

Napoli 17 aprile 2015



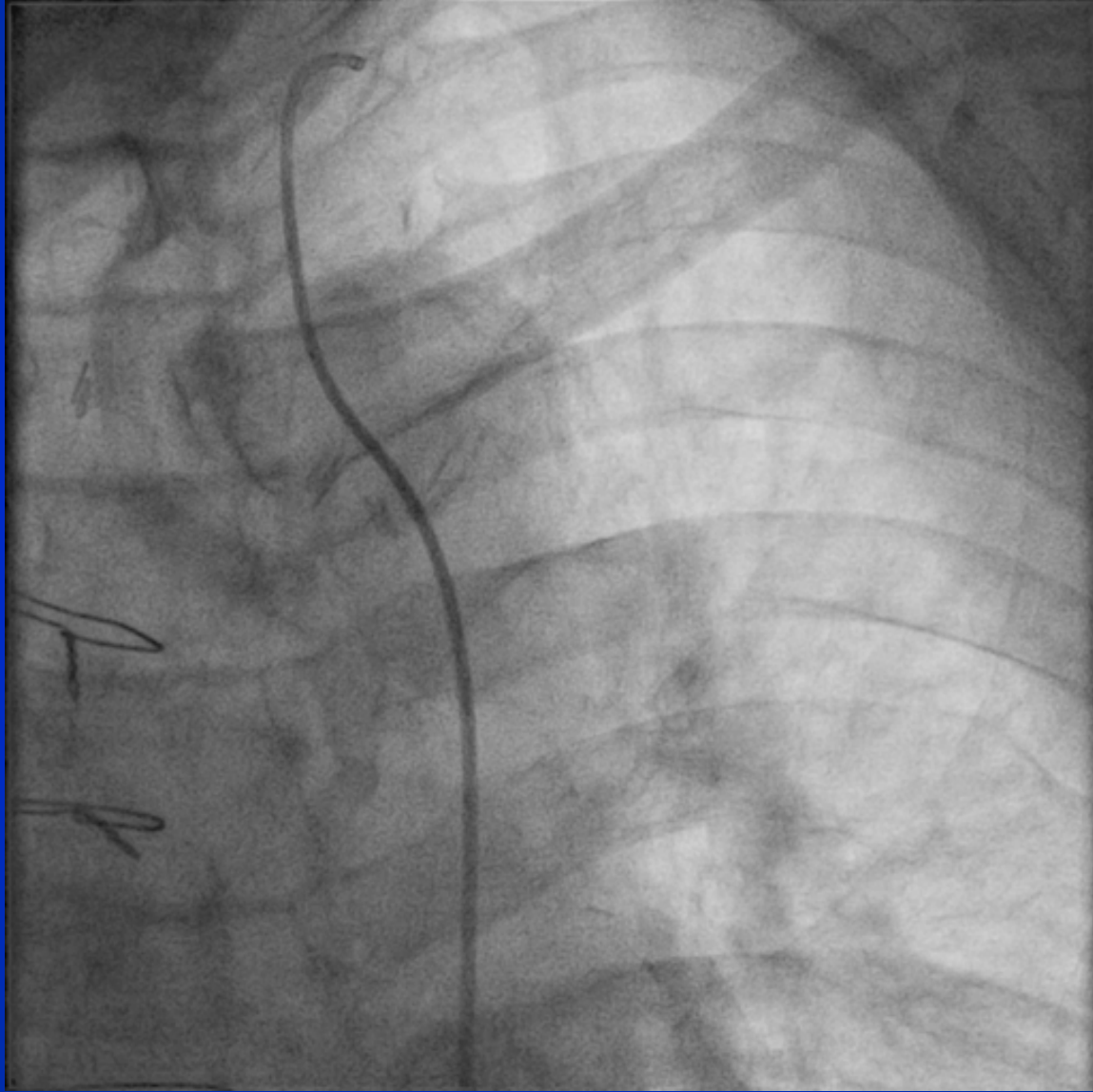
Società Italiana di Ecografia Cardiovascolare  
[WWW.SIEC.IT](http://WWW.SIEC.IT)



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

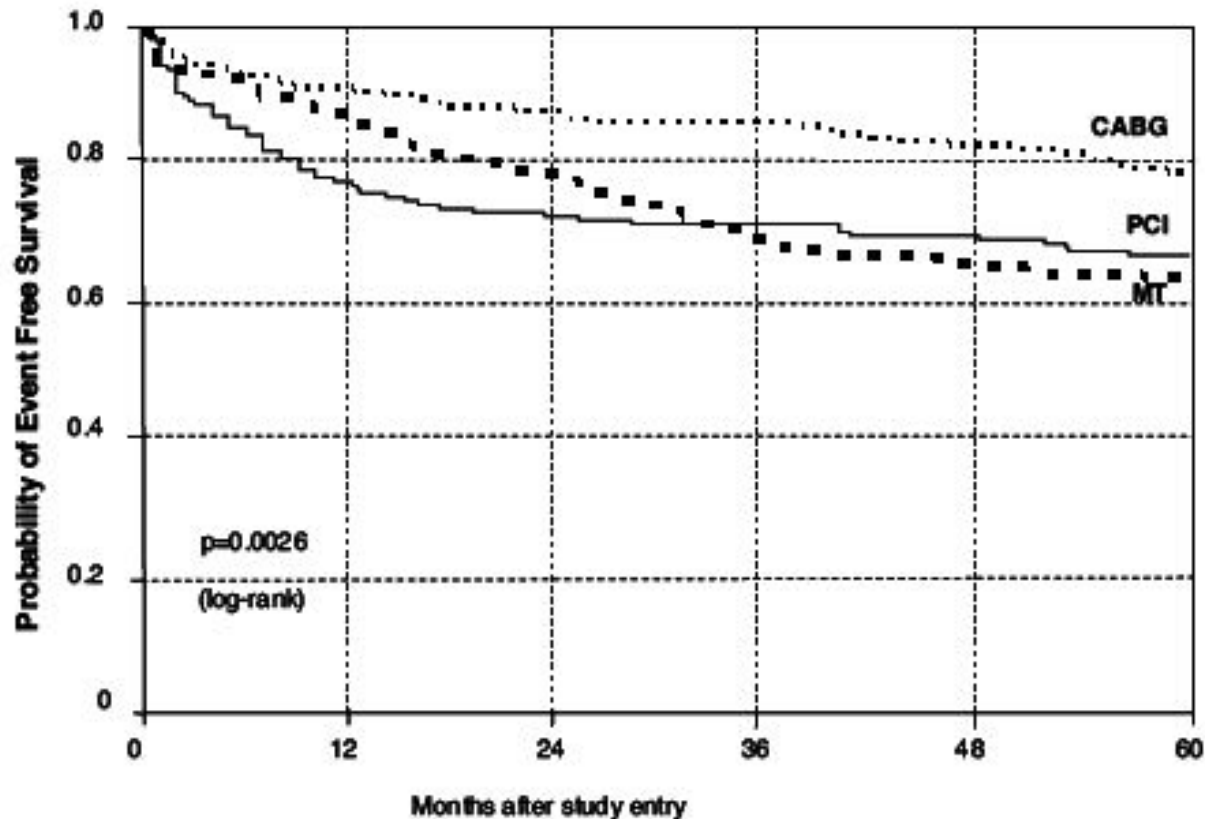
# Ecostream, perfusione e riserva coronarica: quando e quale?

Francesco Bartolomucci MD, Ph.D, FESC



**MASS II:** 611 pz con angina, con coronaropatia multivasale , e funz. ventricolare sn conservata , randomizzati a **CABG PCI TERAPIA MEDICA** (no pz con malattia del TC)

**ENDPOINT PRIMARIO:** mortalità totale, infarto Q, angina refrattaria con necessità di rivascolarizzazione



2007

*OMT vs  
PCI vs  
CABG*

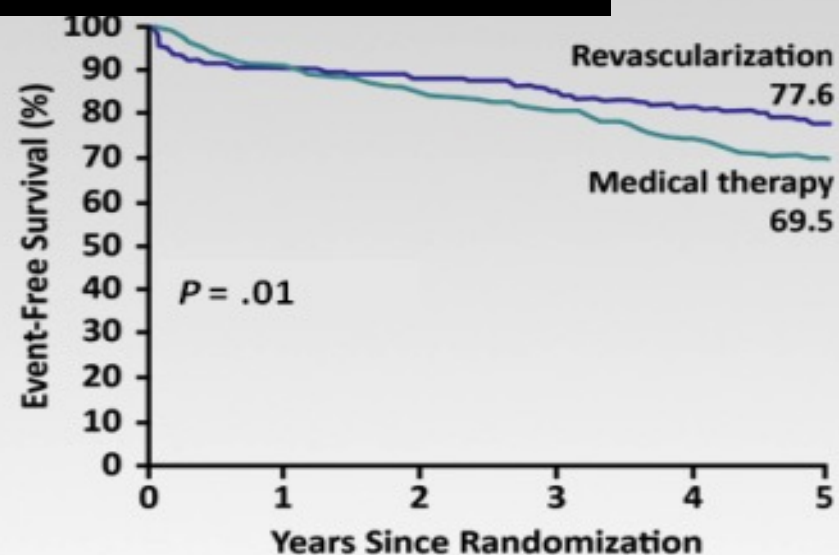
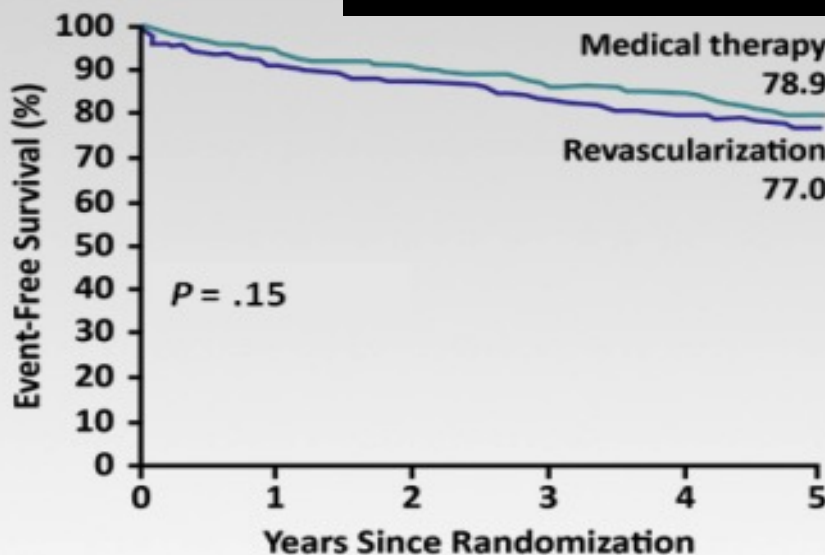
ENDPOINT COMPOSITO CABG (21.2%) – PCI (32.7%) – MT (36%)

NECESSITA' DI RIVASCOLARIZZAZIONE ADDIZIONALE: CABG (3.5%) – PCI (32.2%) – MT (24.2%)

# BARI 2D: Death, MI, Stroke— Medical Therapy vs Type of Revascularization

PCI

**moderna TERAPIA MEDICA è altrettanto efficace della RIVASCOLARIZZAZIONE**



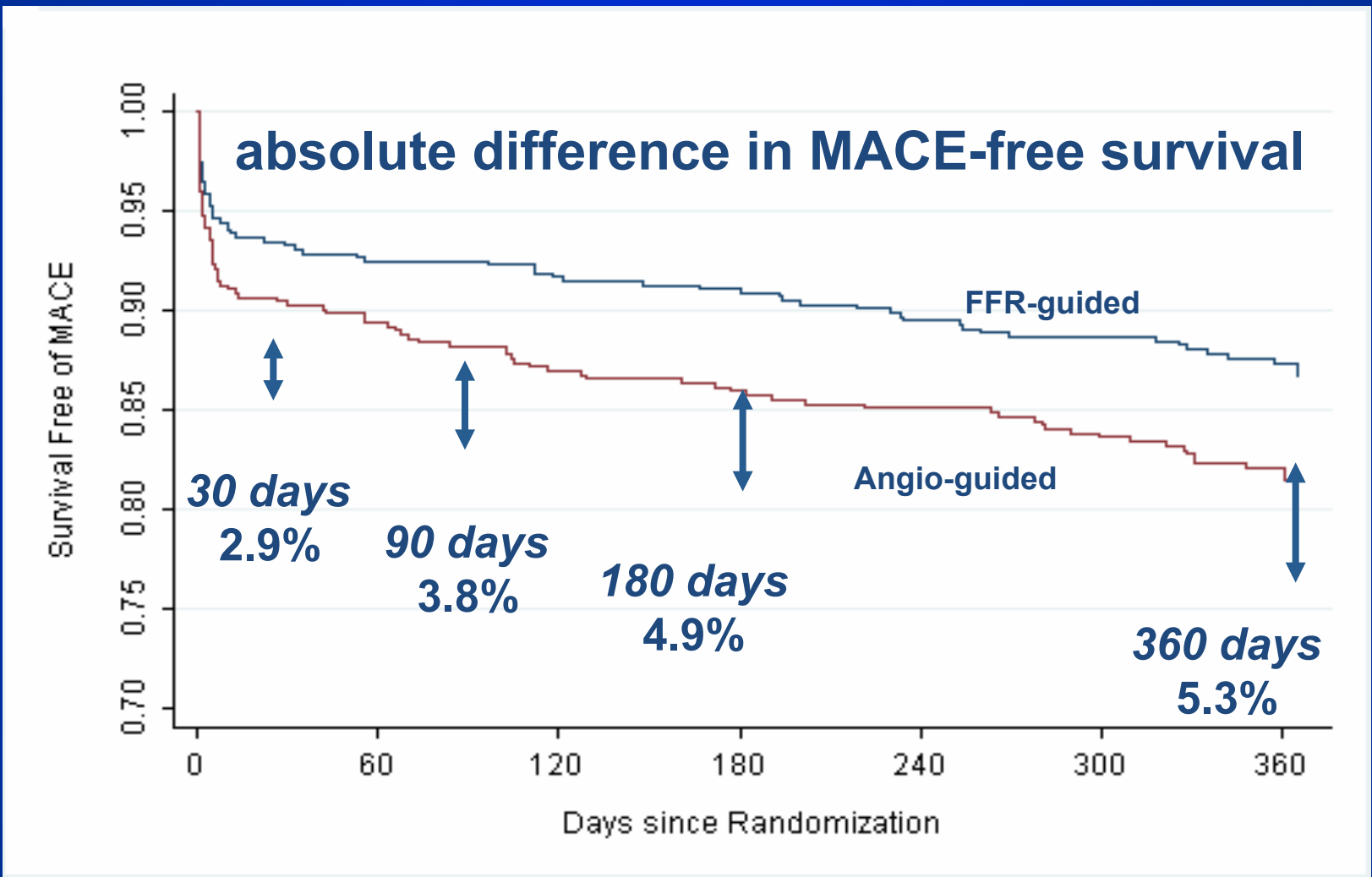
Si può dire che la CABG, (nel gruppo “RIVASCOLARIZZAZIONE”) dimostra una minore incidenza di eventi cardiovascolari e che la RIVASCOLARIZZAZIONE, in generale” rispetto alla TERAPIA MEDICA determina un miglioramento della sintomatologia.

Ma il messaggio forte del BARI-2D è che:

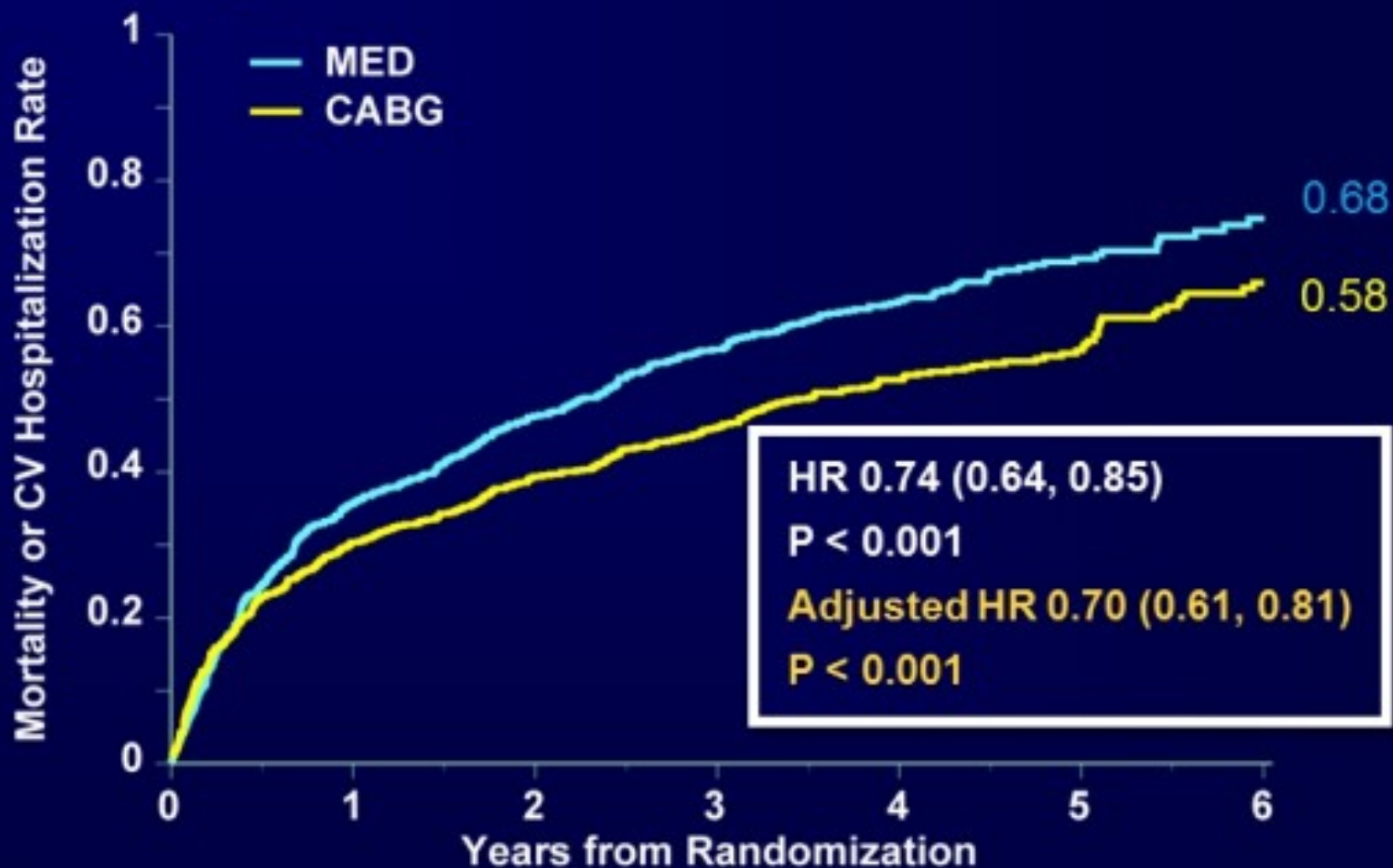
**2009**

**Nei pz diabetici con malattia coronarica complessa la**

# FAME II study: Event-free Survival

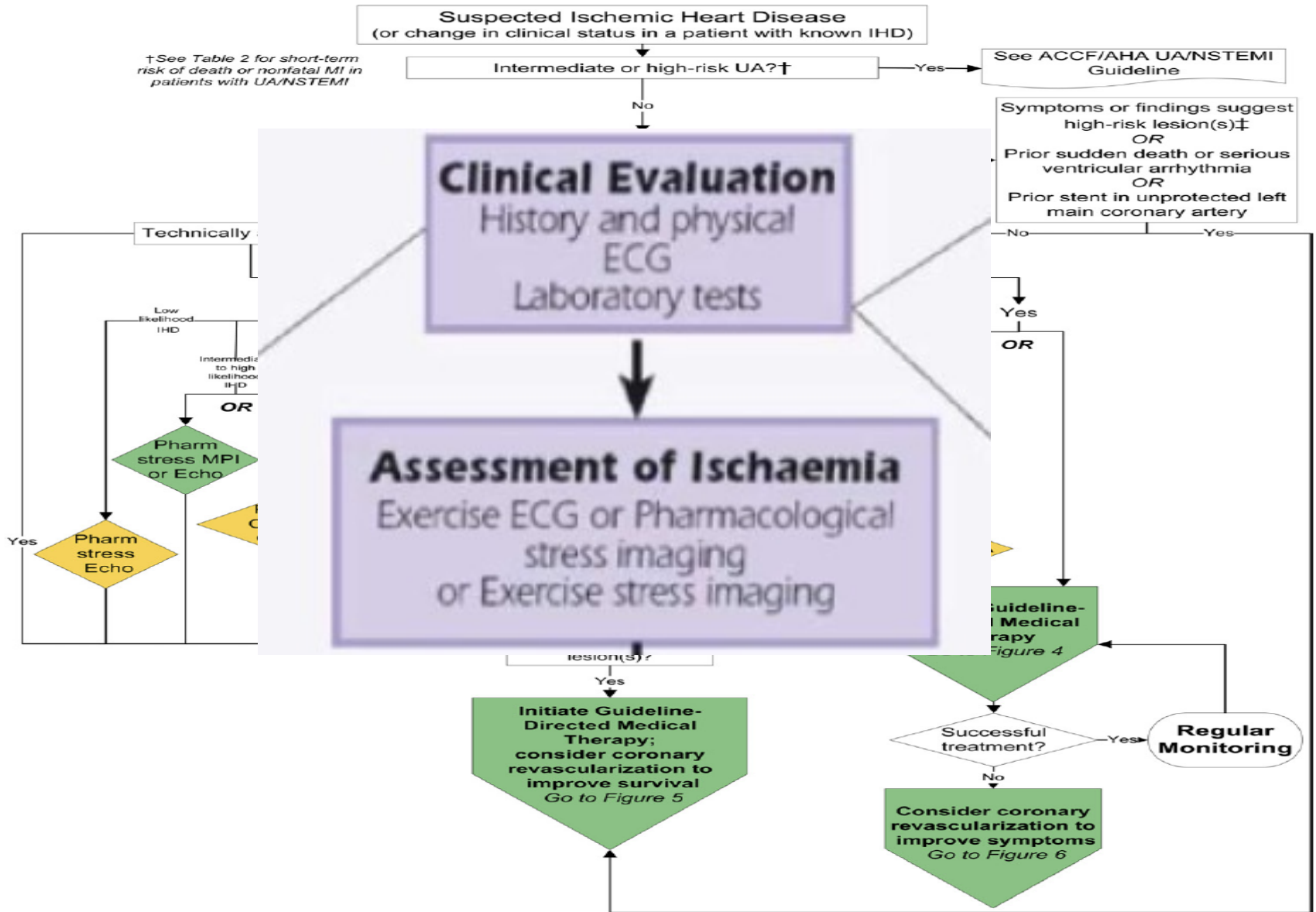


# Death or Cardiovascular Hospitalization — As Randomized



MED	602	387	315	260	158	65	28
CABG	610	431	375	334	221	100	43

# Stable angina



Qual'è il processo decisionale in base alla gravità dei sintomi / ischemia?

## 2013 ESC guidelines on the management of stable coronary artery disease

**Severe:** Angina CCS III–IV or ischaemia >10% ➡ catheterization laboratory.

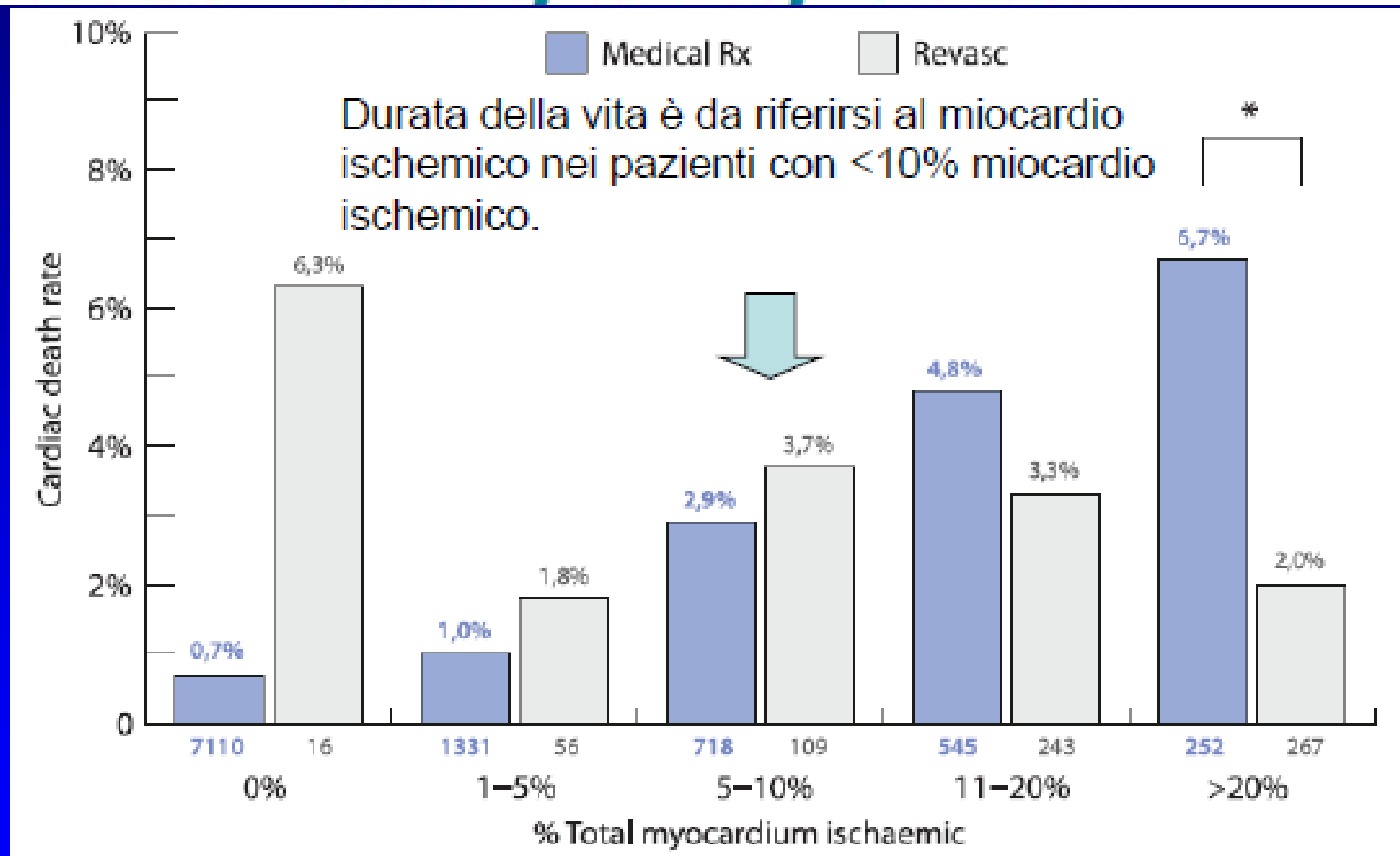
**Moderate-to-severe:** Angina CCS II or ischaemia 5–10% ➡ OMT<sup>a</sup> only or catheterization laboratory.

**Mild-to-moderate:** Angina CCS I or ischaemia <5% ➡ OMT<sup>a</sup> first and defer catheterization laboratory. → **Prima terapia medica e rinviare coro !**

<sup>a</sup>If symptoms and/or ischaemia are markedly reduced/eliminated by OMT, then OMT may be continued; if not, catheterization should follow. CCS = Canadian Cardiovascular Society; OMT = optimal medical therapy.



# 2013 ESC guidelines on the management of stable coronary artery disease



**Figure W2** Relationship between cardiac mortality and extent of myocardial ischaemia, depending on type of therapy.<sup>45</sup> Numbers below columns indicate numbers of patients in each group. \* $P < 0.02$ . Medical Rx = medical therapy; Revasc = revascularization.

# 2014 ESC/EACTS Guidelines on myocardial revascularization

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>	Ref <sup>c</sup>
<b>Asymptomatic patients</b>			
Early imaging testing should be considered in specific patient subsets. <sup>d</sup>	IIa	C	
Routine stress testing may be considered >2 years after PCI and >5 years after CABG.	IIb	C	
After high-risk PCI (e.g. unprotected LM stenosis) late (3–12 months) control angiography may be considered, irrespective of symptoms.	IIb	C	
<b>Symptomatic patients</b>			
It is recommended to reinforce medical therapy and lifestyle changes in patients with low-risk findings <sup>d</sup> at stress testing.	I	C	
With intermediate- to high-risk findings <sup>e</sup> at stress testing, coronary angiography is recommended.	I	C	

<sup>a</sup>Class of recommendation.

<sup>b</sup>Level of evidence.

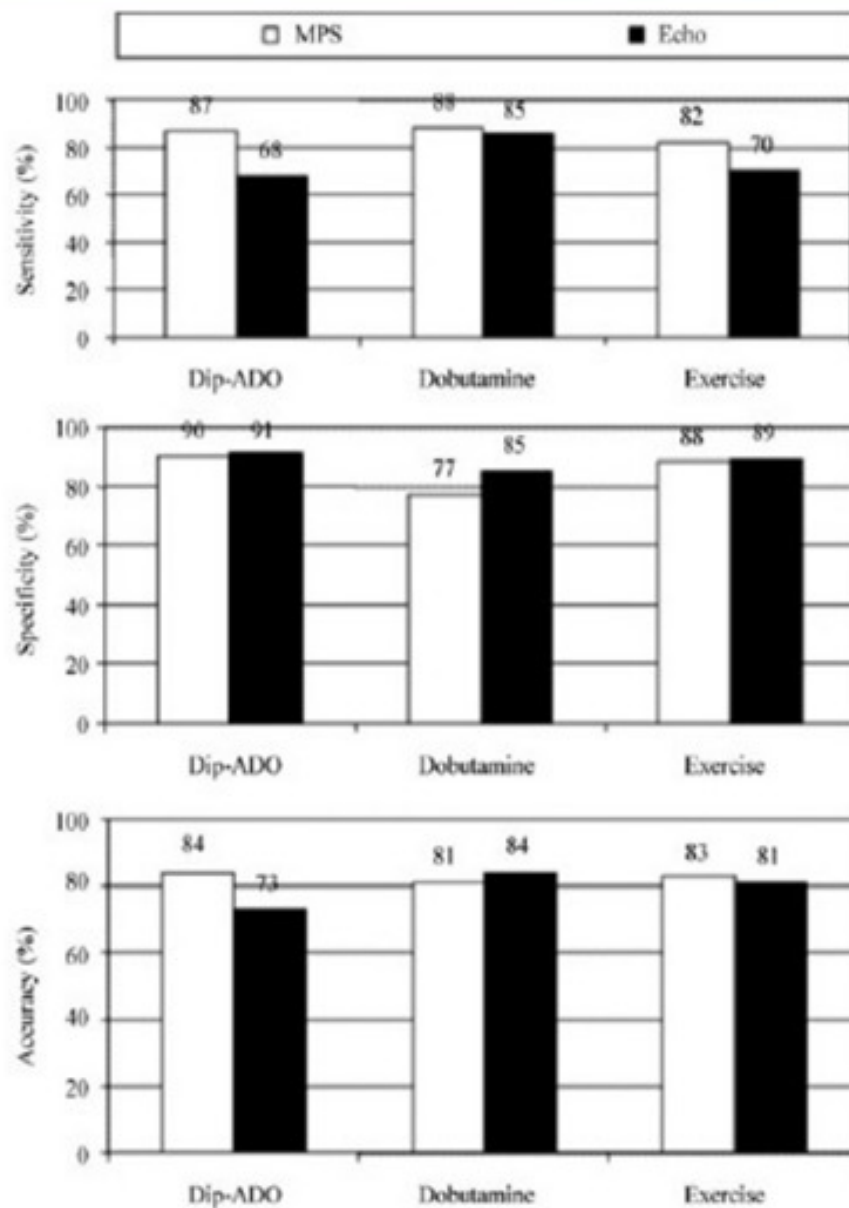
<sup>c</sup>References.

<sup>d</sup>Specific patient subsets indicated for early stress testing with imaging:

- patients with safety-critical professions (e.g. pilots, drivers, divers) and competitive athletes;
- patients engaging in recreational activities for which high oxygen consumption is required;
- patients resuscitated from sudden death;
- patients with incomplete or suboptimal revascularization, even if asymptomatic;
- patients with a complicated course during revascularization (perioperative myocardial infarction, extensive dissection during PCI, endarterectomy during CABG, etc.);
- patients with diabetes (especially those requiring insulin);
- patients with multivessel disease and residual intermediate lesions, or with silent ischaemia.

<sup>e</sup>Intermediate- and high-risk findings at stress imaging are ischaemia at low workload, early onset ischaemia, multiple zones of high-grade wall motion abnormality, or reversible perfusion defect.

CABG = coronary artery bypass grafting; LM = left main; PCI = percutaneous coronary intervention.

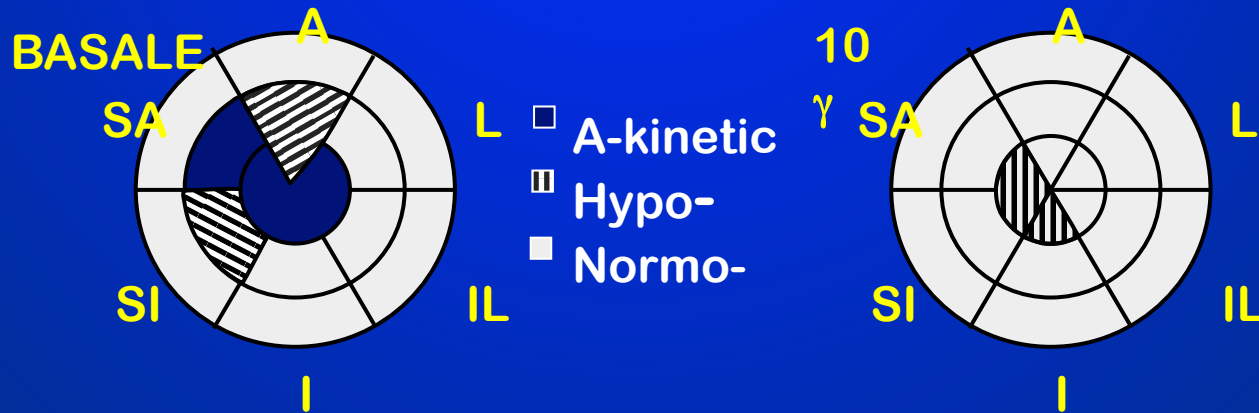
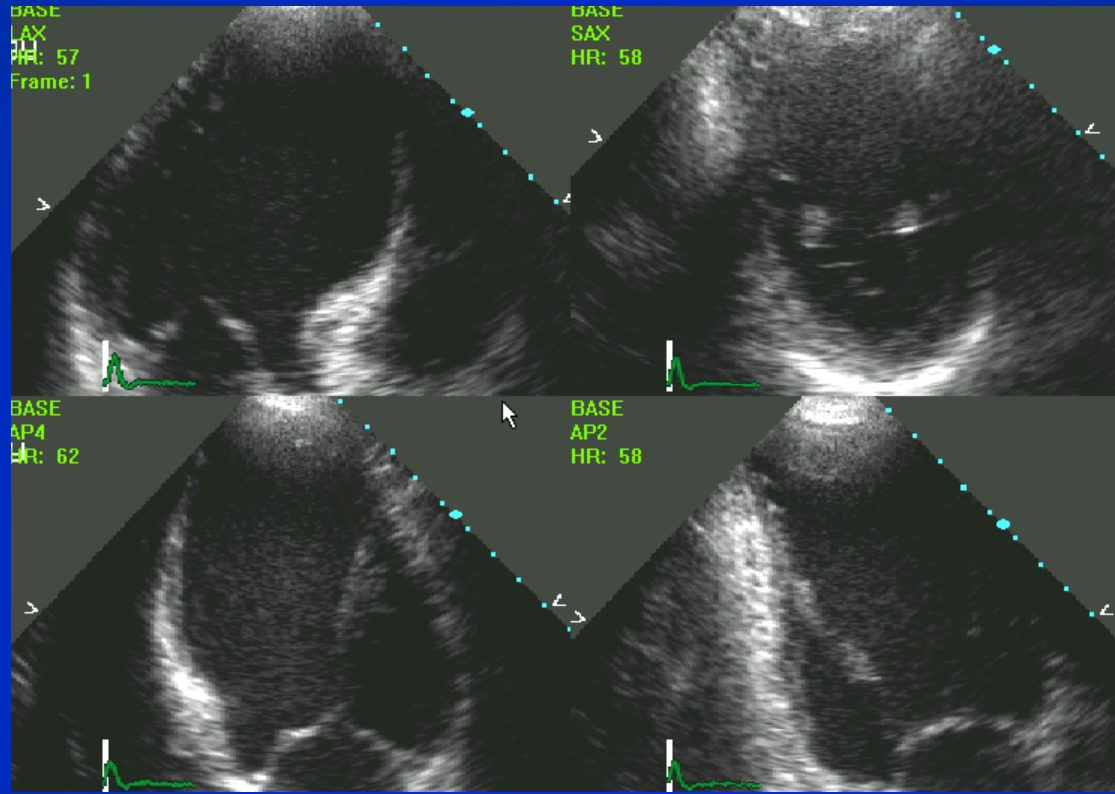


**Figure 1** Sensitivity, specificity, and accuracy of myocardial perfusion scintigraphy (MPS) (white boxes) and echocardiography (echo) (black boxes) for vasodilators, dobutamine, and exercise stress tests derived from head-to-head comparison studies. Dip, dipyridamole; ADO, adenosine

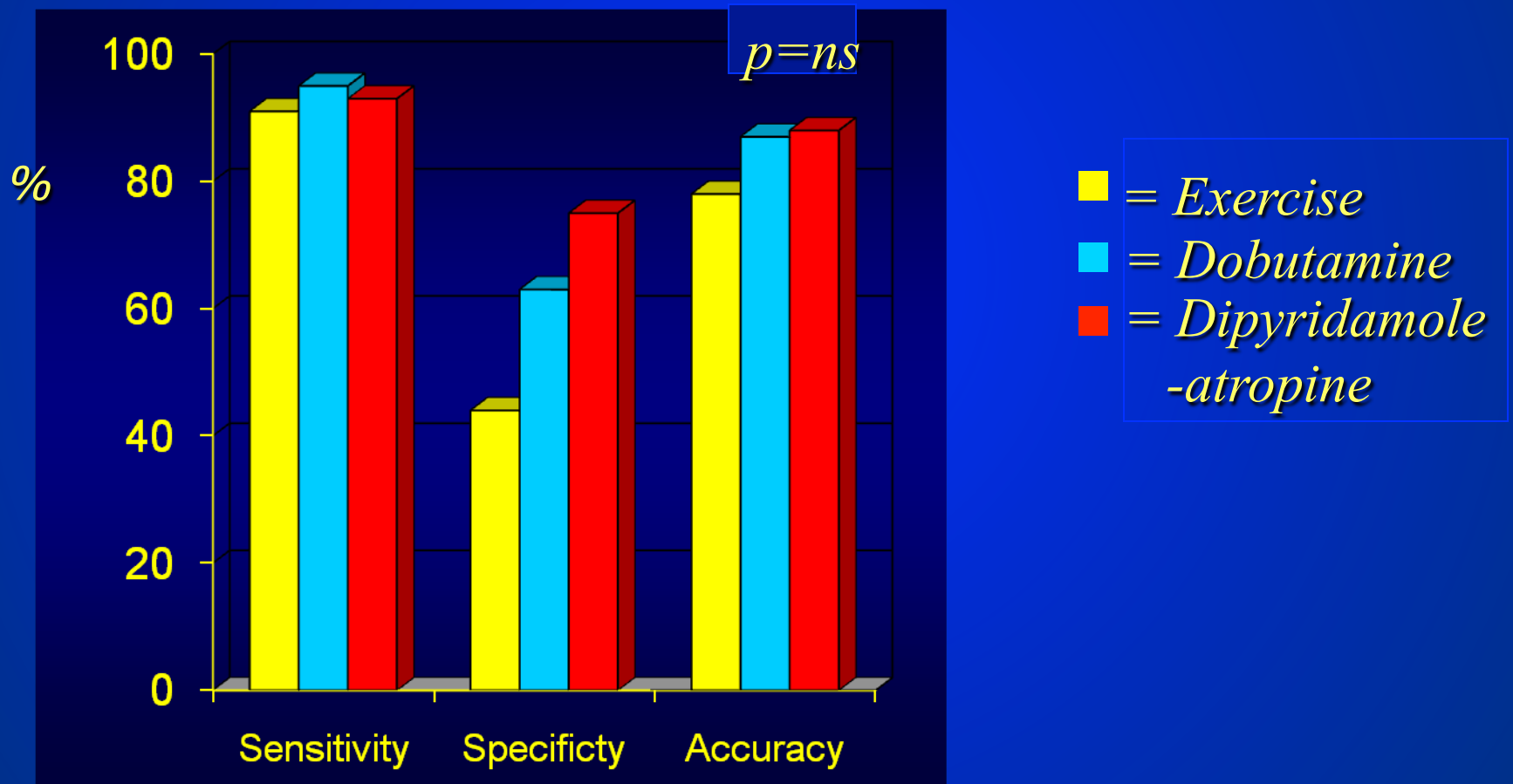
## Sensibilità, specificità e accuratezza della scintigrafia miocardica e dell'eco-stress

# Studies	4	10	5
# Patients	263	822	320

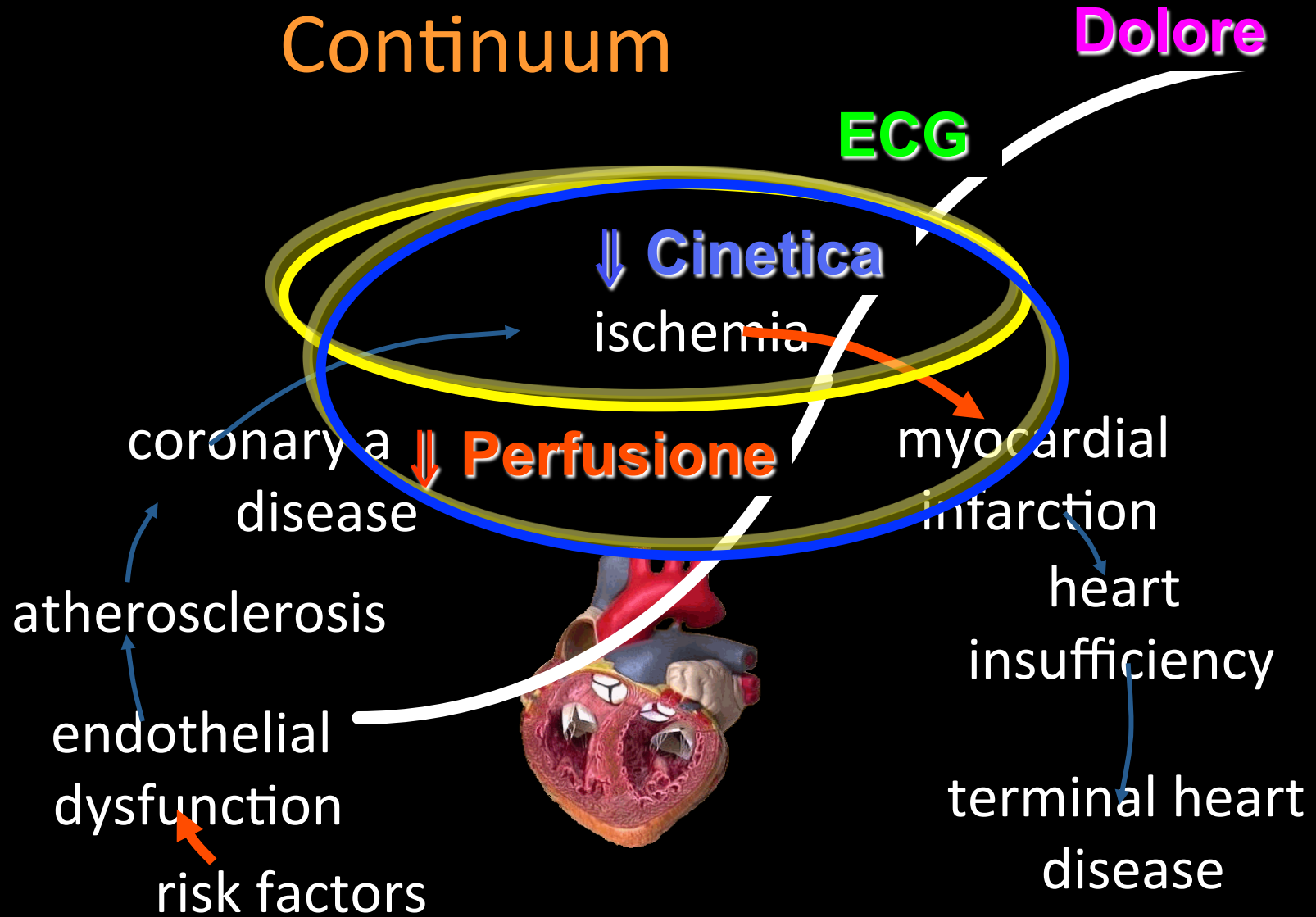
# ECO STRESS



## Diagnostic Accuracy of Stress Echocardiography for CAD. Head-to-head comparison



# The Cardiovascular Continuum



# Flusso coronarico diastolico con eco-Doppler transtoracico

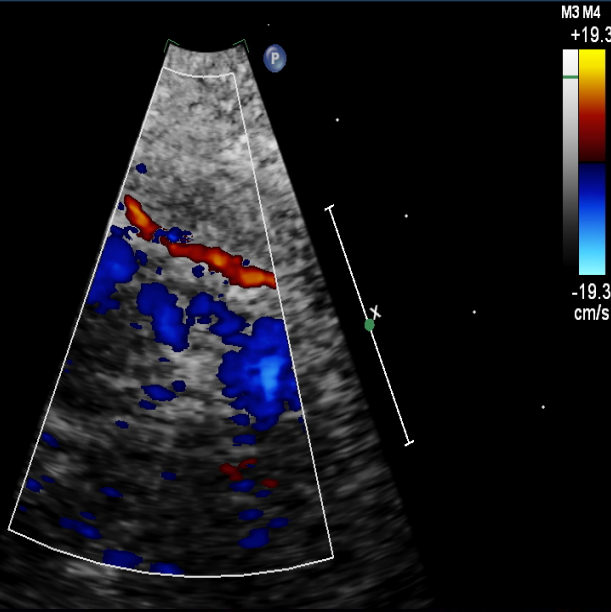
## Anterior Interventricular

FR 33Hz  
5.8cm

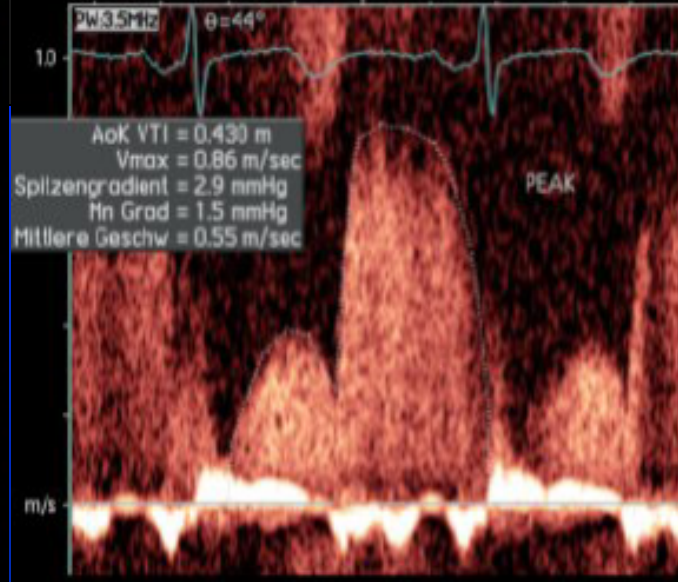
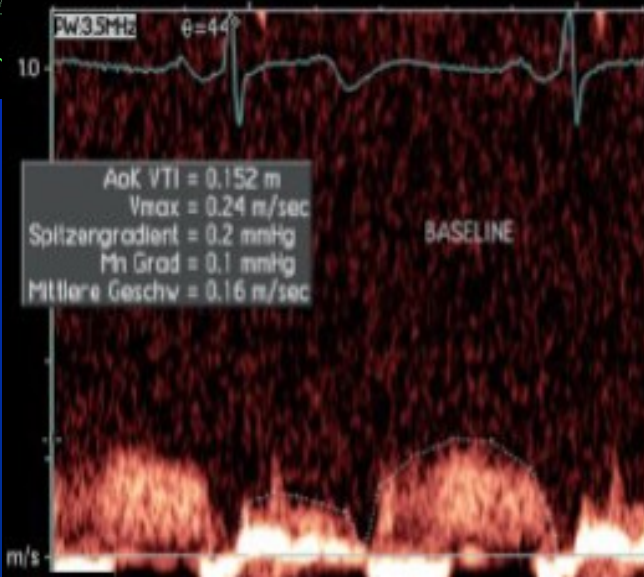
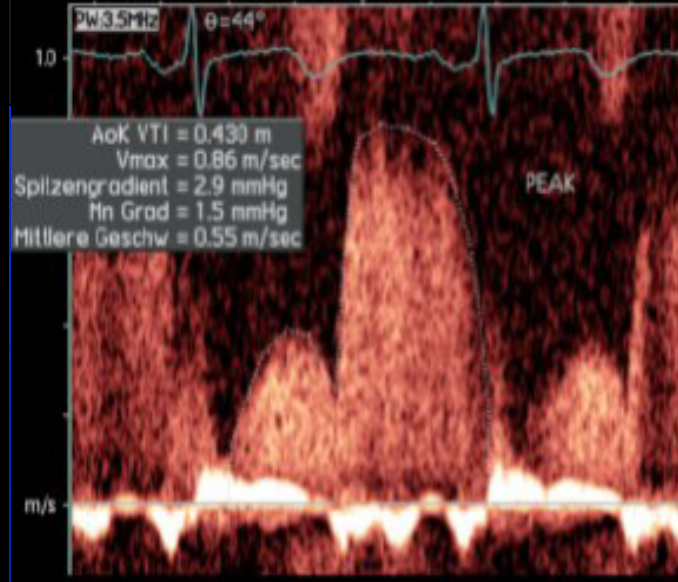
2D  
69%  
C 50  
P Off  
AGen

CF  
75%  
3.3MHz  
WF Alto  
Alto

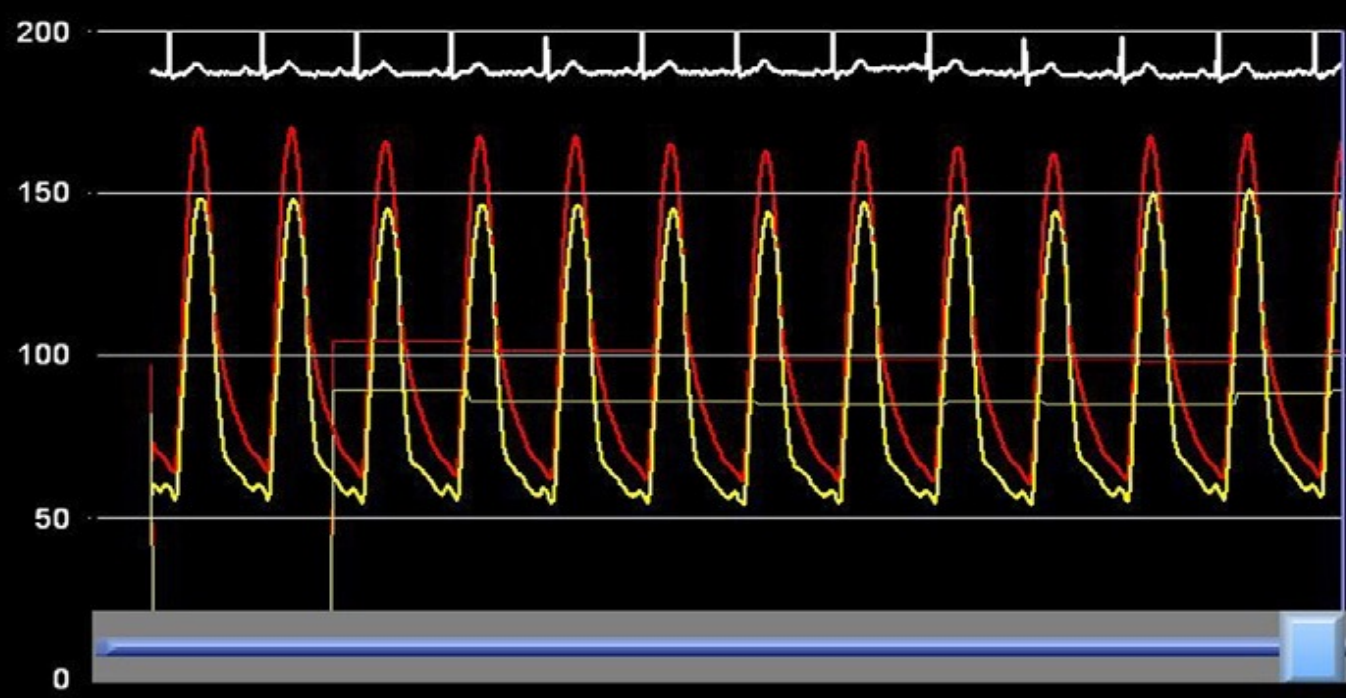
⊙  
P R  
2.6 5.2



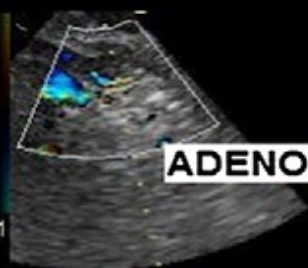
## Posterior Interventricular



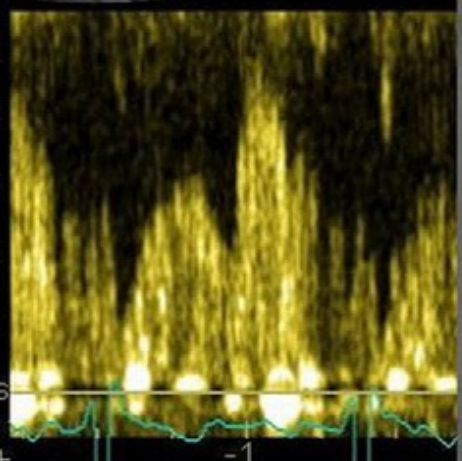
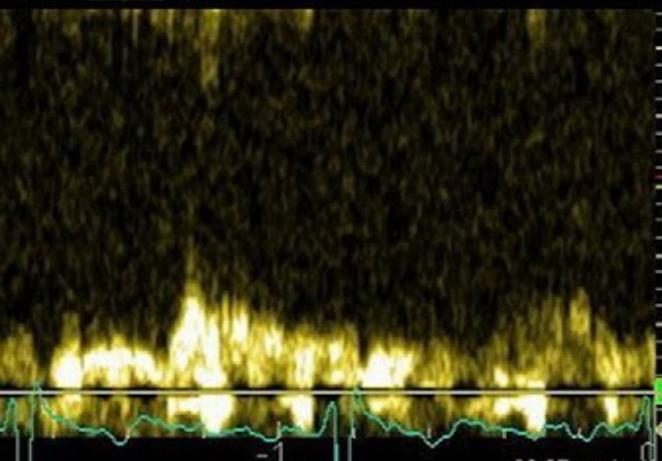
**FFR** **0.86**  
I.C. 12:44:23 PM  
Pa:iPa **101:167**  
Pd:iPd **89:150**  
Pd/Pa **0.88**  
HR **56**



**BASAL**



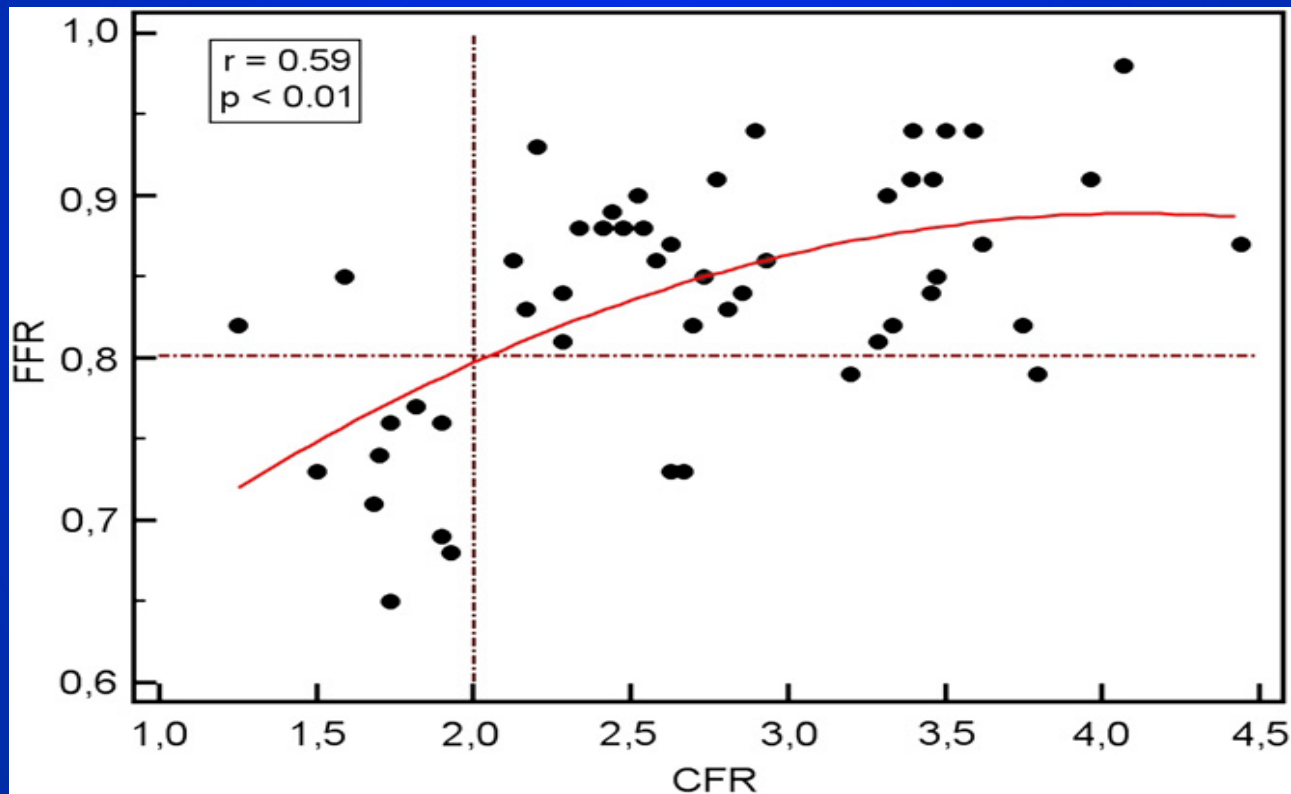
**ADENOSINE**





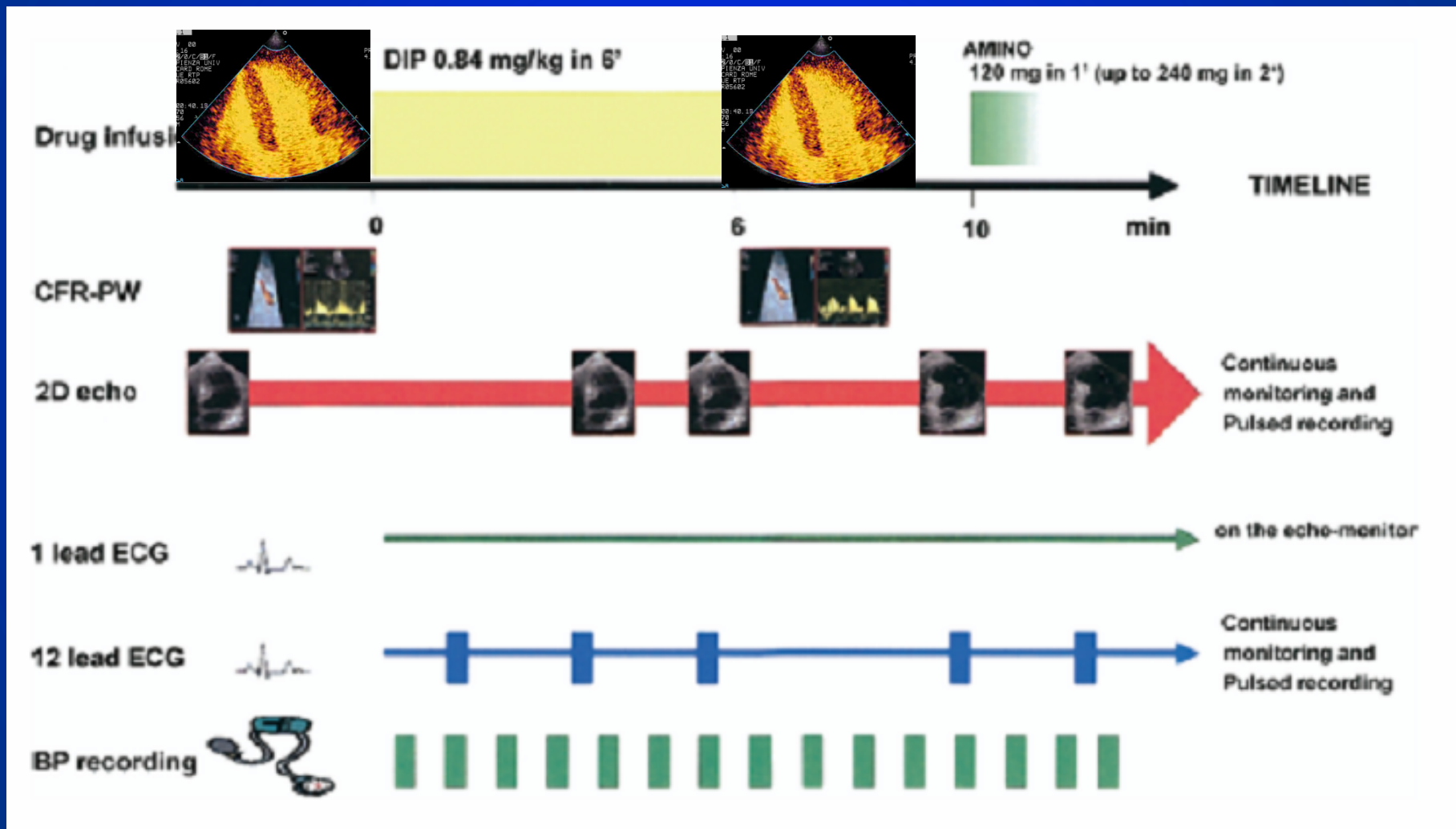
# Comparison Between Non-Invasive Coronary Flow Reserve and Fractional Flow Reserve to Assess the Functional Significance of Left Anterior Descending Artery Stenosis of Intermediate Severity

P. Meimoun, S. Sayah, A.Luycx-Bore, J. Boulanger, F. Elmkies, T.Benali, H.Zemir, Luc Doutrelan, and J.Clerc,  
Journal of the American Society of Echocardiography. April 2011

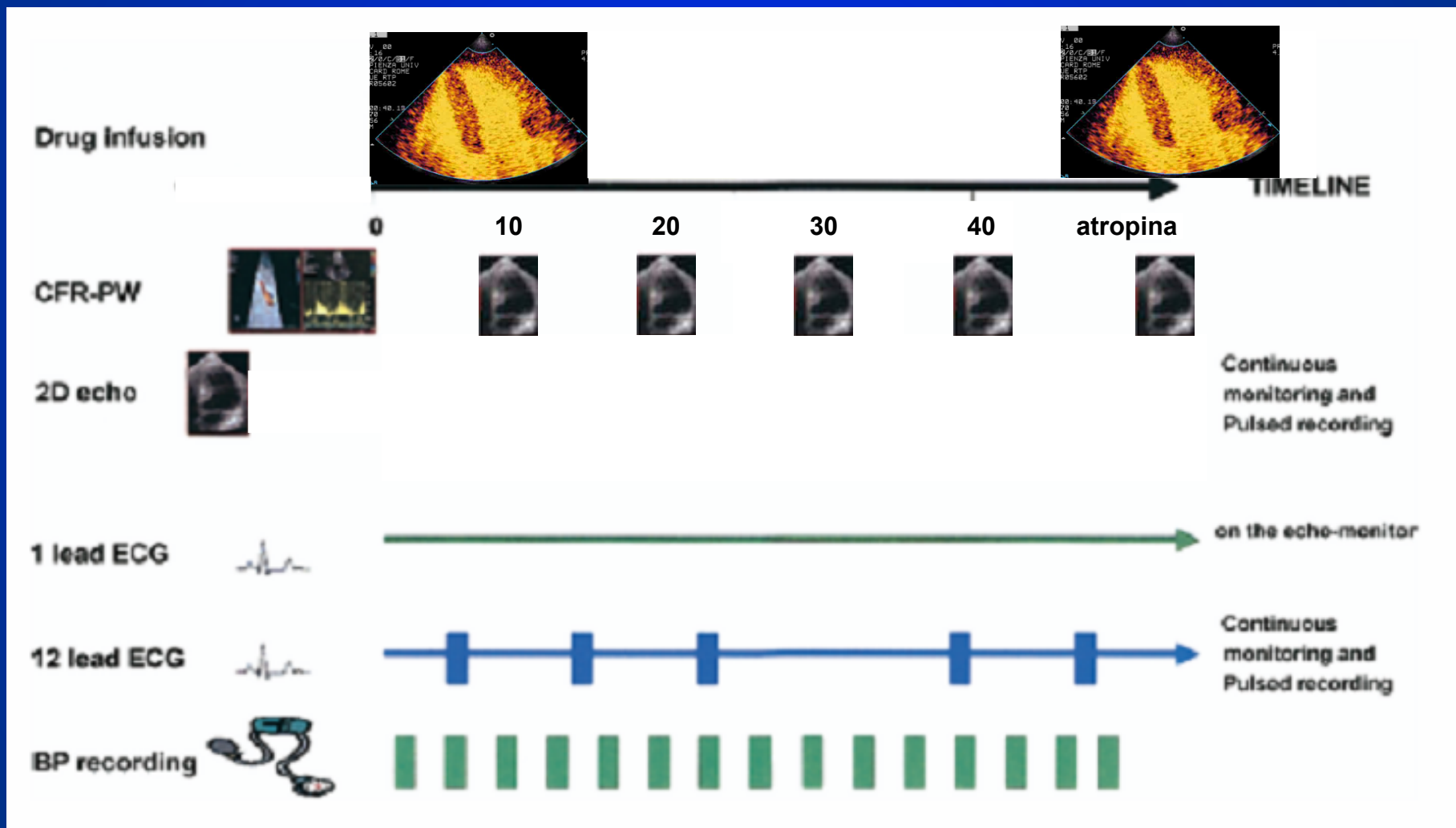


Scatterplot of the curvilinear relationship between noninvasive CFR and FFR. Horizontal and vertical dashed lines are depicted at the set points of CFR of 2 and FFR of 0.8, respectively, to show the limit between normal and abnormal values.

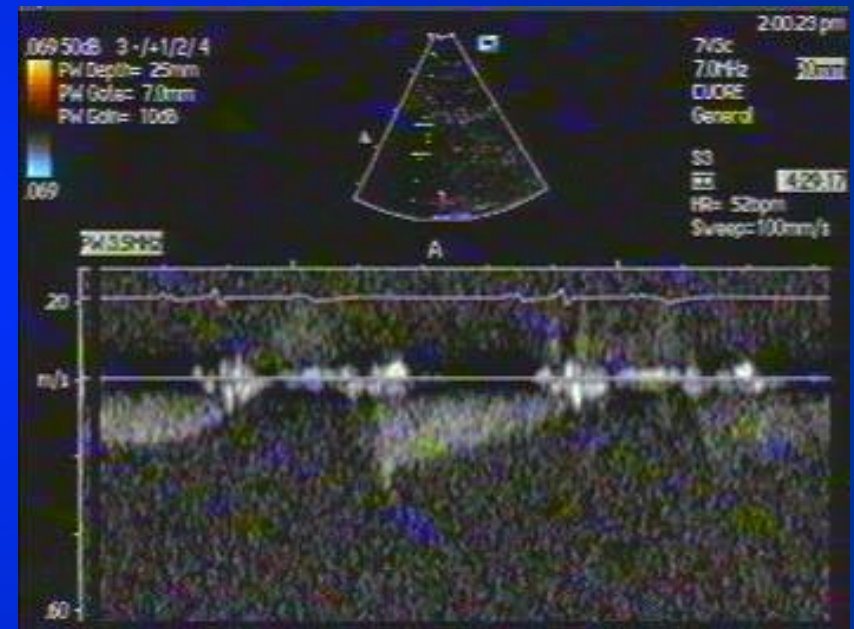
# Test eco-dipirdamolo: cinetica + flusso coronarico + perfusione



# Test eco-dobutamina: cinetica + flusso coronarico + perfusione



Adenosine 6 mg or  
ATP 5 mg in 20 sec



Be as Simple (and Cheap) as Possible

PHILIPS

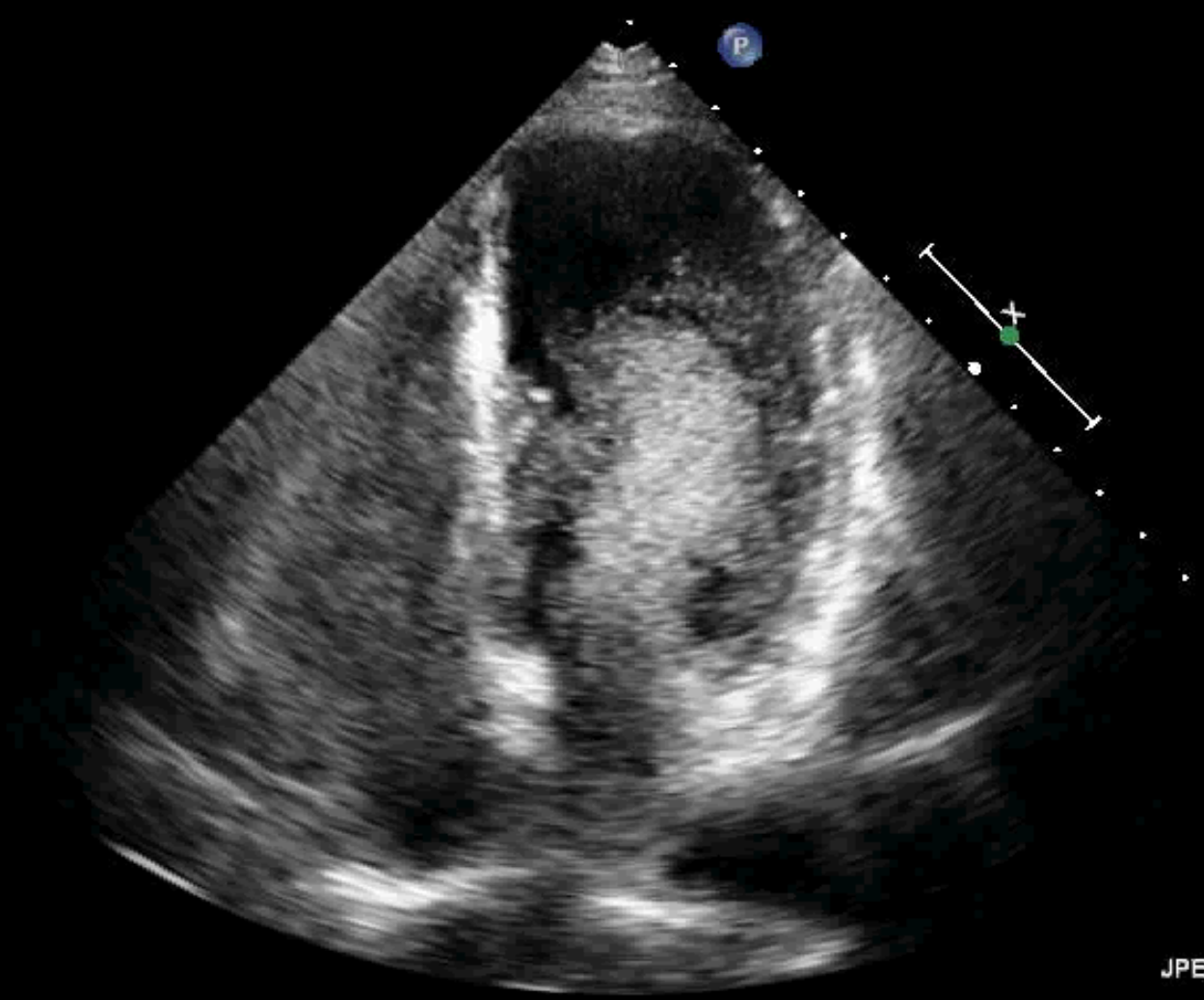
TISO.8 MI 1.5

S5-1/EcoSoft

FR 49Hz  
16cm

M5

2D  
64%  
C 51  
P Bassa  
AGen



JPEG

74 bpm

PHILIPS

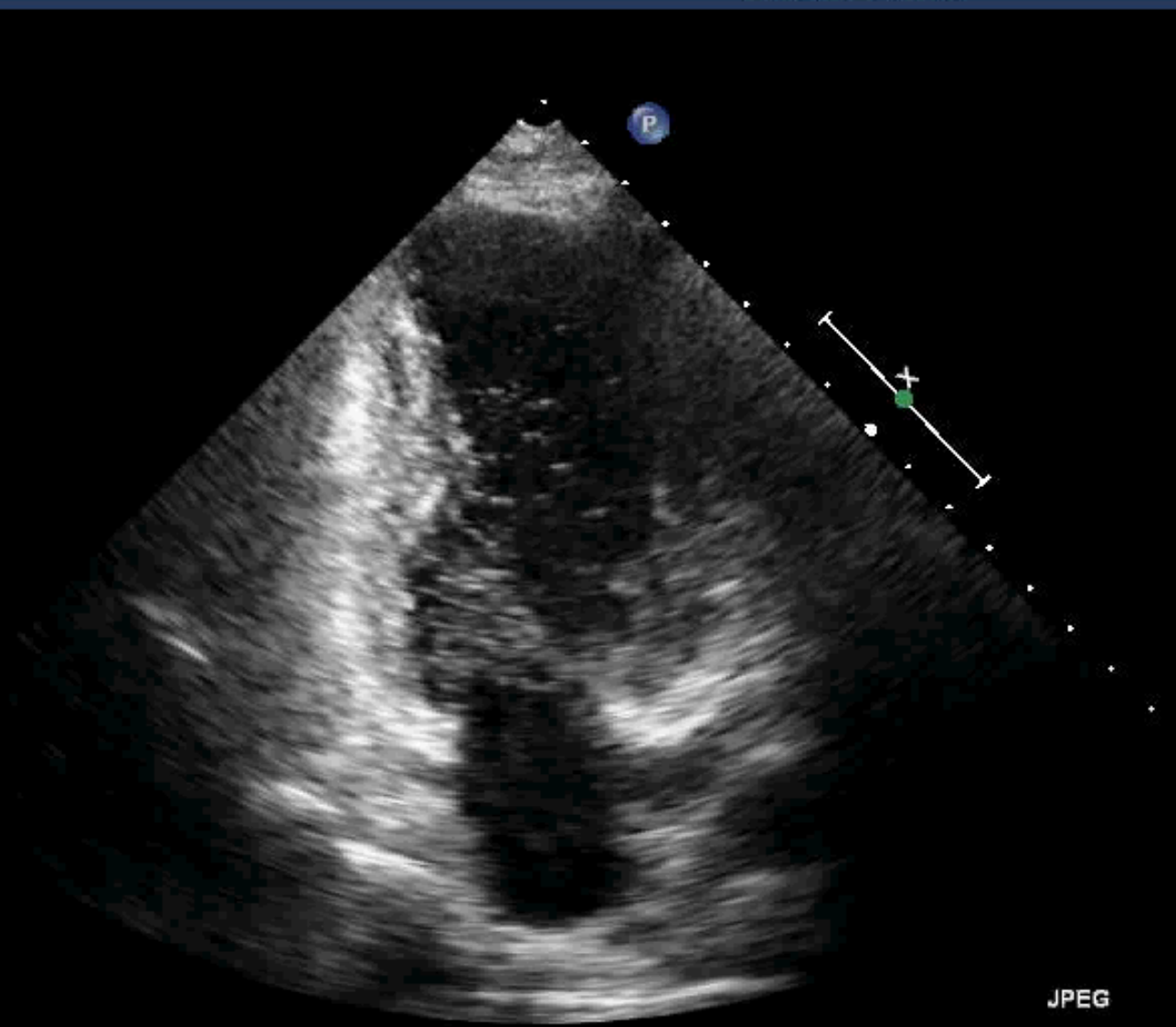
TISO.8 MI 1.5

S5-1/EcoSoft

FR 49Hz  
16cm

M5

2D  
64%  
C 51  
P Bassa  
AGen



JPEG

77 bpm

FR 18Hz

10cm

2D

71%

C 50

P Off

AGen

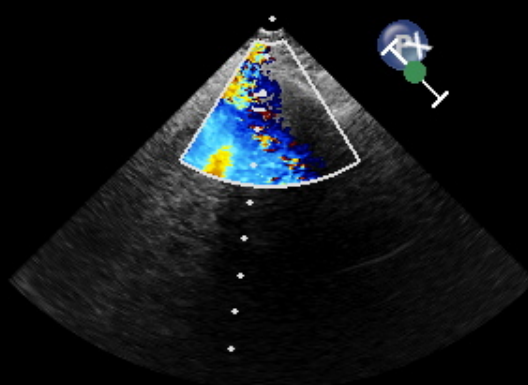
CF

75%

3.3MHz

WF Alto

Alto



PW

55%

3.0MHz

WF 150Hz

SV4.0mm

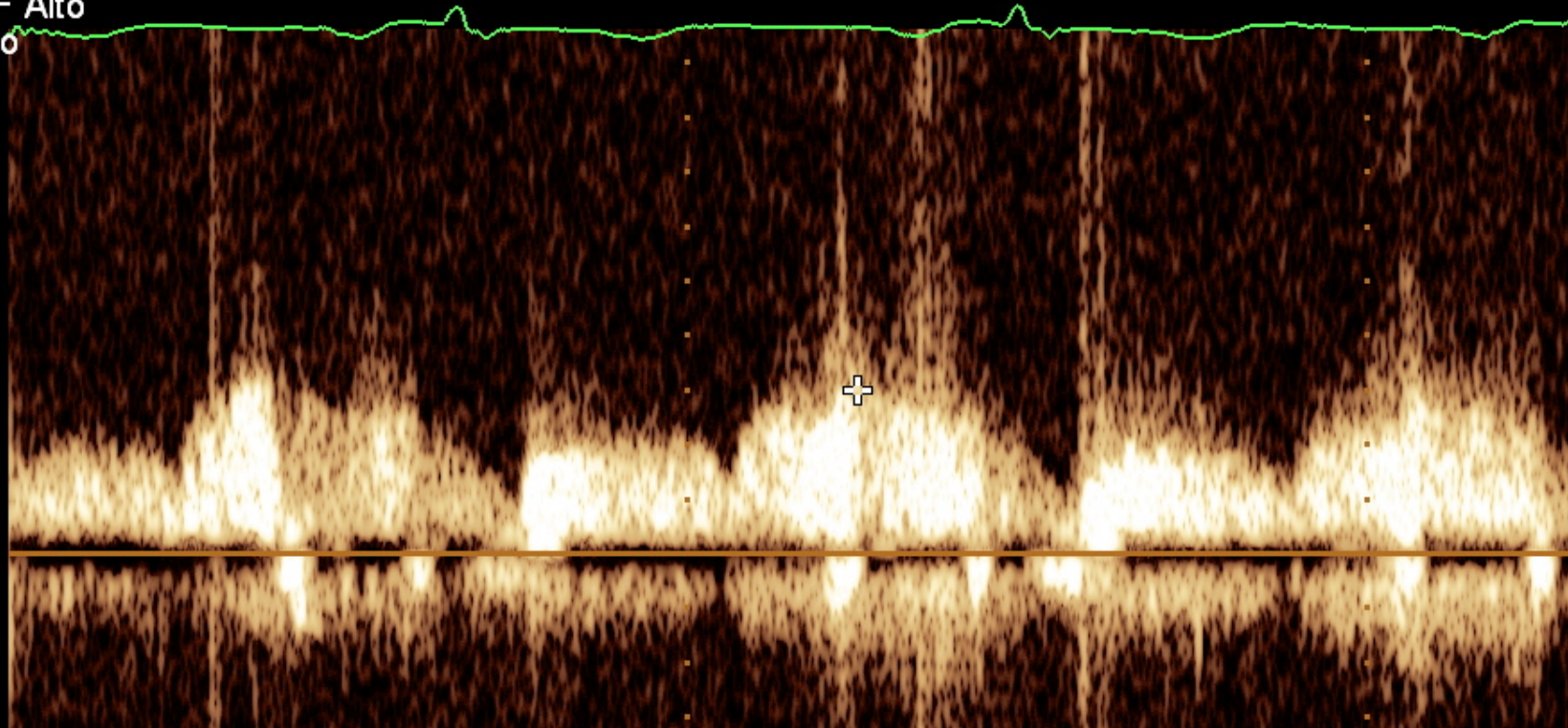
2.2cm

M3 M4

+19.3



-19.3  
cm/s



-  
-80  
-60  
-40  
-20  
- cm/s  
-20  
-

21

+ REŤ sist CFR 29.9 cm/s

FR 18Hz  
10cm

2D  
71%  
C 50  
P Off  
AGen

CF  
75%  
3.3MHz  
WF Alto  
Alto



PW  
55%  
3.0MHz  
WF 150Hz  
SV4.0mm  
2.7cm



-

-80

-

-60

-

-40

-

-20

-

-cm/s

-

-20

JPEG

100mm/s

86 bpm



PHILIPS

TIS0.0 MI 0.08 B

S5-1/BR125

MI 0.54 F

FR 39Hz  
8.1cm

Contrasto

61%  
C 50  
P Off  
Pen.

M3



P

G  
P((O))R  
2.0 2.0

JPEG

66 bpm

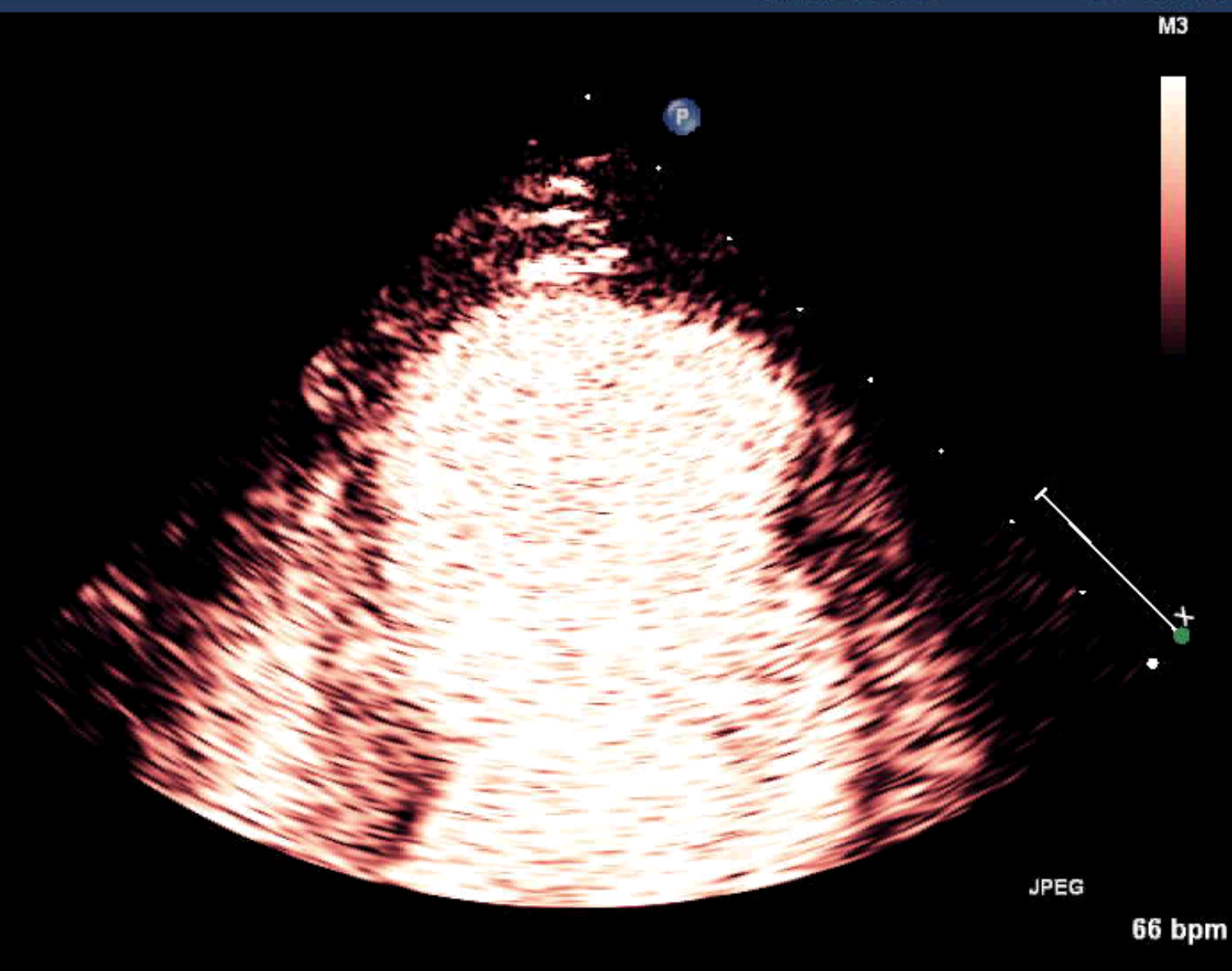
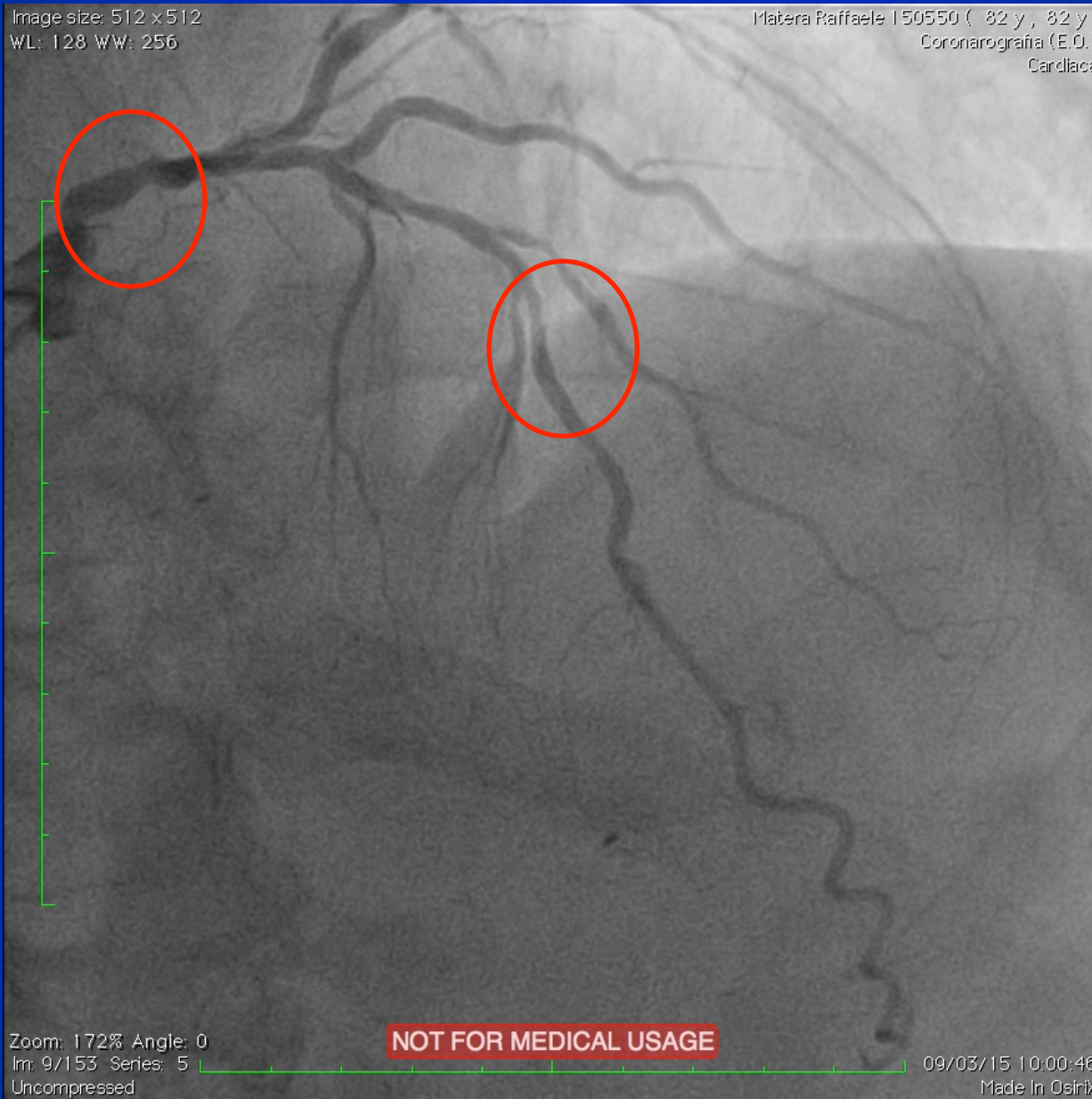


Image size: 512 x 512  
WL: 128 WW: 256

Matera Raffaele 150550 ( 82 y , 82 y )  
Coronarografia (E.O.)  
Cardiaca



Zoom: 172% Angle: 0  
In: 9/153 Series: 5  
Uncompressed

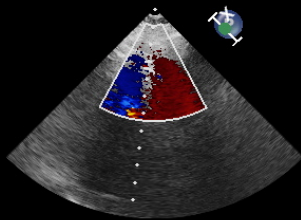
**NOT FOR MEDICAL USAGE**

09/03/15 10:00:46  
Made In OsiriX

FR 14Hz  
12cm

2D  
79%  
C 50  
P Off  
AGen

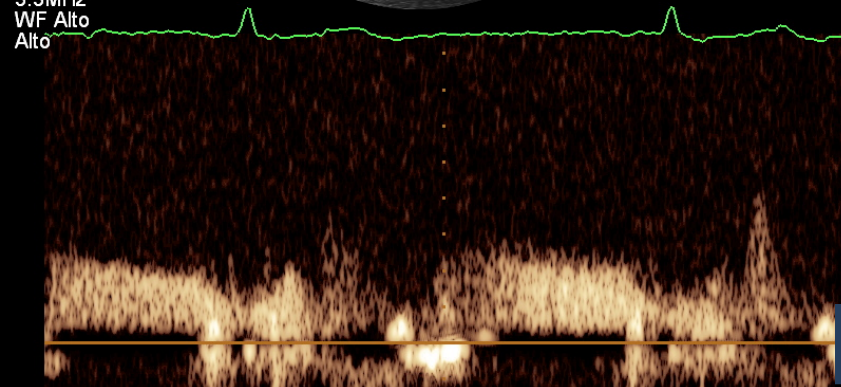
CF  
77%  
3.3MHz  
WF Alto  
Alto



PW  
50%  
3.0MHz  
WF 150Hz  
SV4.0mm  
3.2cm



-80  
-60  
-40  
-20



FR 13Hz

VOLCANO FFR MATERA, RAFFAELE 150550 Scegli vaso 1 Fotogramma

0:10

**FFR 0,76**

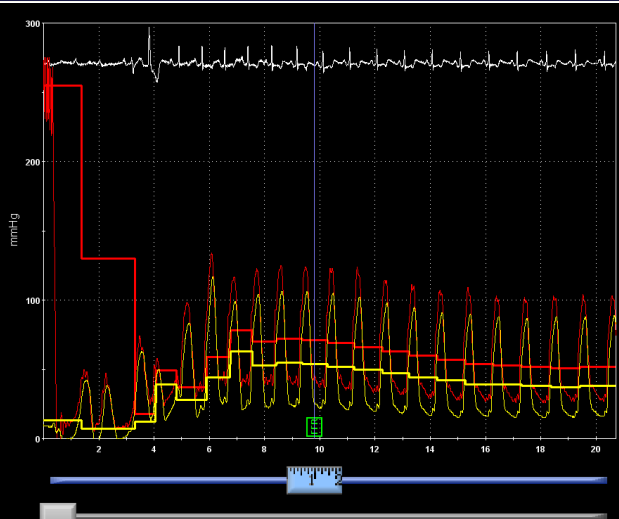
Pd/Pa 0,76

Pa:iPa 71: 43

Pd:iPd 54: 27

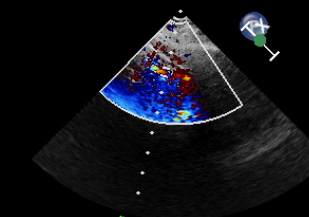
HR 68

Elenco di esecu...	iFR	FFR
16:50:56		0,80
LAD Mid		
16:51:36		0,76



Opzioni Salva fotogramma

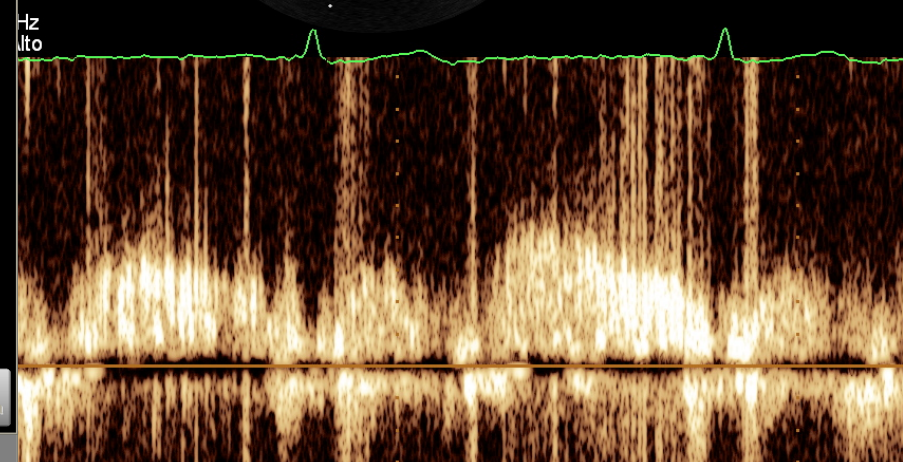
Impostazioni Paziente FFR iFR



PW  
55%  
3.0MHz  
WF 150Hz  
SV4.0mm  
3.0cm

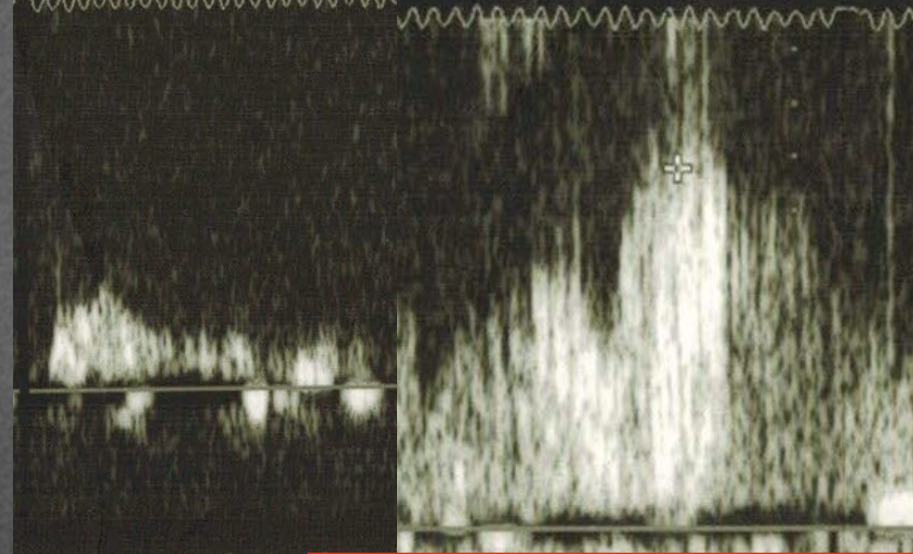
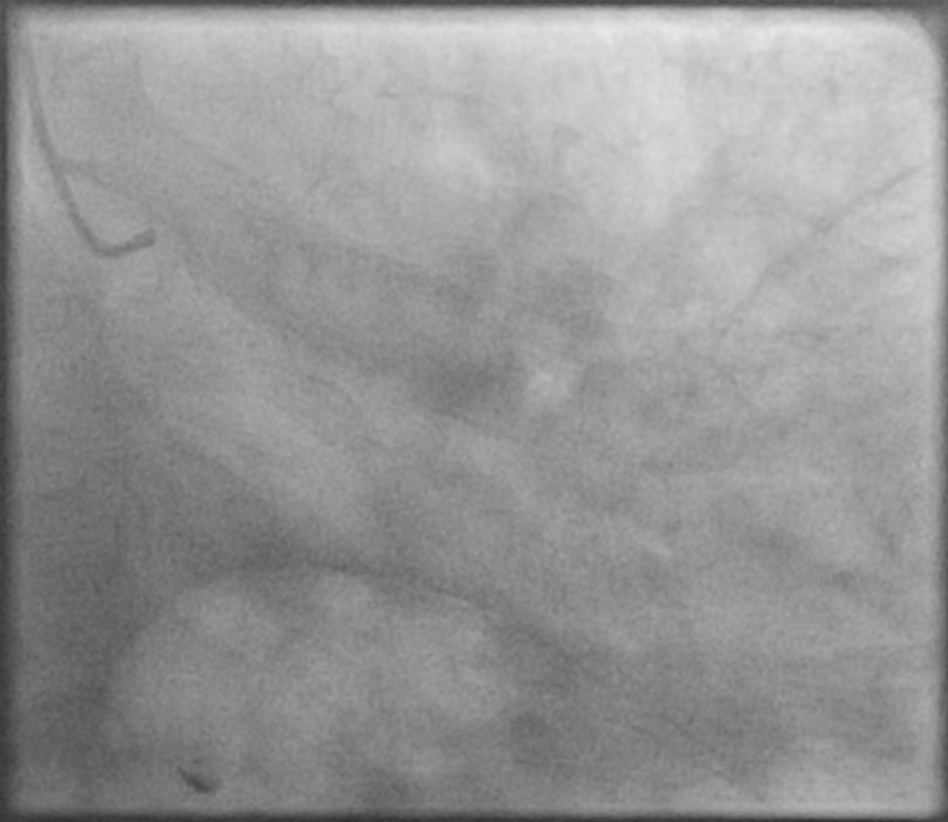


-80  
-60  
-40  
-20  
-cm/s  
-20

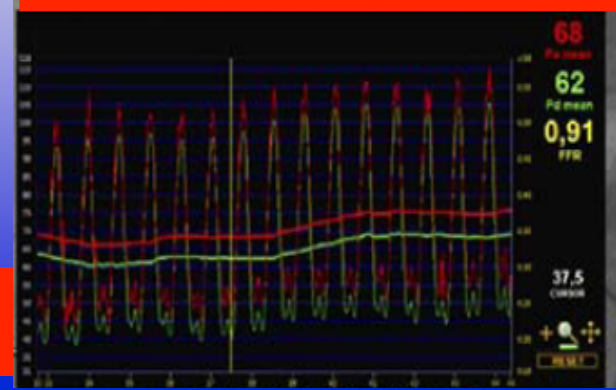


100mm/s

59bpm



✦ HIGH sist CFR 67.8 cm/s  
CFR (V.max) H/R. 3.2



***FFR 0.91***

*Paziente di 48 anni – angor tipico – enzimi negativi – ecostress positivo per ipocinesia parete postero-laterale, CFR 3.*

# LAD Stent Follow-up

ANGIO

REST

ADENOSINE

Stent

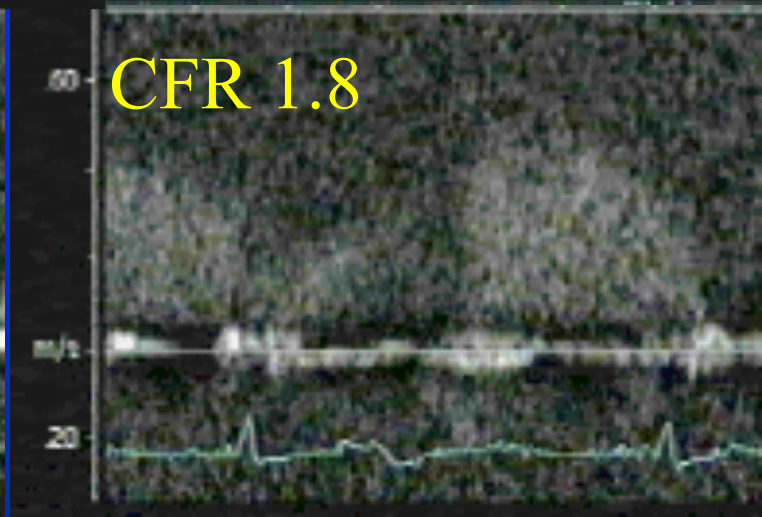
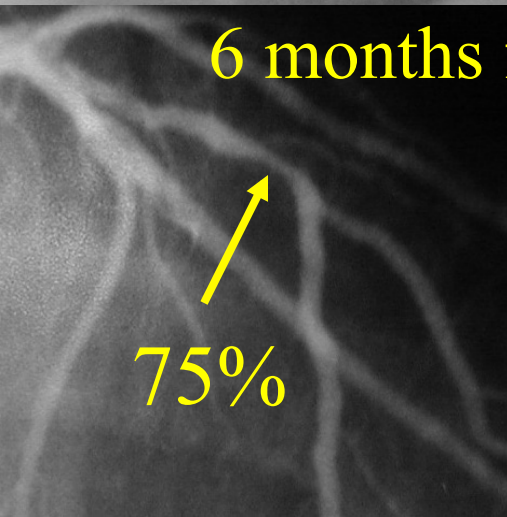
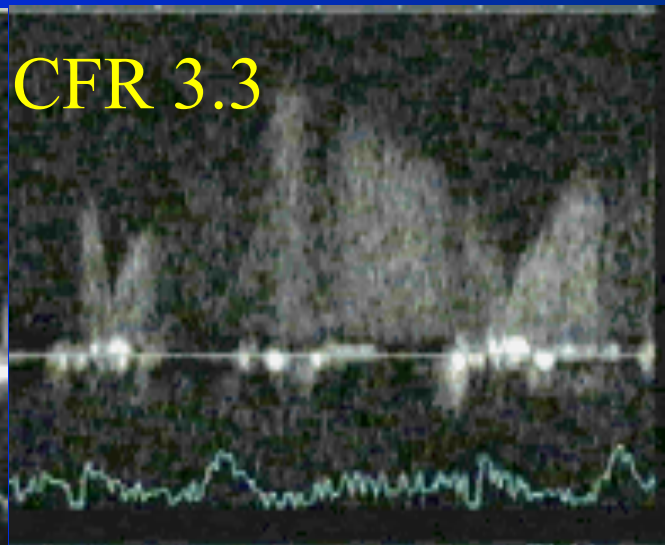
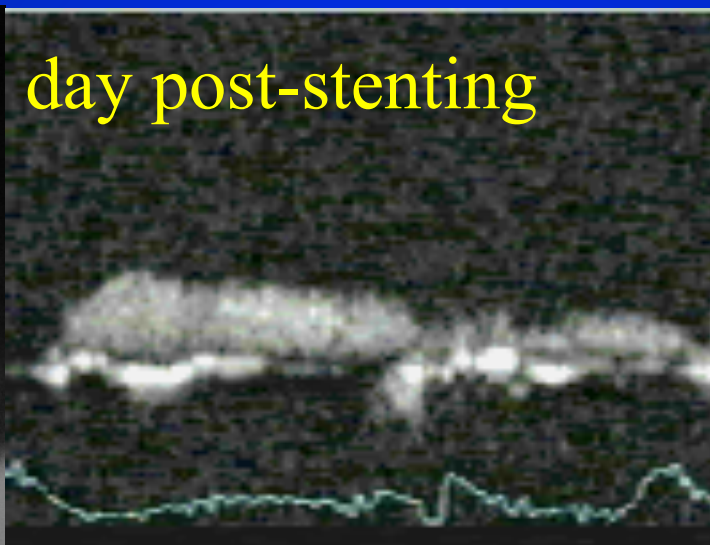
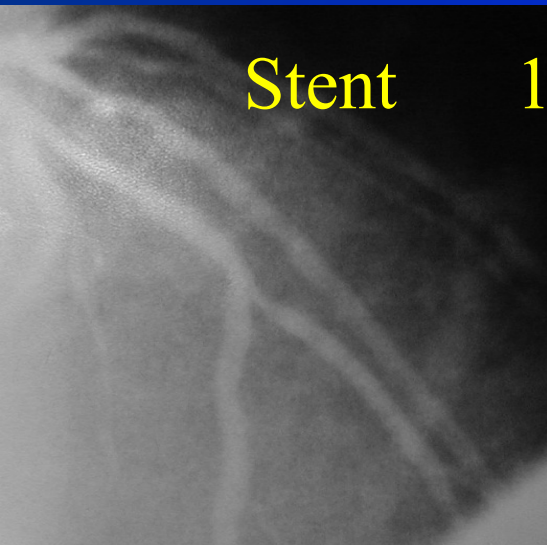
1 day post-stenting

CFR 3.3

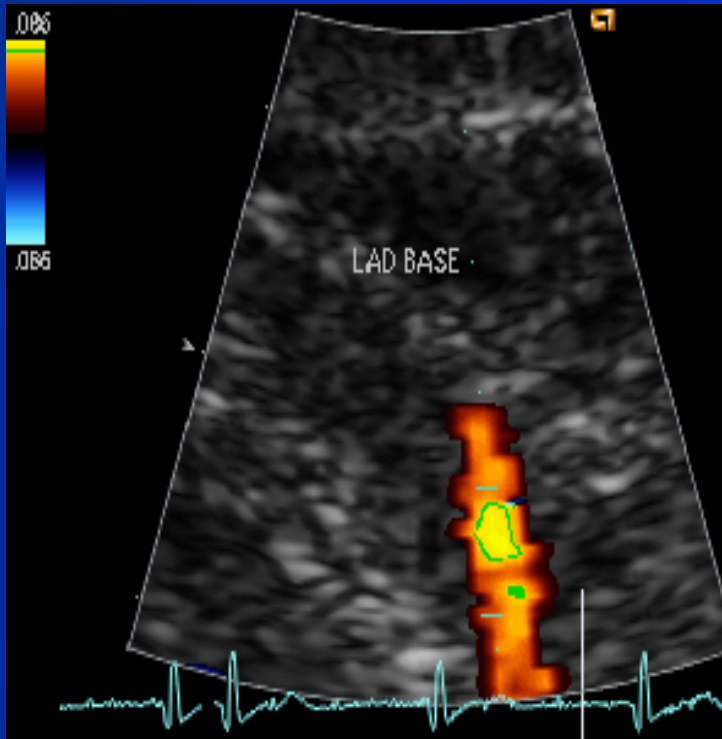
6 months follow-up

75%

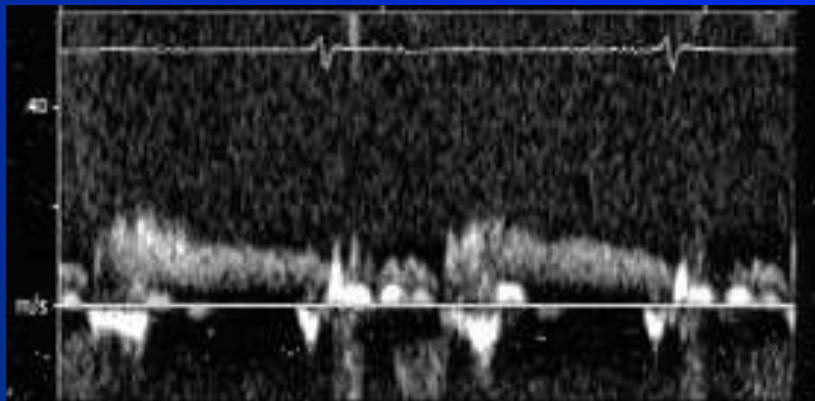
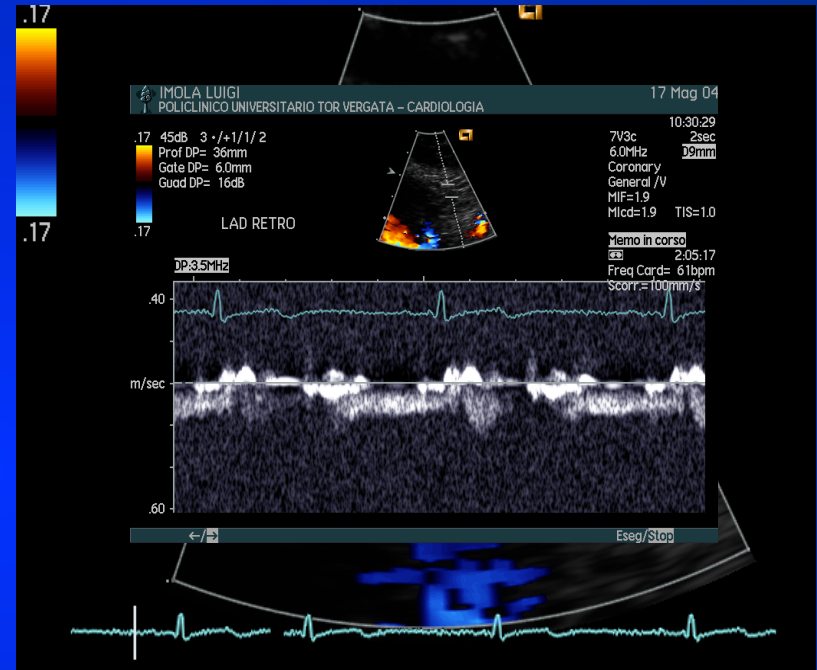
CFR 1.8



# Patent LAD

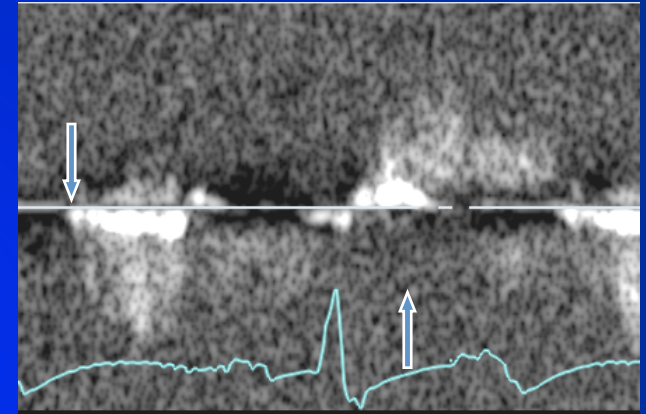
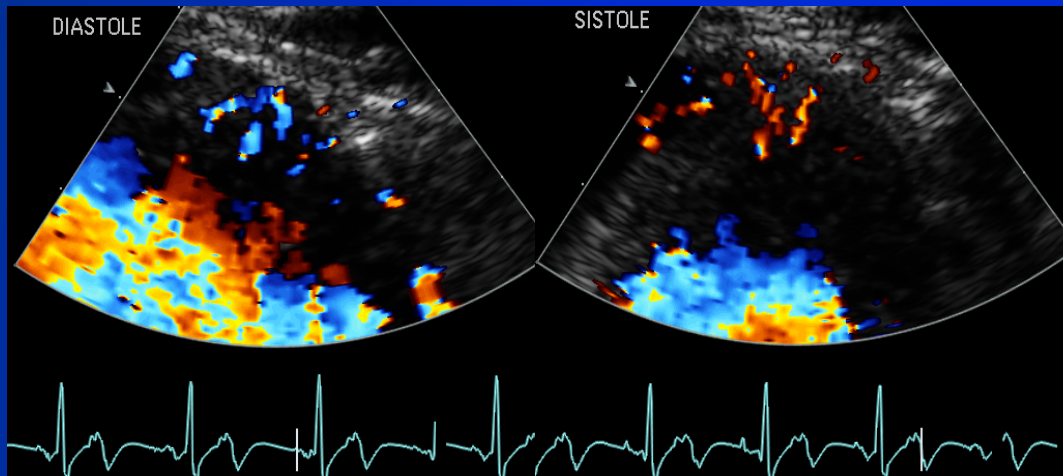


# Occluded LAD

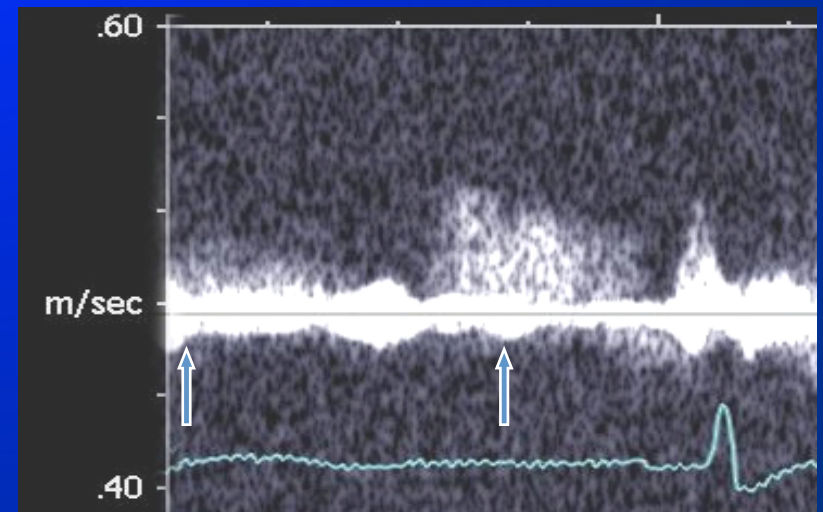
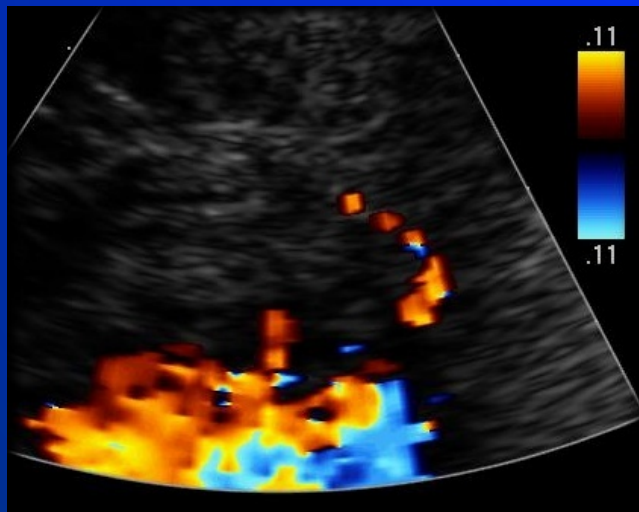


# *Flow Pattern in Perforators*

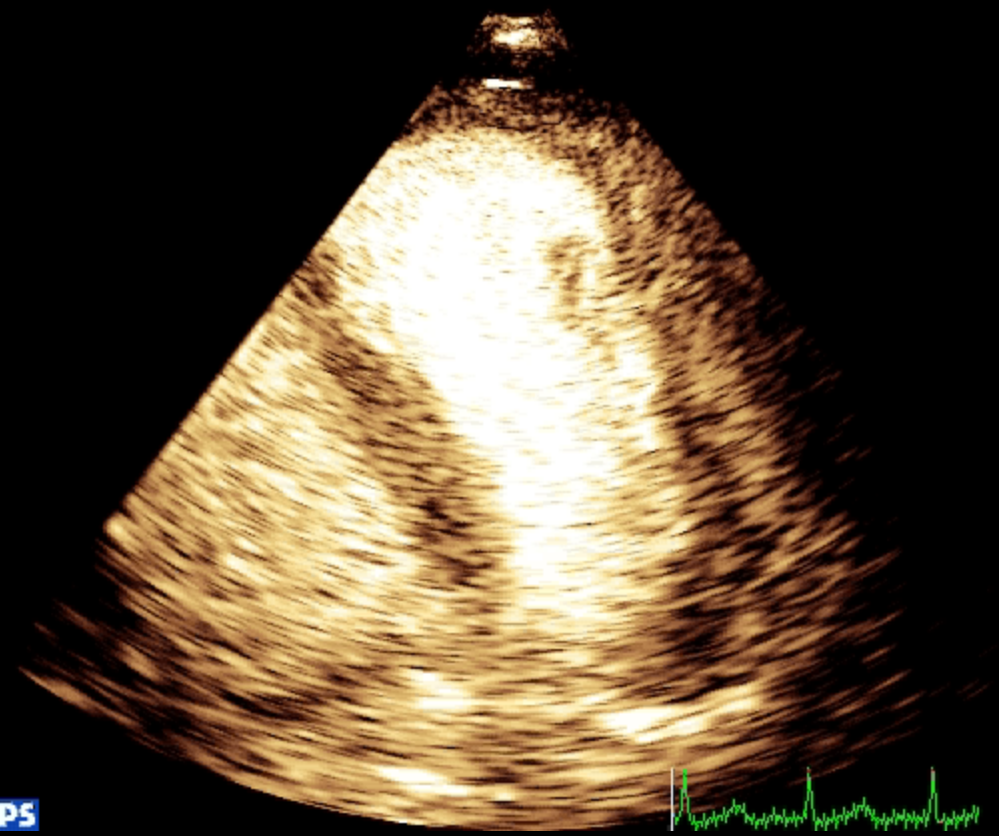
*Normal Flow (Patent LAD)*



*Reverse Flow (Occluded LAD)*



**PHILIPS**



1 cm

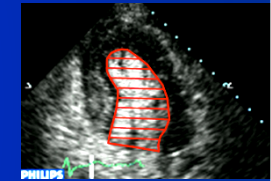
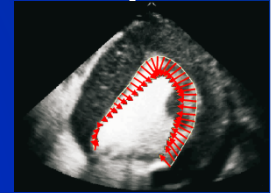


# Echocardiography

## Indications for Rest Contrast Enhanced Ultrasound

### LVO

- assessment of **regional systolic function** (wall motion) for detection of fixed wall motion abnormalities (rest)
- assessment of **global systolic function** (cardiac volumes + EF)



# Identificazione Alterazione Motilità LV

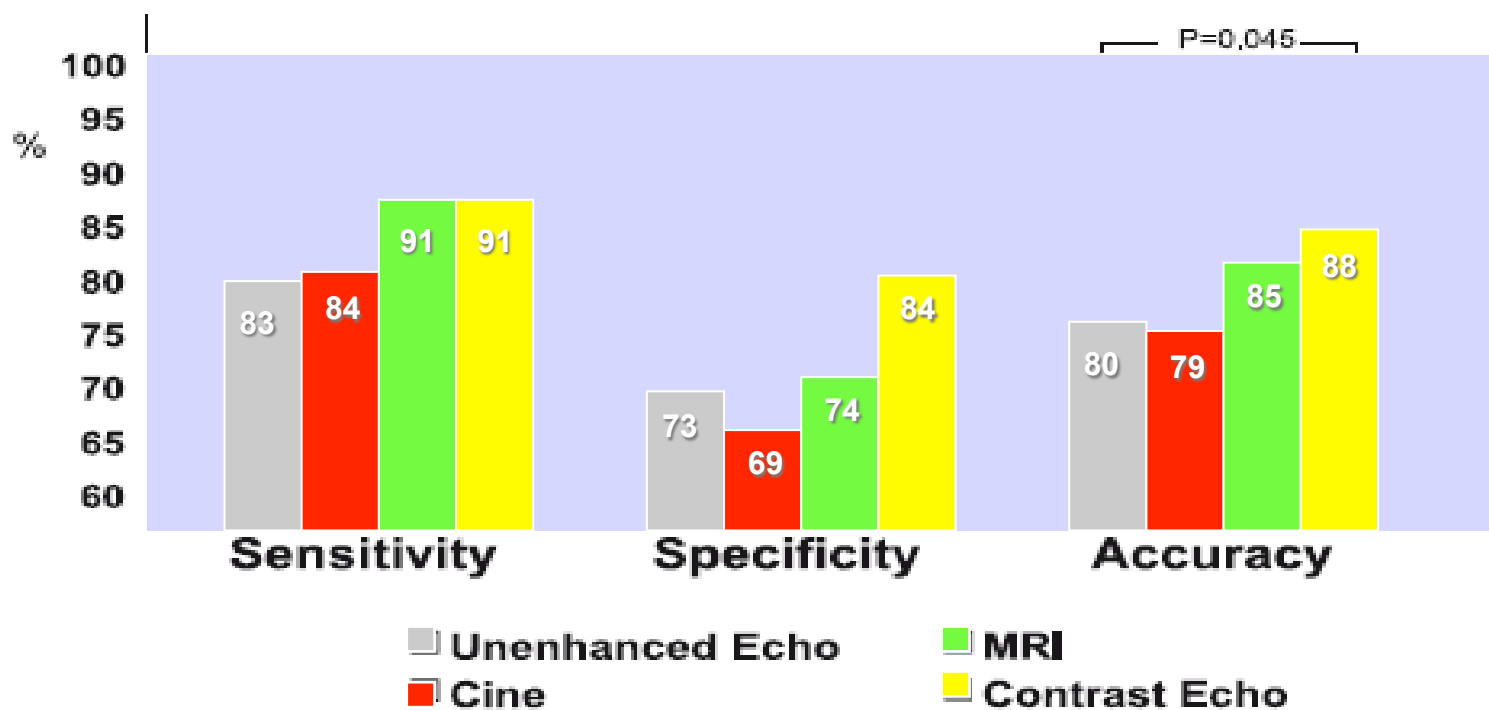
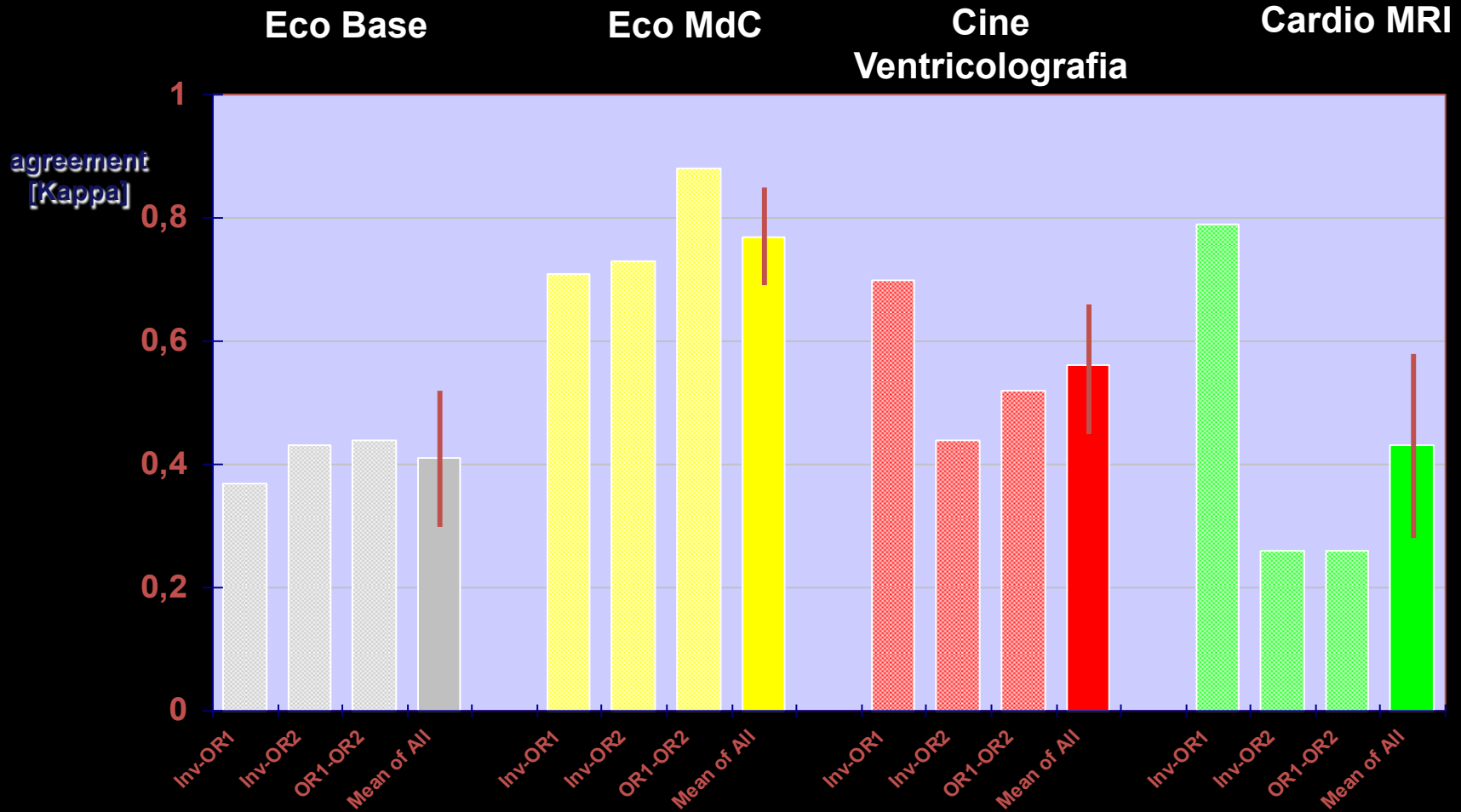


Fig. 4. Sensitivity, specificity and accuracy of the four imaging modalities to detect panel-defined wall motion abnormalities.

Eco con MdC è la metodica più accurata nell'identificare Alterazioni di motilità

Meta-analisi di Fleischmann et al e di Picano et al

# Riproducibilità: Identificazione Alterazione Motilità LV



Riduzione statisticamente significativa della variabilità inter osservatore nella valutazione delle alterazione di motilità del LV

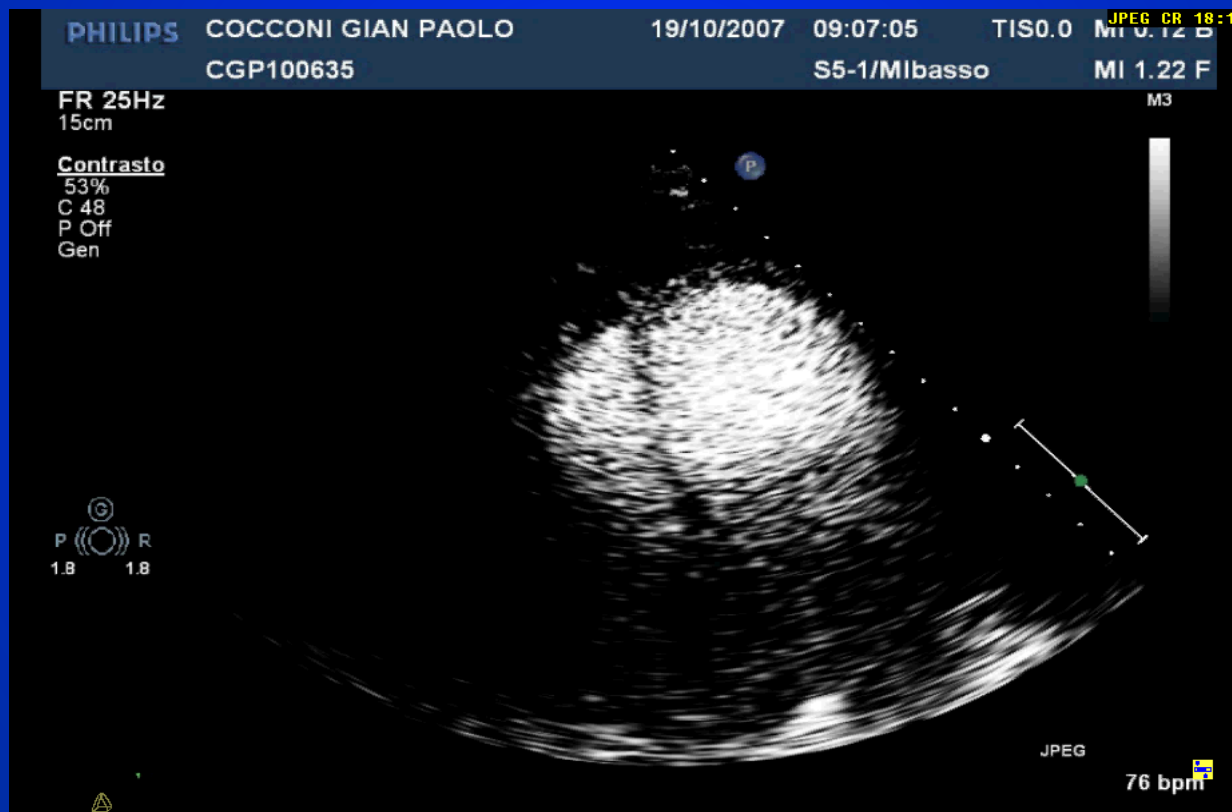
**Il contrasto aiuta anche nei rarissimi casi di brutte immagini nonostante mdc.**

**Paziente 180 KG, BPCO-Dolore toracico**

**Eco apparentemente assolutamente non eseguibile**

**Il contrasto, pur non permettendo le migliori immagini, permette di localizzare una ipoacinesia**

**settale medioapicale -possibile SCA in assenza di chiare alterazioni ECG. ECO base:**



**(paziente con IVA media 90% alla  
coronarografia)**

## EAE RECOMMENDATIONS

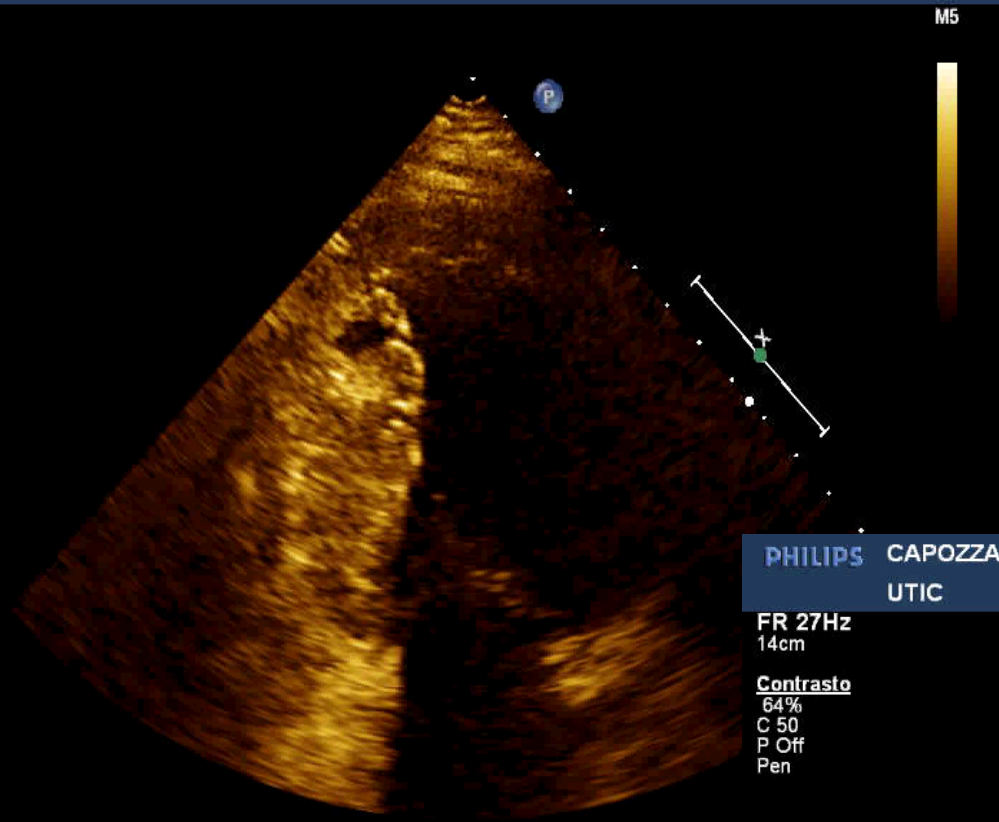
# Contrast echocardiography: evidence-based recommendations by European Association of Echocardiography

Roxy Senior<sup>1\*</sup>, Harald Becher<sup>2</sup>, Mark Monaghan<sup>3</sup>, Luciano Agati<sup>4</sup>, Jose Zamorano<sup>5</sup>, Jean Louis Vanoverschelde<sup>6</sup>, and Petros Nihoyannopoulos<sup>7</sup>

- To confirm or exclude the echocardiographic diagnosis of the following LV structural abnormalities, when nonenhanced images are suboptimal for definitive diagnosis
  - Apical variant of hypertrophic cardiomyopathy
  - Ventricular noncompaction
  - Apical thrombus
  - Complications of myocardial infarction, such as LV aneurysm, pseudoaneurysm, and myocardial rupture
- To assist in the detection and correct classification of intracardiac masses, including tumors and thrombi

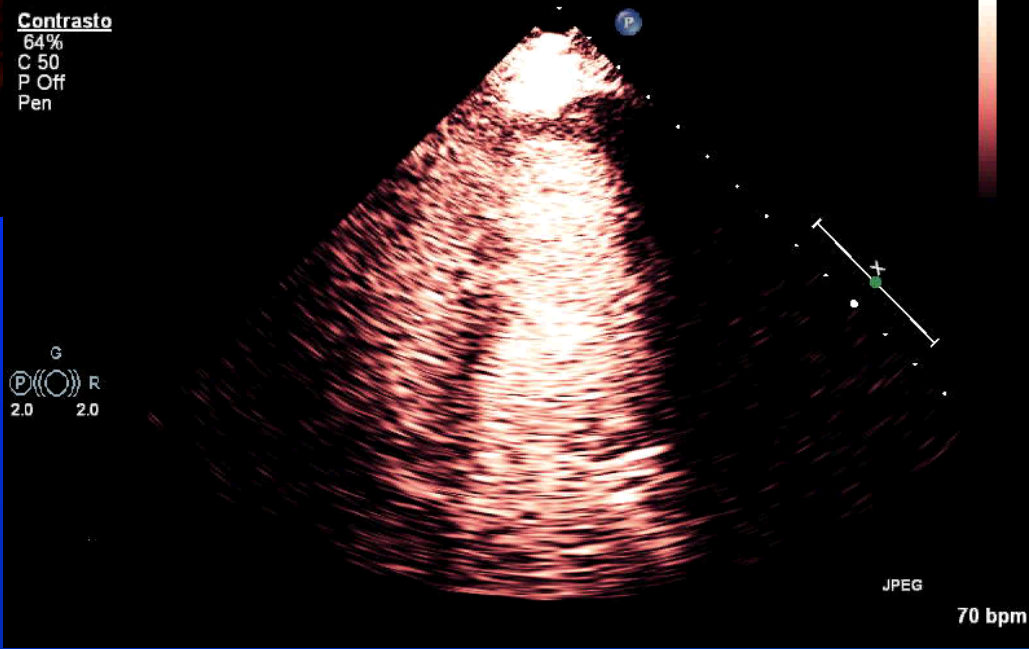
FR 53Hz  
14cm

2D  
58%  
C 51  
P Bassa  
AGen



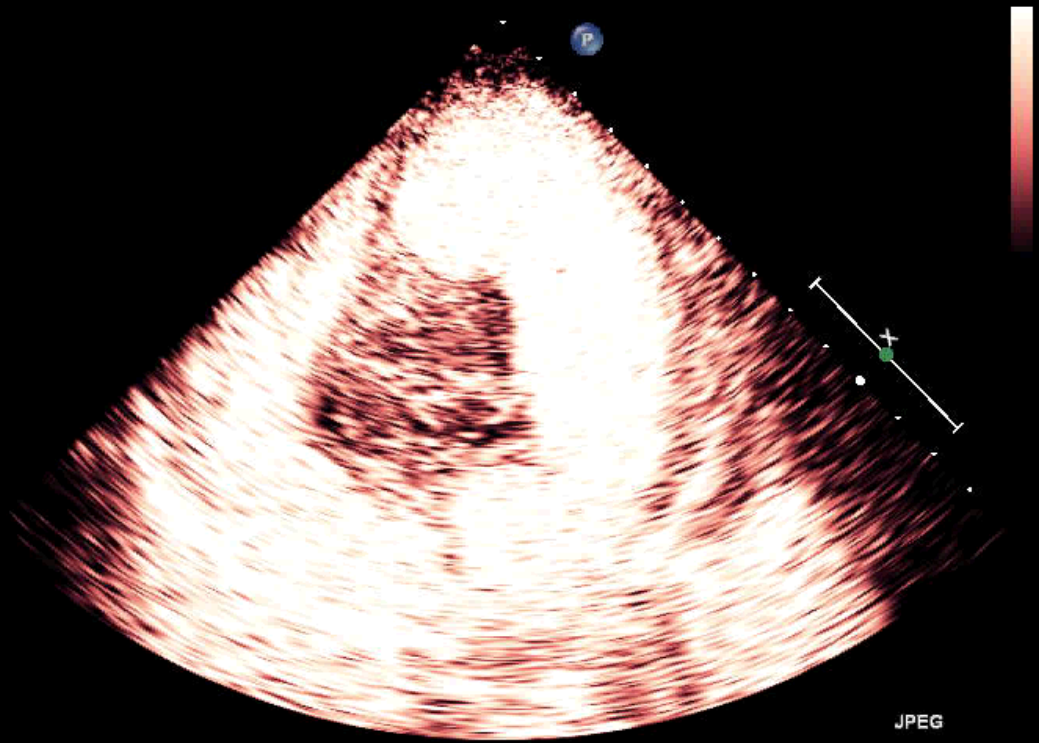
FR 27Hz  
14cm

Contrasto  
64%  
C 50  
P Off  
Pen



FR 27Hz  
14cm  
Contrasto  
64%  
C 50  
P Off  
Pen

G  
P((O))R  
2.0 2.0



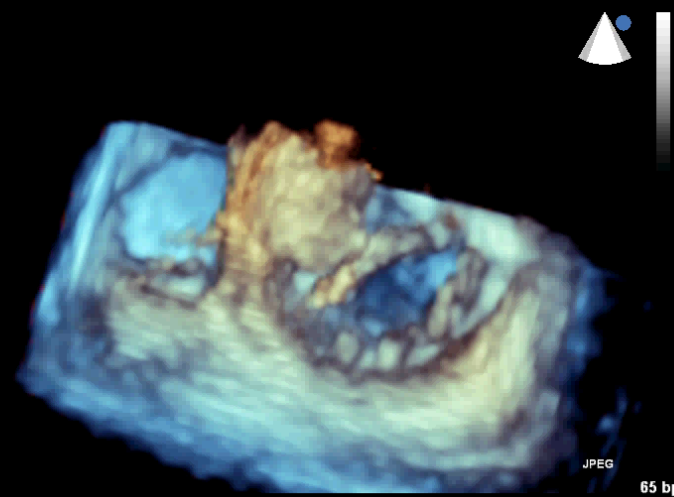
JPEG

77 bpm

Ritardo 230ms

Battiti 0

Live 3D  
3D 26%  
3D 43dB  
AGen



JPEG

65 bpm

PHILIPS MASTRODONATO ENZO

31/03/2009

10:44:55

TISO.1

MI 0.44

23/07/1940 24251020090331

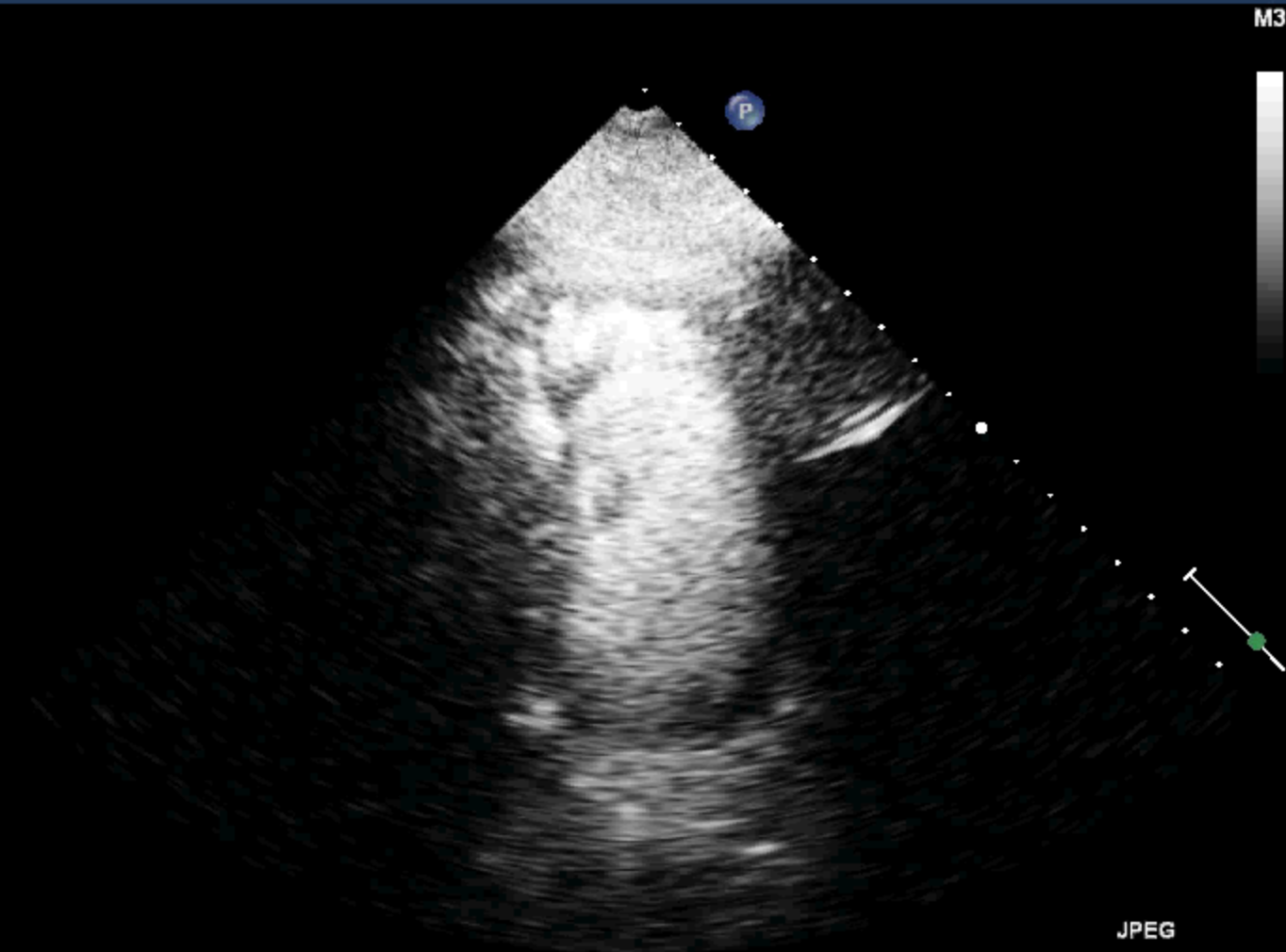
S5-1/Contr. LVO

FR 29Hz  
18cm

M3

LVO  
92%  
C 50  
P Bassa  
Ris

G  
P ((O)) (R)  
1.6 3.2



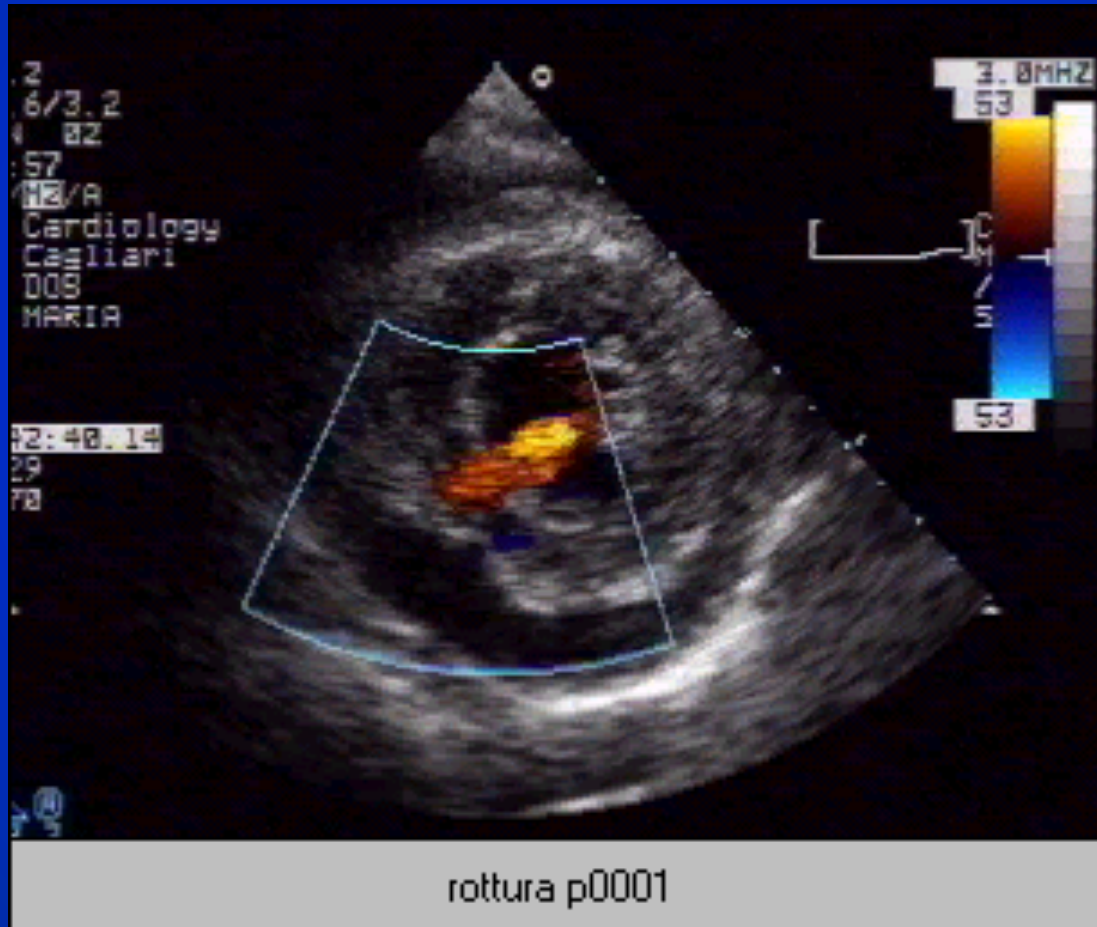
JPEG

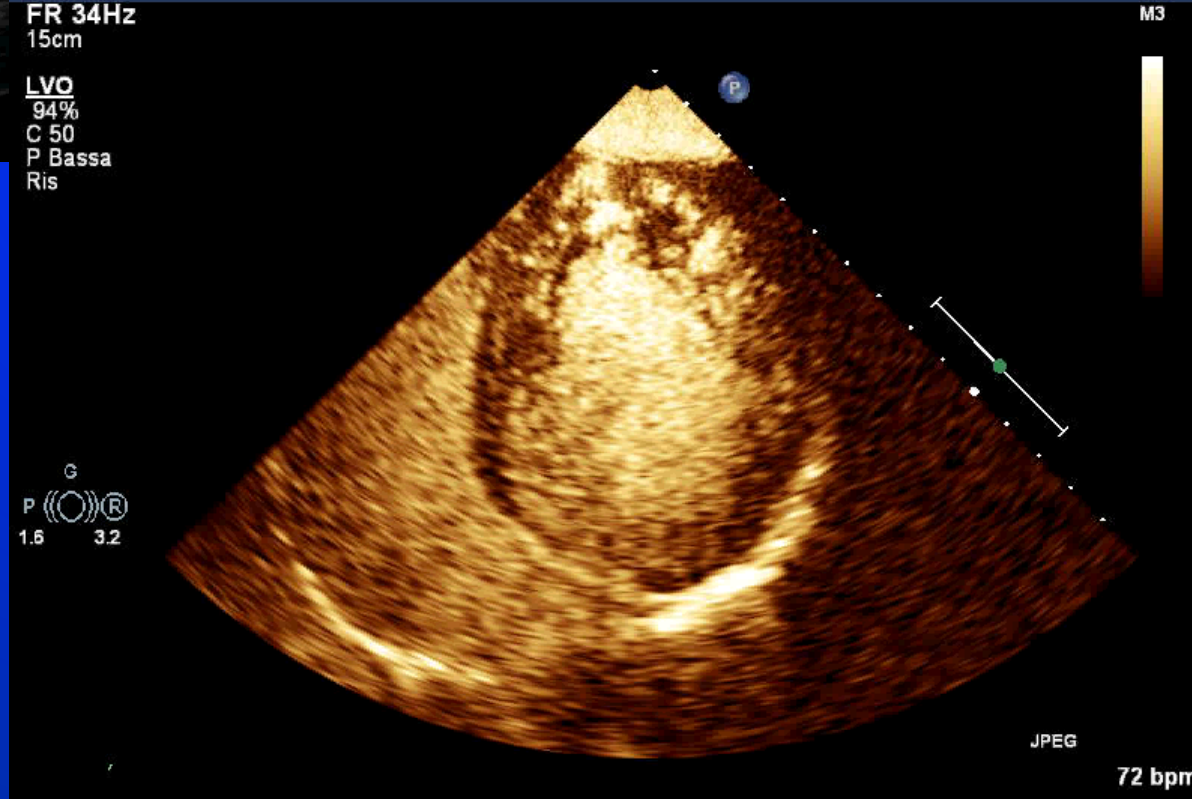
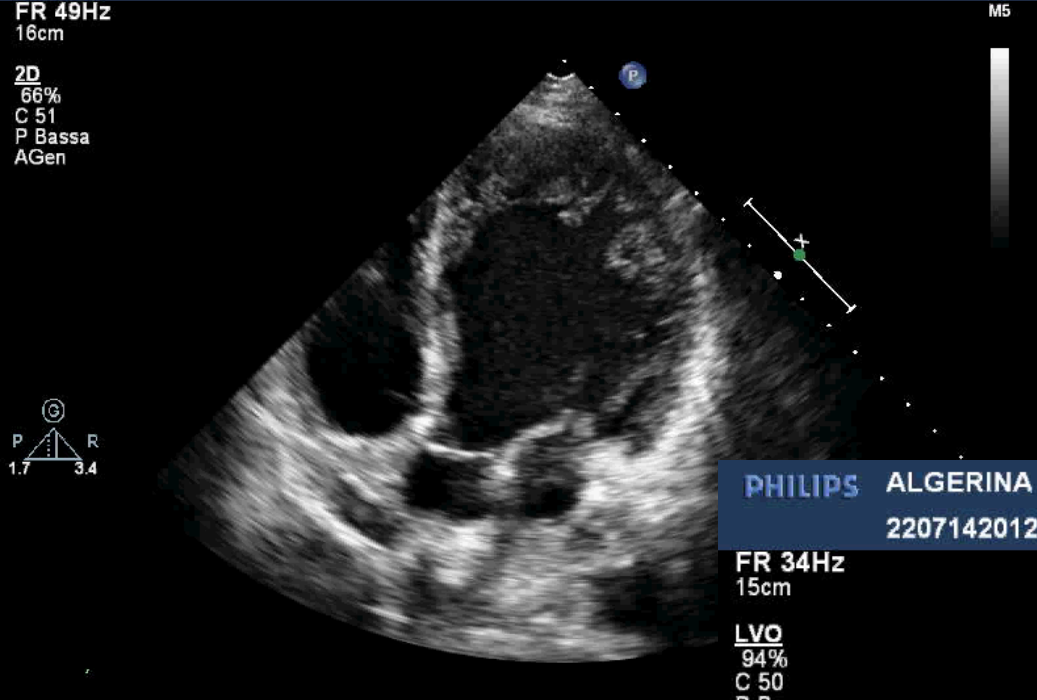
107 bpm



# No reflow after primary PTCA 5 days after procedure

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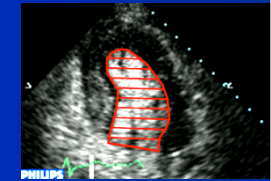
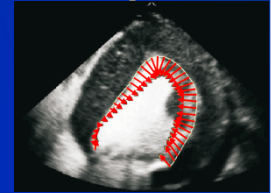


# Echocardiography

## Indications for Rest Contrast Enhanced Ultrasound

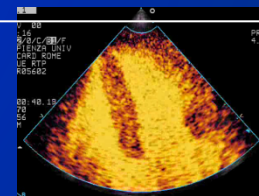
### LVO

- assessment of regional systolic function (wall motion) for detection of fixed wall motion abnormalities (rest)
- assessment of global systolic function (cardiac volumes + EF)



### MCE

- assessment of **myocardial perfusion**
- for detection of acute ischemia / myocardial infarction (rest)  
for assessment of post-infarction viability / necrosis



# ECOCONTRASTOGRAFIA MIOCARDICA

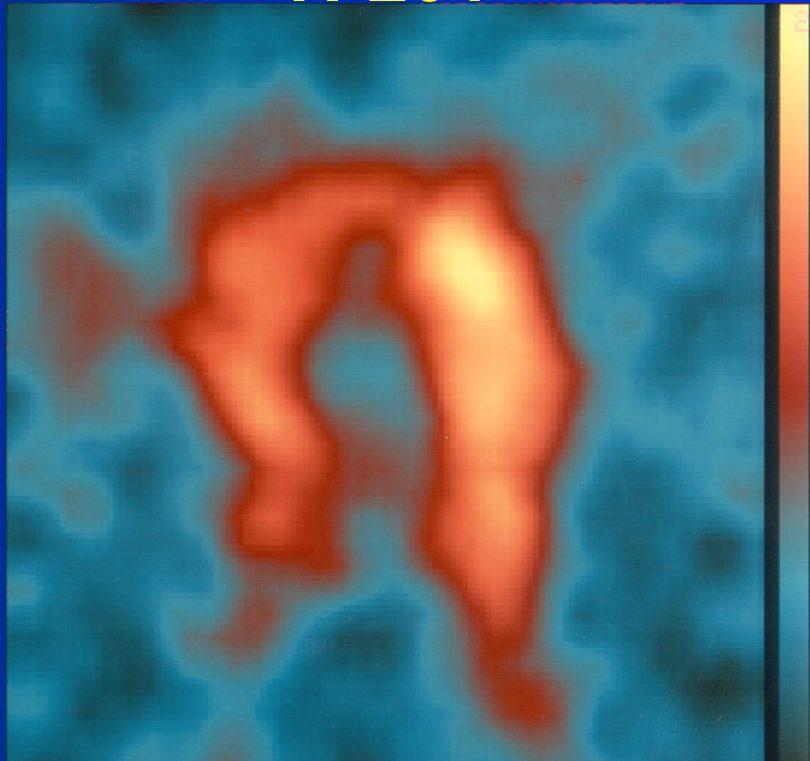
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## Applicazioni Cliniche MCE:

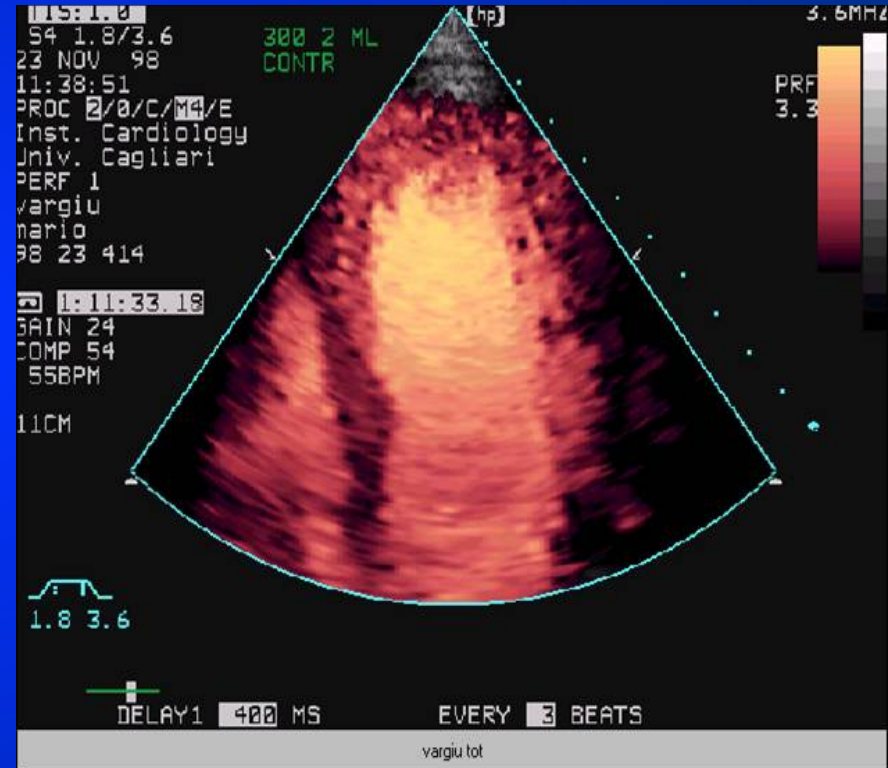
- Area a rischio durante occlusione coronarica
- Diagnosi di IMA (BBS, BBD, pacemaker)
- Monitoraggio della trombolisi e.v
- Area infartuale dopo riperfusione

# Harmonic Power Doppler MFT Contrast Ecocardiography vs TI-201 vitalità

**TI-201**

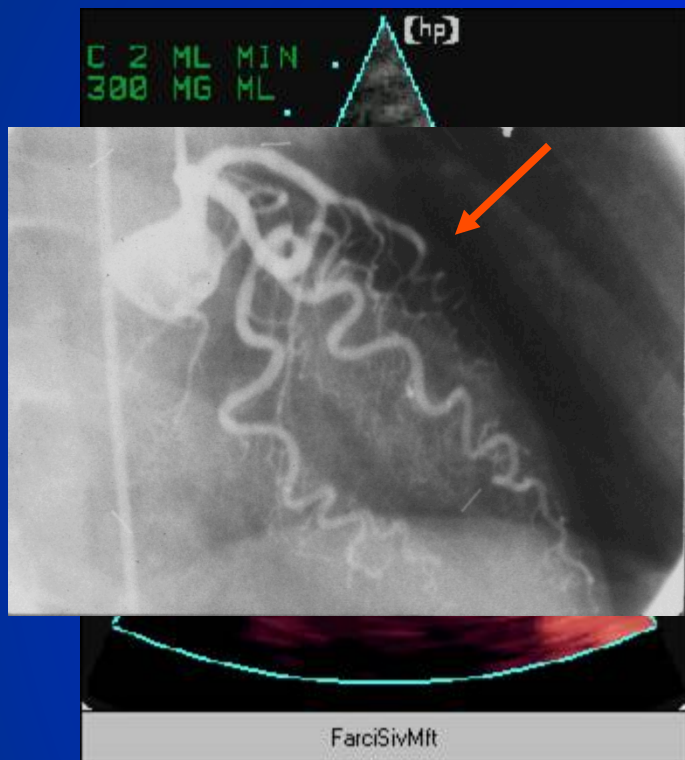


**MCE**

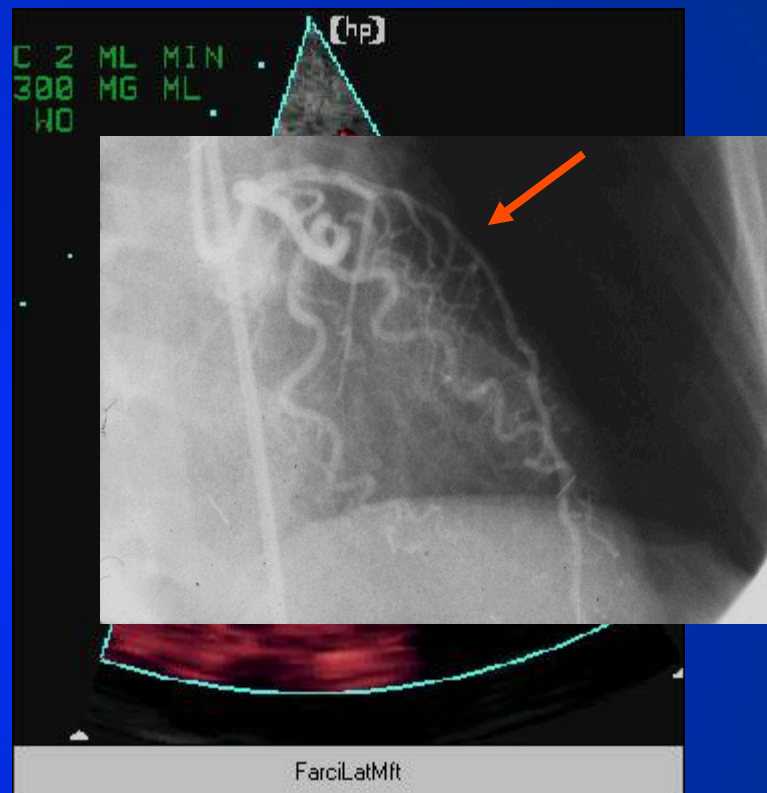


**IMA anteriosa sottoposto a PTCA primaria su tratto  
prossimale IVA entro 1 ora inizio sintomi**

# MCE: ampio difetto di perfusione



**4 camere apicale  
SIV**

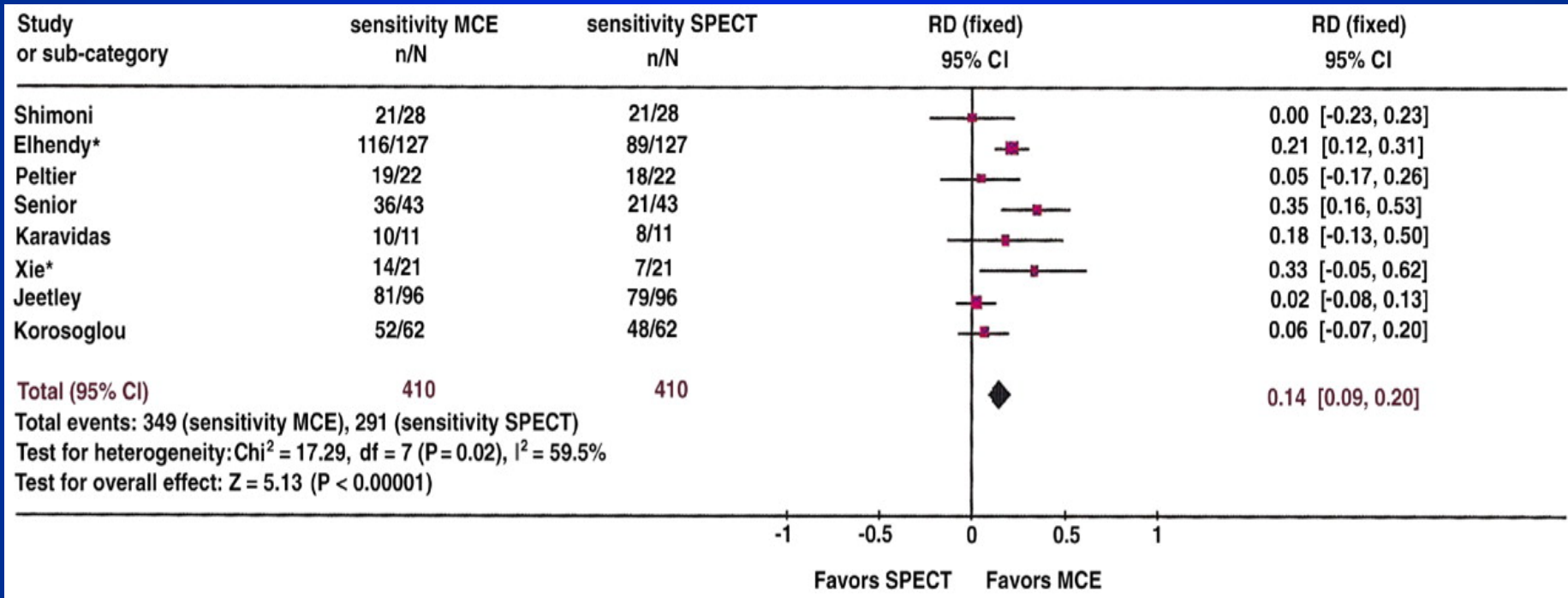


**4 camere apicale  
Parete laterale**

**IMA anteriosa sottoposto a PTCA primaria su tratto prossimale IVA entro 5 ora inizio sintomi**

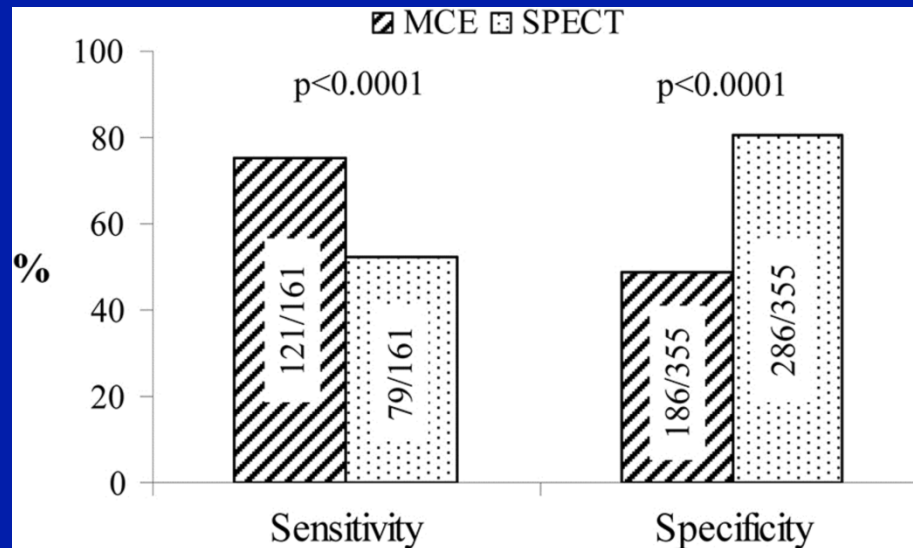
# Sens and Spec of MCE and SPECT/DSE to detect stable CAD: gold standard angiography

## Metanalisi di Dijkmans, JACC 2006



**The addition of MCE may improve sensitivity for detection of CAD over wall motion analysis during DSE. A meta-analysis of these studies and determined that the sensitivity and specificity of MCE for detection of CAD are at least not inferior to SPECT/DSE**

## From: Comparison of Sulfur Hexafluoride Microbubble (SonoVue)-Enhanced Myocardial Contrast Echocardiography With Gated Single-Photon Emission Computed Tomography for Detection of Significant Coronary Artery Disease: A Large European Multicenter Study



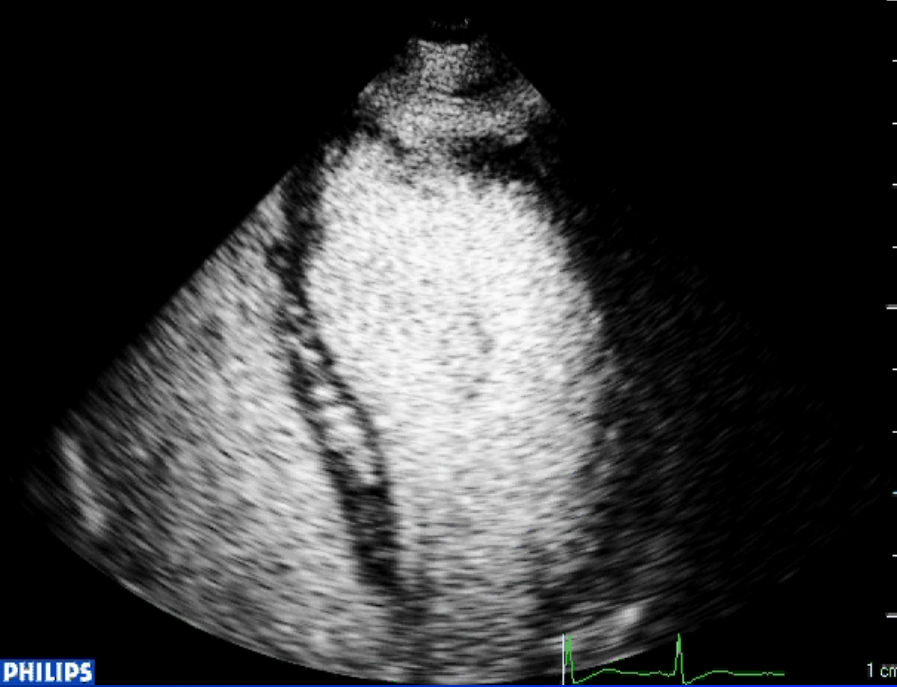
### MCE Versus SPECT for Detection of Significant ( $\geq 70\%$ Stenosis) CAD

The sensitivity of myocardial contrast echocardiography (MCE) was significantly superior to that of single-photon emission computed tomography (SPECT) for coronary artery disease (CAD) detection, although specificity was lower.



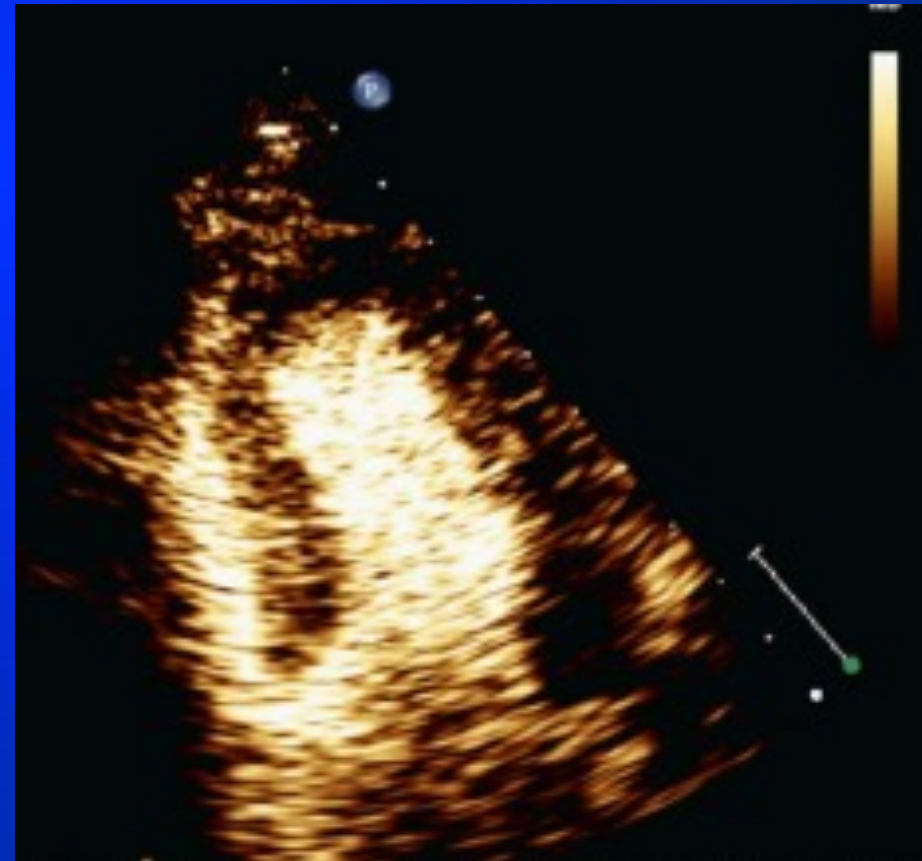
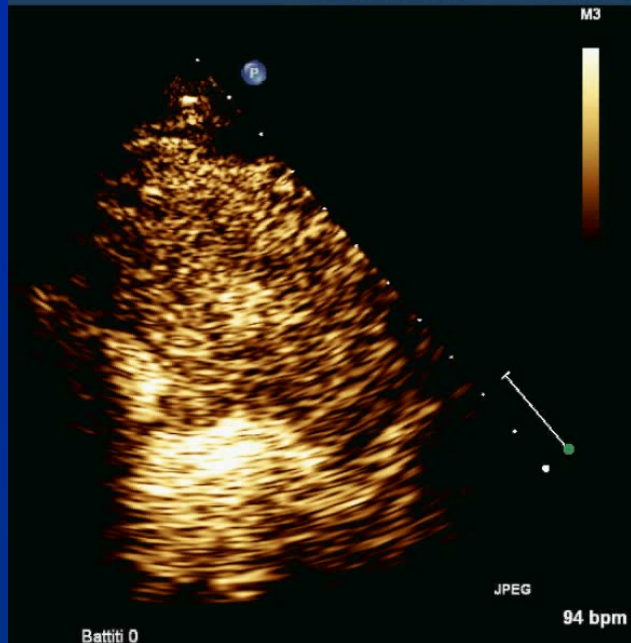
*Alterazioni della cinetica? E della perfusione?*

*Cinetica dubbia ma perfusione patologica laterale e apicale*

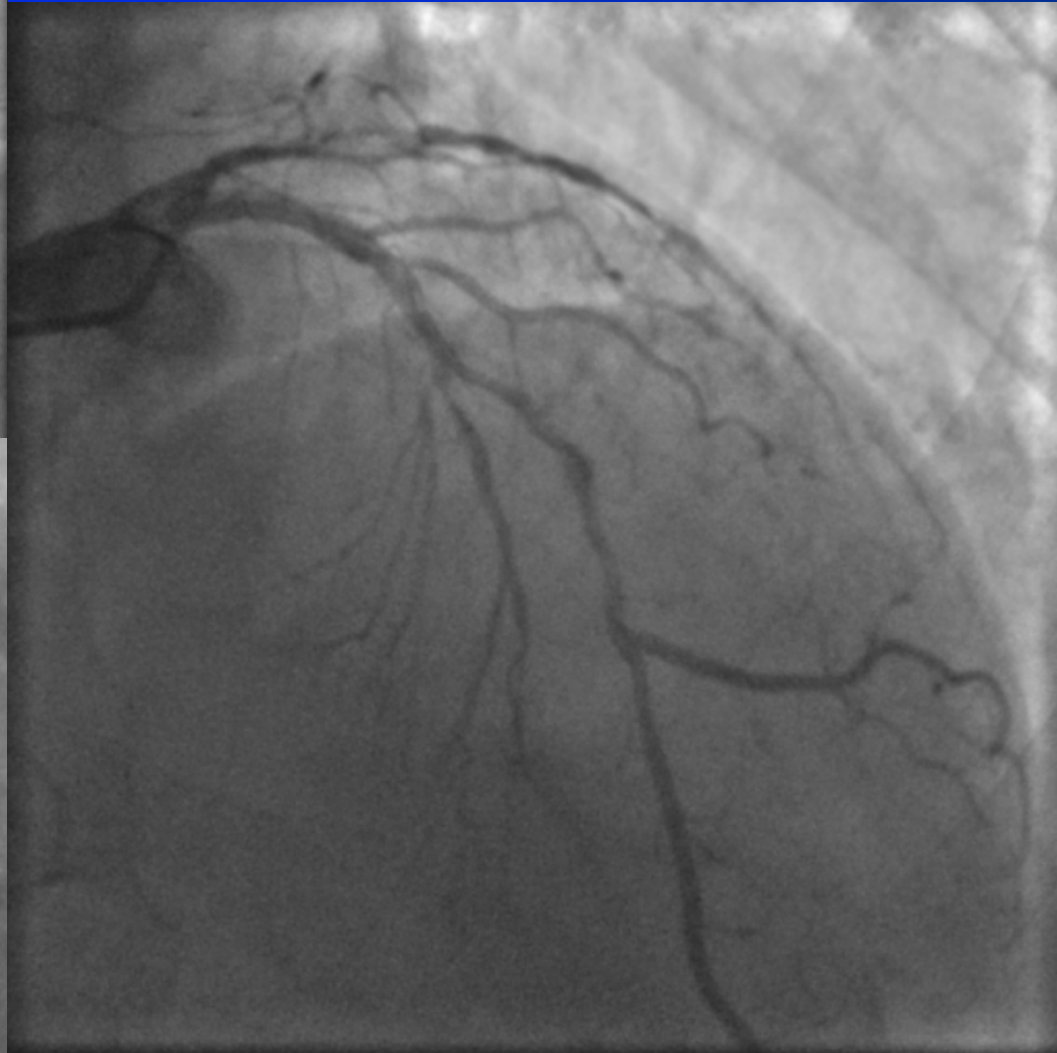
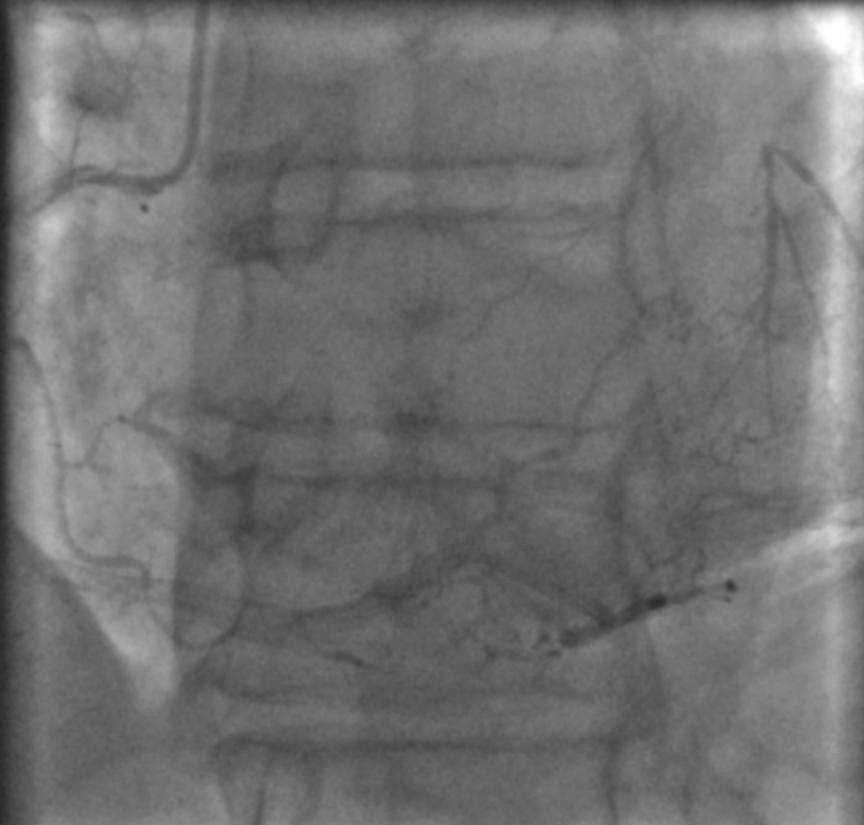


PHILIPS

22/11/2007 13:14:20 TIS0.0 JPEG CR 15  
S5-1/MIBassoG MI 1.02 F

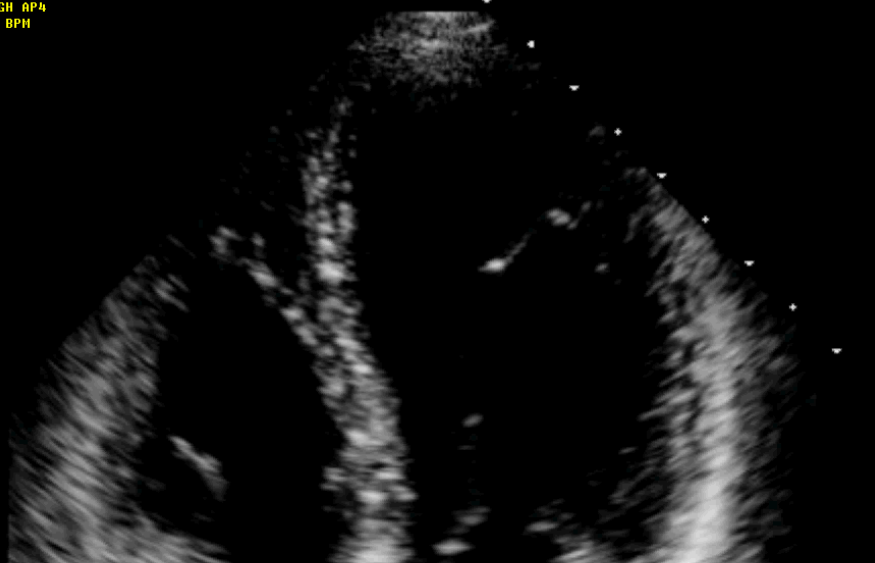


# Coronarografia (Cx, IVA, IVP)

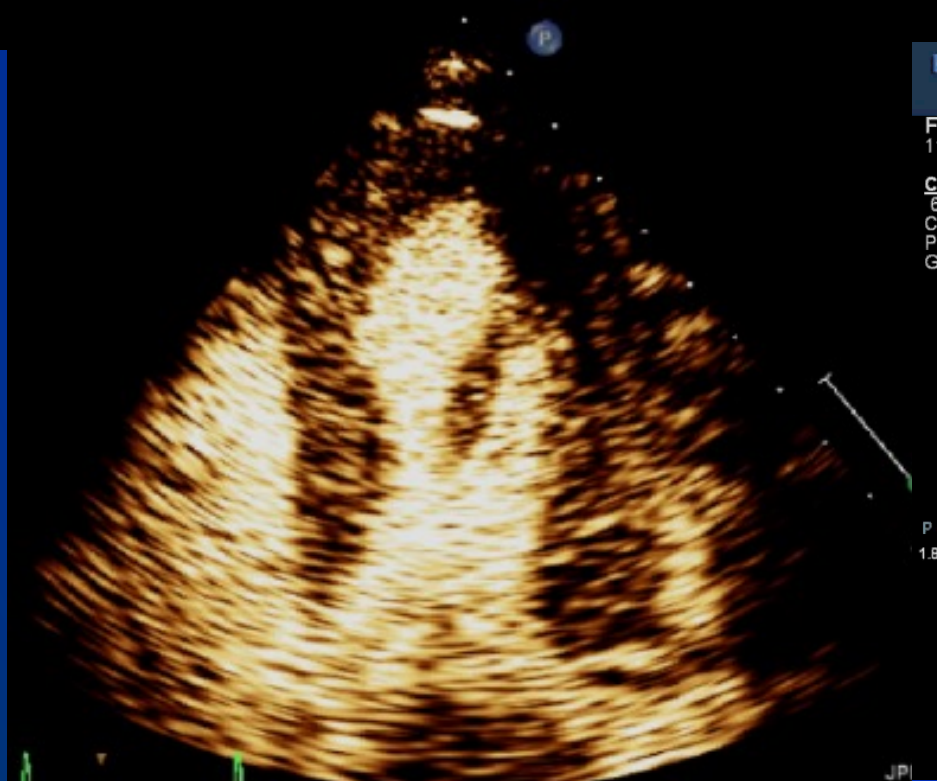


DIP HIGH AP4  
FC 71 BPM

JPEG CR 16:1



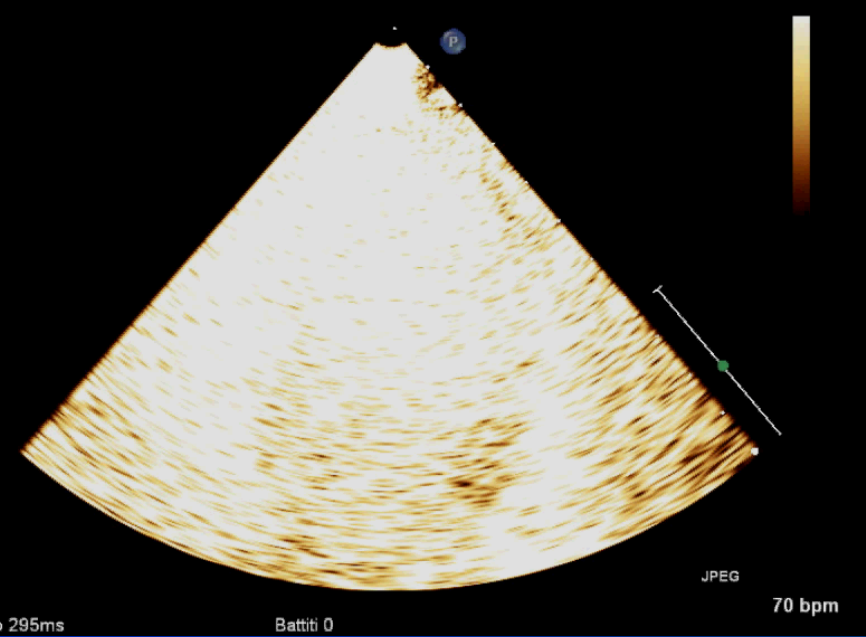
*Cinetica normale- ma marginale occluso  
(laterale medio-apicale evidente ritardo  
di perfusione)*



PHILIPS FADINI GIANPAOLO 19/11/2007 10:54:13 TIS0.0 MI 0.10 B  
FG300149 S5-1/MIBassoG MI 1.14 F

FR 36Hz  
11cm  
Contrasto  
60%  
C 46  
P Off  
Gen

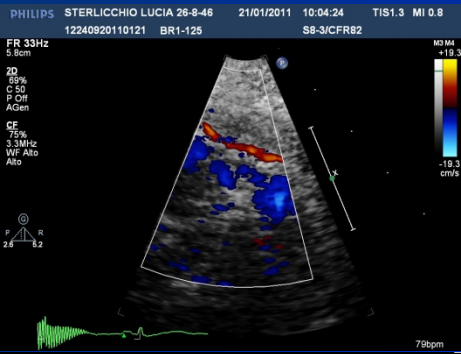
⊙  
P ⊙ R  
1.8 1.8



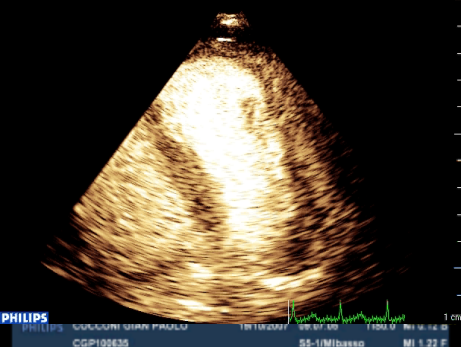
JPI Ritardo 295ms

Battiti 0

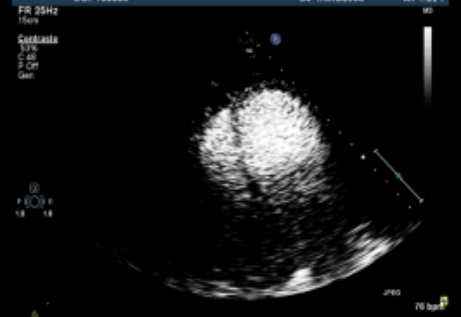
70 bpm



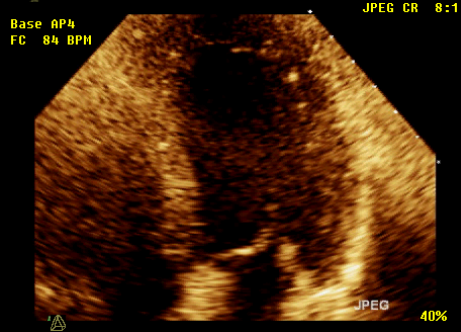
W WHAT



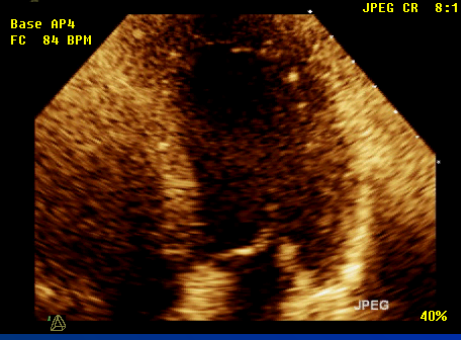
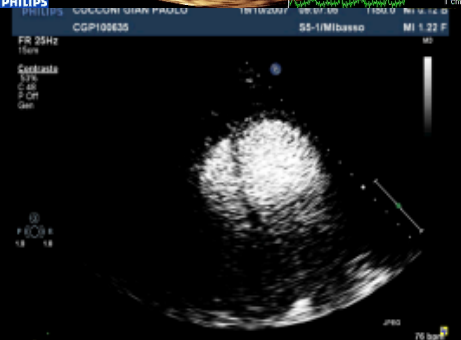
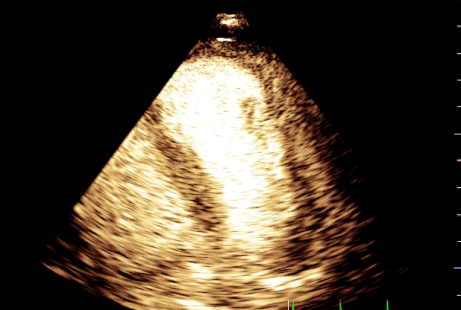
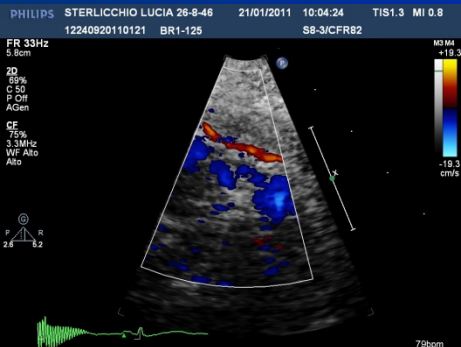
W WHERE



W WHY

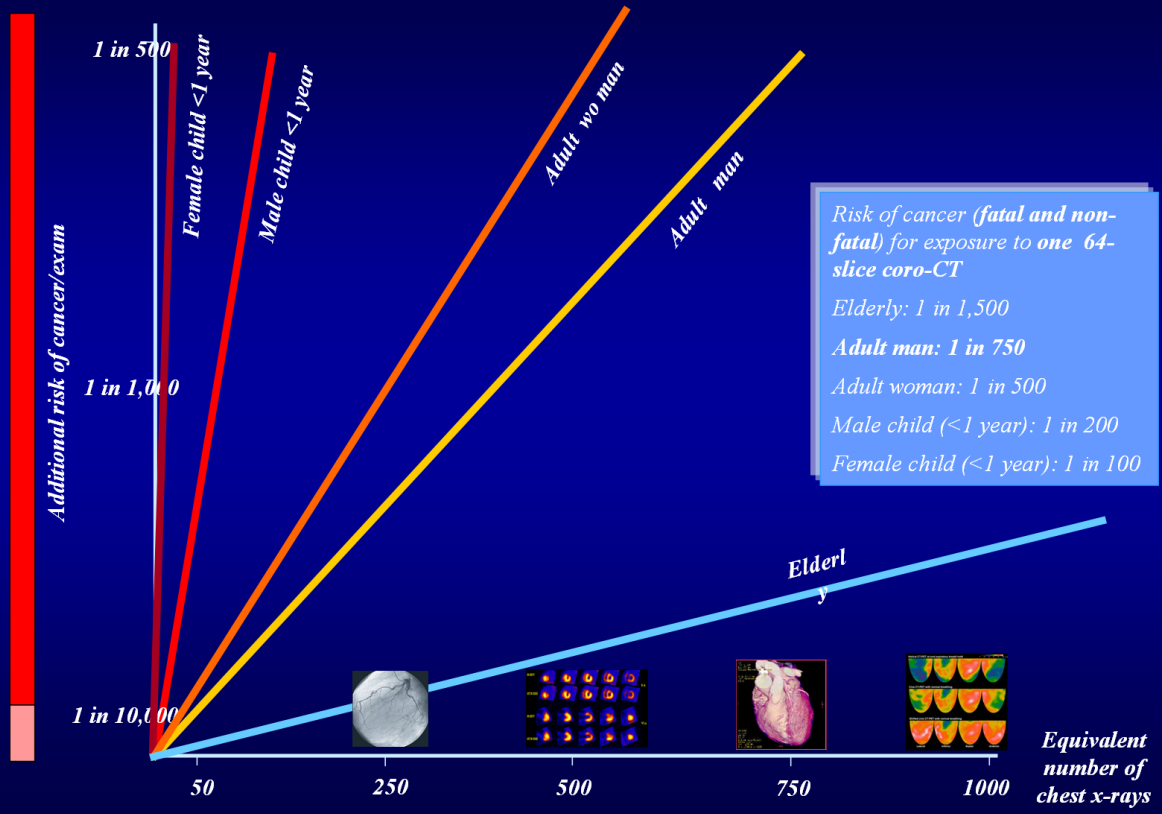


W WHEN



# W WHY

Picano E, BMJ 9 October 2004, updated with BEIR VII, 2006





**Se non riuscite a  
CONVINCERLI  
CONFONDETELI**

**Soprattutto a chi crede nell'ECO STRESS,  
meno alla CFR  
e non crede nella PERFUSIONE**