

**STRESS-ECHO**  
**Δυναμική**  
**υπερηχοκαρδιογραφία**

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**Β΄ ΚΑΡΔΙΟΛΟΓΙΚΗ ΚΛΙΝΙΚΗ**  
**Γ.Ν.Γ.ΠΑΠΑΝΙΚΟΛΑΟΥ**

# STRESS-ECHO

- 1935: Απόφραξη στεφανιαίας αρτηρίας



διαταραχή κινητικότητας τοιχώματος Αρ κοιλίας

Tennant R, Wiggers CJ  
Am J Physiol 1935;112:351-61

# Παθοφυσιολογία

Φόρτιση σε κ.φ. στεφανιαία αγγεία



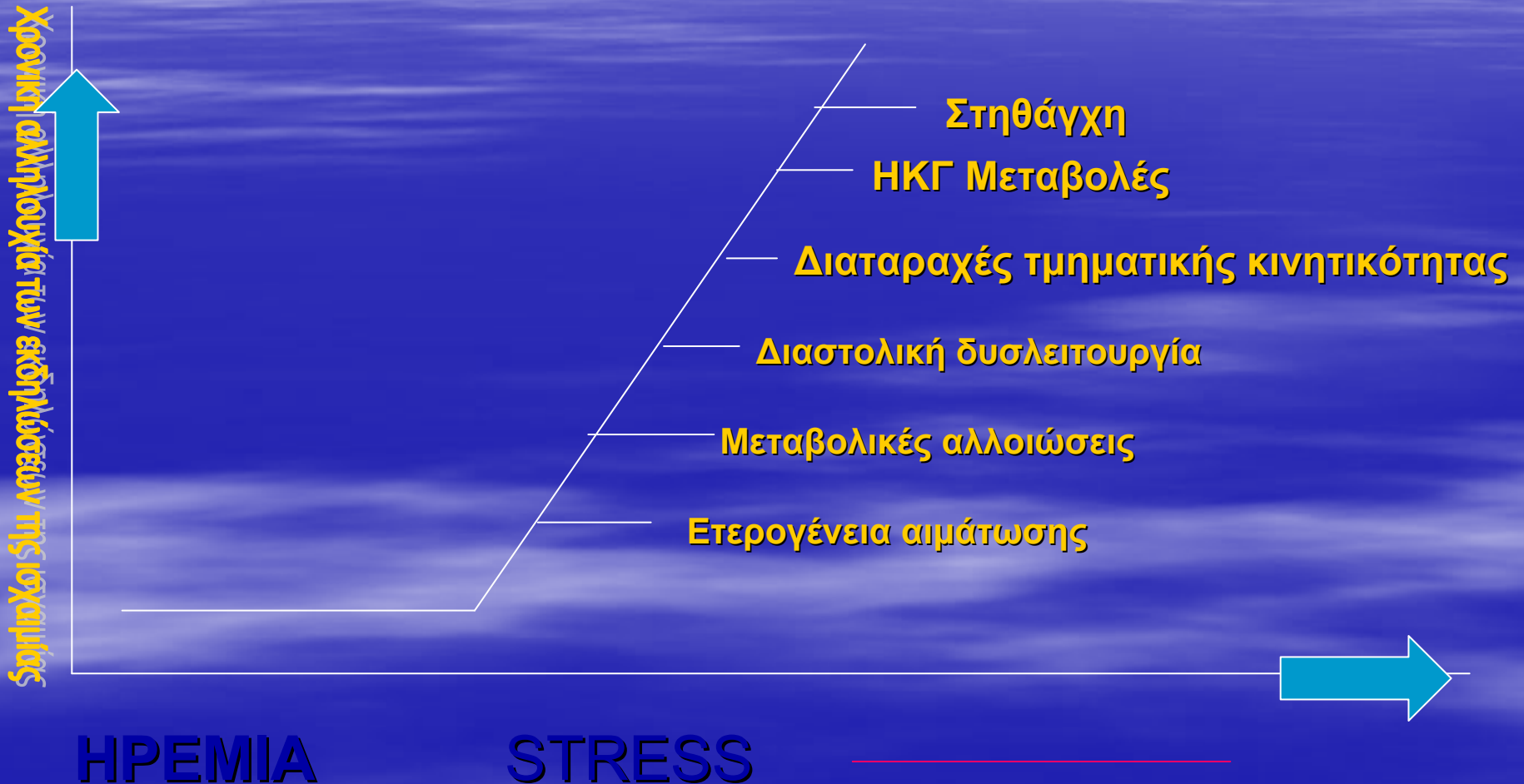
↑ καρδιακής συχνότητας  
&

↑ συσταλτικότητας ( μέσω ↑ αιματικής ροής )



↓ LVESV & ↑ EF

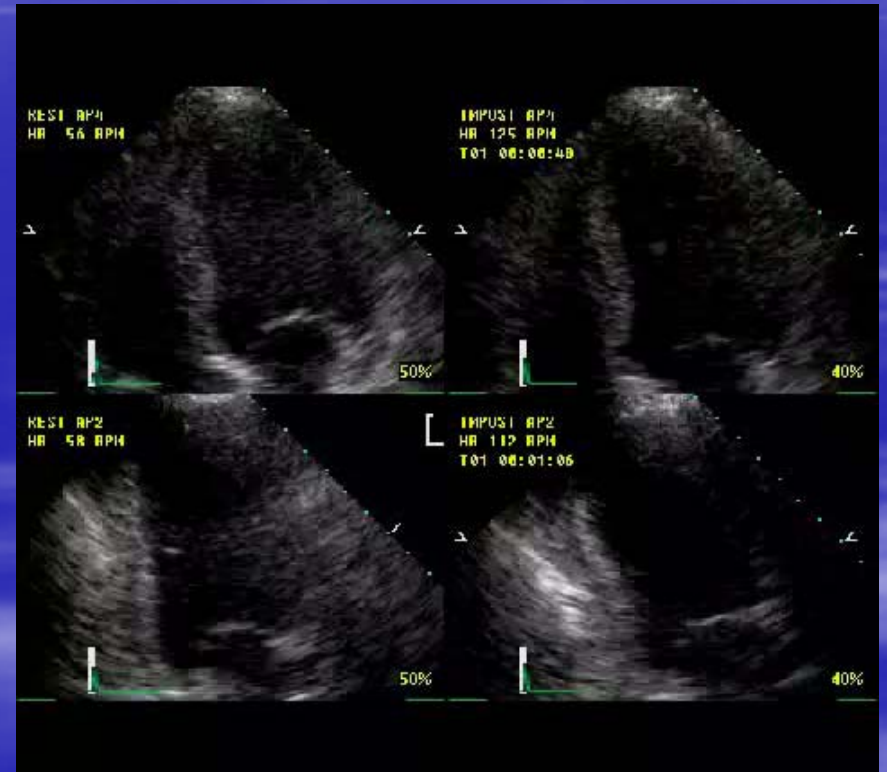
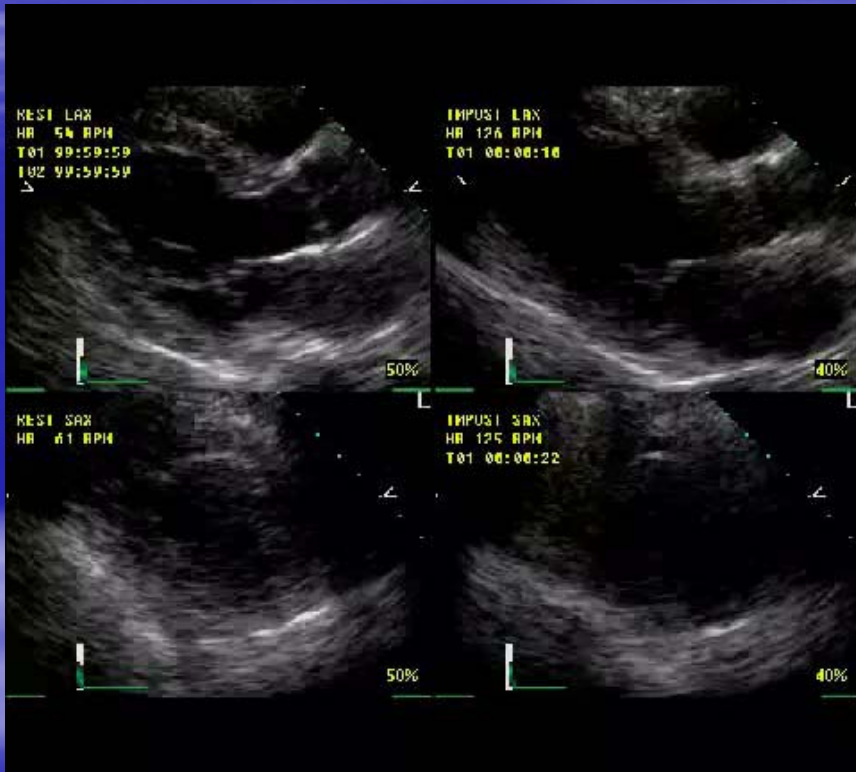
# Ο ΙΣΧΑΙΜΙΚΟΣ ΚΑΤΑΡΡΑΚΤΗΣ



# ΤΡΟΠΟΙ ΦΟΡΤΙΣΗΣ ΣΤΟ STRESS ECHO

Άσκηση	Κόπωση χωρίς άσκηση
Κυλιόμενος τάπητας	Δοβουταμίνη
Εργομετρικό ποδήλατο σε ύπτια θέση	Δυπιριδαμόλη
Εργομετρικό ποδήλατο σε όρθια θέση	Αδενοσίνη
Ισομετρική σύσφιξη χεριών	Βηματοδότηση

# Stress-echo σε κυλιόμενο τάπητα

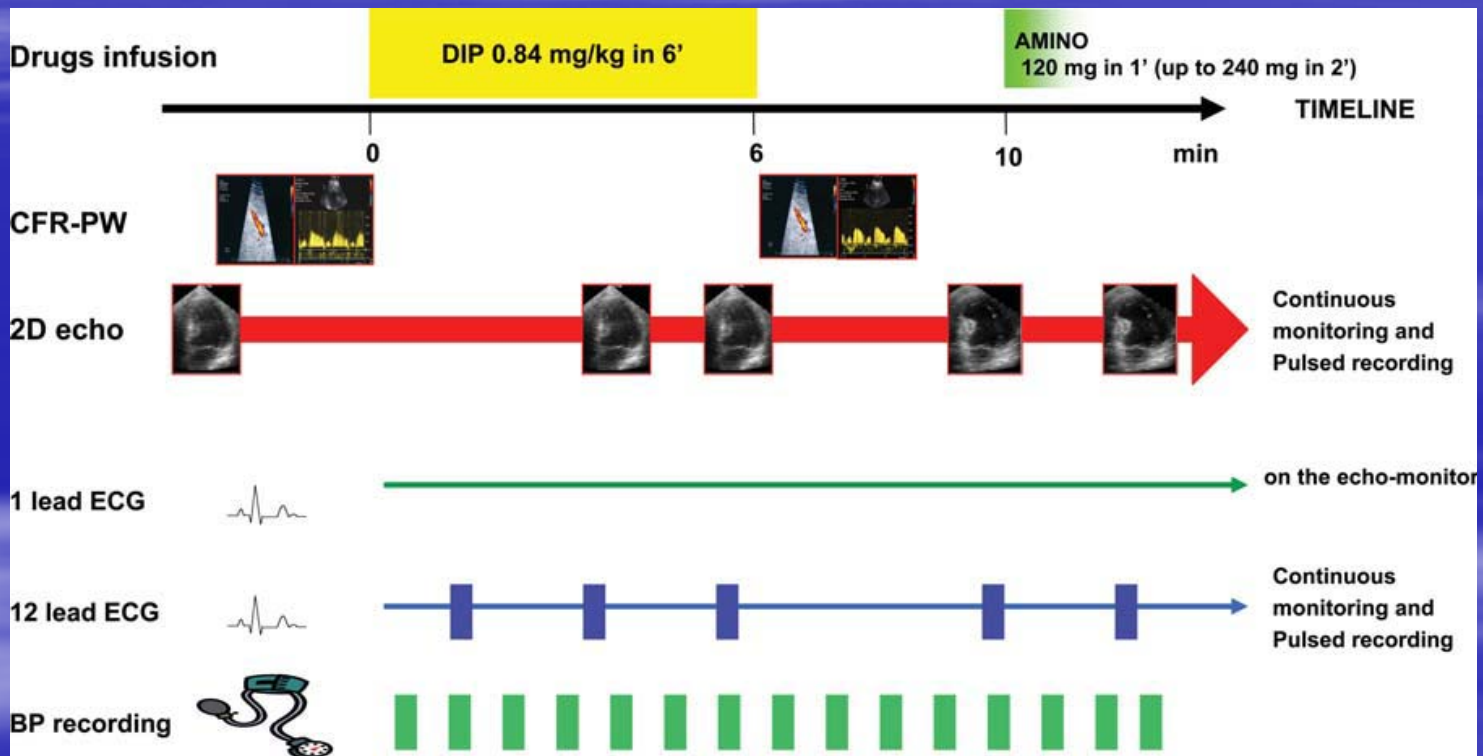


# Pharmacological stresses

**Table 1** Pharmacological stresses

	Vasodilator	Dobutamine
Receptor targets	A <sub>2</sub> adenosine	α1; β1; β2 adrenoreceptors
Haemodynamic mechanisms	Reduces supply	Increases supply
Physiological targets	Coronary arterioles	Myocardium
Cellular targets	Smooth muscle cells	Myocytes
Antidote	Aminophylline	β-Blockers
Stress	Dipyridamole (adenosine)	Dobutamine
Contraindications	Asthma, bradyarrhythmias	Tachyarrhythmias, hypertension

# State of the art protocol of Dypiridamole Stress echo

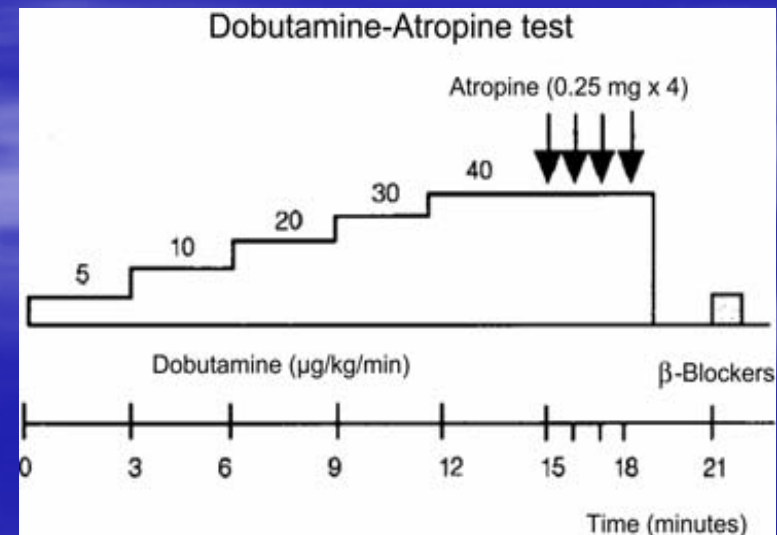


# ΑΝΤΕΝΔΕΙΞΕΙΣ ΓΙΑ STRESS-ECHO με Δυπιριδαμόλη ή Αδενοσίνη

- Σοβαρός βρογχόσπασμος
- 2<sup>ου</sup> ή 3<sup>ου</sup> βαθμού κ-Κ αποκλεισμός
- Σύνδρομο νοσούντος φλεβοκόμβου
- ↓ ΑΠ ( < 90 mmHg )
- Χρήση ξανθινών (τελευταίες 12 hr)

# ΠΡΩΤΟΚΟΛΛΟ STRESS-ECHO ΜΕ ΔΟΒΟΥΤΑΜΙΝΗ ΓΙΑ ΑΝΙΧΝΕΥΣΗ ΜΥΟΚΑΡΔΙΑΚΗΣ ΙΣΧΑΙΜΙΑΣ

- IV οδός
- Ψηφιακές εικόνες σε ηρεμία-*Echo loops* ( PLAX,SAX,4CH,2CH view)
- ΗΚΓ & ΑΠ
- Έγχυση δοβουταμίνης
- Σταδιακή  $\uparrow$  ρυθμού έγχυσης **κάθε 3 min σε δόσεις 10,20,30,40  $\mu\text{g}/\text{kg}/\text{min}$ .**
- Ανά 3 min  $\rightarrow$  ΗΚΓ,ΑΠ, -*Echo loops*
- Ατροπίνη 0,25-1 mg (αν δεν επιτευχθεί ΚΣ στόχου)
- Ανάνηψη



# ΤΕΛΙΚΟΙ ΣΤΟΧΟΙ ΚΑΙ ΛΟΓΟΙ ΤΕΡΜΑΤΙΣΜΟΥ ΤΗΣ ΕΓΧΥΣΗΣ ΔΟΒΟΥΤΑΜΙΝΗΣ ΣΕ STRESS-ECHO

- Επίτευξη ΚΣ στόχου ( 85% μέγιστης ΚΣ με βάση την ηλικία)
- Στηθάγχη
- Εντοπισμός νέας διαταραχής κινητικότητας
- ↓ ΣΑΠ > 20 mmHg από την πίεση ηρεμίας ή  
↑ ΣΑΠ > 240/120 mmHg
- Αρρυθμίες (A flutter, NSTVT)
- Ανεπιθύμητες ενέργειες ή συμπτώματα που περιορίζουν τη δοκιμασία  
(αίσθημα παλμών, ναυτία, κεφαλαλγία, ρίγος, ακράτεια ούρων, έντονη ανησυχία)

# ΑΝΤΕΝΔΕΙΞΕΙΣ ΓΙΑ STRESS-ECHO

- Οξεία στεφανιαία σύνδρομα
- Καρδιακή ανεπάρκεια ( ΝΥΗΑ III ή IV )
- Πρόσφατο ιστορικό με VT-VF
- Μη ελεγχόμενη ΑΠ
- Πρόσφατη ΠΕ
- Ενδοκαρδίτιδα, μυοκαρδίτιδα, περικαρδίτιδα

# Prognostic value of inducible myocardial ischemia

**Table 5** Stress echo risk titration of a positive test

One-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 dys-synergy	Homozonal	Heterozonal
CFR	> 2.0	< 2.0

CFR, coronary flow reserve; EF, ejection fraction; LAD, left anterior descending artery; LCx, left circumflex; RCA, right coronary artery; WMSI, wall motion score index.

# Prognostic value of inducible myocardial ischemia

**Table 6** Stress echo risk titration of a negative test

One-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; EF, ejection fraction.

# SAFETY PROFILE OF PHARMACOLOGIC STRESS-ECHO

**Table 7** Life-threatening complications in single-centre experience (>1000 patients), multicentre studies (EDIC) and multicentre registries for dobutamine stress echocardiography

Author, year	Patients	Complication(s)
Single institution experience		
Mertes <i>et al.</i> , 1993	1118	None <sup>a</sup>
Pellikka <i>et al.</i> , 1995	1000	1 AMI, 4 VT, 1 prol ischaemia
Zahn <i>et al.</i> , 1996	1000	1 VF, 1 LVF, 1 seizure
Secknus and Marwick, 1997	3011	5 VT, 1 AMI, 1 prol ischaemia, 1 hypo
Elhendy <i>et al.</i> , 1998	1164	7 VT
Bremer <i>et al.</i> , 1998	1035	1 VF, 1 VT
Poldermans <i>et al.</i> , 1994	1734	3 VF, 13 VT, 6 hypo
Mathias <i>et al.</i> , 1999	4033	1 VF, 8 VT, 1 MI; 5 atropine intoxications
Multicentre registry		
Picano <i>et al.</i> (EDIC), 1994	2949	2 VF, 2 VT, 2 AMI, 1 prol ischaemia, 1 hypo
Pezzano <i>et al.</i> (RITED), 1994	3041	2 VF, 1 asystole
Beckmann <i>et al.</i> , 1999	9354	324 (2 VF)
Varga <i>et al.</i> , 2006	35 103	63 (5 deaths)
Total	64 542	461

**Table 8** Life-threatening complications in multicentre studies (EPIC) and multicentre registries for dipyridamole stress echocardiography

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

# SAFETY PROFILE OF PHARMACOLOGIC STRESS-ECHO

**Table 9** Safety profile of pharmacological stress echocardiography

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

# ΤΑΞΙΝΟΜΗΣΗ ΤΟΙΧΩΜΑΤΙΚΗΣ ΚΙΝΗΤΙΚΟΤΗΤΑΣ

- **Υποκινησία:** διατήρηση κάποιου βαθμού πάχυνσης & προς τα έσω κίνησης του ενδοκαρδίου κατά τη συστολή < 5 mm
- **Ακινησία :** απουσία συστολικής μυοκαρδιακής πάχυνσης & ενδοκαρδιακής κίνησης
- **Δυσκινησία :** συστολική λέπτυνση & προς τα έξω κίνηση ή προβολή του μυοκαρδίου κατά τη συστολή

# Ερμηνεία τοιχωματικής κινητικότητας στο Stress-echo

**Table 2** Stress echocardiography in four equations

Rest	+	Stress	=	Diagnosis
Normokinesis	+	Normo- to hyperkinesis	=	Normal
Normokinesis	+	Hypokinesis, akinesis, dyskinesis	=	Ischaemia
Akinesis	+	Hypokinesis, normokinesis	=	Viable
Akinesis to dyskinesis	+	Akinesis to dyskinesis	=	Necrosis

# Stress Echo Appropriateness Criteria

Journal of the American College of Cardiology  
© 2011 by the American College of Cardiology Foundation  
Published by Elsevier Inc.

Vol. 57, No. 9, 2011  
ISSN 0735-1097/\$36.00  
doi:10.1016/j.jacc.2010.11.002

## APPROPRIATE USE CRITERIA

### **ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography**

A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Society of Echocardiography, American Heart Association, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Critical Care Medicine, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance

*Endorsed by the American College of Chest Physicians*

# Stress Echo Appropriateness Criteria

**Table 9. Stress Echocardiography for Detection of CAD/Risk Assessment: Symptomatic or Ischemic Equivalent**

Indication		Appropriate Use Score (1-9)
<b>Evaluation of Ischemic Equivalent (Nonacute) With Stress Echocardiography</b>		
114.	<ul style="list-style-type: none"> <li>• Low pretest probability of CAD</li> <li>• ECG interpretable and able to exercise</li> </ul>	I (3)
115.	<ul style="list-style-type: none"> <li>• Low pretest probability of CAD</li> <li>• ECG uninterpretable or unable to exercise</li> </ul>	A (7)
116.	<ul style="list-style-type: none"> <li>• Intermediate pretest probability of CAD</li> <li>• ECG interpretable and able to exercise</li> </ul>	A (7)
117.	<ul style="list-style-type: none"> <li>• Intermediate pretest probability of CAD</li> <li>• ECG uninterpretable or unable to exercise</li> </ul>	A (9)
118.	<ul style="list-style-type: none"> <li>• High pretest probability of CAD</li> <li>• Regardless of ECG interpretability and ability to exercise</li> </ul>	A (7)

# Stress Echo Appropriateness Criteria

Indication		Appropriate Use Score (1-9)
<b>Acute Chest Pain With Stress Echocardiography</b>		
119.	<ul style="list-style-type: none"> <li>• Possible ACS</li> <li>• ECG: no ischemic changes or with LBBB or electronically paced ventricular rhythm</li> <li>• Low-risk TIMI score</li> <li>• Negative troponin levels</li> </ul>	A (7)
120.	<ul style="list-style-type: none"> <li>• Possible ACS</li> <li>• ECG: no ischemic changes or with LBBB or electronically paced ventricular rhythm</li> <li>• Low-risk TIMI score</li> <li>• Peak troponin: borderline, equivocal, minimally elevated</li> </ul>	A (7)
121.	<ul style="list-style-type: none"> <li>• Possible ACS</li> <li>• ECG: no ischemic changes or with LBBB or electronically paced ventricular rhythm</li> <li>• High-risk TIMI score</li> <li>• Negative troponin levels</li> </ul>	A (7)
122.	<ul style="list-style-type: none"> <li>• Possible ACS</li> <li>• ECG: no ischemic changes or with LBBB or electronically paced ventricular rhythm</li> <li>• High-risk TIMI score</li> <li>• Peak troponin: borderline, equivocal, minimally elevated</li> </ul>	A (7)
123.	<ul style="list-style-type: none"> <li>• Definite ACS</li> </ul>	I (1)

# Stress Echo Appropriateness Criteria

**Table 10. Stress Echocardiography for Detection of CAD/Risk Assessment: Asymptomatic (Without Ischemic Equivalent)**

Indication		Appropriate Use Score (1-9)
<b>General Patient Populations With Stress Echocardiography</b>		
124.	• Low global CAD risk	I (1)
125.	• Intermediate global CAD risk • ECG interpretable	I (2)
126.	• Intermediate global CAD risk • ECG uninterpretable	U (5)
127.	• High global CAD risk	U (5)

# Stress Echo Appropriateness Criteria

**Table 12. Stress Echocardiography Following Prior Test Results**

Indication	Appropriate Use Score (1-9)	
<b>Asymptomatic: Prior Evidence of Subclinical Disease With Stress Echocardiography</b>		
136.	<ul style="list-style-type: none"> <li>• Coronary calcium Agatston score &lt;100</li> </ul>	I (2)
137.	<ul style="list-style-type: none"> <li>• Low to Intermediate global CAD risk</li> <li>• Coronary calcium Agatston score between 100 and 400</li> </ul>	U (5)
138.	<ul style="list-style-type: none"> <li>• High global CAD risk</li> <li>• Coronary calcium Agatston score between 100 and 400</li> </ul>	U (6)
139.	<ul style="list-style-type: none"> <li>• Coronary calcium Agatston score &gt;400</li> </ul>	A (7)
140.	<ul style="list-style-type: none"> <li>• Abnormal carotid intimal medial thickness (<math>\geq 0.9</math> mm and/or the presence of plaque encroaching into the arterial lumen)</li> </ul>	U (5)
<b>Coronary Angiography (Invasive or Noninvasive) With Stress Echocardiography</b>		
141.	<ul style="list-style-type: none"> <li>• Coronary artery stenosis of unclear significance</li> </ul>	A (8)

# Stress Echo Appropriateness Criteria

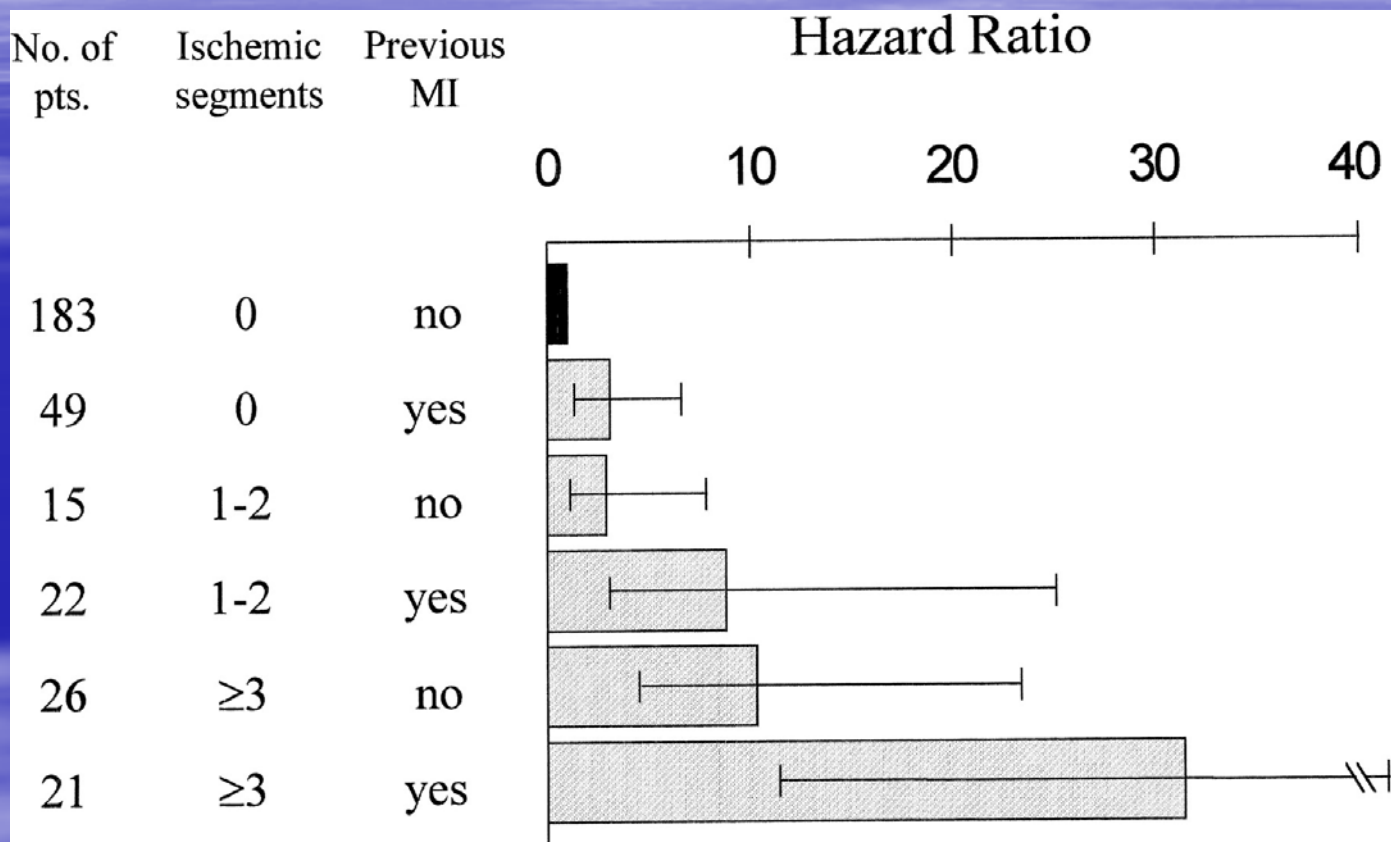
**Table 13. Stress Echocardiography for Risk Assessment: Perioperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions**

Indication		Appropriate Use Score (1–9)
<b>Low-Risk Surgery With Stress Echocardiography</b>		
154.	• Perioperative evaluation for risk assessment	I (1)
<b>Intermediate-Risk Surgery With Stress Echocardiography</b>		
155.	• Moderate to good functional capacity ( $\geq 4$ METs)	I (3)
156.	• No clinical risk factors	I (2)
157.	• $\geq 1$ clinical risk factor • Poor or unknown functional capacity ( $< 4$ METs)	U (8)
158.	• Asymptomatic $< 1$ y post normal catheterization, noninvasive test, or previous revascularization	I (1)
<b>Vascular Surgery With Stress Echocardiography</b>		
159.	• Moderate to good functional capacity ( $\geq 4$ METs)	I (3)
160.	• No clinical risk factors	I (2)
161.	• $\geq 1$ clinical risk factor • Poor or unknown functional capacity ( $< 4$ METs)	A (7)
162.	• Asymptomatic $< 1$ y post normal catheterization, noninvasive test, or previous revascularization	I (2)

# Προεγχειρητική εκτίμηση κινδύνου σε εξωκαρδιακή χειρουργική επέμβαση

- Απουσία προκλητής διαταραχής κινητικότητας → **πολύ ευνοϊκή πρόγνωση**
- Ύπαρξη προκλητής διαταραχής κινητικότητας →  
↑ **περιεγχειρητικός κίνδυνος**
- Διαταραχή κινητικότητας σε ηρεμία, αλλά χωρίς ένδειξη ισχαιμίας → **ενδιάμεση ομάδα**

Hazard ratios for all late cardiac events after major vascular surgery (ie, cardiac death, myocardial infarction (MI), or coronary revascularization) as a function of the extent of new wall motion abnormalities during dobutamine stress echocardiography and the presence or absence of preoperative myocardial infarction



Poldermans, D. et al. *Circulation* 1997;95:53-58

# Stress Echo Appropriateness Criteria

**Table 14. Stress Echocardiography for Risk Assessment: Within 3 Months of an ACS**

Indication		Appropriate Use Score (1–9)
<b>STEMI With Stress Echocardiography</b>		
163.	<ul style="list-style-type: none"> <li>• Primary PCI with complete revascularization</li> <li>• No recurrent symptoms</li> </ul>	I (2)
164.	<ul style="list-style-type: none"> <li>• Hemodynamically stable, no recurrent chest pain symptoms, or no signs of HF</li> <li>• To evaluate for inducible ischemia</li> <li>• No prior coronary angiography since the index event</li> </ul>	A (7)
165.	<ul style="list-style-type: none"> <li>• Hemodynamically unstable, signs of cardiogenic shock, or mechanical complications</li> </ul>	I (1)
<b>UA/NSTEMI With Stress Echocardiography</b>		
166.	<ul style="list-style-type: none"> <li>• Hemodynamically stable, no recurrent chest pain symptoms, or no signs of HF</li> <li>• To evaluate for inducible ischemia</li> <li>• No prior coronary angiography since the index event</li> </ul>	A (8)
<b>ACS—Asymptomatic Postrevascularization (PCI or CABG) With Stress Echocardiography</b>		
167.	<ul style="list-style-type: none"> <li>• Prior to hospital discharge in a patient who has been adequately revascularized</li> </ul>	I (1)
<b>Cardiac Rehabilitation With Stress Echocardiography</b>		
168.	<ul style="list-style-type: none"> <li>• Prior to initiation of cardiac rehabilitation (as a stand-alone indication)</li> </ul>	I (3)

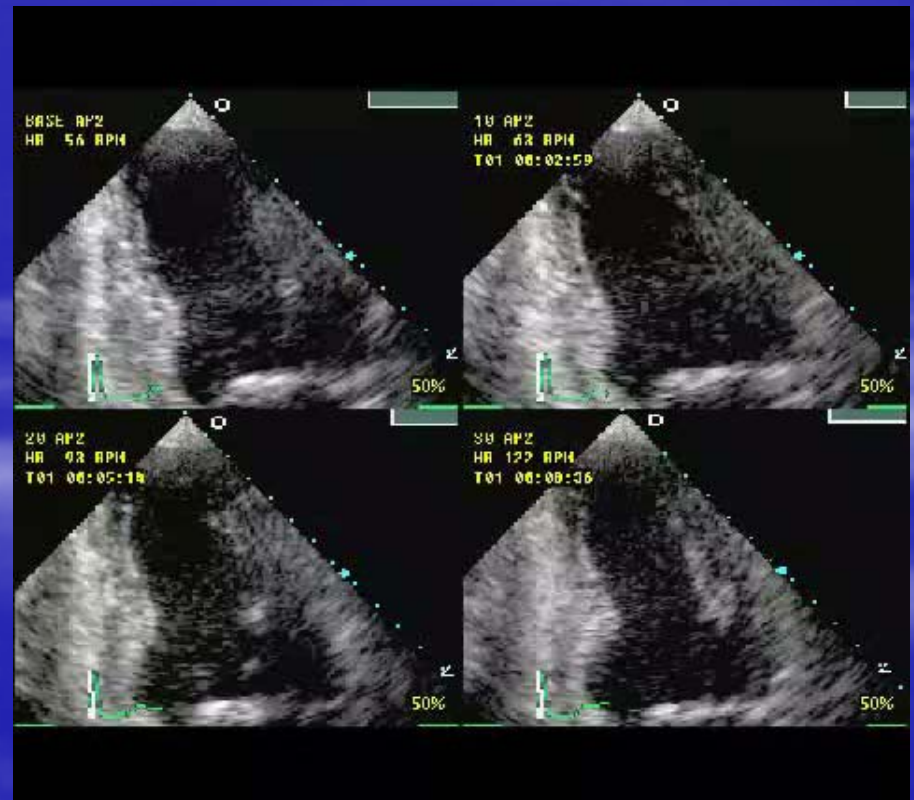
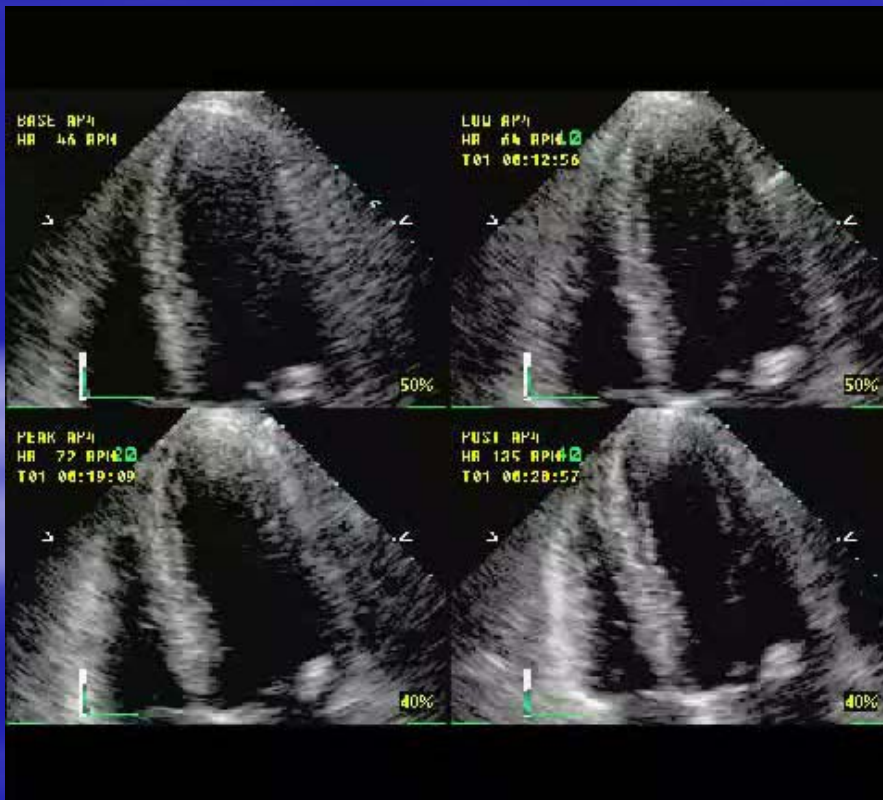
# Stress Echo Appropriateness Criteria

**Table 15. Stress Echocardiography for Risk Assessment: Postrevascularization (PCI or CABG)**

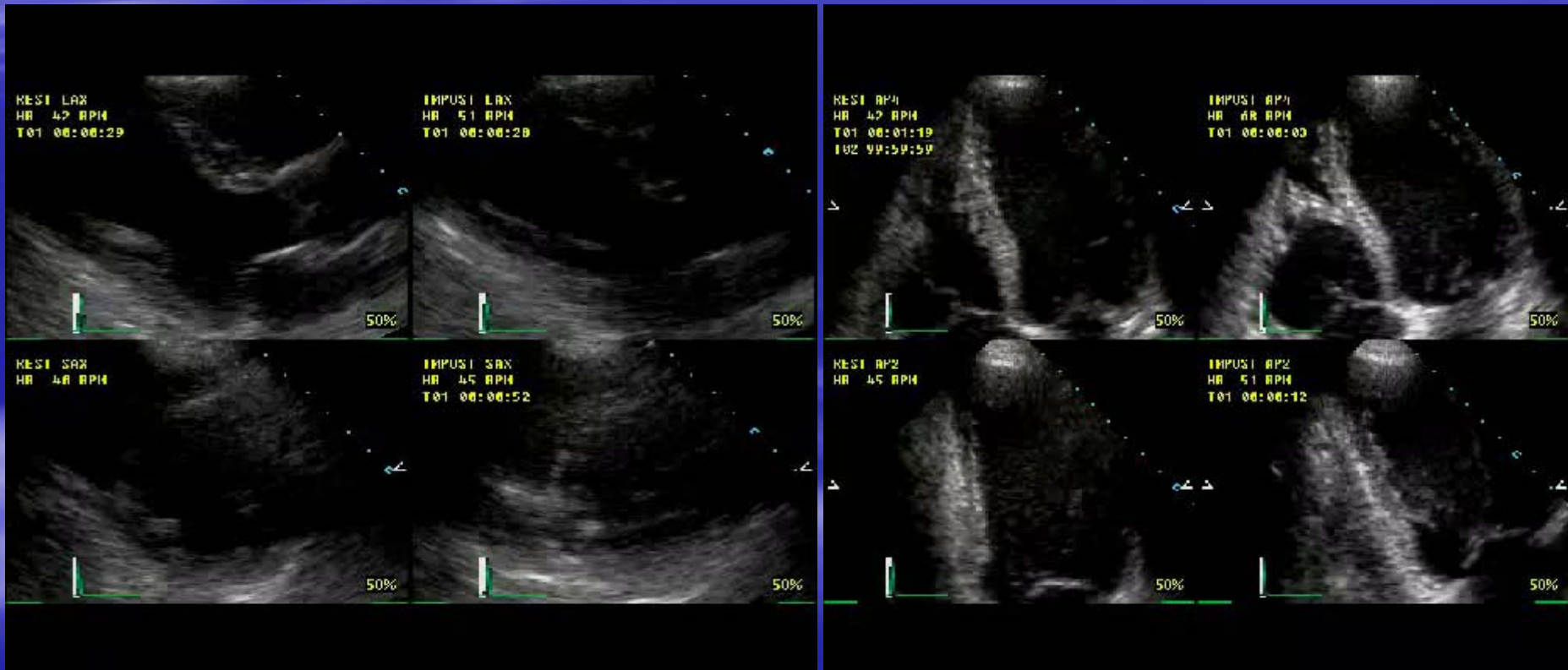
Indication		Appropriate Use Score (1–9)
<b>Symptomatic With Stress Echocardiography</b>		
169.	• Ischemic equivalent	A (8)
<b>Asymptomatic With Stress Echocardiography</b>		
170.	• Incomplete revascularization • Additional revascularization feasible	A (7)
171.	• <5 y after CABG	I (2)
172.	• ≥5 y after CABG	U (6)
173.	• <2 y after PCI	I (2)
174.	• ≥2 y after PCI	U (5)
<b>Cardiac Rehabilitation With Stress Echocardiography</b>		
175.	• Prior to initiation of cardiac rehabilitation (as a stand-alone indication)	I (3)

# Stress echo για εντόπιση στεφανιαίων βλαβών

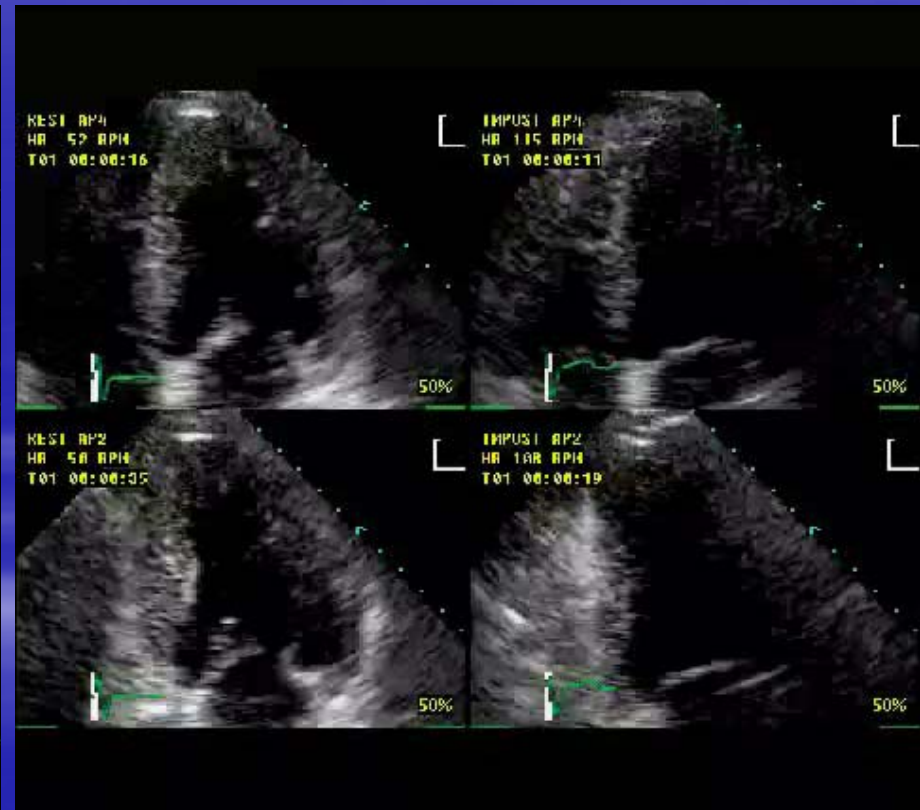
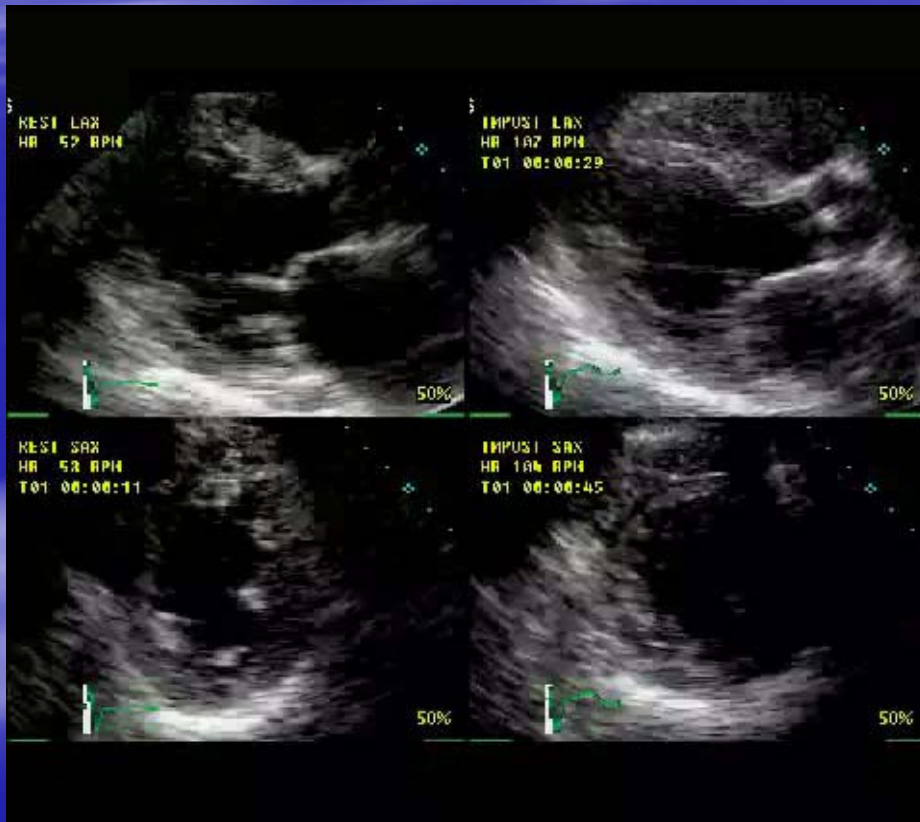
- Πιο ευαίσθητο σε πολυαγγειακή νόσο
- Πιο ακριβής σε LAD & RCA



# STRESS-ECHO σε πολυαγγειακή νόσο

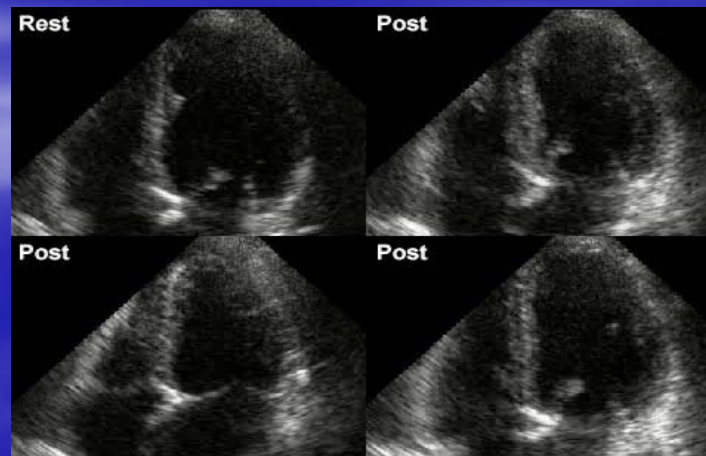
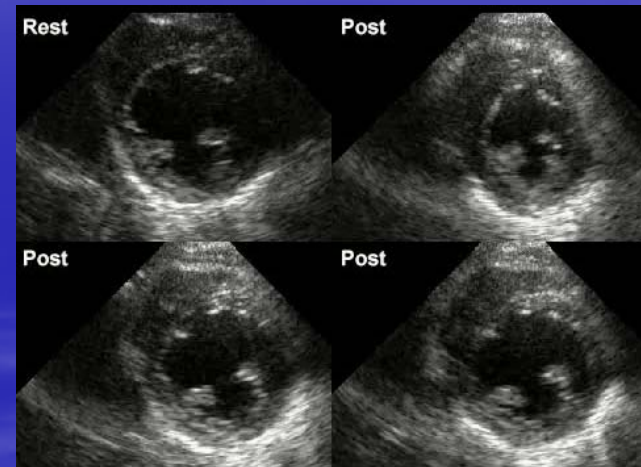
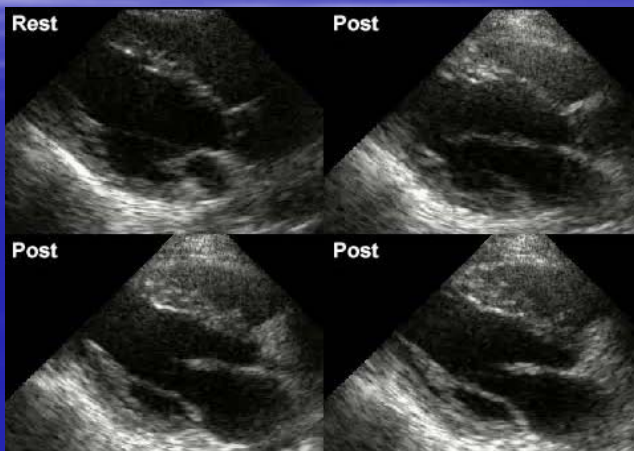


# STRESS-ECHO σε πολυαγγειακή νόσο



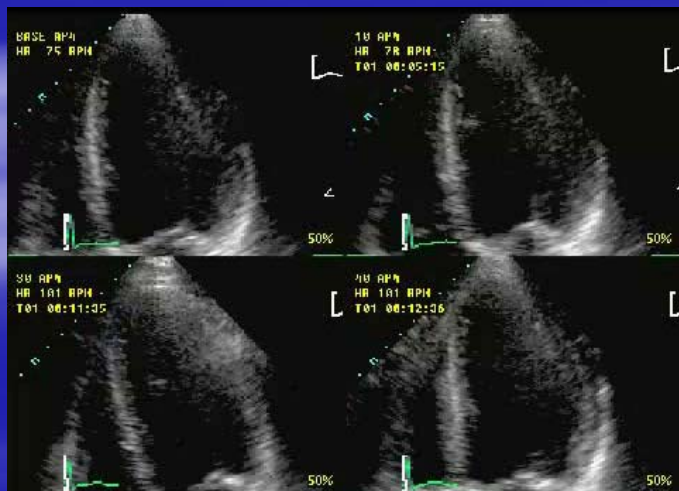
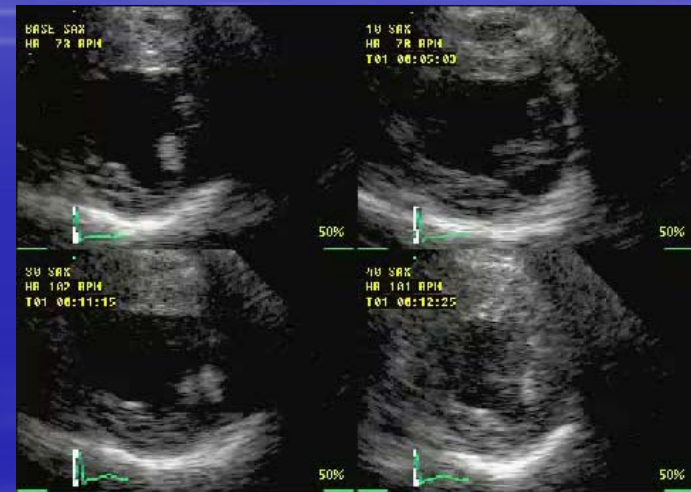
# Stress echo σε Παθολογικό ή μη διαγνωστικό test κοπώσεως

- Παθολογικό ΗΚΓ (LBBB, strain LV )

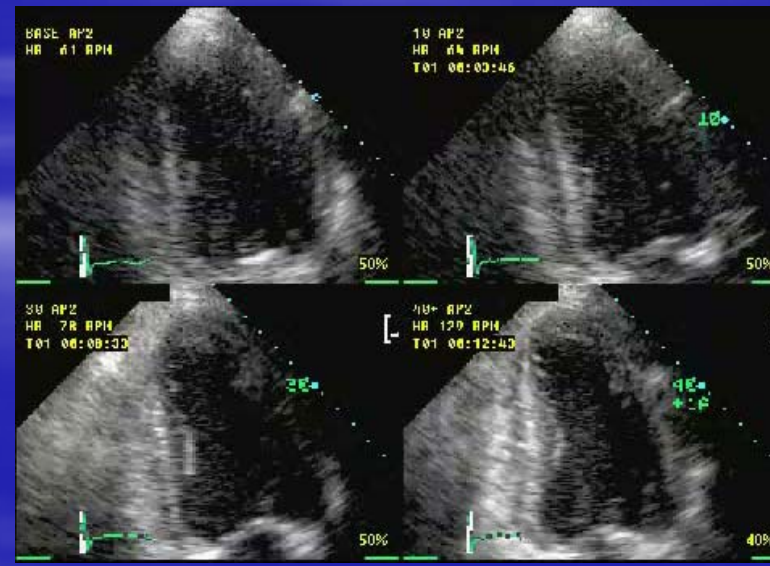
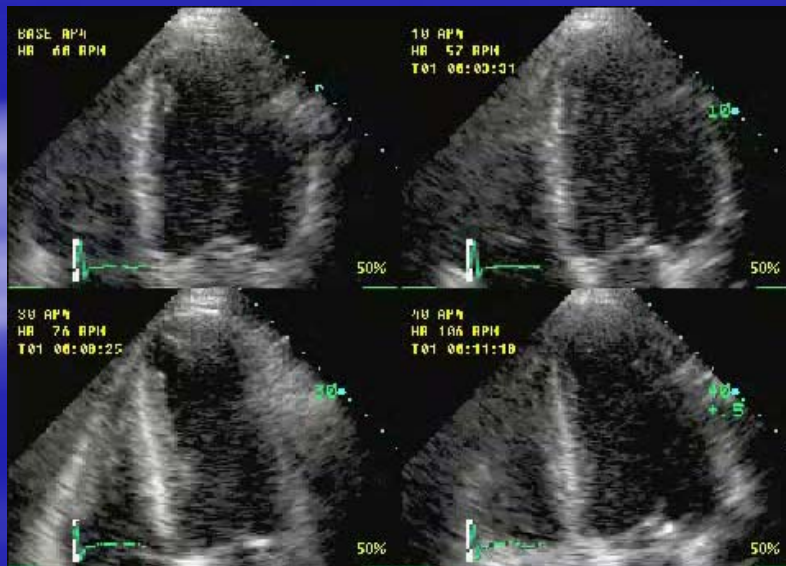
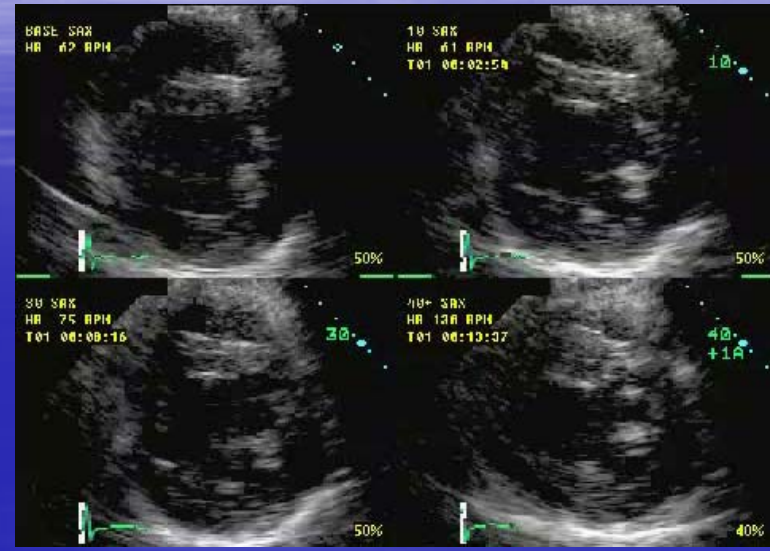
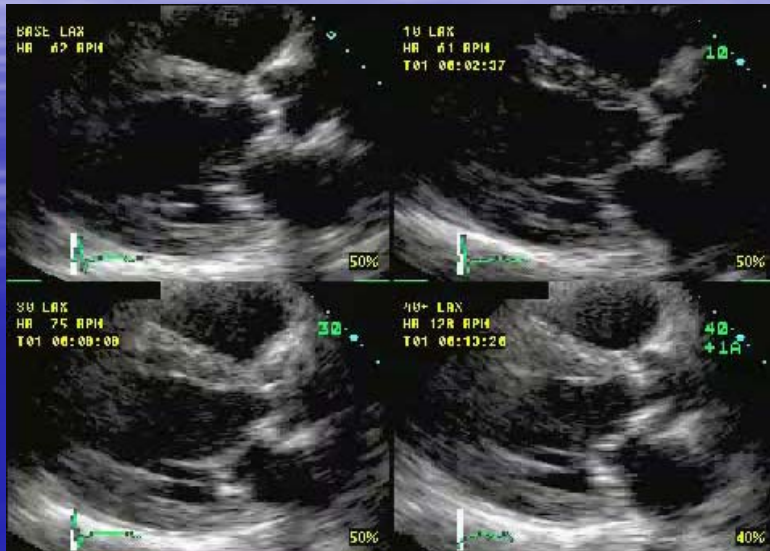


# Stress echo μετά επαναιμάτωση

- Αξιολόγηση αρχικής επιτυχίας επαναιμάτωσης

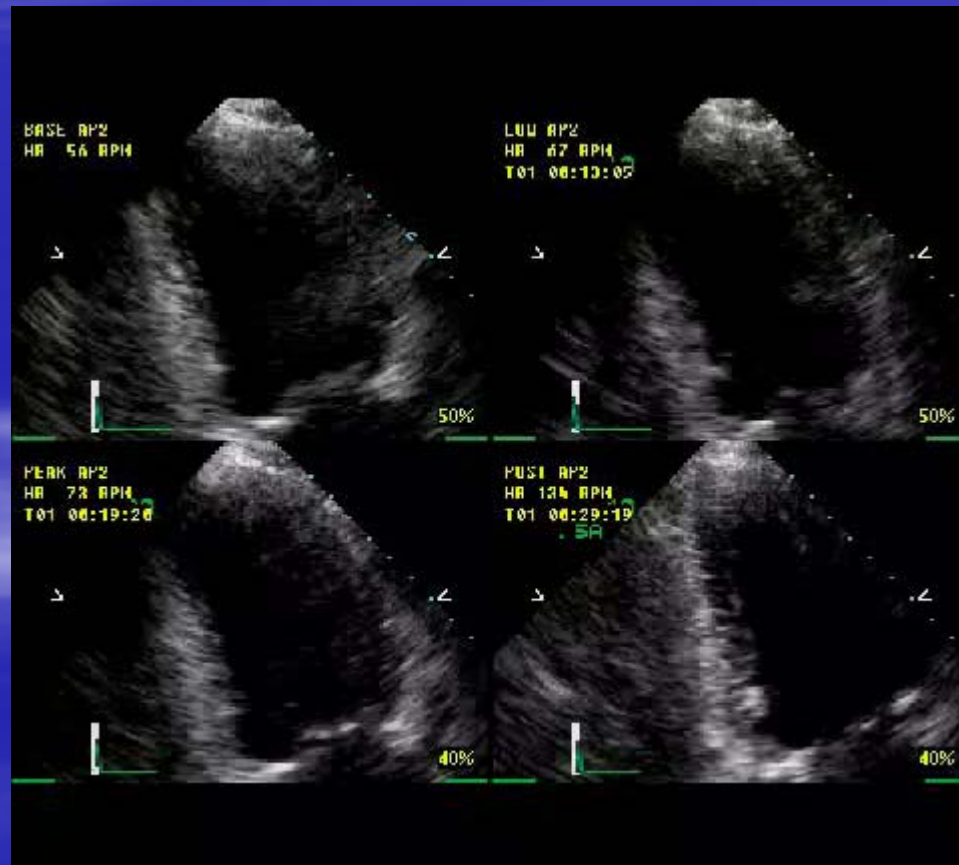


# Stress echo μετά επαναιμάτωση



# Stress-echo για εκτίμηση βιωσιμότητας

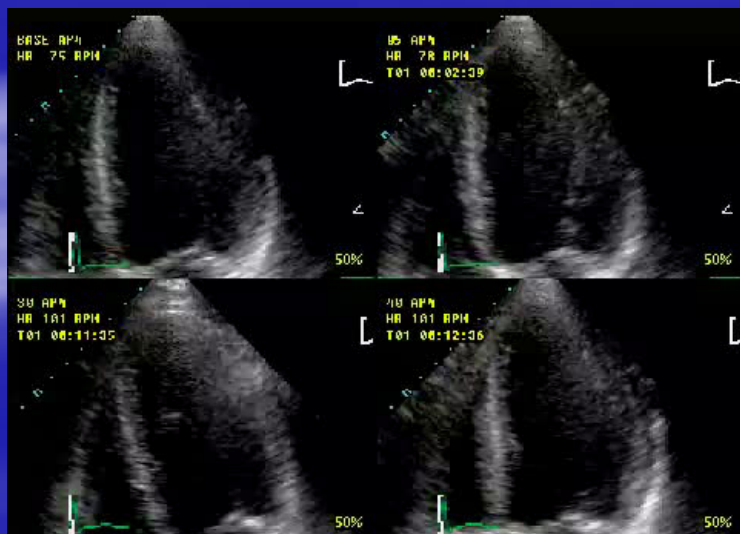
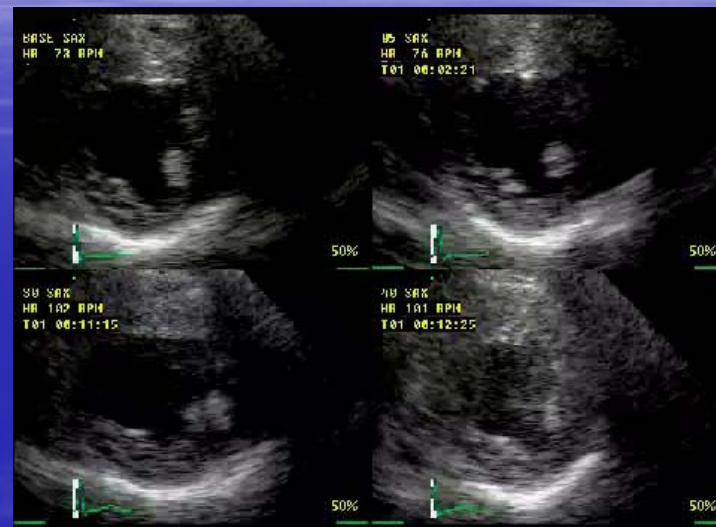
- Μη βιώσιμα μυοκαρδιακά τμήματα = δυσκινητικές περιοχές, λεπτές, ουλοποιημένες



# ΠΡΩΤΟΚΟΛΛΟ STRESS-ECHO ΜΕ ΔΟΒΟΥΤΑΜΙΝΗ ΓΙΑ ΑΝΙΧΝΕΥΣΗ ΒΙΩΣΙΜΟΤΗΤΑΣ

- IV οδός
- Ψηφιακές εικόνες σε ηρεμία-*Echo loops*  
( PLAX,SAX,4CH,2CH view)
- ΗΚΓ & ΑΠ
- Έναρξη με έγχυση δοβουταμίνης σε δόση  
5μg/kg/min
- Ανά 5 min σταδιακή ↑ δοβουταμίνης σε 10  
μg/kg/min, 20 μg/kg/min

# Stress-echo για εκτίμηση βιωσιμότητας



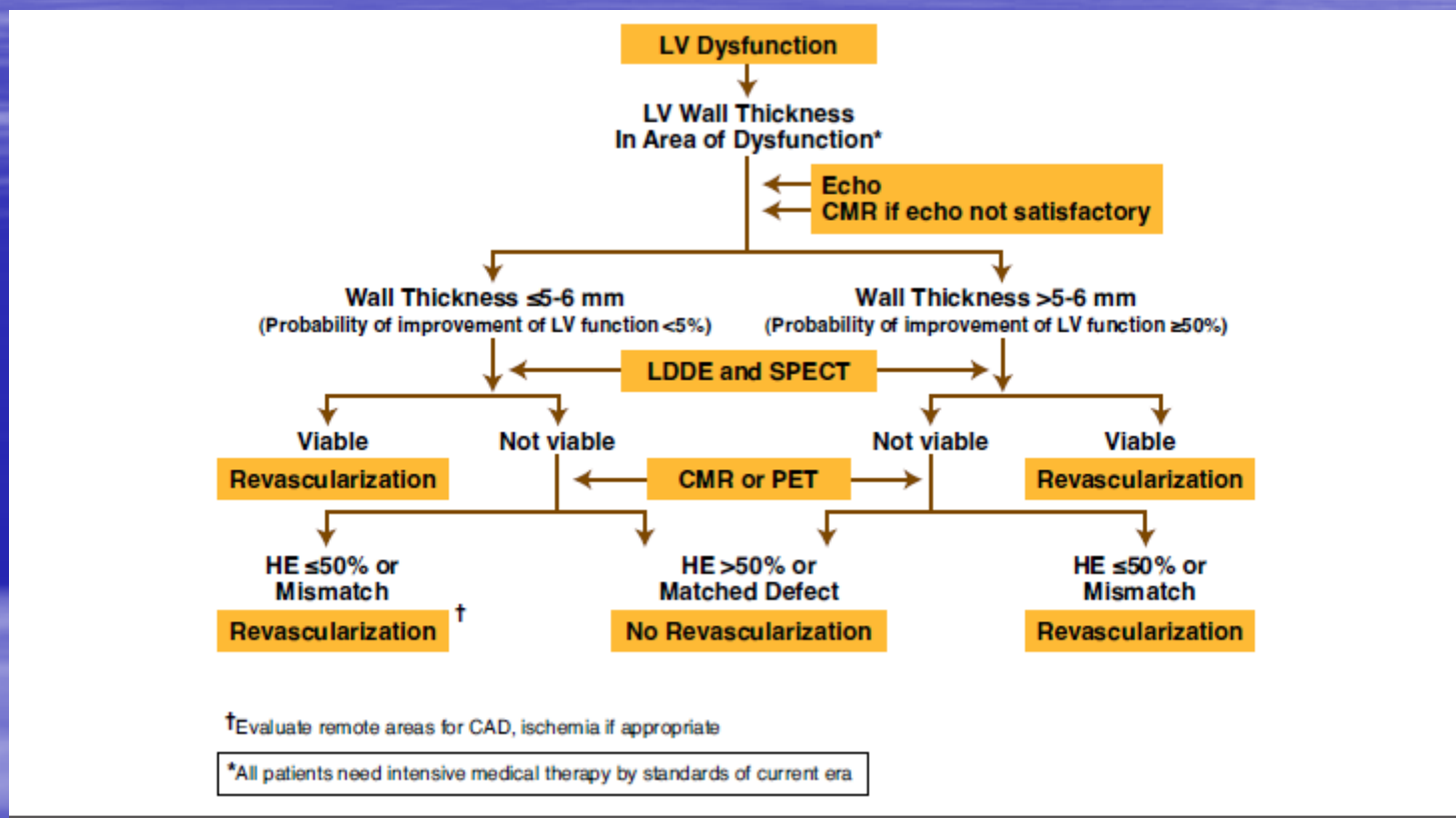
# Stress Echo Appropriateness Criteria

Table 16. Stress Echocardiography for Assessment of Viability/Ischemia

Indication		Appropriateness Score(1-9)
	<b>Ischemic Cardiomyopathy/Assessment of Viability With Stress Echocardiography</b>	
176.	Known moderate or severe LV dysfunction Patient eligible for revascularization Use of dobutamine stress only	A(8)

## Algorithm 1.

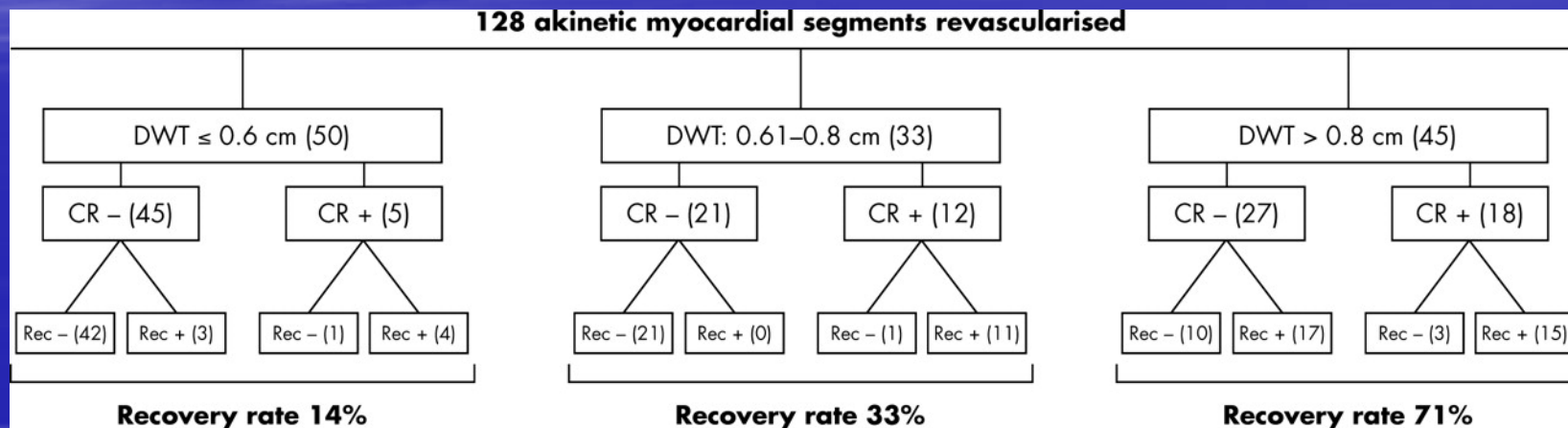
# For Diagnosis of *viable myocardium* and need for myocardial revascularization



Rahimtoola et al

JACC:CARDIOVASCULAR IMAGING, VOL 1, No 4, 2008 July:536-55

**Chart showing the postoperative outcome of 128 revascularised akinetic segments grouped according to diastolic wall thickness (DWT) and response to dobutamine stress echocardiography.**



Zaglavara T et al. Heart 2005;91:613-617



## Table 3. Patients With Global LVD and Multivessel Disease

Criteria indicating LV function with low probability of improvement with revascularization

- Major criteria:

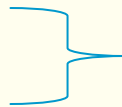
LVWT  $\leq 5$  to 6 mm

No response to LDDE

SPECT negative for viability

CMR: LGE  $> 50\%$

PET: negative for HM



- Minor criteria:

LVEF  $\leq 0.20$

LV volumes: 1 or more of the following:

By angiography: LVEDVI  $\geq 200$  ml/m<sup>2</sup> and/or LVESVI  $\geq 120$  ml/m<sup>2</sup>

By echocardiography: LVEDVI  $\geq 170$  ml/m<sup>2</sup> and/or LVESVI  $\geq 90$  ml/m<sup>2</sup>

Echocardiographic dimension: LVEDDI  $\geq 5.5$  cm<sup>2</sup>/m<sup>2</sup>

Criteria indicating LV function not likely to improve with revascularization:

- $\geq 4$  major

- 3 major plus 1 minor

- 2 major plus 2 minor

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# Quantitative Analysis Methods in STRESS ECHO

- Color kinesis
- Tissue Doppler : Strain  
Strain rate

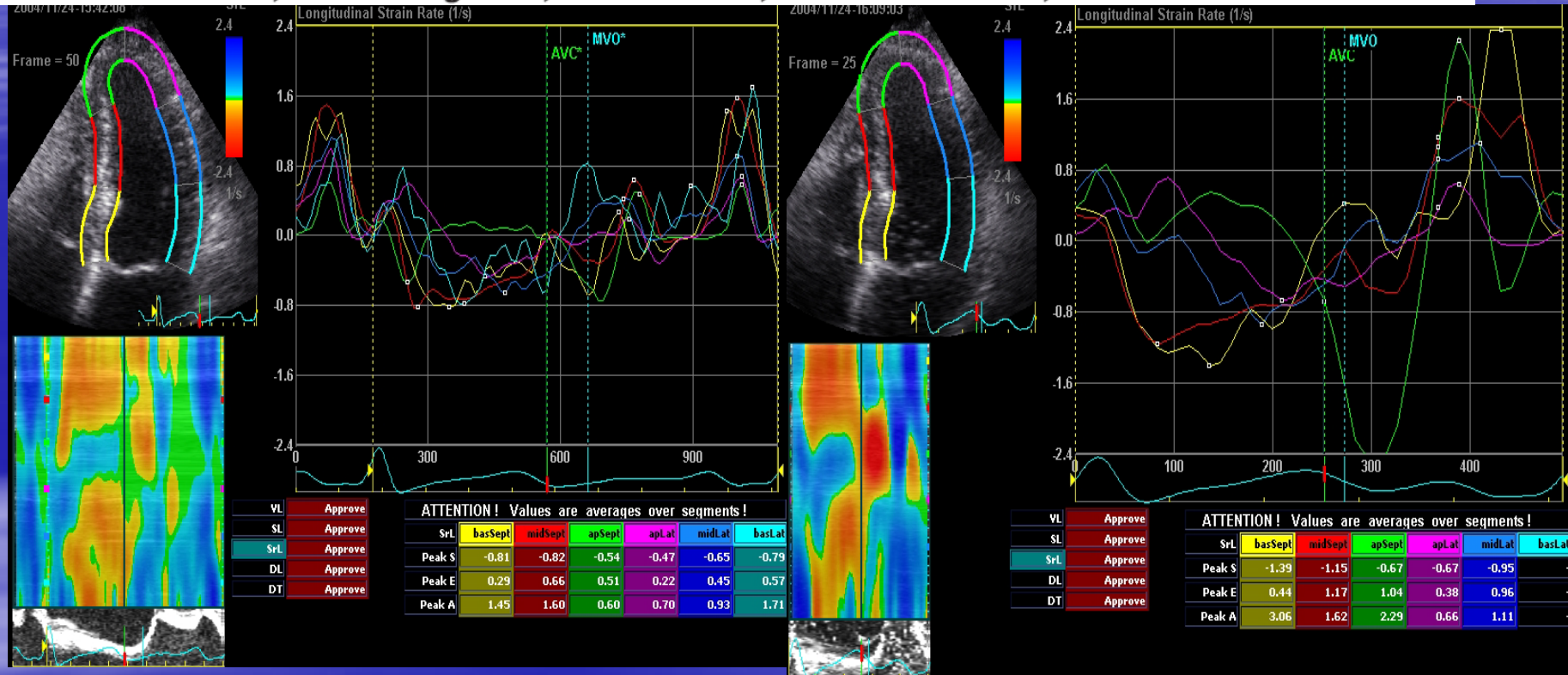
*Disadvantage*: angulation  
signal noise

## Speckle tracking

angle independent  
less demanding acquisition

# Comparison of two-dimensional speckle and tissue Doppler strain measurement during dobutamine stress echocardiography: an angiographic correlation

Lizelle Hanekom<sup>†</sup>, Goo-Yeong Cho<sup>†</sup>, Rodol Leano, Leanne Jeffriess, and Thomas H. Marwick<sup>\*</sup>



Identification of ischaemia from strain rate curves at rest and stress in a 74-year-old woman with chest pain. Resting images demonstrate similar levels of strain rate at baseline (nadir of each wave marked in white). At peak stress, strain rate at apical septum showed no contraction during systolic phase and marked post-systolic contraction (arrow). The coronary angiogram showed occlusion of the mid-LAD.

## ORIGINAL RESEARCH

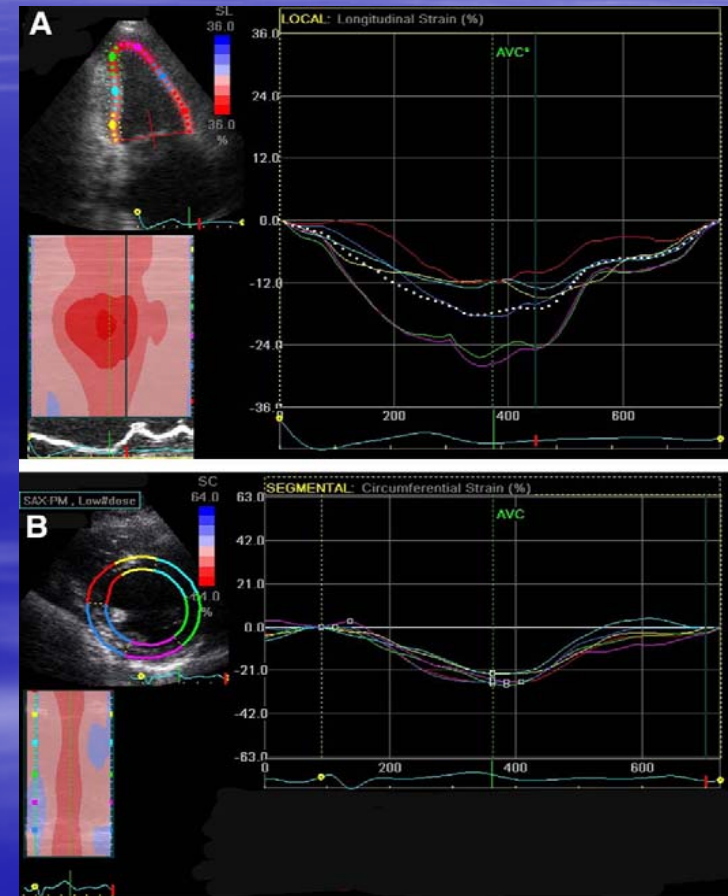
# Assessment of Myocardial Viability at Dobutamine Echocardiography by Deformation Analysis using Tissue Velocity and Speckle-Tracking

Manish Bansal, MD, Leanne Jeffriess, BS, Rodol Leano, BS, Julie Mundy, MBBS

Thomas H. Marwick, MBBS, PHD

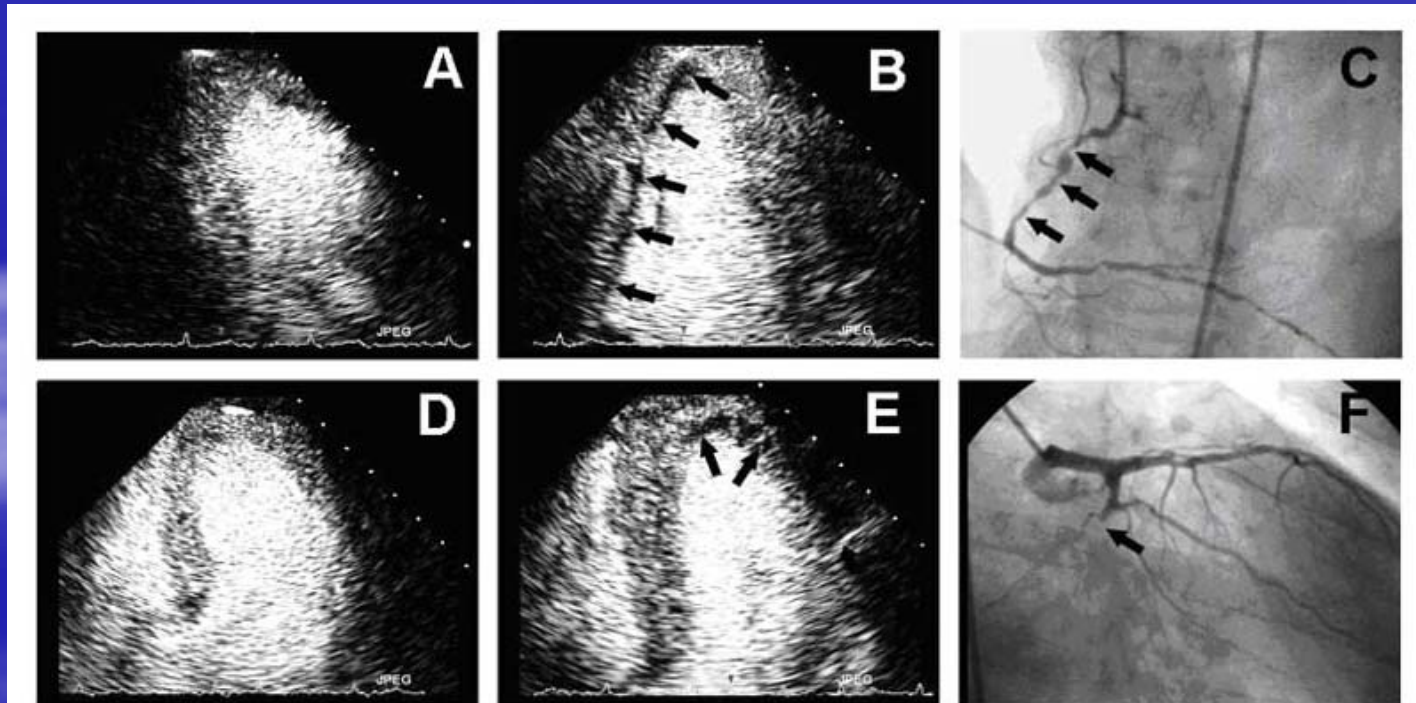
*Brisbane, Queensland, Australia,*

Strain and SR measurement with both TVI and STE are feasible during DbE and can predict recovery of regional contractile function after revascularization. However, TVI strain and SR measurements at low-dose dobutamine are more accurate for this purpose and can predict viability in both anterior and posterior circulations. In contrast, STE measurements appear to be most effective in the anterior circulation.

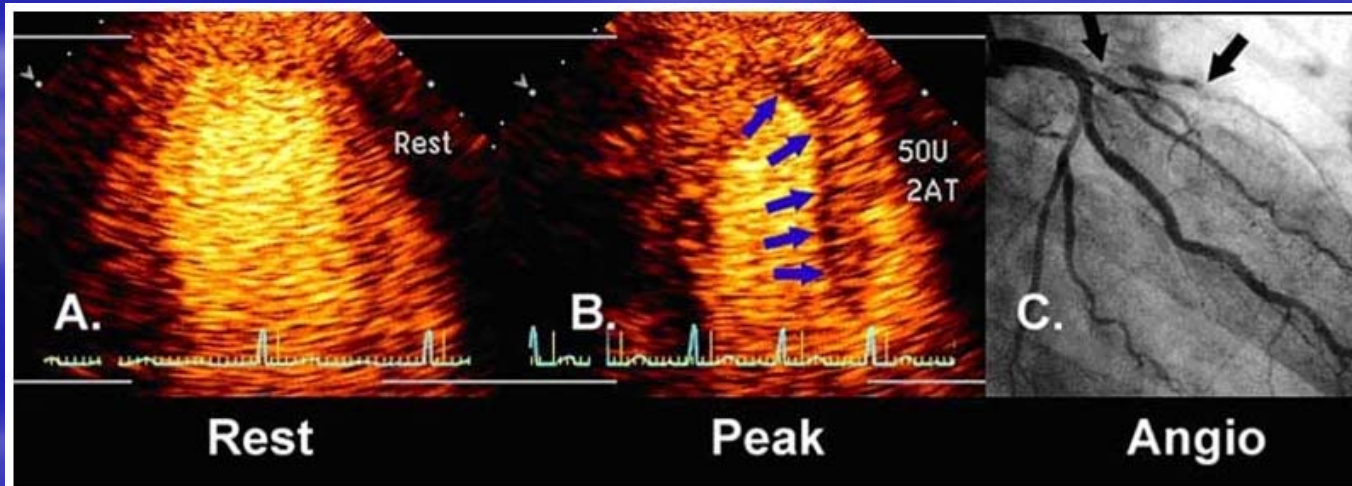
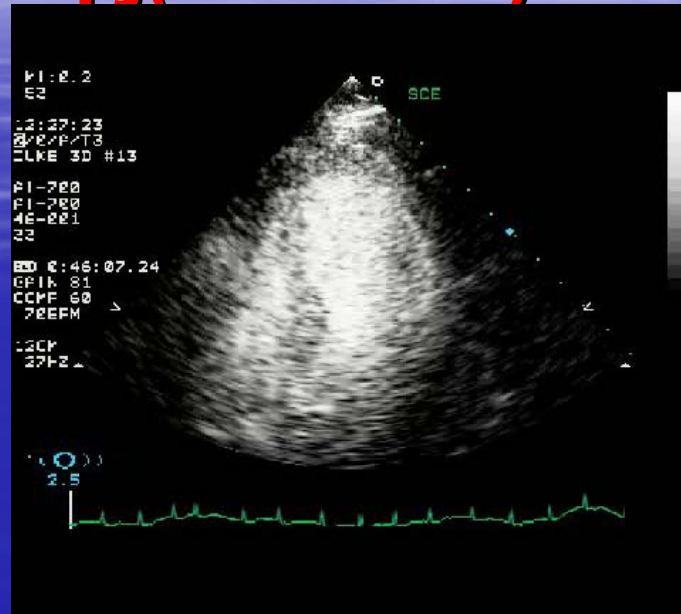


# Χρήση τεχνικών μυοκαρδιακής ηχοαντίθεσης(contrast) σε stress-echo

- Σκιαγράφιση Αρ.κοιλίας
- Απεικόνιση μυοκαρδιακής αιμάτωσης



# Χρήση τεχνικών μυοκαρδιακής ηχοαντίθεσης(contrast) σε stress-echo



# Contrast Echocardiography: what have we learned from the New Guidelines?

*Kevin Wei. Cur Cardiol Rep 2010;12:237-242*

- Common uses of contrast agents in Echocardiography
- Labeled use of contrast agents
  - In pts with suboptimal echocardiograms to **opacify LV chamber** and to improve delineation of the **LV endocardial border**
- OFF-label use of contrast agents
  - Myocardial perfusion imaging
  - Identification of LV **thrombus** and masses
  - Diagnosis of **LV non compaction** and LV apical hypertrophy
  - Diagnosis of **LV aneurysm** and pseudoaneurysm
  - Selection of LAD septal perforators to be embolized during percutaneous ablation in HOCM
  - Improvement of **Doppler signal** in suboptimal echocardiograms

# Stress Echo Appropriateness Criteria

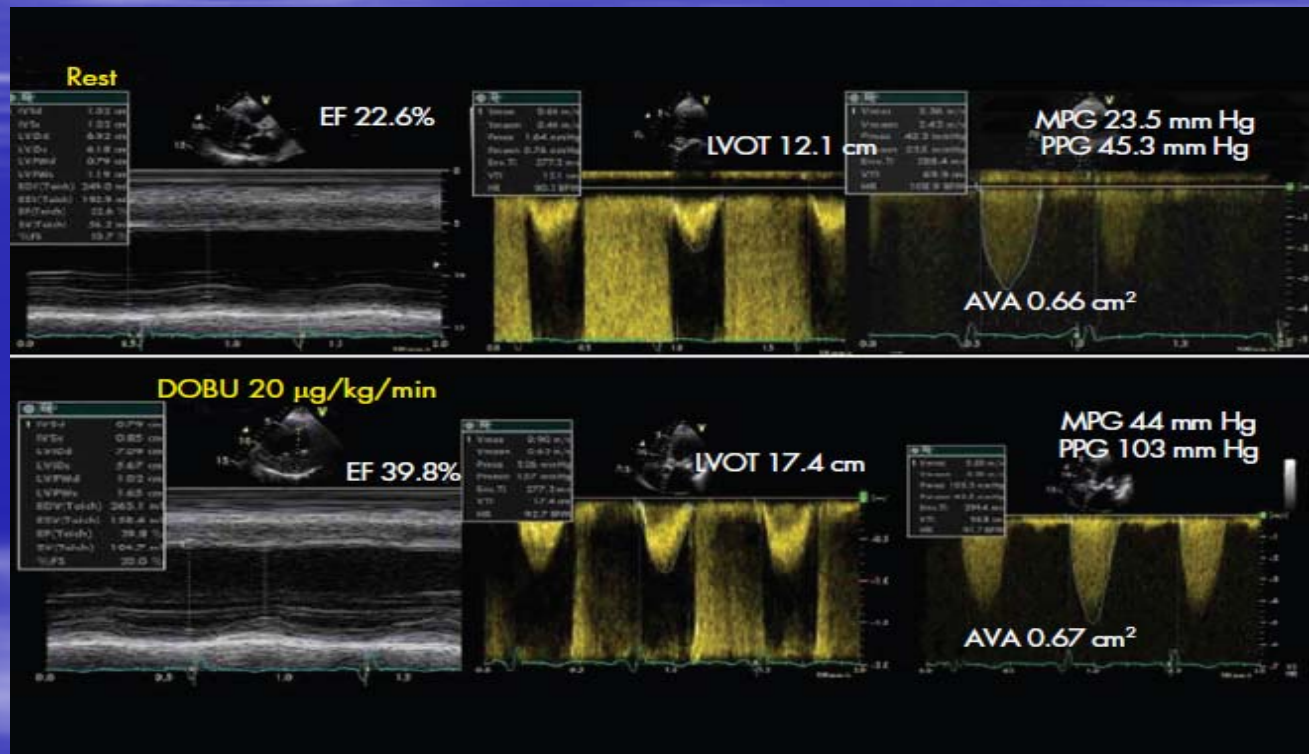
**Table 18. Contrast Use in TTE/TEE or Stress Echocardiography**

Indication		Appropriate Use Score (1-9)
201.	<ul style="list-style-type: none"><li>• Routine use of contrast</li><li>• All LV segments visualized on noncontrast images</li></ul>	I (1)
202.	<ul style="list-style-type: none"><li>• Selective use of contrast</li><li>• <math>\geq 2</math> contiguous LV segments are not seen on noncontrast images</li></ul>	A (8)

A indicates appropriate; and I, inappropriate.

# Stress testing in Valve disease

**AS**  
*Fixed vs  
relative*

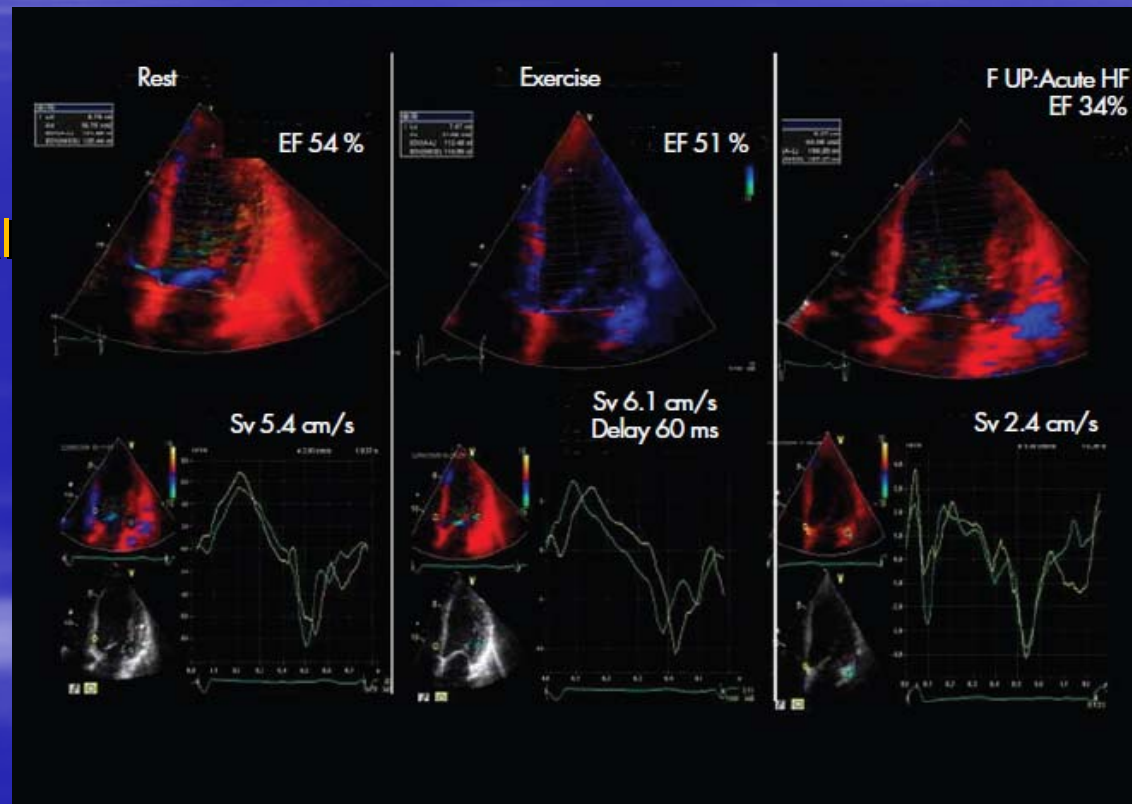


Luc A Pierard and P.Lancellotti  
Heart 2007,93:766-772

# Stress testing in Valve disease

## AR

Assessment of functional capacity and symptomatic response in pts with equivocal symptoms or before participation in athletic activities (Class IIA)



Luc A Pierard and P.Lancelloti  
Heart 2007,93:766-772

# Real-time three-dimensional dobutamine stress echocardiography for coronary artery disease diagnosis: validation with coronary angiography

- **RT3DE**



↑ sensitivity in LAD area

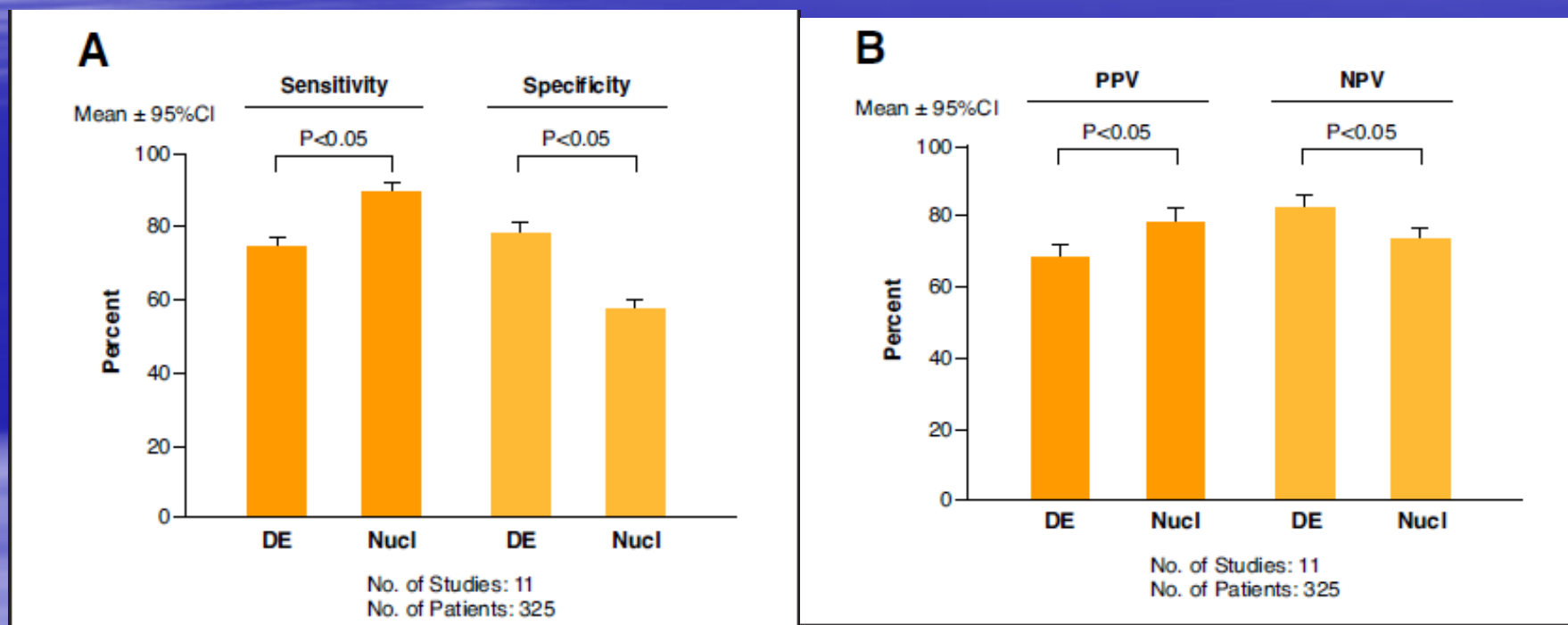
Equivalent diagnostic value to 2DE in *dobutamine stress protocols*



Aggeli et al

Heart 2007;93:672-675

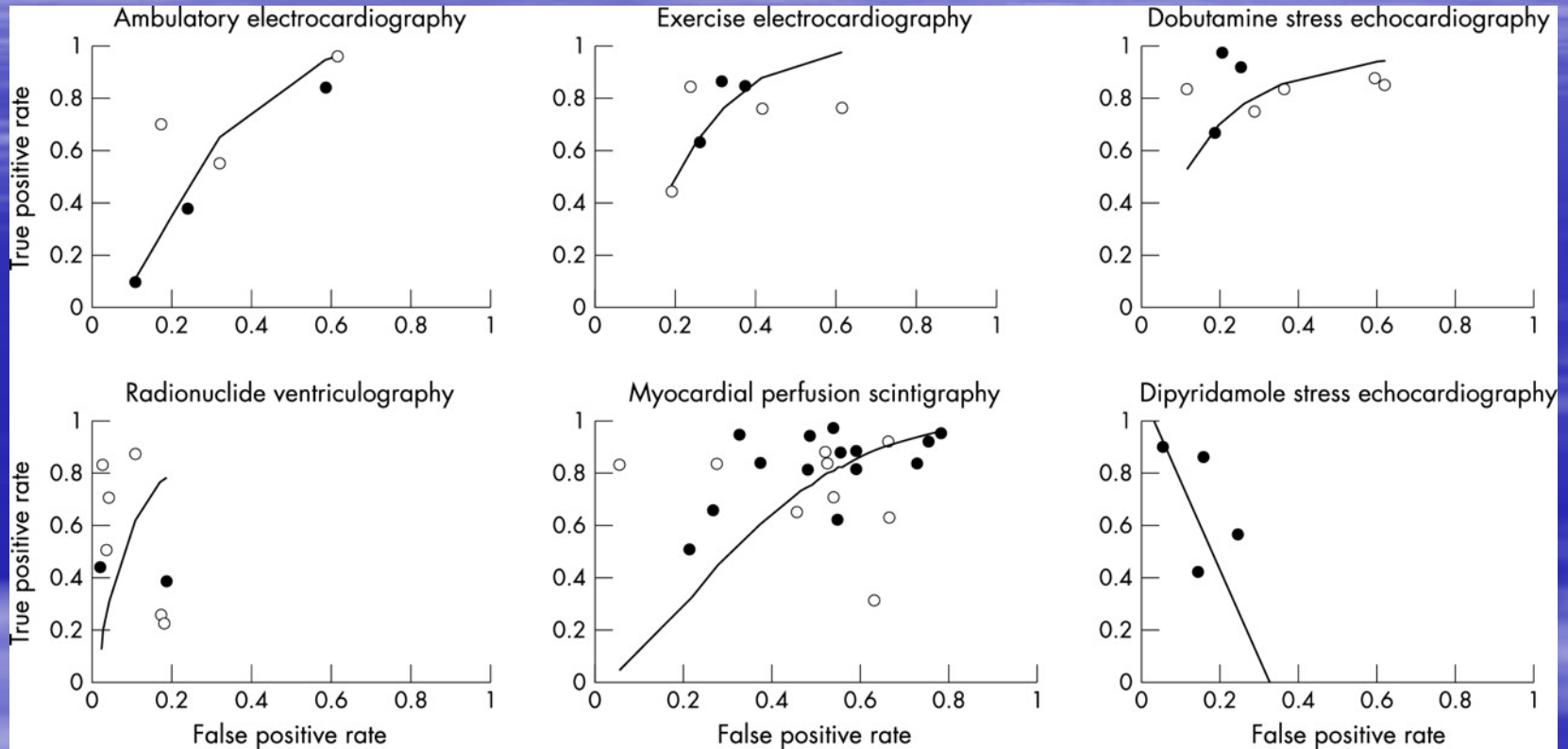
**Figure 11.** Comparison of Diagnostic Accuracy of Dobutamine Echocardiography and Nuclear Imaging



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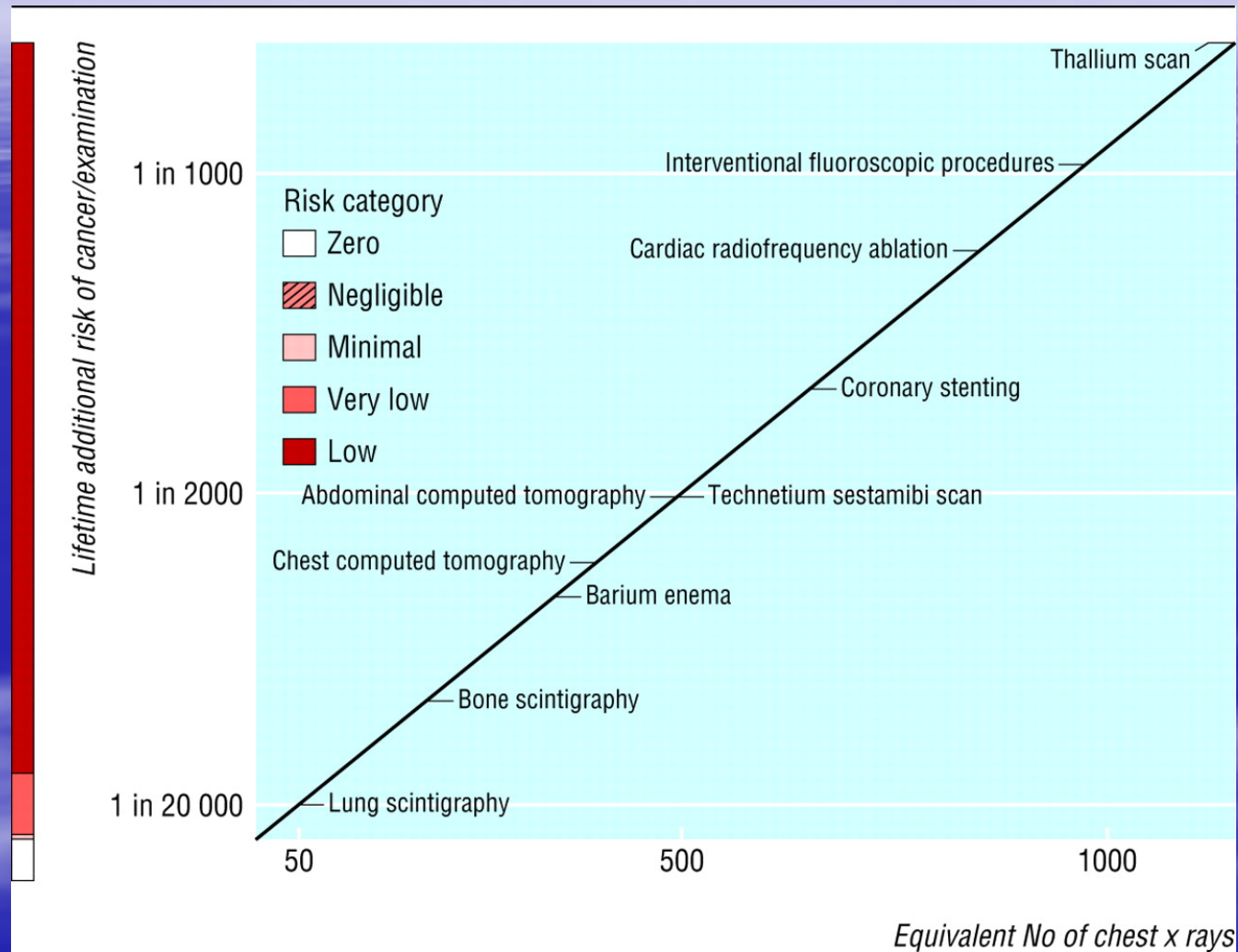
**Graphs showing summary receiver operating characteristic (SROC) curves for ambulatory ECG, exercise ECG, dobutamine stress echocardiography, radionuclide ventriculography, and myocardial perfusion scintigraphy.**



Kertai M D et al. Heart 2003;89:1327-1334



# Graphical presentation of cancer risk and radiation dose (in multiples of dose from a simple chest x ray) for some common radiological examinations.



Picano E BMJ 2004;329:849-851

# Stress Echo

vs

# TL-scan

- ↑ Stress Echo

♀

LVH

HBP

LBBB

Small vessel disease

- ↑ TL-scan

1 vessel disease

Submaximal stress

B-blocker Rx

# Strengths and weaknesses of stress echocardiography

## ■ Strengths

- “patient friendly”, versatility
- accuracy (sensitivity 88%-specificity 83%)
- prognostic value
- detection of viable myocardium after infarction
- assessment of left ventricular reserve (for example, valvular heart disease)

## ■ Weaknesses

- dependence on image quality (**contrast agents**)
- subjectivity, need for an expert reader (**TVI-Speckle tracking-3D-4D**)
- dependence on ischaemia (hence problems with mild disease, submaximal stress, and testing on treatment)

ΕΥΧΑΡΙΣΤΩ