. Myocardial hibernation was defined as increased uptake of the F-18-2-fluoro-2-deoxy-glucose tracer concentration to ≥15%. Myocardial scarring was defined as a concordant decrease in rubidium-82 perfusion and F-18-2-

Prognosi migliore dei soggetti con significativa vitalità (>5 segmenti) sottoposti a CABP e correzione di severa IM secondaria.

2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

Recommendations for Secondary MR Intervention			
COR	**LOE**	**Recommendations**	**Comment/Rationale**
IIa	**C**	**Mitral valve surgery is reasonable for patients with chronic severe secondary MR (stages C and D) who are undergoing CABG or AVR.**	2014 recommendation remains current.
IIa See Online Data Supplement 18. (Updated From 2014 VHD Guideline)	**B-R**	**It is reasonable to choose chordal-sparing MVR over downsized annuloplasty repair if operation is considered for severely symptomatic patients (NYHA class III to IV) with chronic severe ischemic MR (stage D) and persistent symptoms despite GDMT for HF (69,70,125,127,130-139).**	**NEW:** An RCT has shown that mitral valve repair is associated with a higher rate of recurrence of moderate or severe MR than that associated with mitral valve replacement (MVR) in patients with severe, symptomatic, ischemic MR, without a difference in mortality rate at 2 years' follow-up.
In an RCT of mitral valve repair versus MVR in 251 patients with severe ischemic MR, mortality rate at 2 years was 19.0% in the repair group and 23.2% in the replacement group (p=0.39) (70). There was no difference between repair and MVR in LV remodeling. The rate of recurrence of moderate or severe MR over 2 years was higher in the repair group than in the replacement group (58.8% versus 3.8%, p<0.001), leading to a higher incidence of HF and repeat hospitalizations in the repair group (70). The high mortality rate at 2 years in both groups emphasizes the poor prognosis of secondary MR. The lack of apparent benefit of valve repair over valve replacement in secondary MR versus primary MR highlights that primary and secondary MR are 2 different diseases (69,125,127,130-139).			
IIb	**B**	**Mitral valve repair or replacement may be considered for severely symptomatic patients (NYHA class III to IV) with chronic severe secondary MR (stage D) who have persistent symptoms despite optimal GDMT for HF (125,127,130-140).**	2014 recommendation remains current.
IIb See Online Data Supplement 18 (Updated From 2014 VHD Guideline)	**B-R**	**In patients with chronic, moderate, ischemic MR (stage B) undergoing CABG, the usefulness of mitral valve repair is uncertain (71,72).**	**MODIFIED: LOE updated from C to B-R.** The 2014 recommendation supported mitral valve repair in this group of patients. An RCT showed no clinical benefit of mitral repair in this population of patients, with increased risk of postoperative complications.
In an RCT of 301 patients with moderate ischemic MR undergoing CABG, mortality rate at 2 years was 10.6% in the group undergoing CABG alone and 10.0% in the group undergoing CABG plus mitral valve repair (HR in the combined-procedure group = 0.90; 95% CI: 0.45 to 1.83; p=0.78) (71). There was a higher rate of moderate or severe residual MR in the CABG-alone group (32.3% versus 11.2%; p<0.001), even though LV reverse remodeling was similar in both groups (71). Although rates of hospital readmission and overall serious adverse events were similar in the 2 groups, neurological events and			

supraventricular arrhythmias were more frequent with combined CABG and mitral valve repair. Thus, only weak evidence to support mitral repair for moderate secondary MR at the time of other cardiac surgery is currently available (71,72).			

Insufficienza mitralica secondaria

Indicazioni all'eco da stress

1) **Pazienti con dispnea da sforzo incongrua con la severità della disfunzione ventricolare a riposo ed il grado di rigurgito mitralico**

2) Pazienti con episodi di edema polmonare non giustificato

3) Pazienti con rigurgito mitralico moderato prima della rivascolarizzazione

LINEE GUIDA

Linee guida per il trattamento delle valvulopatie (versione 2012)

Task Force congiunta per il Trattamento delle Valvulopatie della Società Europea di Cardiologia (ESC) e dell'Associazione Europea di Chirurgia Cardiotoracica (EACTS)

Autori/Membri della Task Force

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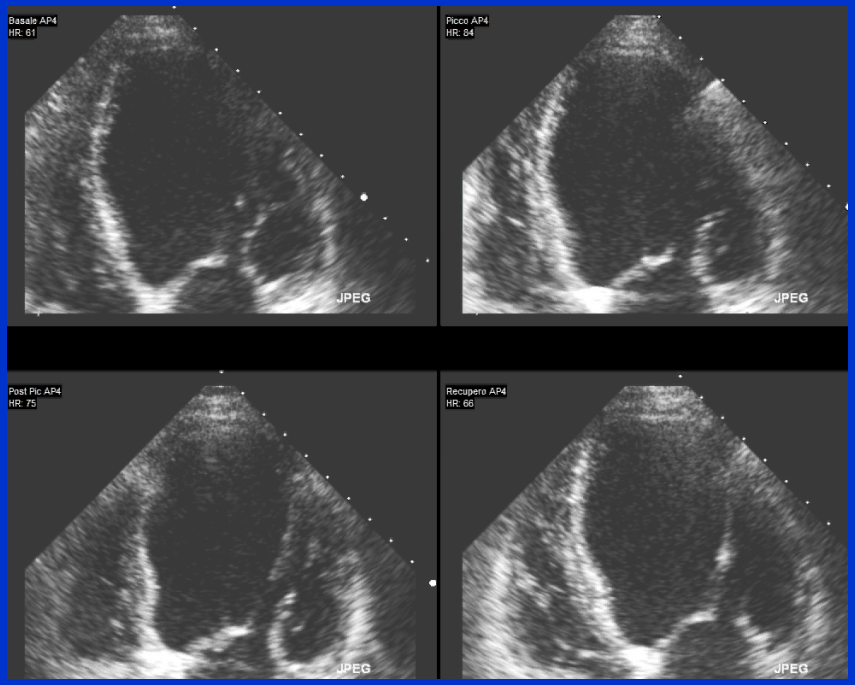
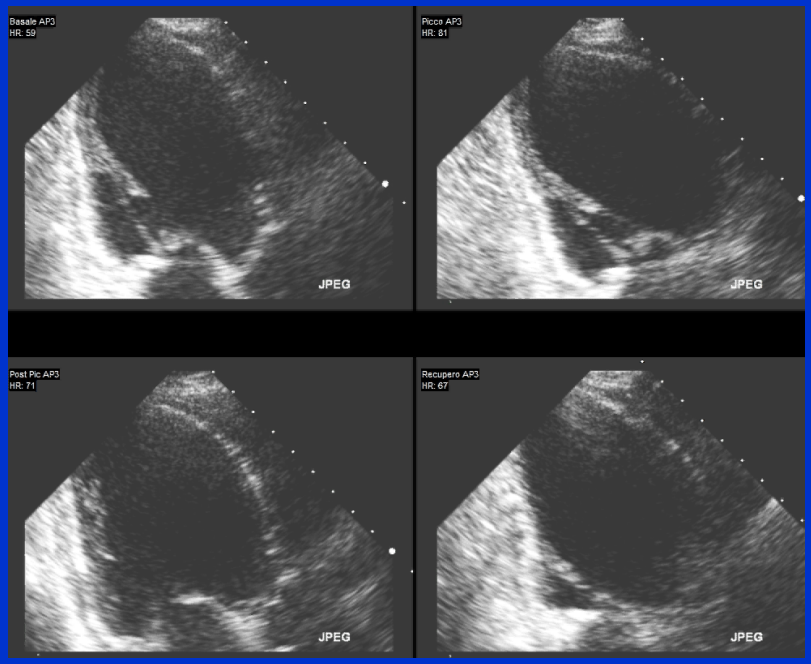
Il trattamento dell'IM ischemica moderata nei pazienti candidati ad intervento di CABG è fonte di continuo dibattito. In questi casi, è preferibile procedere alla riparazione valvolare. Nei pazienti con ridotta FEVS, la chirurgia valvolare mitralica sarà più facilmente presa in considerazione qualora si riscontri la presenza di miocardio vitale e una bassa comorbilità. Nei pazienti in grado di effettuare la prova da sforzo, ogniqualvolta possibile deve essere presa in considerazione l'ecocardiografia da sforzo. L'insorgenza di dispnea da sforzo ed un considerevole aumento del grado di severità dell'IM e della pressione sistolica polmonare contribuiscono a favorire l'indicazione all'intervento associato.

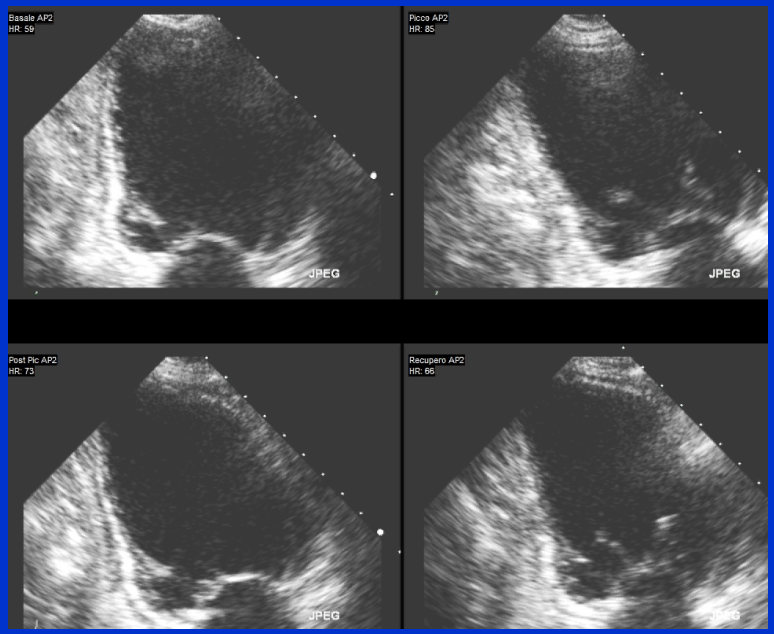
Non vi sono evidenze a supporto della correzione chirurgica dell'IM lieve.



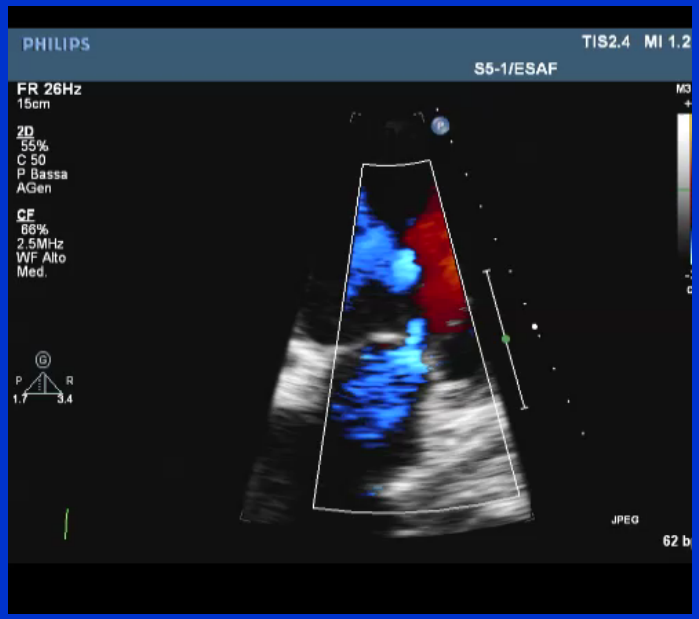


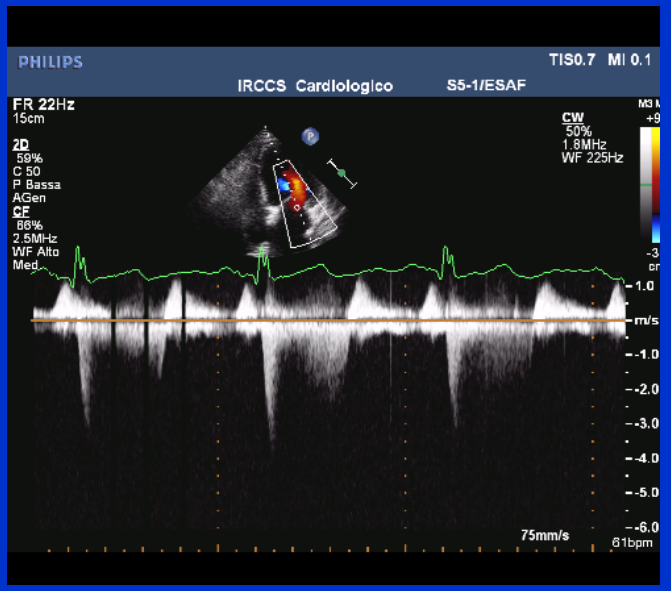
Donna di anni 64
CAD dilatativa, frequenti EPA

Esame interrotto a 1’ a 50 watts

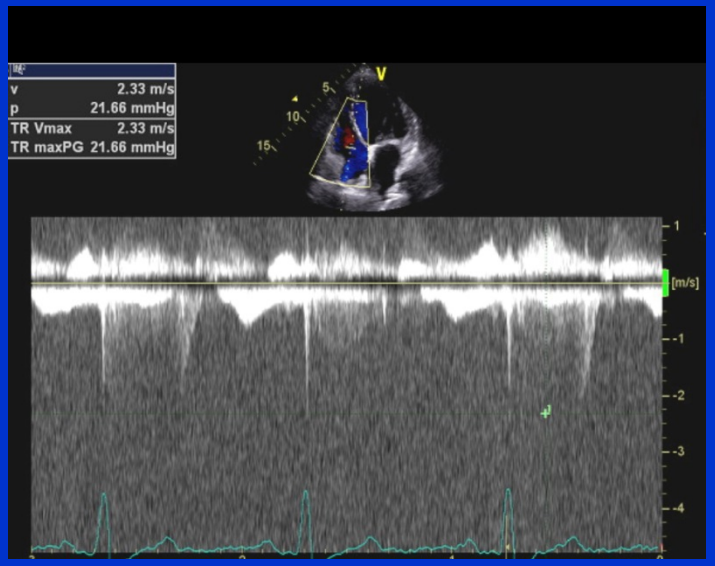


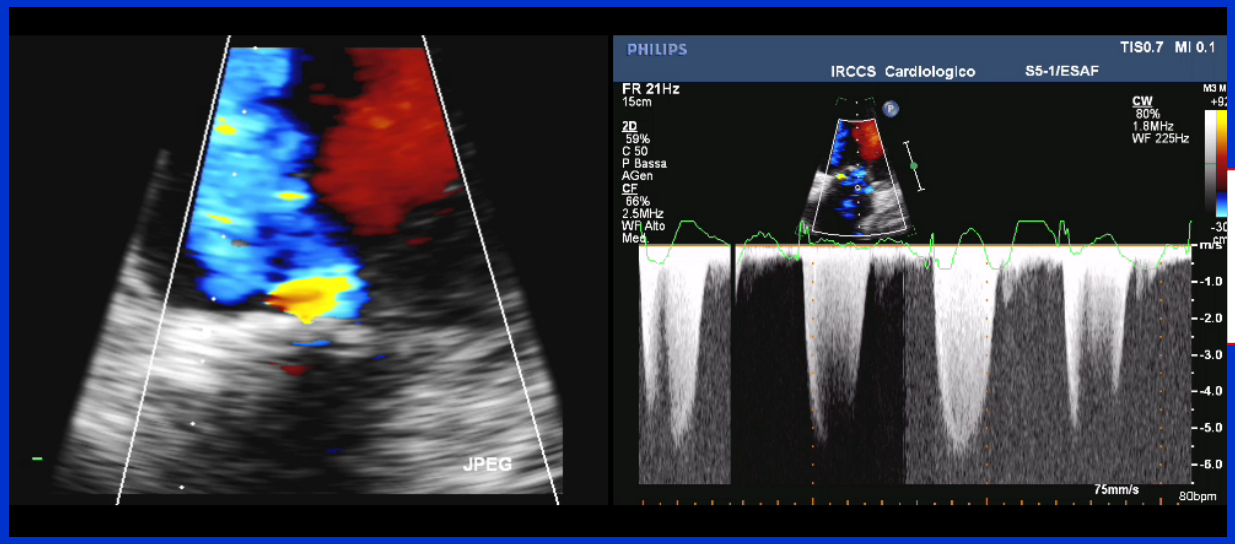
Ecocardiogramma basale





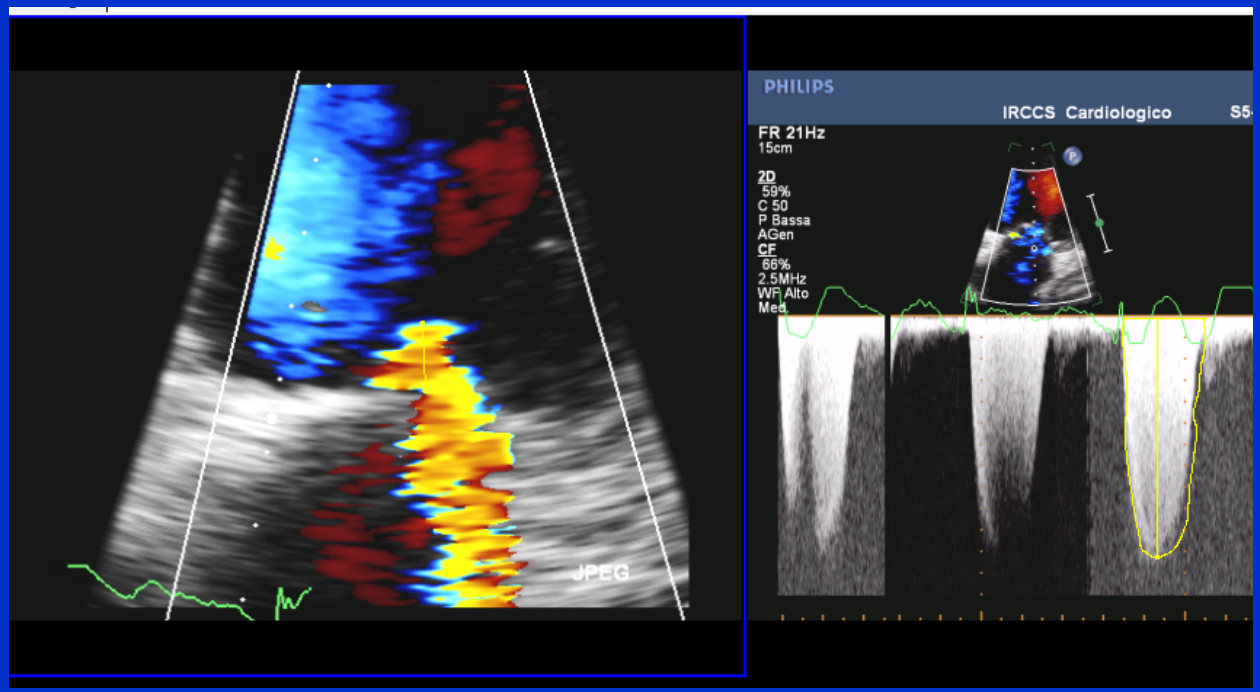
EROA 0,18 cm2
PAPs 27mm Hg

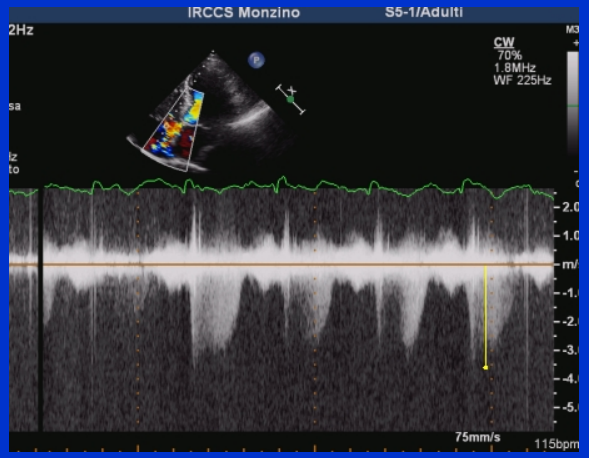




EROA 0,38 cm2

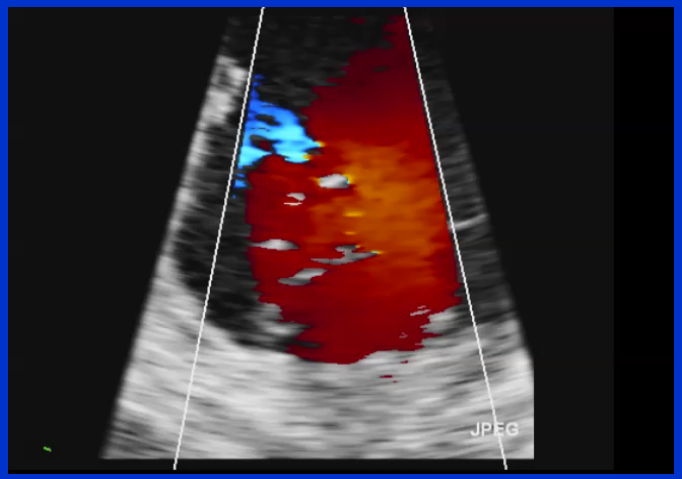
PAPs 60 mm HG

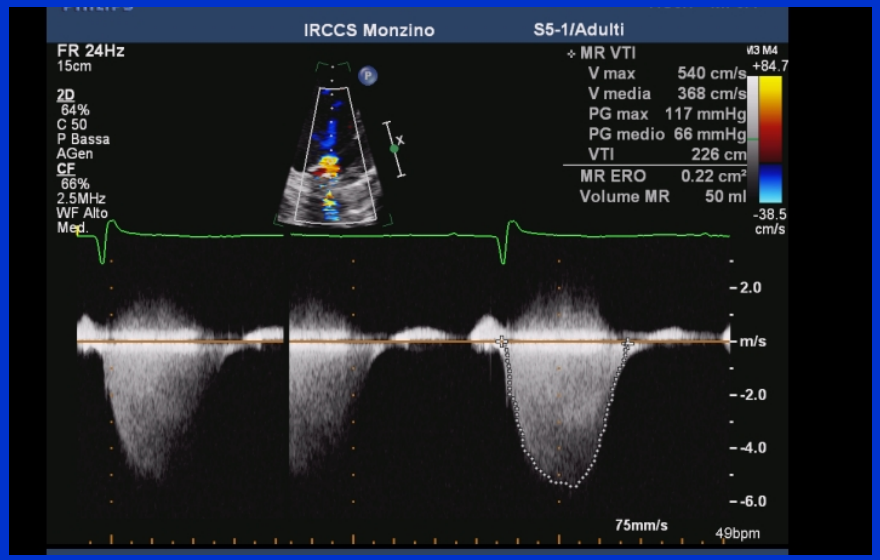


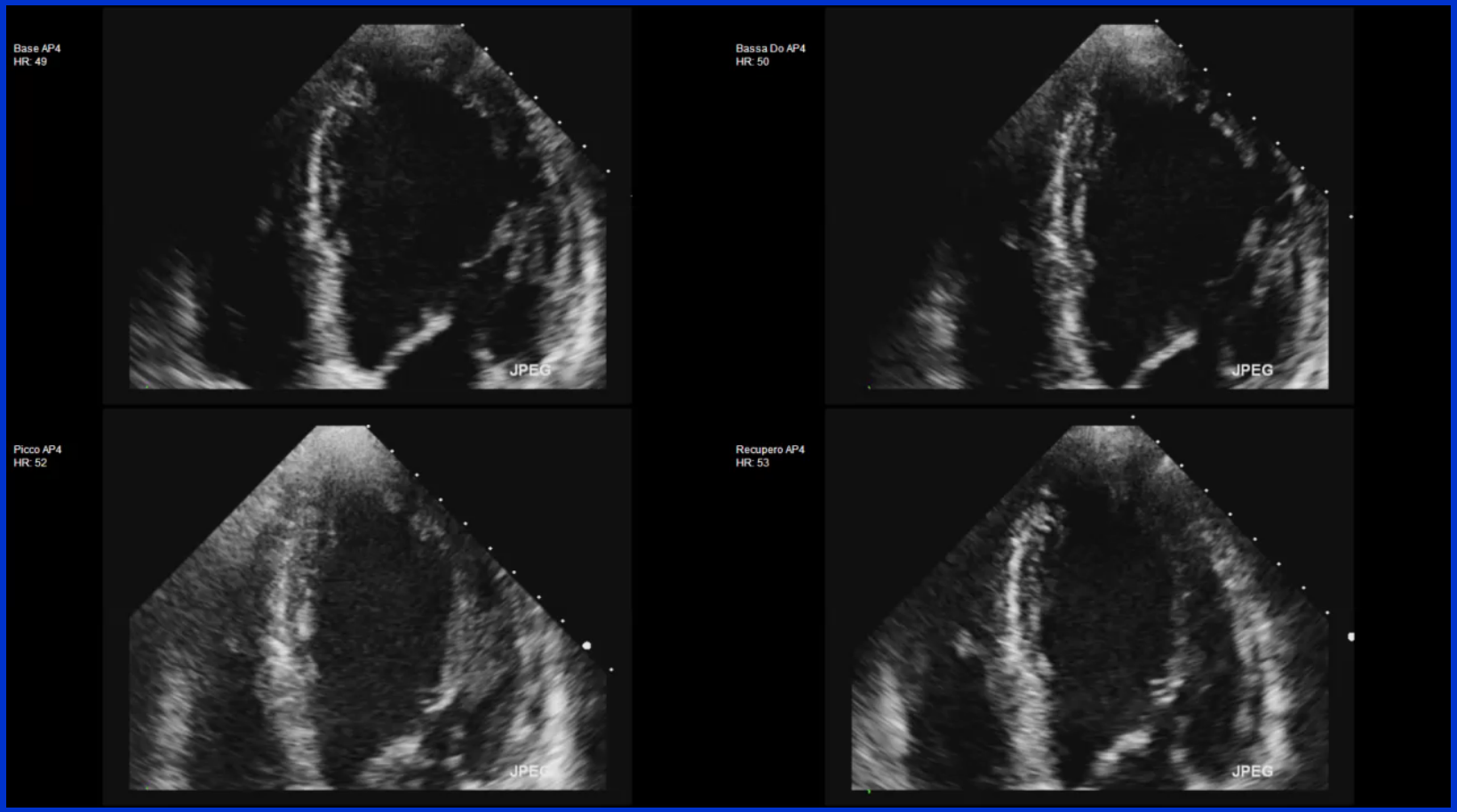


Paziente di anni 63

Pregresso IMA inferiore e by-pass aorto-coronarico.
Volumi basali 180/127, FE 29%



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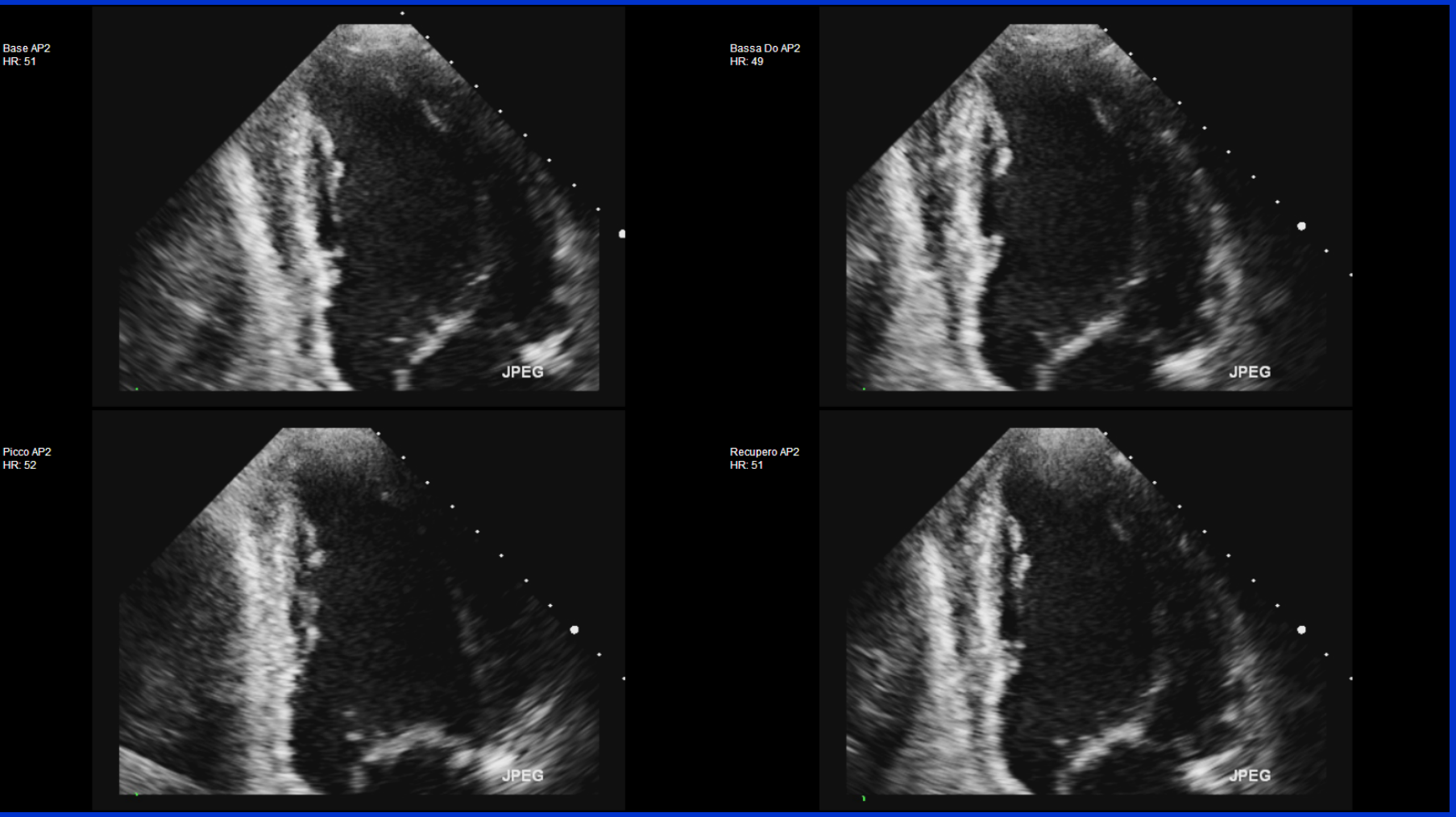
JPEG
Bassa Do AP4
HR: 50
JPEG
Picco AP4
HR: 52
Recupero AP4
HR: 53
JPEG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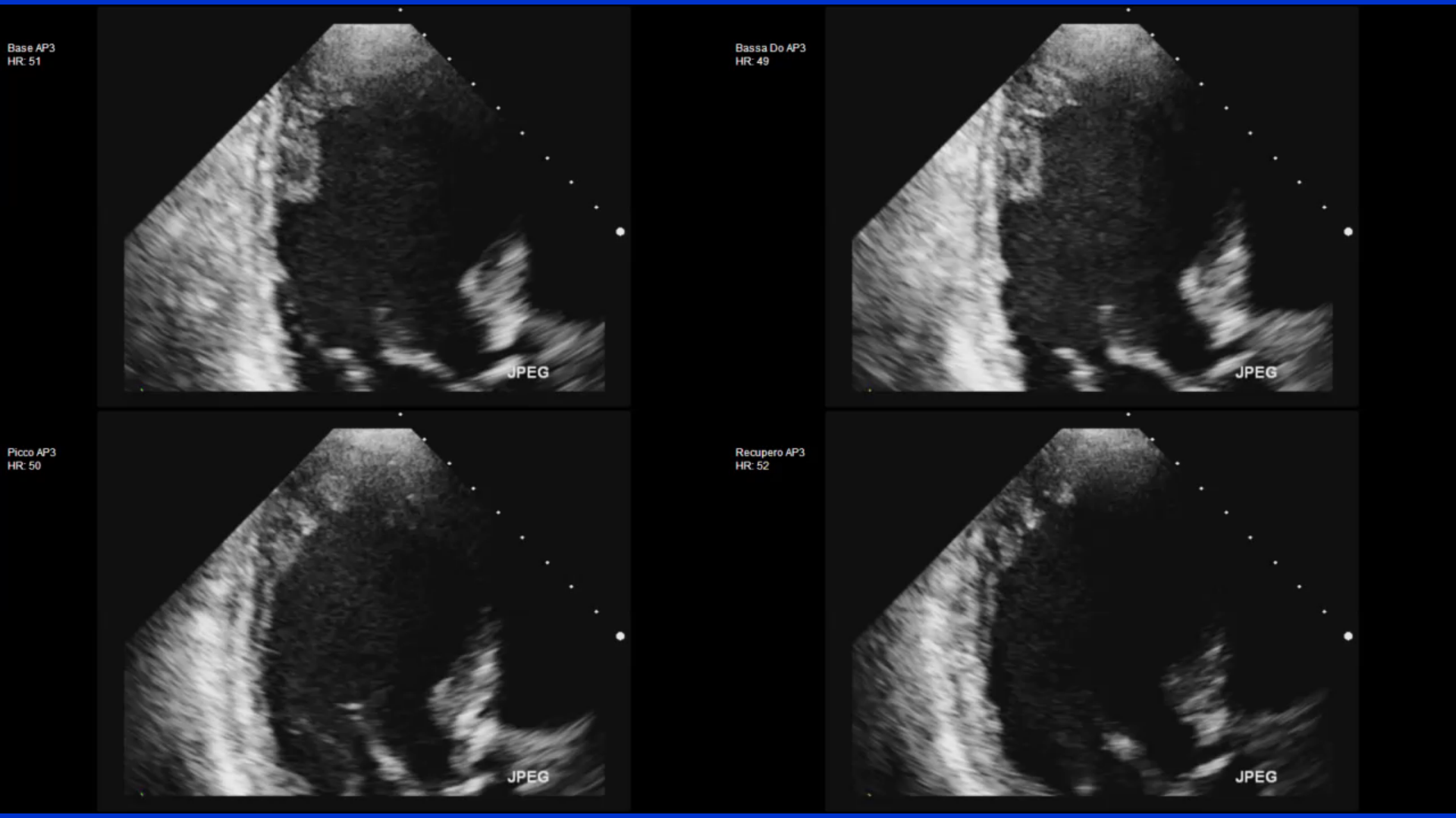
HR: 51
JPEG
Bassa Do AP2
HR: 49
JPEG
Picco AP2
HR: 52
JPEG
Recupero AP2
HR: 51
JPEG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HR: 50
JPEG
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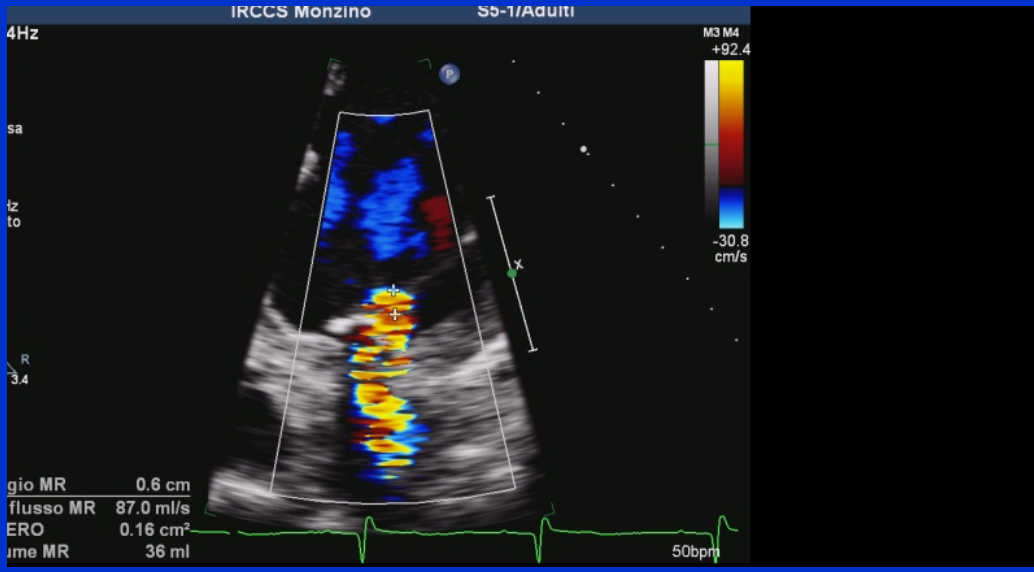
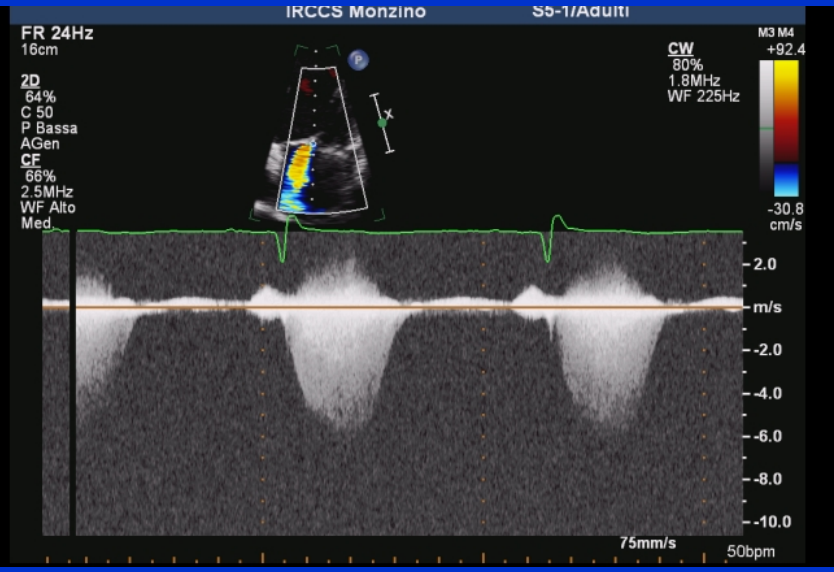
HR: 52
JPEG

Picco


IRCCS Monzino
S5-1/Adulti
4Hz
M3 M4
+92.4
-30.8
cm/s
gio MR 0.6 cm
flusso MR 87.0 ml/s
ERO 0.16 cm²
ume MR 36 ml
50bpm


IRCCS Monzino
S5-1/Adulti
FR 24Hz
16cm
2D
64%
C 50
P Bassa
AGen
CF
66%
2.5MHz
WF Alto
Med
CW
80%
1.8MHz
WF 225Hz
M3 M4
+92.4
-30.8
cm/s
2.0
m/s
-2.0
-4.0
-6.0
-8.0
-10.0
75mm/s
50bpm

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Centre for Reviews and Dissemination

NHS
National Institute for
Health Research

A meta-analytic comparison of echocardiographic stressors

Noguchi Y, Nagata-Kobayashi S, Stahl J E, Wong J B

Authors' conclusions

The authors conclude that Tap-TEE is a very accurate test for both ruling in and ruling out CAD, although its invasiveness may limit its clinical acceptability. Exercise is a well-balanced satisfactory test for both ruling in and ruling out CAD, but performance might be lower in the elderly. Dobutamine offers a reasonable compromise to exercise. Dipyridamole might be good for ruling in but not for ruling out CAD. Adenosine was the least useful stressor in diagnosing CAD.

Attrezzatura del laboratorio
Esperienza dell'operatore
Caratteristiche del paziente

Nel nostro laboratorio:

1700 esami/anno
> 95% test con esercizio

Impossibilità all'esercizio
Controindicazione esercizio (es aneurisma aortico)
Scarsa qualità della finestra acustica