

# *Stress Echo*

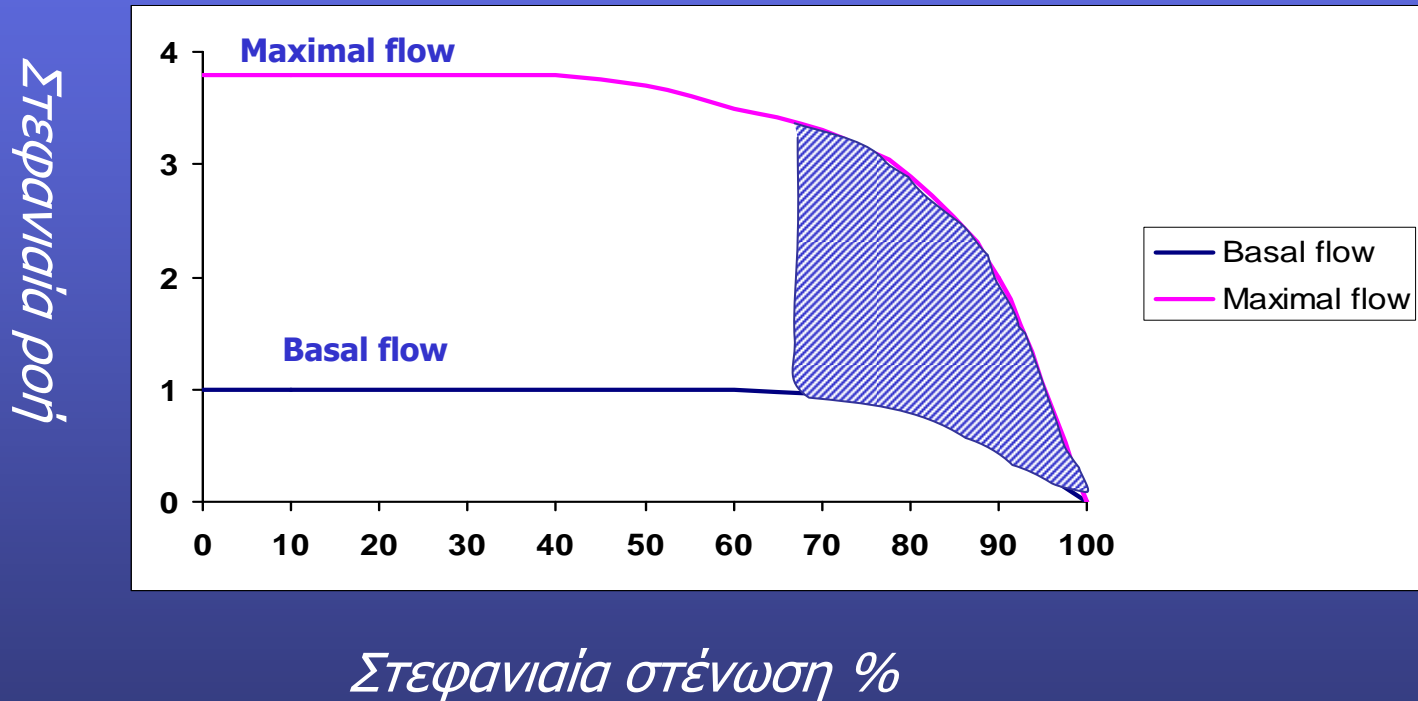
## *σε Διαβητικούς Ασθενείς*

*Θεοδώρα Α. Ζαγκλαβάρα, MD, PhD*

*Καρδιολόγος, Υπεύθυνη Τμήματος Ηχοκαρδιογραφίας*

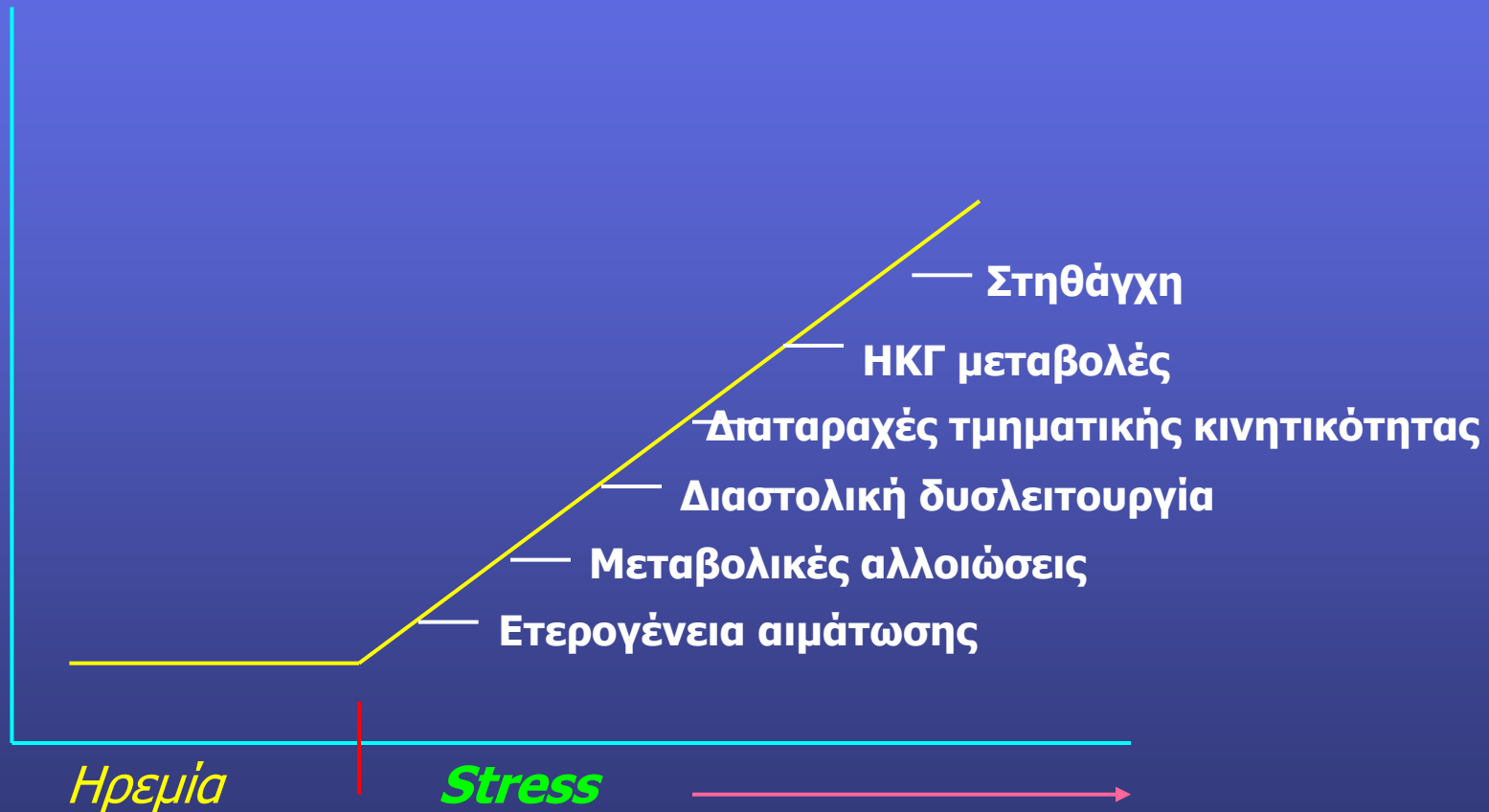
*EUROMEDICA ΚΥΑΝΟΥΣ ΣΤΑΥΡΟΣ*

# Η επίδραση του βαθμού της στένωσης στη βασική στεφανιαία ροή και τις στεφανιαίες εφεδρείες

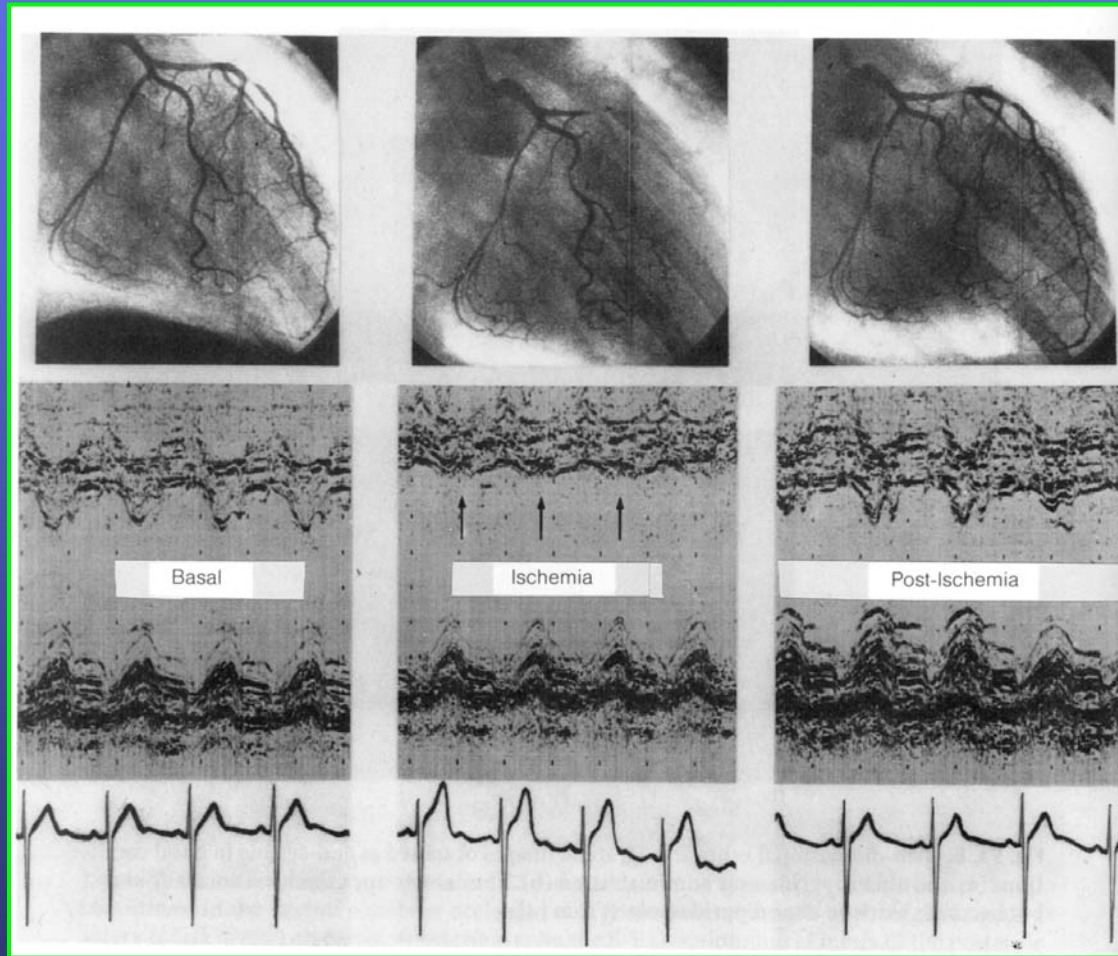


# Ο Ισχαιμικός Καταράκτης

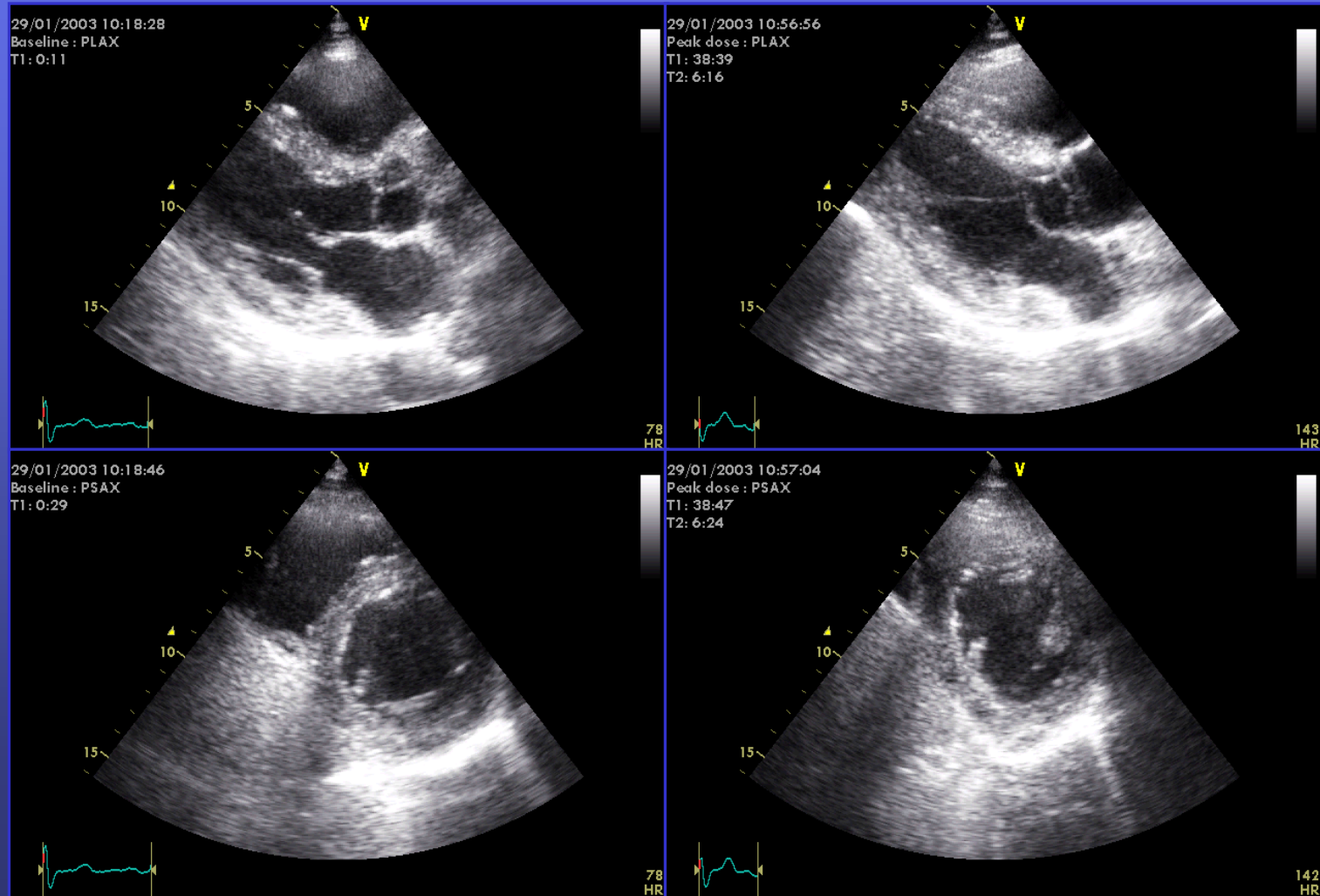
Χρονική αλληλουχία των εκδηλώσεων της ισχαιμίας



# Οι Πρωτοπόροι της *Stress* Ηχοκαρδιογραφίας: Η εποχή της *M-mode* Ηχοκαρδιογραφίας



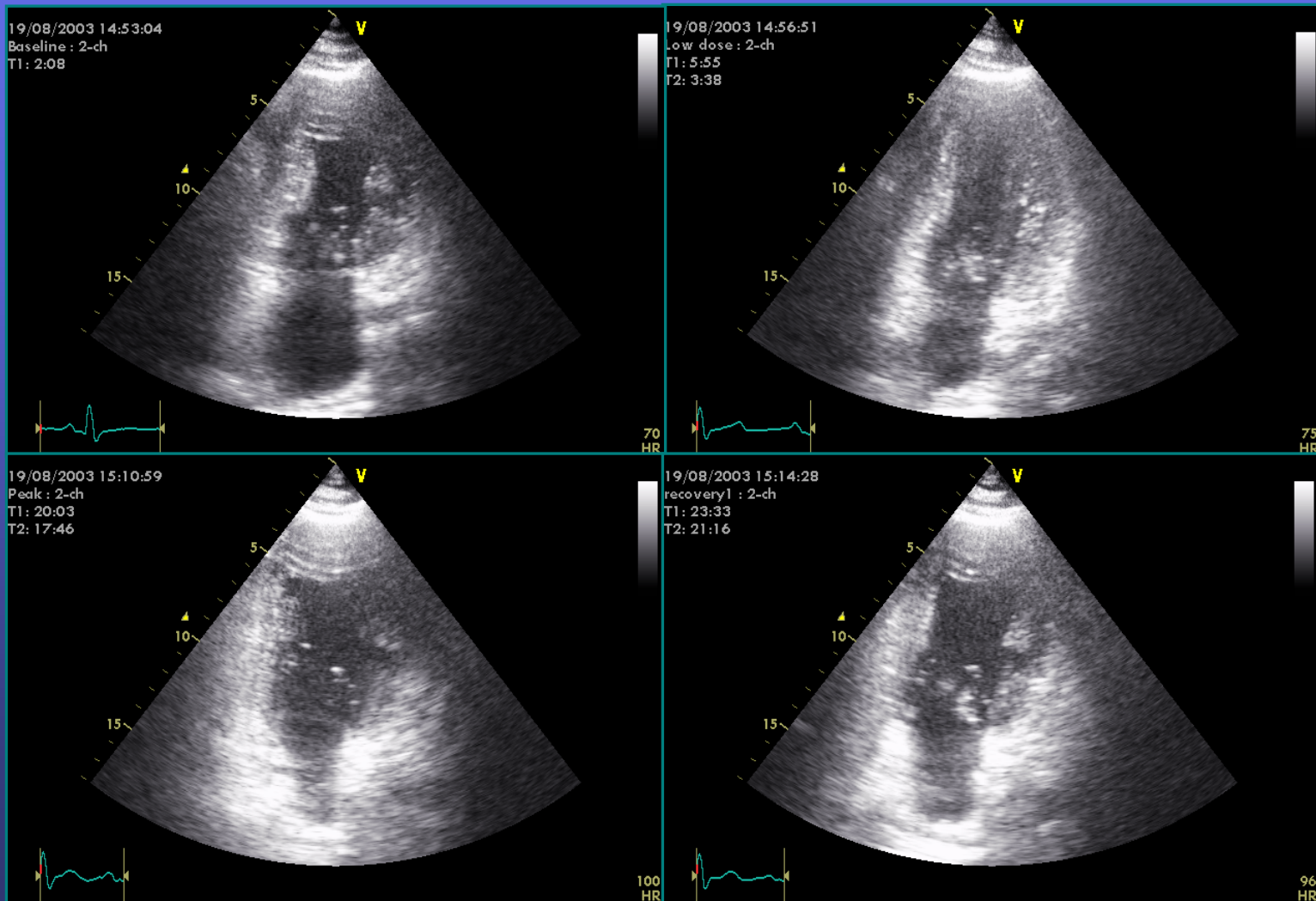
# Φυσιολογική Μελέτη Stress Ηχοκαρδιογραφίας



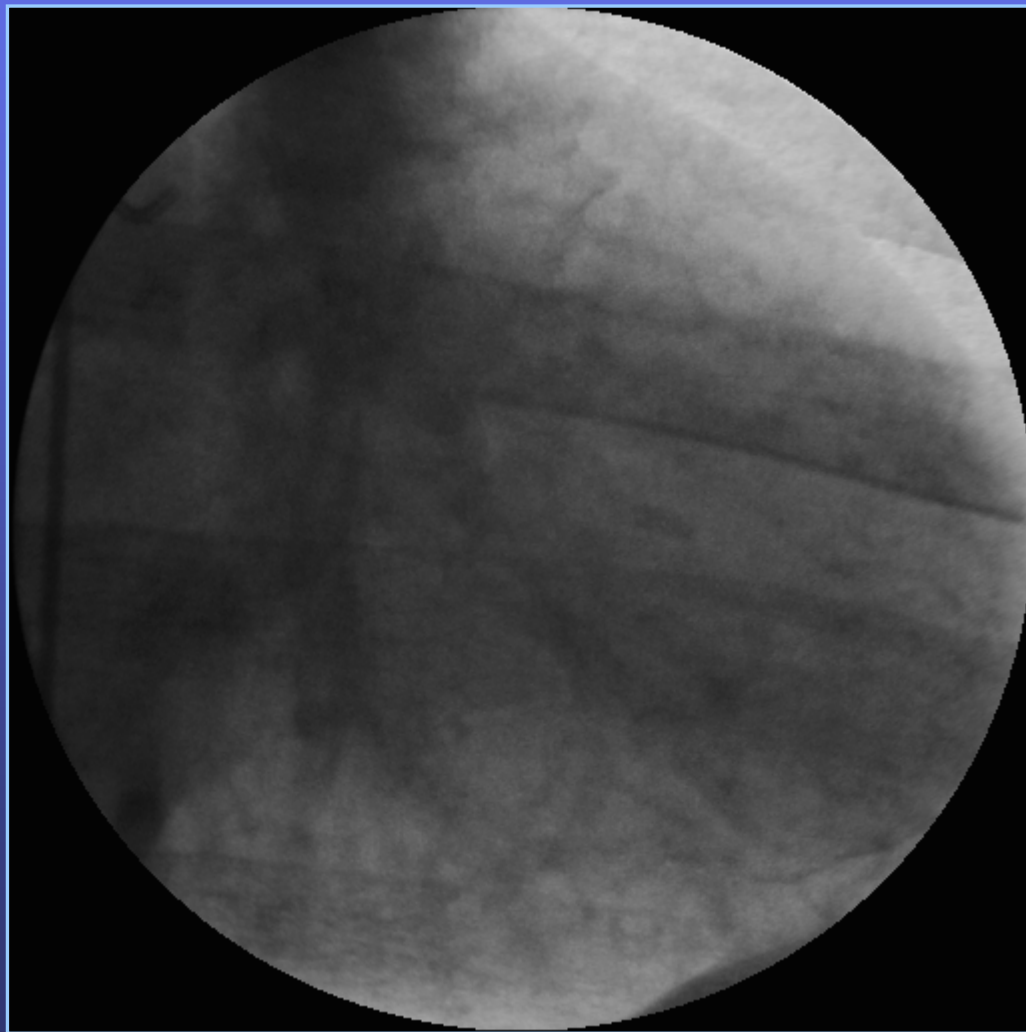
**REST**

**STRESS**

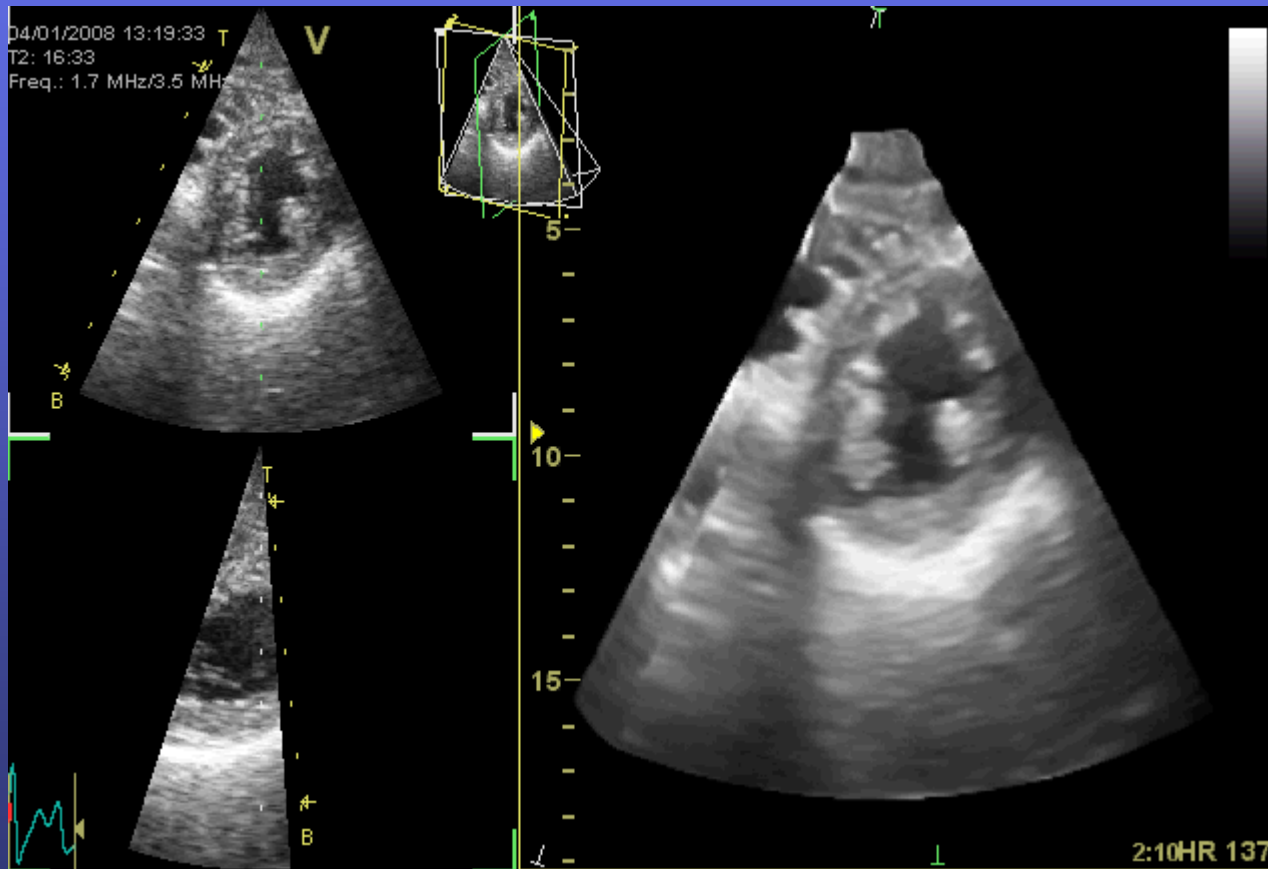
# Κατάδειξη Προκλητής Ισχαιμίας



# *Κατάδειξη Προκλητής Ισχαιμίας*

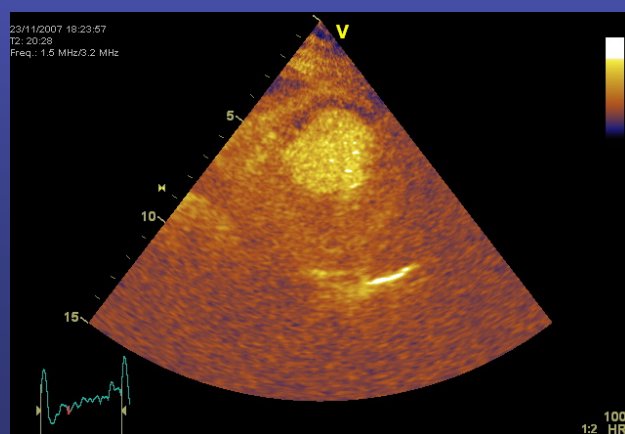
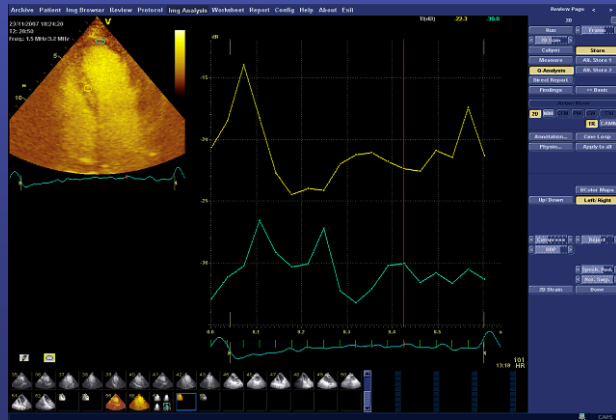
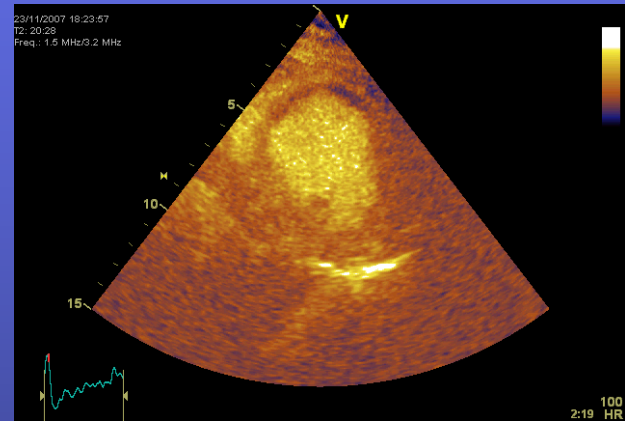
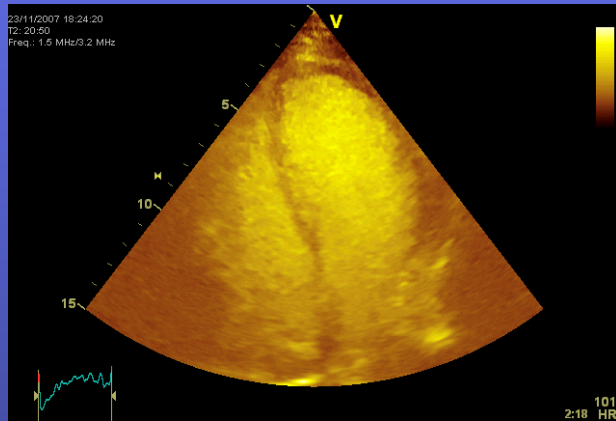


# 3 – D Ηχοκαρδιογραφία

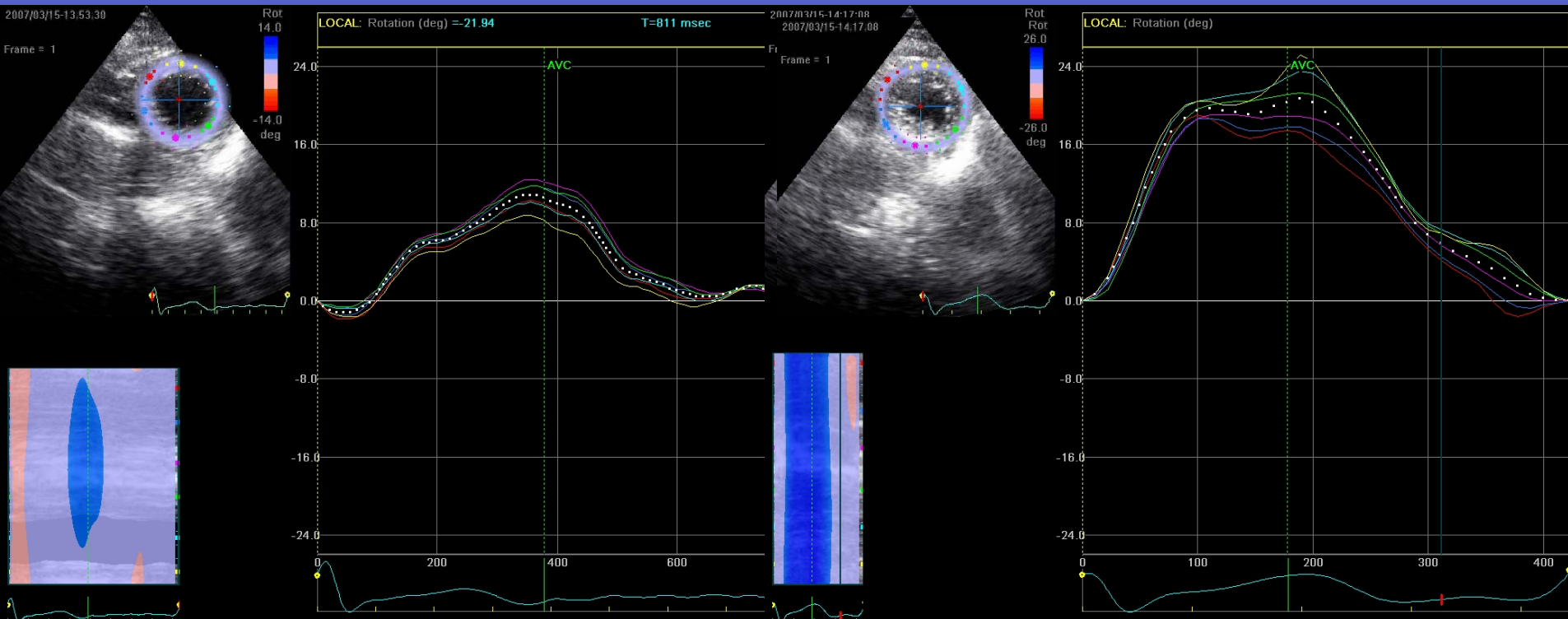




# Αιμάτωση Μυοκαρδίου με τη χρήση *contrast*/Απεικόνιση Μυοκαρδιακής Ουλής



# 2- D Strain: Φυσιολογική Απάντηση στο Stress: Αύξηση της Καρδιακής Συστροφής (Rotation)



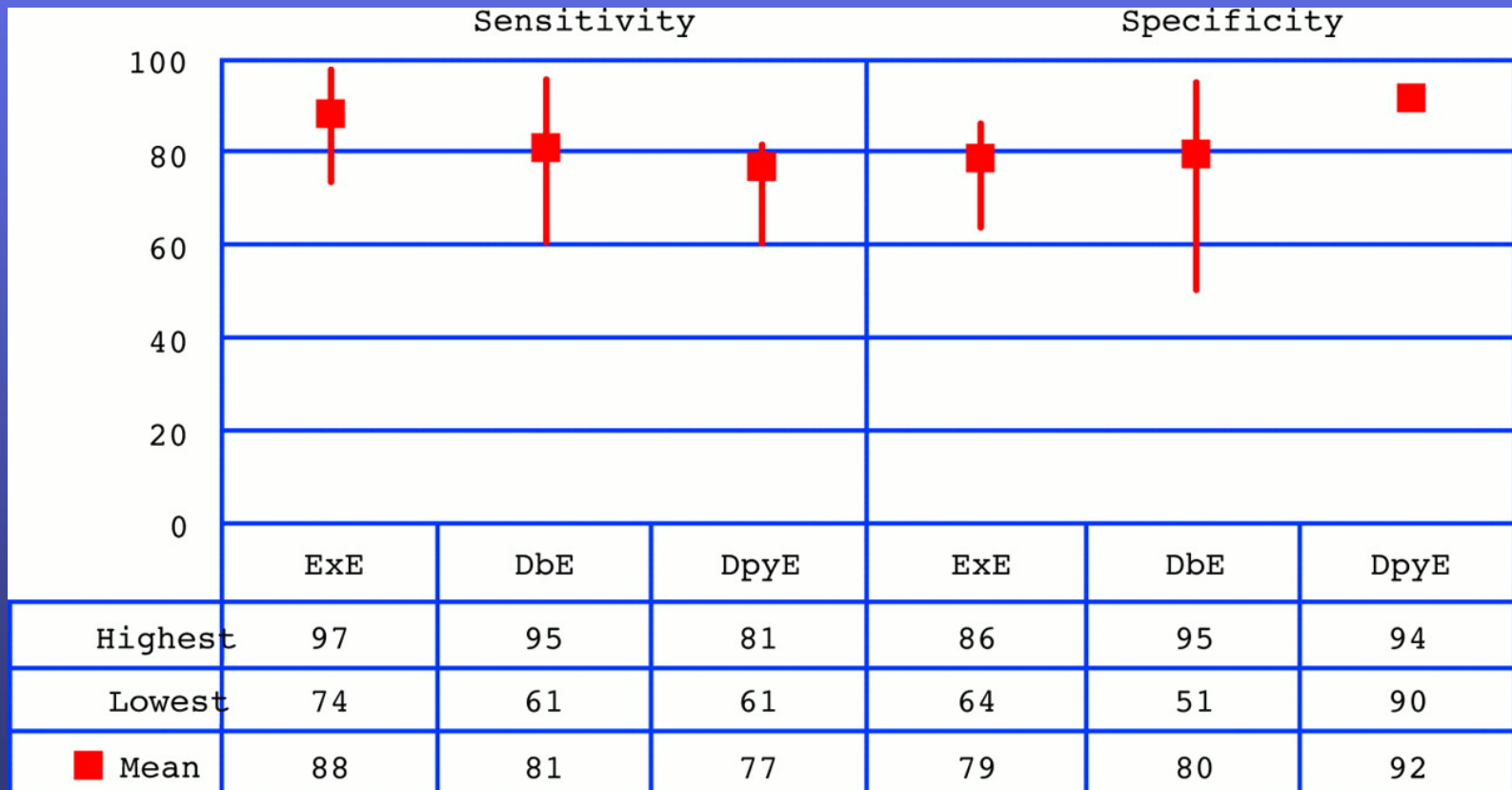
## *Μείζονες παρενέργειες σε 4033 μελέτες stress ηχοκαρδιογραφίας ντομπουταμίνης*

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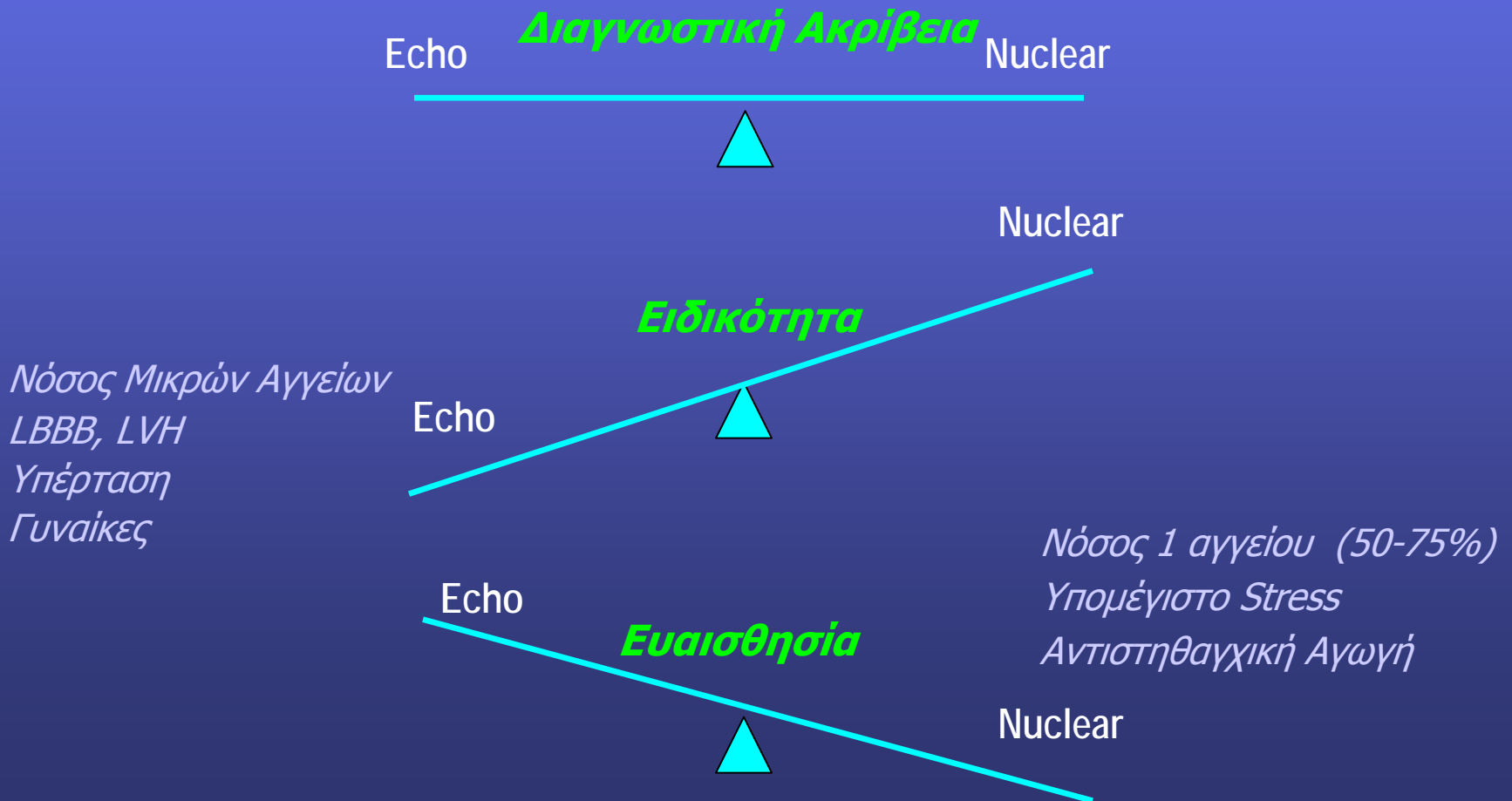
<b>Μείζονες επιπλοκές</b>	<b>No.</b>	<b>Ποσοστό</b>
<b>Μείζονες καρδιακές επιπλοκές</b>	<b>10</b>	<b>0.25</b>
<b>Εμμένουσα κοιλιακή ταχυκαρδία</b>	<b>8</b>	<b>0.20</b>
<b>Κοιλιακή μαρμαρυγή</b>	<b>1</b>	<b>0.02</b>
<b>Οξύ έμφραγμα μυοκαρδίου</b>	<b>1</b>	<b>0.02</b>
<b>Μείζονες μή-καρδιακές επιπλοκές</b>	<b>5</b>	<b>0.12</b>
<b>Δηλητηρίαση από ατροπίνη</b>	<b>1</b>	<b>0.12</b>
<b>Θάνατοι</b>	<b>0</b>	<b>0</b>
<b>Σύνολο</b>	<b>15</b>	<b>0.37</b>

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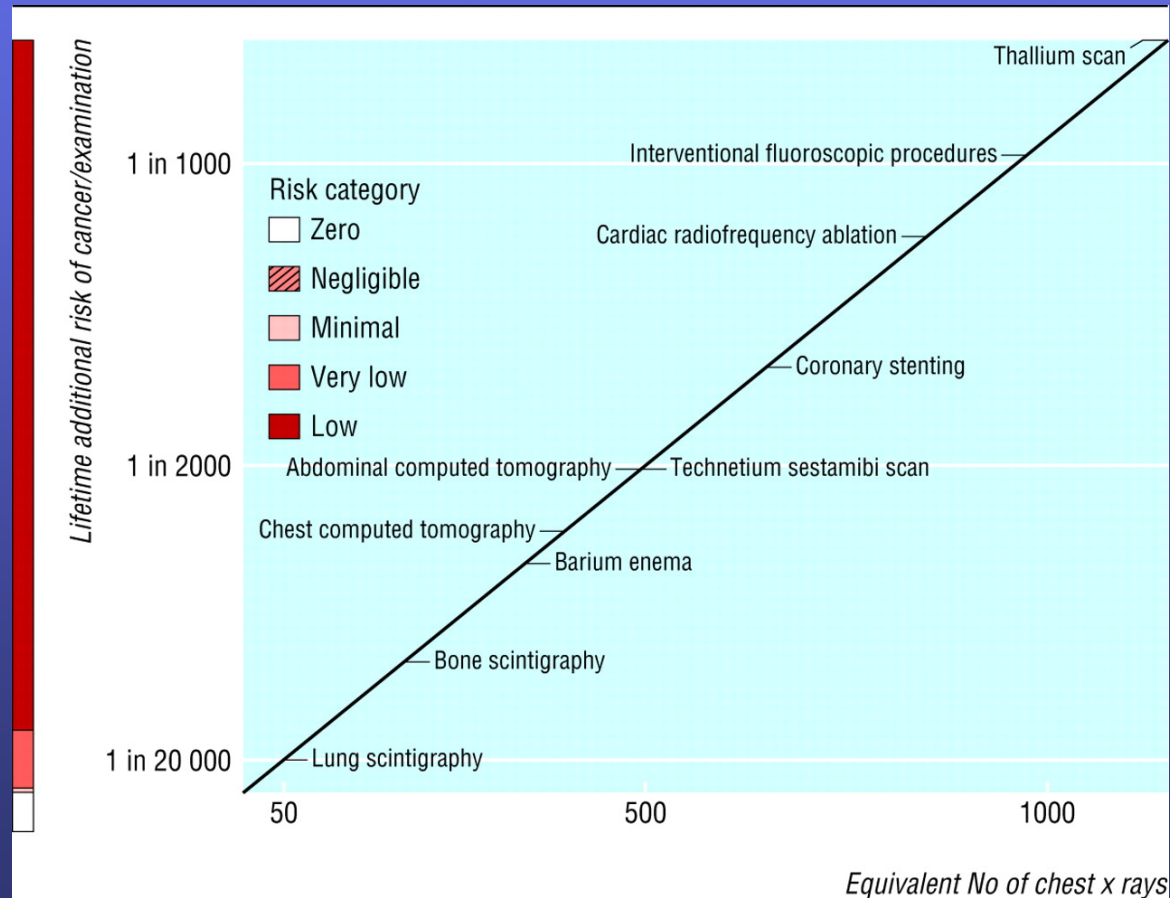
*Ανασκόπηση της Ευαισθησίας και της Ειδικότητας για την Κατάδειξη προκλητής Ισχαιμίας σε μελέτες > 100 ασθενών με Stress Ηχοκαρδιογραφία Άσκησης, Ντομπουταμίνης και Διπυριδαμόλης*



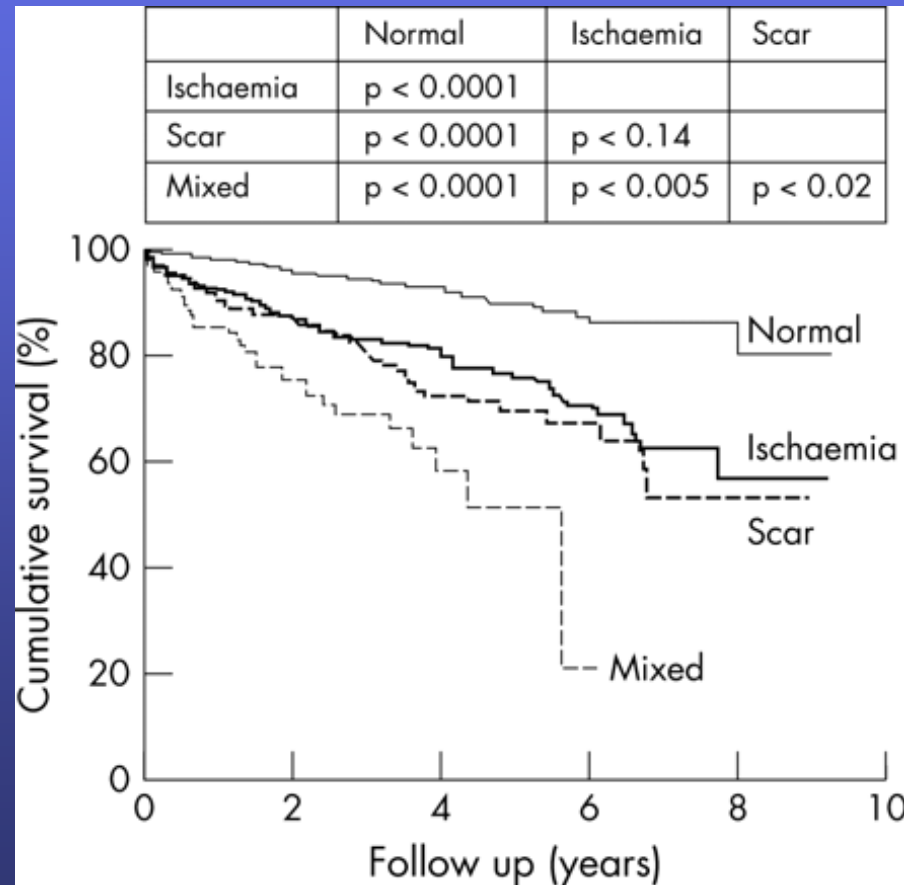
# Σύγκριση Διαγνωστικής Ακρίβειας ανάμεσα στη Stress Ηχοκαρδιογραφία και τις Πυρηνικές Τεχνικές Αιμάτωσης



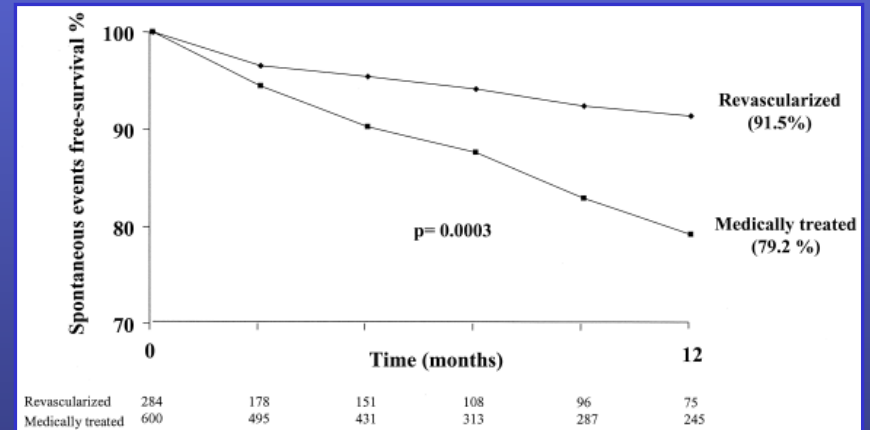
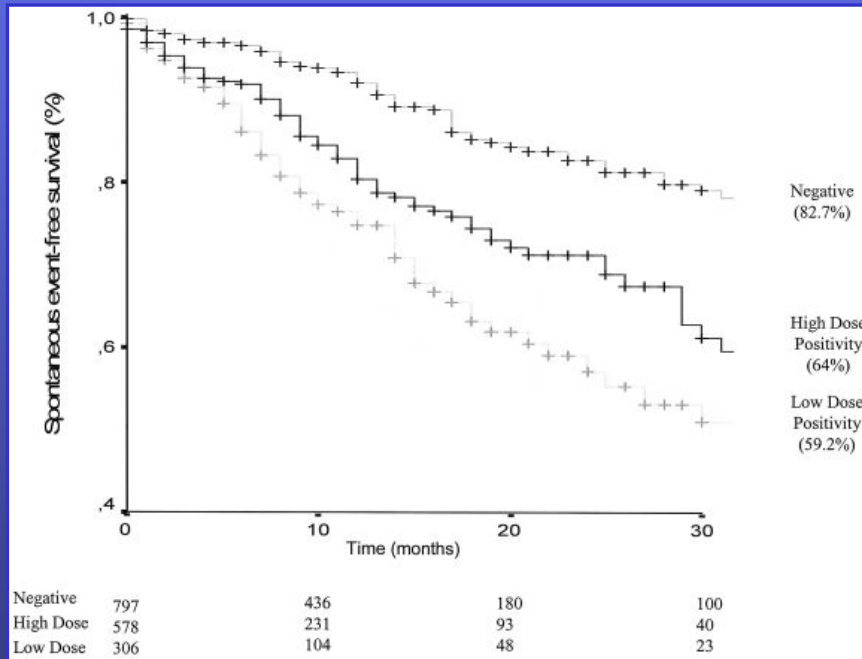
# Δόση Ραδιενέργειας (Ισοδύναμα Ακτινογραφίας Θώρακος) και Κίνδυνος Ανάπτυξης Καρκίνου



# Καρδιακή Θνητότητα με βάση την Stress Ηχοκαρδιογραφία Ντομπουταμίνης (3156 ασθενείς)

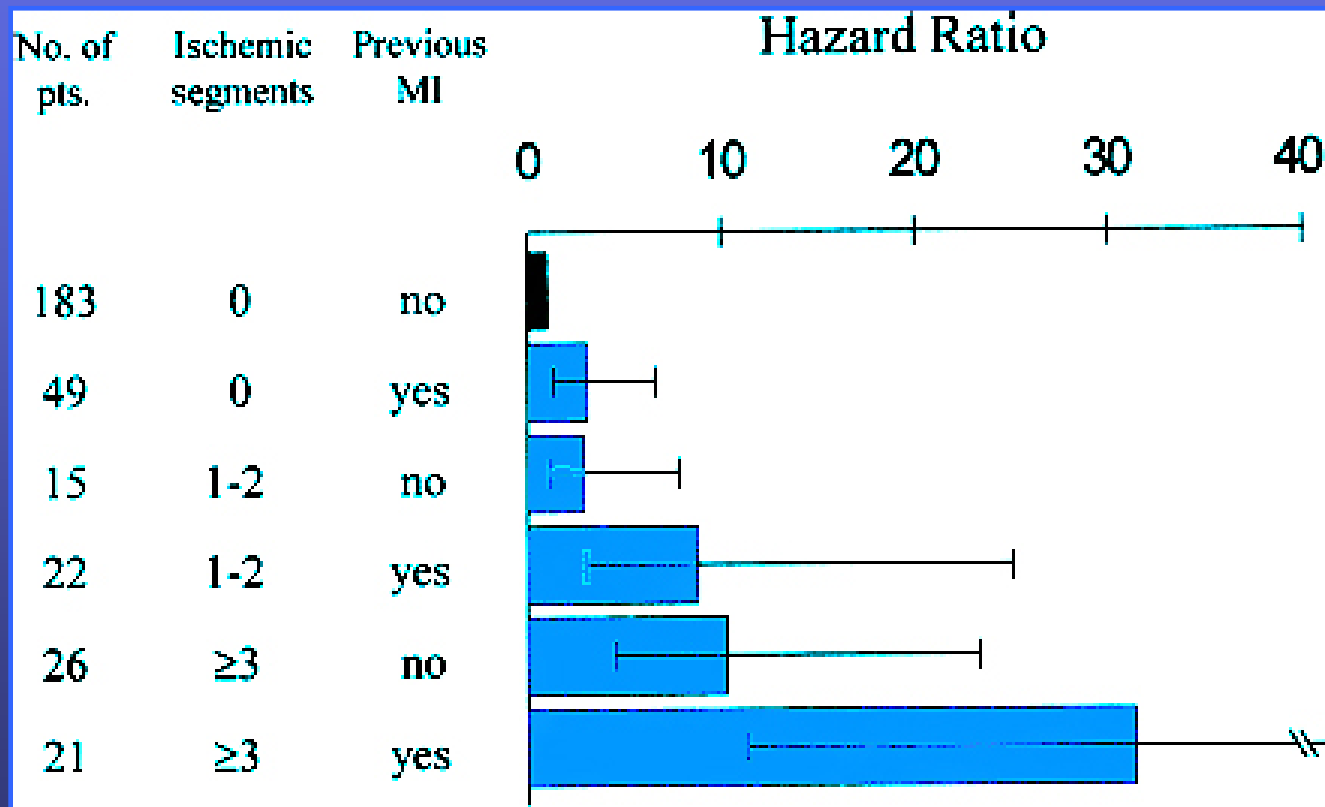


# Διαστρωμάτωση Κινδύνου Μετά Από Έμφραγμα Μυοκαρδίου



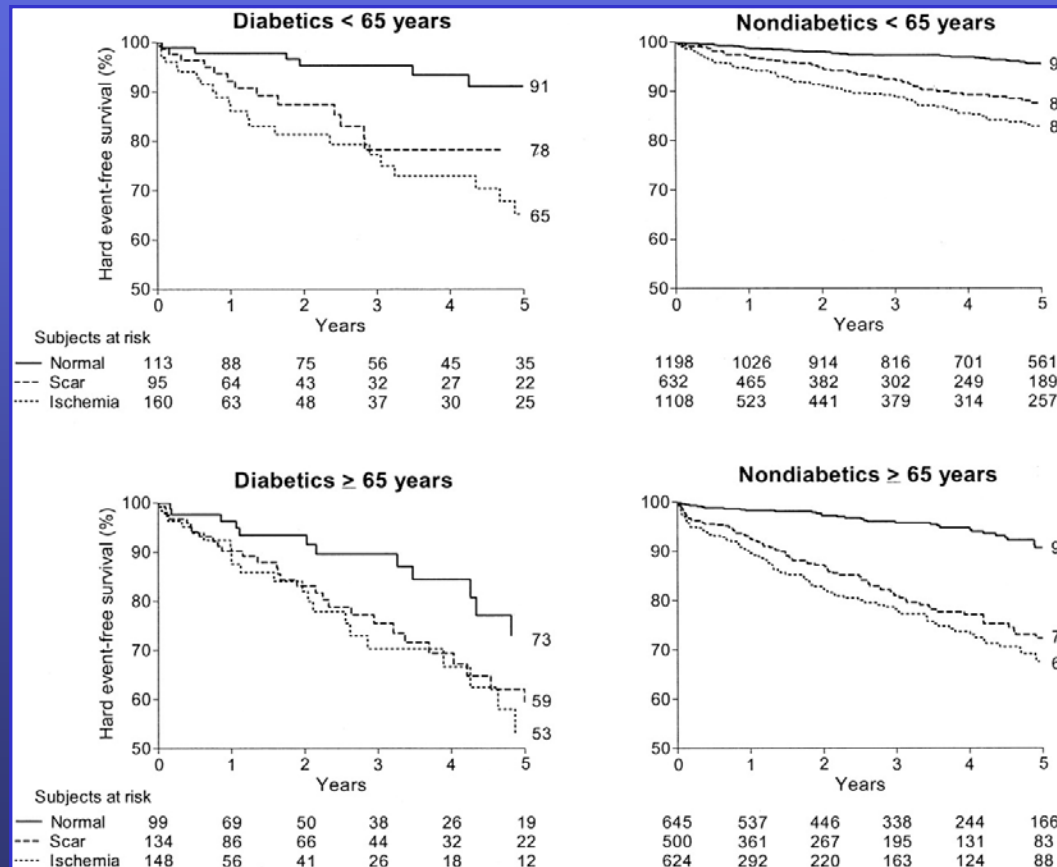


# Hazard Ratios για Καρδιακά Συμβάματα μετά από Μείζονα Μή - καρδιακή Χειρουργική Επέμβαση με Βάση την Stress Ηχοκαρδιογραφία



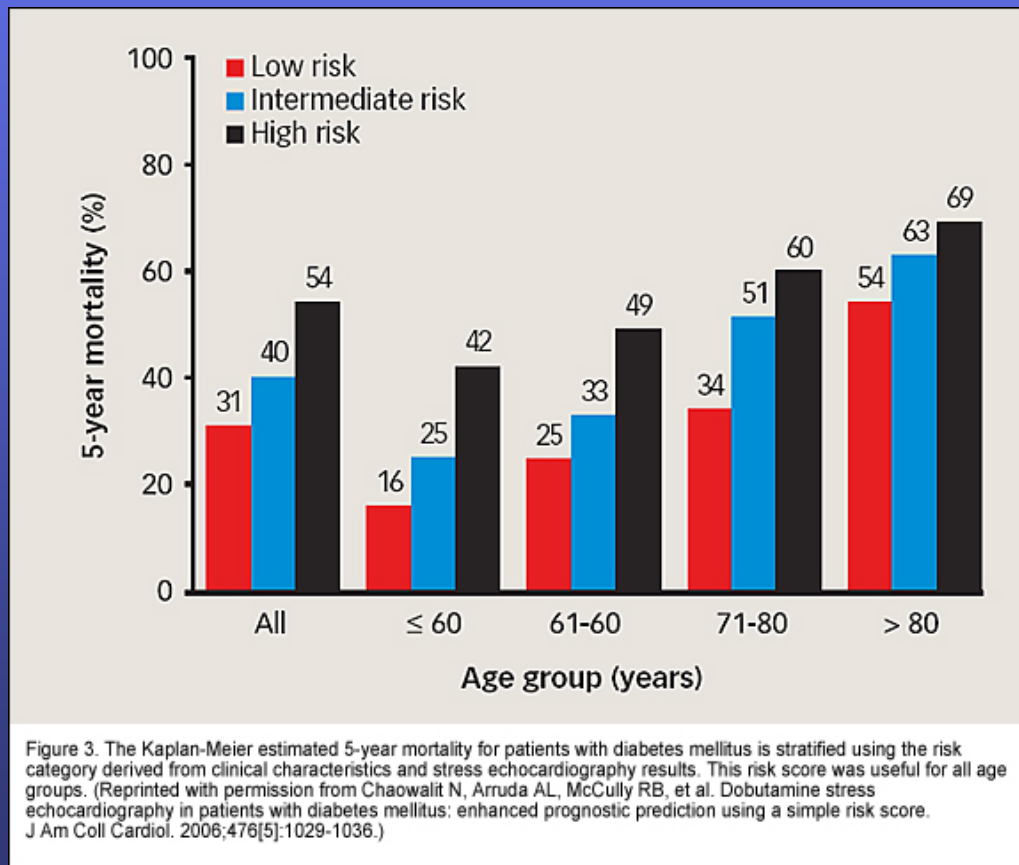
# Stress Ηχοκαρδιογραφία: Ένα Ισχυρό Προγνωστικό Εργαλείο σε Πληθυσμούς Υψηλού Κινδύνου

## ΣΑΚΧΑΡΩΔΗΣ ΔΙΑΒΗΤΗΣ



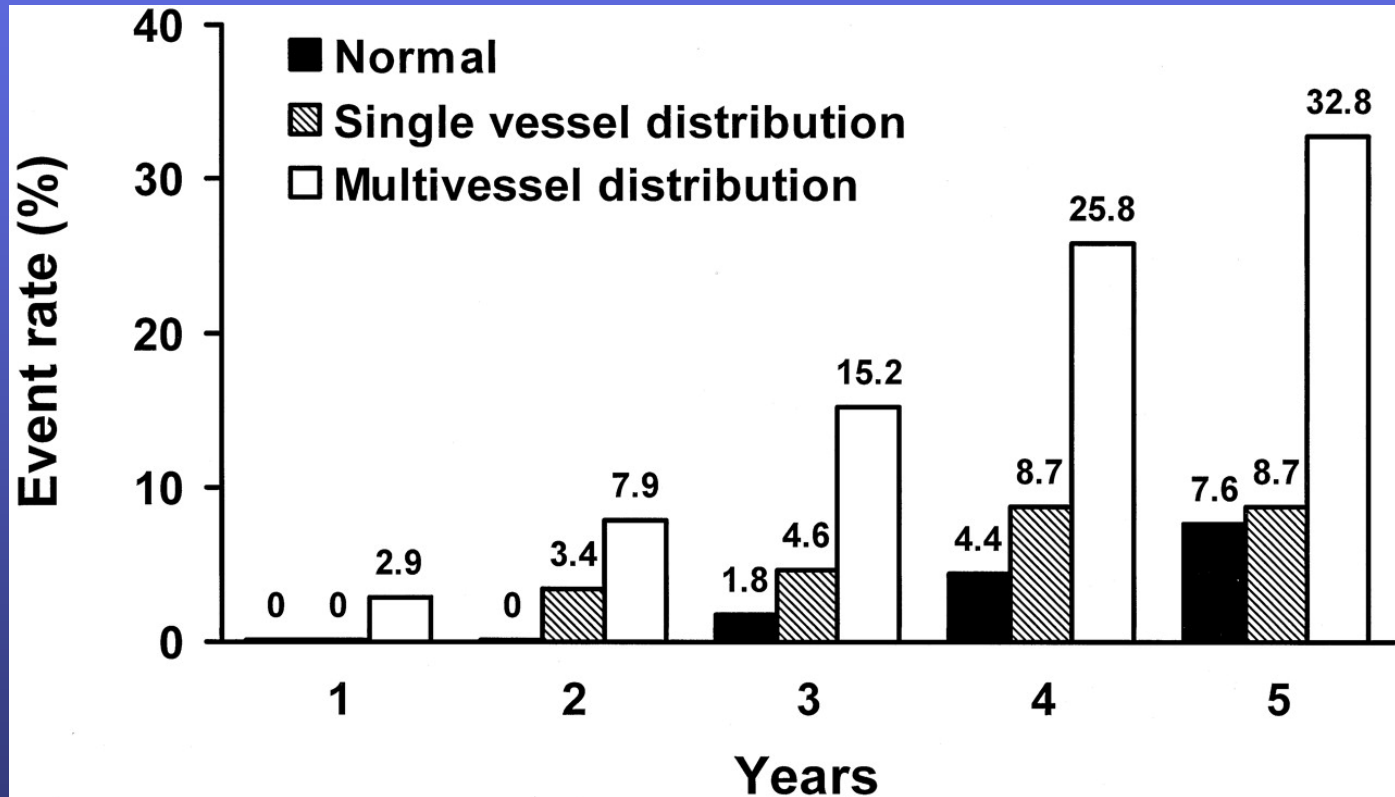
# *Stress Ηχοκαρδιογραφία Ντομπουταμίνης σε Διαβητικούς Ασθενείς:*

*Βελτιωμένη Προγνωστική Αξία με τη Χρήση ενός απλού Risk Score*



*2.349 patients, F/U 5.4 years, Chaowalit et al. JACC 2006*

# *Stress Echo: Προγνωστική Διαστρωμάτωση Κινδύνου σε Διαβητικούς Ασθενείς*



*563 patients, mean F/U 3 years, Elhendy et al. JACC 2001*

## *American diabetes Association/ American College of Cardiology Consensus Statement (1998)*

Αναίμακτος έλεγχος ισχαιμίας (δοκιμασία κόπωσης, σπινθηρογράφημα αιμάτωσης, stress echo) σε ασυμπτωματικούς διαβητικούς ασθενείς:

- ✓ Ασθενείς με περιφερική αγγειακή νόσο
- ✓ Ασθενείς με αγγειακή εγκεφαλική νόσο
- ✓ Ασθενείς με ΗΚΓφικές αλλοιώσεις σε ηρεμία
- ✓ Ασθενείς με τουλάχιστον 2 επιπρόσθετους παράγοντες κινδύνου

*Χρονική Εξέλιξη στη Χρήση Διαγνωστικών  
Εξετάσεων και Επεμβάσεων για Καρδιαγγειακά  
Νοσήματα στις ΗΠΑ, 1993-2001*

Ετήσια αύξηση 6.1% κατά μέσο όρο παρατηρήθηκε στην χρήση απεικονιστικών τεχνικών stress (πυρηνικές τεχνικές και stress echo), ενώ η αύξηση ήταν 2.0% για καρδιακούς καθετηριασμούς, 0.8% για PCI και 0.1% για νοσηλείες με OEM.

*Circulation 2006;113:374-379.*

**ACCF/ASE/ACEP/AHA/ASNC/SCAI/SCCT/SCMR 2008 Appropriateness  
Criteria for Stress Echocardiography: A Report of the American College of  
Cardiology Foundation Appropriateness Criteria Task Force, American  
Society of Echocardiography, American College of Emergency Physicians,  
American Heart Association, American Society of Nuclear Cardiology, Society  
for Cardiovascular Angiography and Interventions, Society of Cardiovascular  
Computed Tomography, and Society for Cardiovascular Magnetic Resonance  
Endorsed by the Heart Rhythm Society and the Society of Critical Care  
Medicine**

Pamela S. Douglas, Bijoy Khandheria, Raymond F. Stainback, Neil J. Weissman,  
Eric D. Peterson, Robert C. Hendel, Raymond F. Stainback, Michael Blaivas, Roger  
D. Des Prez, Linda D. Gillam, Terry Golash, Loren F. Hiratzka, William G.  
Kussmaul, Arthur J. Labovitz, JoAnn Lindenfeld, Frederick A. Masoudi, Paul H.  
Mayo, David Porembka, John A. Spertus, L. Samuel Wann, Susan E. Wieggers,  
Ralph G. Brindis, Pamela S. Douglas, Robert C. Hendel, Manesh R. Patel, Eric D.  
Peterson, Michael J. Wolk, and Joseph M. Allen

*J. Am. Coll. Cardiol.* 2008;51;1127-1147; originally published online Mar 3, 2008;  
doi:10.1016/j.jacc.2007.12.005



# Stress Echocardiography Appropriateness Criteria

**Table 1. Detection of CAD/Risk Assessment: Symptomatic**

Indication		Appropriateness Score (1–9)
<b>Evaluation of Chest Pain Syndrome or Anginal Equivalent</b>		
1.	<ul style="list-style-type: none"> <li>• Low pre-test probability of CAD</li> <li>• ECG interpretable AND able to exercise</li> </ul>	I (3)
2.	<ul style="list-style-type: none"> <li>• Low pre-test probability of CAD</li> <li>• ECG uninterpretable OR unable to exercise</li> </ul>	✓ A (7)
3.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG interpretable AND able to exercise</li> </ul>	✓ A (7)
4.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG uninterpretable OR unable to exercise</li> </ul>	✓ A (9)
5.	<ul style="list-style-type: none"> <li>• High pre-test probability of CAD</li> <li>• Regardless of ECG interpretability and ability to exercise</li> </ul>	✓ A (7)
6.	<ul style="list-style-type: none"> <li>• Prior stress ECG test is uninterpretable or equivocal</li> </ul>	✓ A (8)
<b>Acute Chest Pain</b>		
7.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG—no dynamic ST changes AND serial cardiac enzymes negative</li> </ul>	✓ A (8)
8.	<ul style="list-style-type: none"> <li>• High pre-test probability of CAD</li> <li>• ECG—ST elevation</li> </ul>	I (1)
<b>New-Onset/Diagnosed Heart Failure With Chest Pain Syndrome or Anginal Equivalent</b>		
9.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability</li> <li>• Normal LV systolic function</li> </ul>	✓ A (8)
10.	<ul style="list-style-type: none"> <li>• LV systolic function</li> </ul>	U (5)



## Stress Echocardiography Appropriateness Criteria

**Table 2. Detection of CAD and Risk Assessment: Asymptomatic (Without Chest Pain Syndrome or Anginal Equivalent)**

Indication		Appropriateness Score (1–9)
General Patient Populations		
11.	<ul style="list-style-type: none"> <li>• Low CHD risk (Framingham risk criteria)</li> </ul>	I (1)
12.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> <li>• ECG Interpretable</li> </ul>	I (3)*
13.	<ul style="list-style-type: none"> <li>• High CHD risk (Framingham)</li> </ul>	✓ U (6)

The ranking of this indication as inappropriate is different from that given to similar but not identical indications in previously published appropriateness criteria. The ratings were done in accordance with established ACCF methodology. Furthermore, the Technical Panel for each modality operated independently without allowance and with discouragement for intermodality comparisons. Discrepancies may be related to rating variability, differing Technical Panel composition, maturation of the appropriateness criteria process, or perceived differences in appropriateness.

# Stress Echocardiography Appropriateness Criteria

**Table 3. Detection of CAD/Risk Assessment: Without Chest Pain Syndrome or Anginal Equivalent in Patient Populations With Defined Comorbidities**

Indication		Appropriateness Score (1–9)
<b>New-Onset or Diagnosed Heart Failure or LV Systolic Dysfunction</b>		
14.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> <li>• No prior CAD evaluation</li> <li>• Normal LV systolic function</li> </ul>	✓ A (7)
15	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> <li>• No prior CAD evaluation</li> <li>• Abnormal LV systolic dysfunction</li> </ul>	✓ U (5)
<b>Valvular Heart Disease Requiring Valve Surgery</b>		
16.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> </ul>	I (3)
<b>New-Onset Atrial Fibrillation</b>		
17.	<ul style="list-style-type: none"> <li>• Low CHD risk (Framingham)</li> <li>• Part of the evaluation</li> </ul>	I (2)*
18.	<ul style="list-style-type: none"> <li>• Moderate to high CHD risk (Framingham)</li> <li>• Part of the evaluation</li> </ul>	✓ A (7)
<b>Nonsustained Ventricular Tachycardia</b>		
19.	<ul style="list-style-type: none"> <li>• Moderate to high CHD risk (Framingham)</li> <li>• Stress echo using exercise stress only</li> </ul>	✓ A (7)

\*The ranking of this indication as inappropriate is different from that given to similar but not identical indications in previously published appropriateness criteria. The ratings were done in accordance with established ACCF methodology. Furthermore, the Technical Panel for each modality operated independently without allowance and with discouragement for intermodality comparisons. Discrepant scores may be related to rating variability, differing Technical Panel composition, maturation of the appropriateness criteria process, or perceived differences in appropriateness.

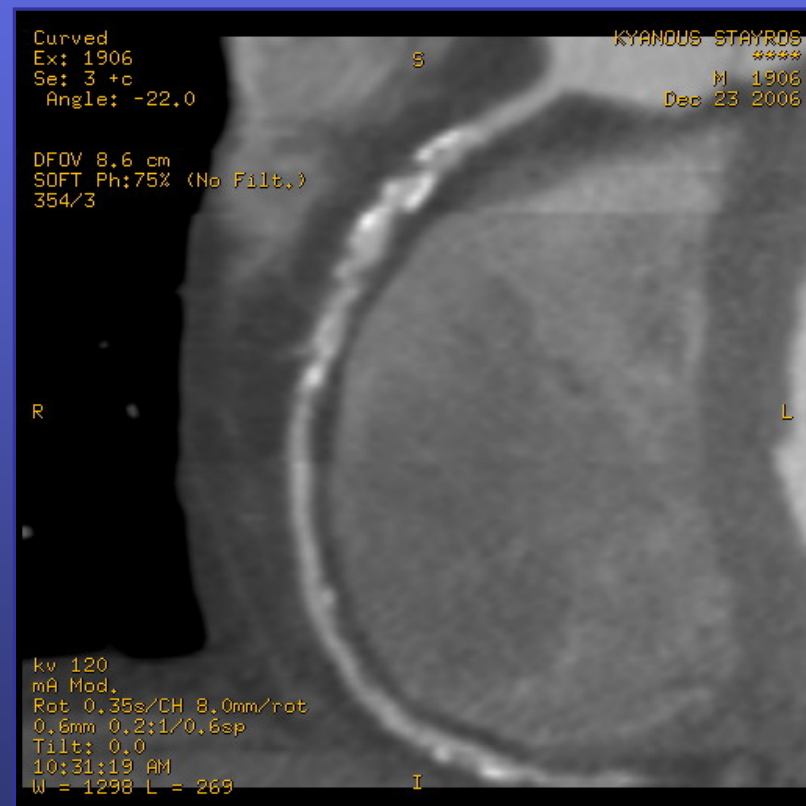
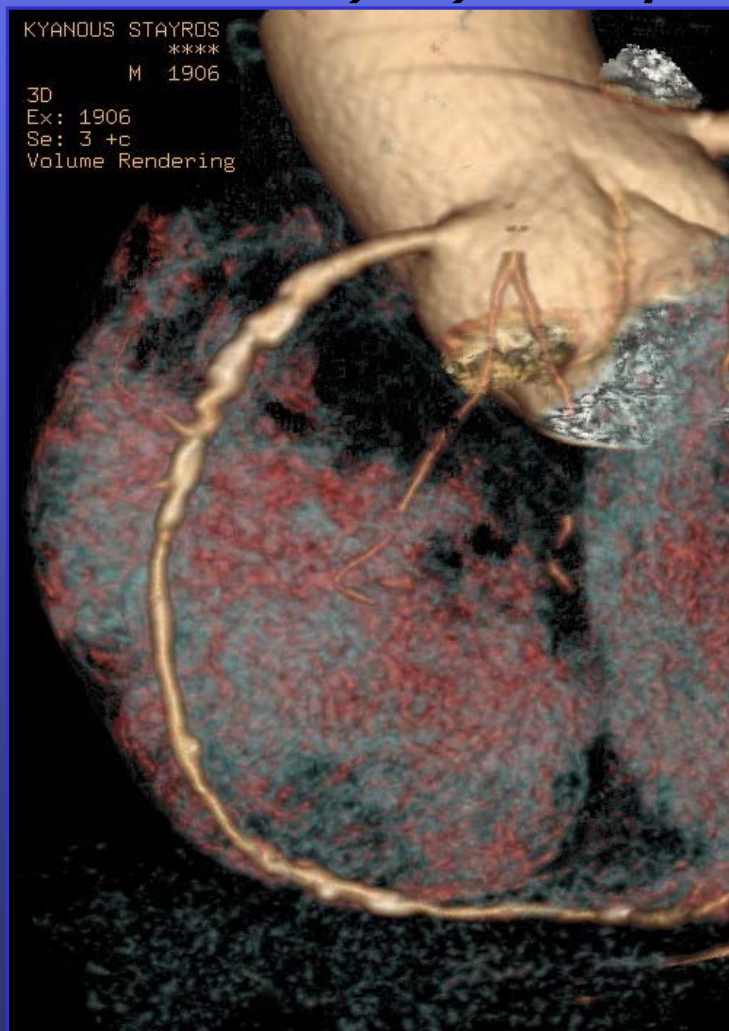
# Stress Echocardiography Appropriateness Criteria

Table 4. Risk Assessment With Prior Test Results

Indication	Appropriateness Score (1-9)
<b>Asymptomatic OR Stable Symptoms, Normal Prior Stress Imaging Study</b>	
20.	<ul style="list-style-type: none"> <li>• High CHD risk</li> <li>• Repeat stress echo study annually</li> </ul> I (2)
21.	<ul style="list-style-type: none"> <li>• High CHD risk</li> <li>• Repeat stress echo study after 2 years or greater</li> </ul> ✓ U (5)
<b>Known CAD: Asymptomatic OR Stable Symptoms, Abnormal Catheterization OR Abnormal Prior Stress Imaging Study</b>	
22.	<ul style="list-style-type: none"> <li>• Assessment of severity of ischemia (CAD)</li> <li>• Less than 1 year to evaluate medically managed patients</li> </ul> I (2)
23.	<ul style="list-style-type: none"> <li>• Assessment of severity of ischemia (CAD)</li> <li>• Greater than or equal to 2 years to evaluate medically managed patients</li> </ul> ✓ U (5)
<b>Worsening Symptoms: Abnormal Catheterization OR Abnormal Prior Stress Imaging Study</b>	
24.	<ul style="list-style-type: none"> <li>• Re-evaluation of medically managed patients</li> </ul> ✓ A (8)
<b>Asymptomatic Prior Coronary Calcium Agatston Score</b>	
25.	<ul style="list-style-type: none"> <li>• Agatston score greater than or equal to 400</li> </ul> ✓ A (7)
26.	<ul style="list-style-type: none"> <li>• Agatston score less than 100</li> </ul> I (1)
<b>Chest Pain Syndrome or Anginal Equivalent</b>	
27.	<ul style="list-style-type: none"> <li>• Coronary artery stenosis of unclear significance (cardiac catheterization or CT angiography)</li> </ul> ✓ A (8)

I

# 64 - Slice CT : Διάχυτη Αθηρωμάτωση Δεξιάς Στεφανιαίας Αρτηρίας



**Table 5. Risk Assessment: Preoperative Evaluation for Noncardiac Surgery†**

Indication		Appropriateness Score (1–9)
<b>Low-Risk Surgery</b>		
28.	<ul style="list-style-type: none"> <li>• Preoperative evaluation for noncardiac surgery risk assessment</li> <li>• Minor or intermediate clinical risk predictors</li> </ul>	I (1)
<b>Intermediate-Risk Surgery</b>		
29.	<ul style="list-style-type: none"> <li>• Poor exercise tolerance (less than or equal to 4 METs)</li> <li>• Minor or no clinical risk predictors</li> </ul>	I (2)
30.	<ul style="list-style-type: none"> <li>• Poor exercise tolerance (less than or equal to 4 METs)</li> <li>• Intermediate clinical risk predictors</li> </ul>	✓ A (7)
<b>High-Risk Nonemergent Surgery</b>		
31.	<ul style="list-style-type: none"> <li>• Poor exercise tolerance (less than 4 METs)</li> </ul>	✓ A (8)
32.	<ul style="list-style-type: none"> <li>• Asymptomatic up to 1 year after normal catheterization, noninvasive test, or previous revascularization</li> </ul>	I (1)

†See discussion and appendix for changes in the revised 2007 ACC/AHA Perioperative Guidelines relevant to these indications (10).

**Table 6. Risk Assessment: Following Acute Coronary Syndrome**

Indication		Appropriateness Score (1–9)
<b>UA/NSTEMI—No Recurrent Symptoms or Signs of Heart Failure</b>		
33.	<ul style="list-style-type: none"> <li>• Not planning to undergo early catheterization</li> </ul>	✓ A (8)
<b>Acute Coronary Syndrome—Asymptomatic Post-Revascularization (PCI or CABG)</b>		
34.	<ul style="list-style-type: none"> <li>• Routine evaluation prior to hospital discharge</li> </ul>	I (1)

# Stress Echocardiography Appropriateness Criteria

**Table 7. Risk Assessment: Post-Revascularization (PCI or CABG)**

Indication		Appropriateness Score (1–9)
Symptomatic		
35.	<ul style="list-style-type: none"> <li>• Evaluation of chest pain syndrome</li> <li>• Not in the early post-procedure period</li> </ul>	✓ A (8)
Asymptomatic		
36.	<ul style="list-style-type: none"> <li>• Less than 5 years after CABG</li> </ul>	I (2)*
37.	<ul style="list-style-type: none"> <li>• Asymptomatic (e.g., silent ischemia) prior to previous revascularization</li> <li>• Greater than or equal to 5 years after CABG</li> </ul>	✓ U (6)
38.	<ul style="list-style-type: none"> <li>• Symptomatic prior to previous revascularization</li> <li>• Greater than or equal to 5 years after CABG</li> </ul>	✓ U (5)
39.	<ul style="list-style-type: none"> <li>• Asymptomatic (e.g., silent ischemia) prior to previous revascularization</li> <li>• Less than 2 years after PCI</li> </ul>	I (3)*
40.	<ul style="list-style-type: none"> <li>• Symptomatic prior to previous revascularization</li> <li>• Less than 2 years after PCI</li> </ul>	I (2)
41.	<ul style="list-style-type: none"> <li>• Asymptomatic (e.g., silent ischemia) prior to previous revascularization</li> <li>• Greater than or equal to 2 years after PCI</li> </ul>	✓ U (5)

\*The ranking of this indication as inappropriate is different from that given to similar but not identical indications in previously published appropriateness criteria. The ratings were done in accordance with established ACCF methodology. Furthermore, the Technical Panel for each modality operated independently without allowance and with discouragement for intermodality comparisons. Discrepant scores may be related to rating variability, differing Technical Panel composition, maturation of the appropriateness criteria process, or perceived differences in appropriateness.

# Stress Echocardiography Appropriateness Criteria

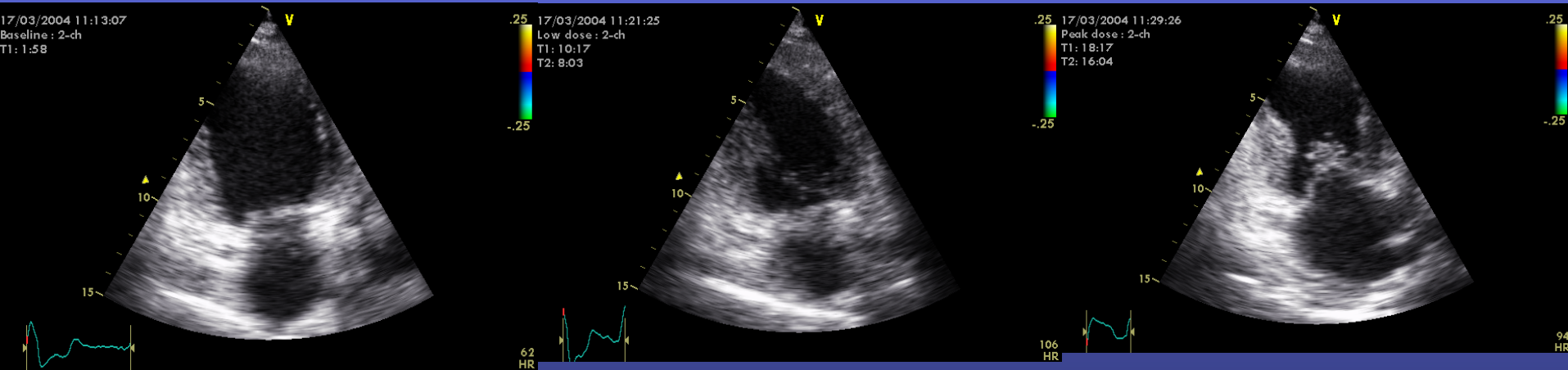
**Table 8. Assessment of Viability/Ischemia**

Indication		Appropriateness Score (1-9)
Ischemic Cardiomyopathy, Assessment of Viability/Ischemia		
42.	<ul style="list-style-type: none"> <li>• Known CAD on catheterization</li> <li>• Patient eligible for revascularization</li> </ul>	✓ A (8)

**Table 10. Contrast Use**

Indication		Appropriateness Score (1-9)
Use of Contrast With Stress Echo		
50.	<ul style="list-style-type: none"> <li>• Routine use of contrast</li> <li>• All segments visualized on noncontrast images</li> </ul>	I (1)
51.	<ul style="list-style-type: none"> <li>• Selective use of contrast</li> <li>• 2 or more contiguous segments are NOT seen on noncontrast images</li> </ul>	✓ A (8)

# *Βιώσιμο Μυοκάρδιο: Διφασική Απάντηση*



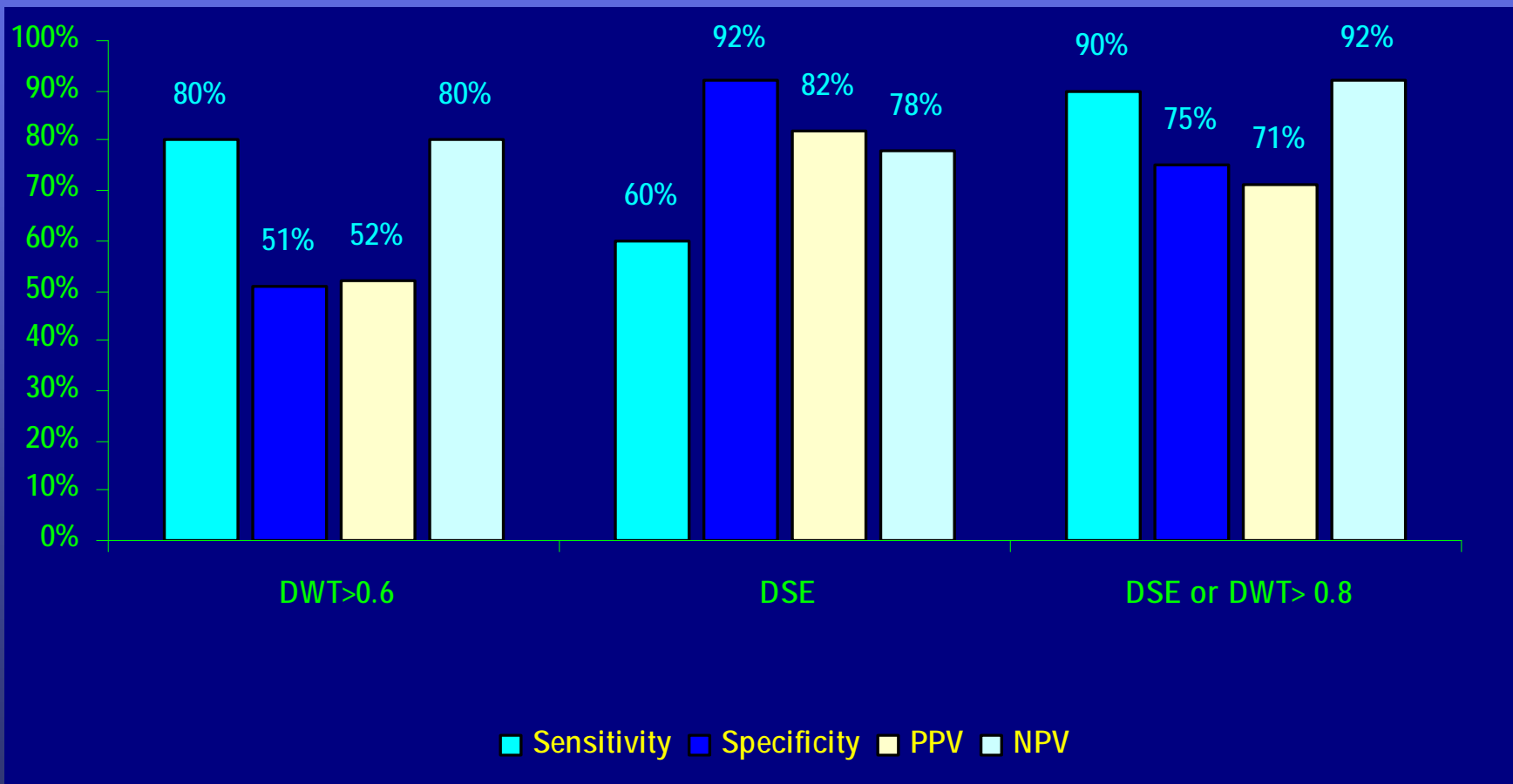
*REST*

*LOW DOSE*

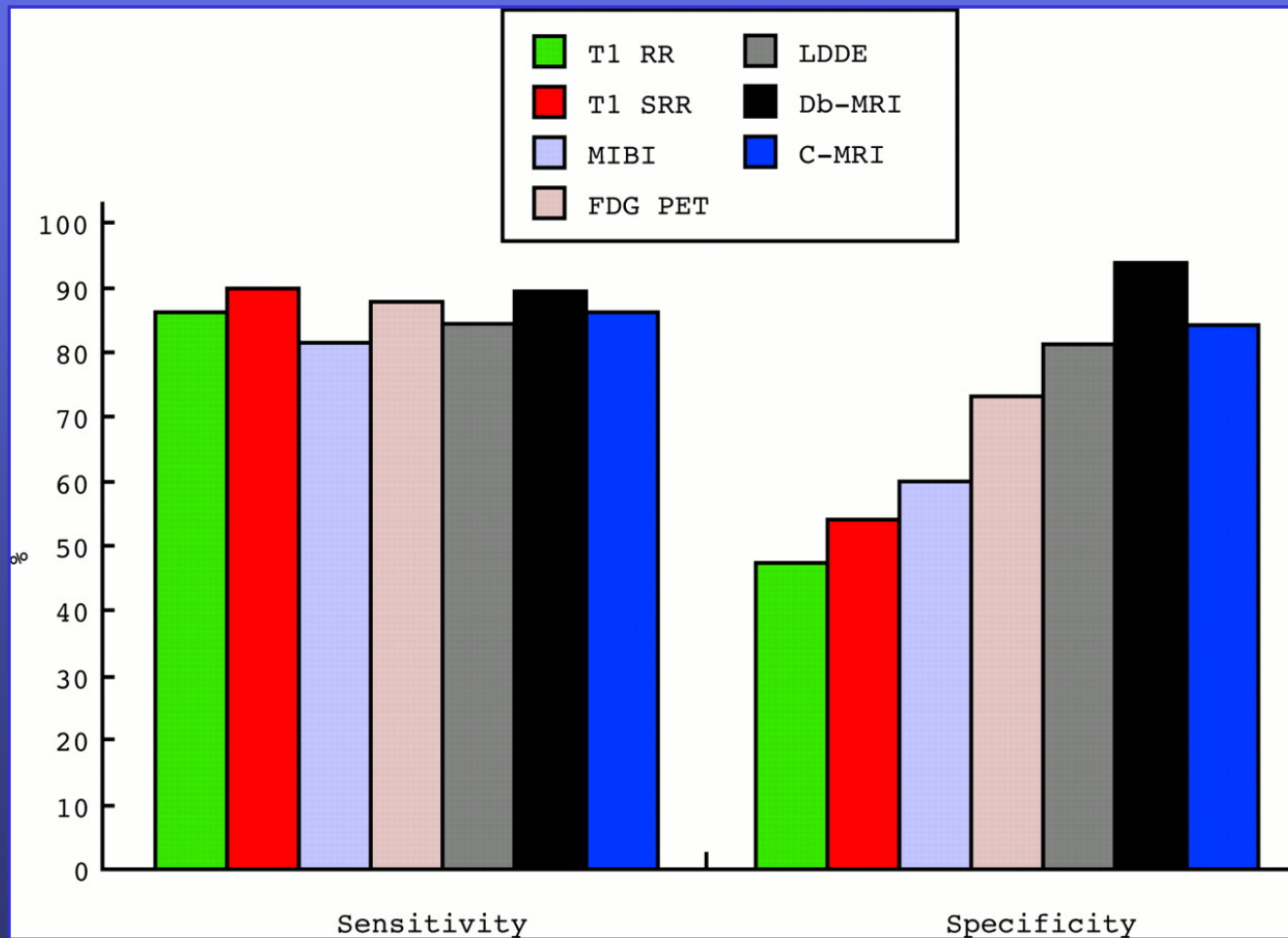
*PEAK STRESS*



# Πρόβλεψη Βιώσιμου Μυοκαρδίου σε Ακίνητικά Τμήματα: Επιπρόσθετη Αξία της Μέτρησης του Διαστολικού Πάχους Τοιχωμάτων



# Ανασκόπηση της Ευαισθησίας και της Ειδικότητας των Διαγνωστικών Τεχνικών για την Κατάδειξη Βιώσιμου Μυοκαρδίου



*Patient's status:*

*no diabetes, no multivessel disease*

medical treatment

revascularization and non viable

revascularization and viable

*diabetes, no multivessel disease*

medical treatment

revascularization and non viable

revascularization and viable

*no diabetes, multivessel disease*

medical treatment

revascularization and non viable

revascularization and viable

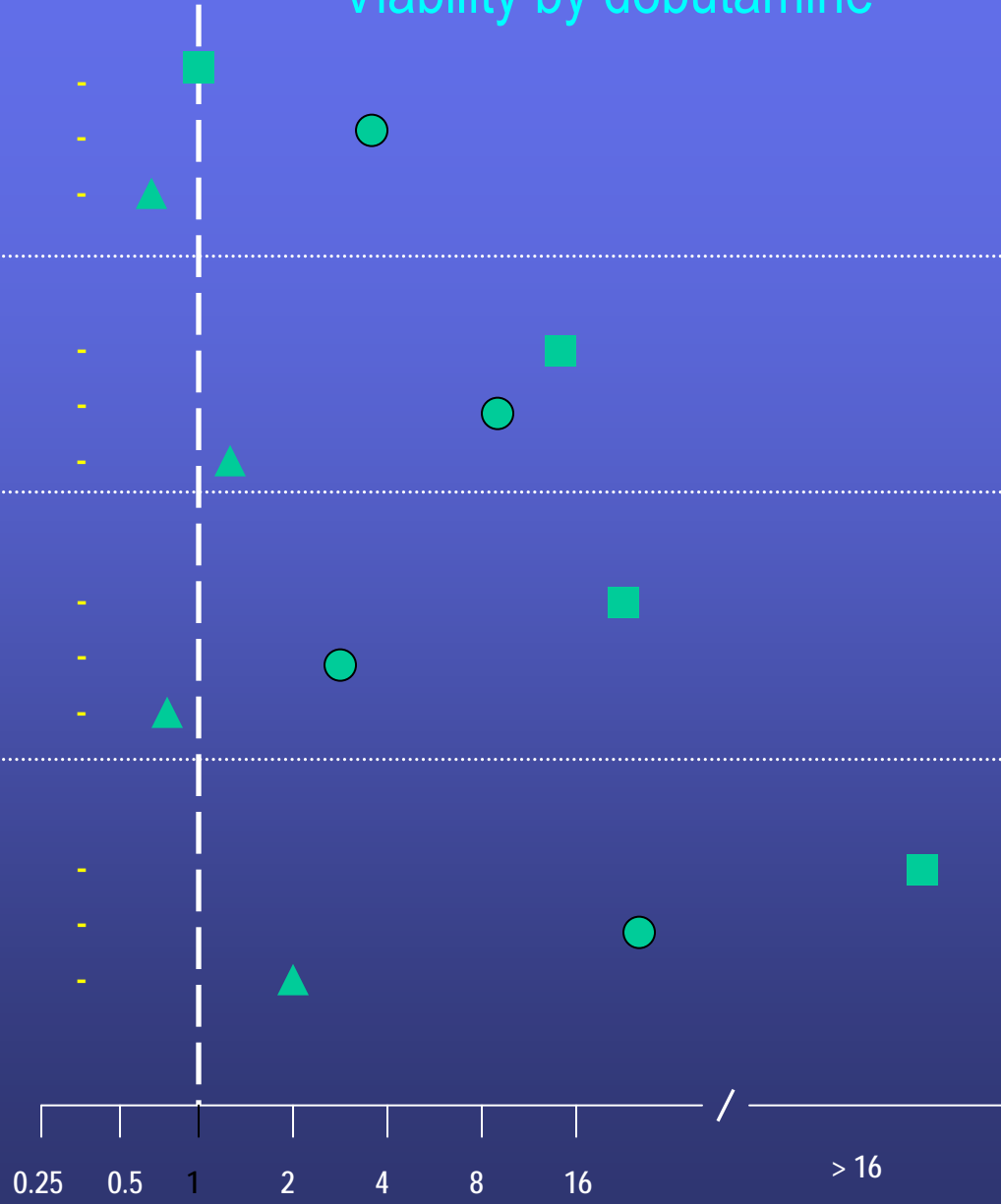
*diabetes, multivessel disease*

medical treatment

revascularization and non viable

revascularization and viable

Viability by dobutamine



Increase in risk (hazards ratio)

*Pasquet et al. Circulation 1999*

# *Stress Echo σε Διαβητικούς Ασθενείς*

- ✓ Σύγχρονη, αναίμακτη απεικονιστική τεχνική με υψηλή διαγνωστική αξία
- ✓ Πληθώρα επιπρόσθετων πληροφοριών εκτός από την διάγνωση ισχαιμίας (βαλβίδες, ΚΕ, διαστολική δυσλειτουργία, αορτή, κτλ)
- ✓ Ασφαλής χωρίς να επιβαρύνει τον ασθενή με ιονίζουσα ακτινοβολία
- ✓ Κατάλληλη για ασθενείς που δεν μπορούν να ασκηθούν ( ασθενείς με σοβαρότερη καρδιαγγειακή επιβάρυνση και συνολική θνησιμότητα)
- ✓ Διαβητικοί ασθενείς με φυσιολογικές μελέτες stress echo σε υψηλότερο κίνδυνο για συμβάματα από τους μη- διαβητικούς ασθενείς
- ✓ Οι διαβητικοί ασθενείς χρήζουν συχνότερου επανελέγχου ( ανά 2 έτη)
- ✓ Η μέθοδος με την υψηλότερη προγνωστική αξία για την πρόβλεψη βιώσιμου μυοκαρδίου σε ασθενείς με ισχαιμική δυσλειτουργία της αριστερής κοιλίας



*Erasistratus Discovering the Cause of Antiochus' Disease*  
*Alexandre-Charles Guillemot, 1808, from Ecole nationale supérieure des Beaux-arts, Paris.*