

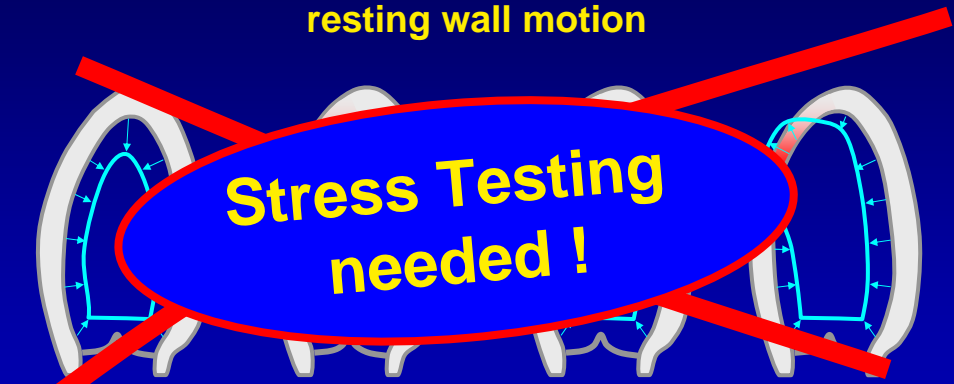
EAE Teaching Course
Bucharest, 2010

Assessment of Ischemia and Viability

Jens-Uwe Voigt
Dpt. of Cardiology
University Leuven
Belgium

Assessment of Ischemia & Viability

resting wall motion



Stress Testing needed !

1 normal 2 hypokinetic 3 akinetic 4 dyskinetic

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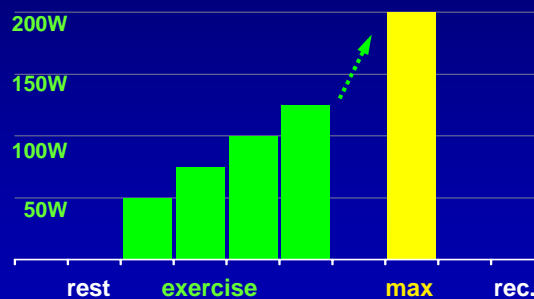
Stress Testing in CAD

Ischemia

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Stress Echocardiography

exercise test (bicycle, treadmill)

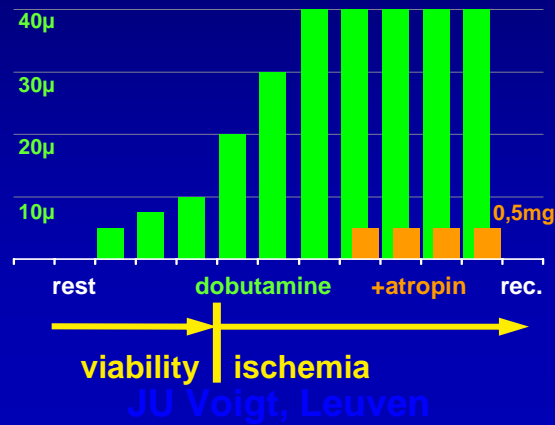


target HR = $(220 - \text{age}) * 0.85$

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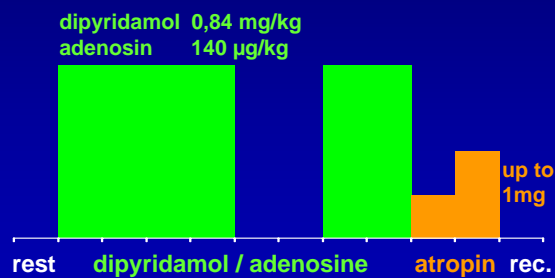
Stress Echocardiography

dobutamine protocol



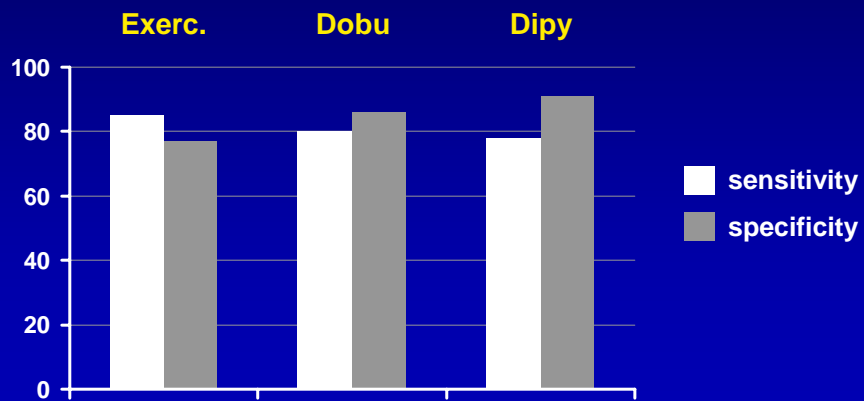
Stress Echocardiography

dipyridamol / adenosine protocol



Comparison of Protocols

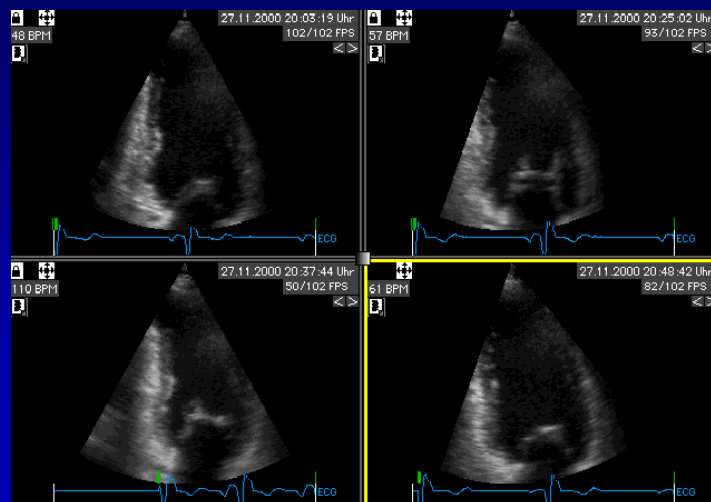
sensitivity / specificity for CAD (stenosis > 50%)



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Fleischmann, JAMA 1998

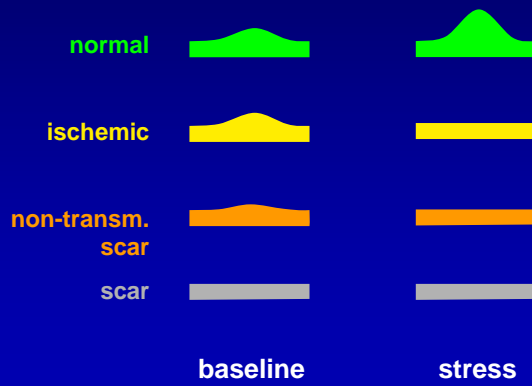
Stress Echocardiography



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Stress Echocardiography

regional wall motion

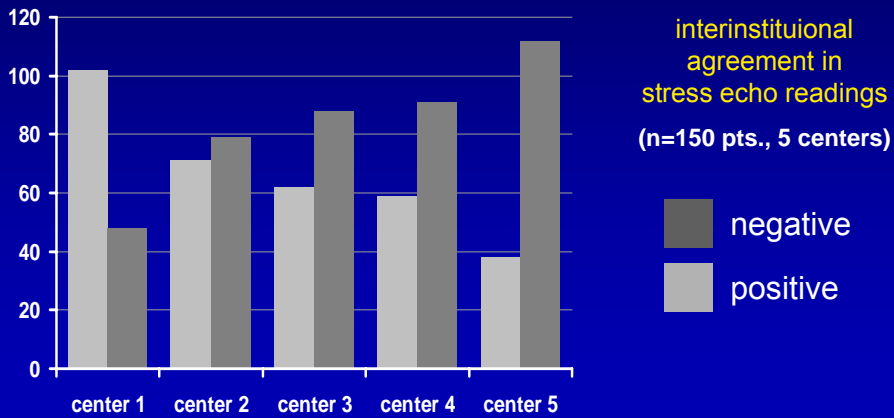


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Afridi et al., Circ 1995

Stress Echo Reading

the human factor

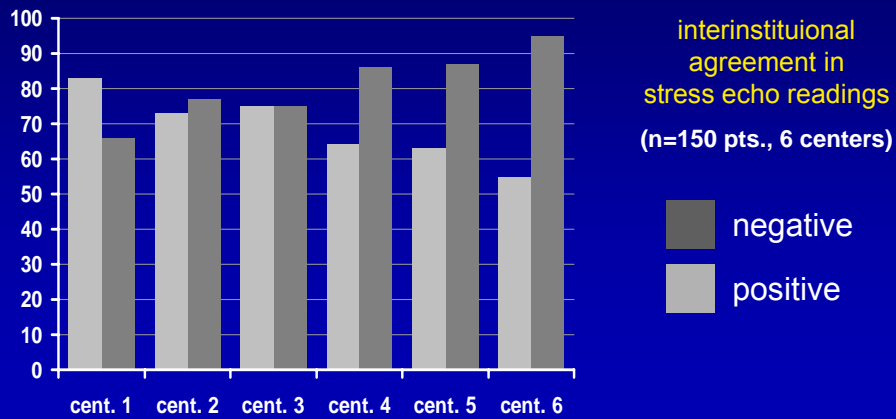


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Hoffmann et al., JACC 1996

Stress Echo Reading

the human factor + modern technology ...

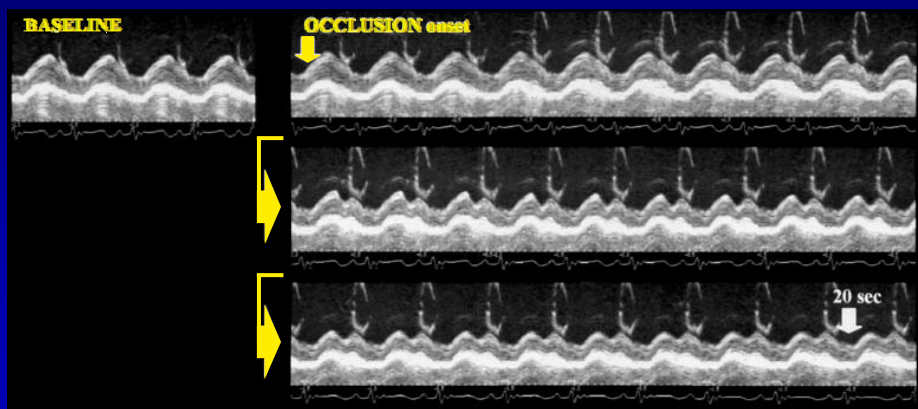


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Hoffmann et al., EHJ 2002

Regional Ischemic Response

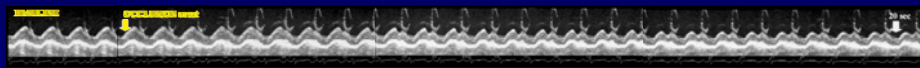
experimental coronary occlusion



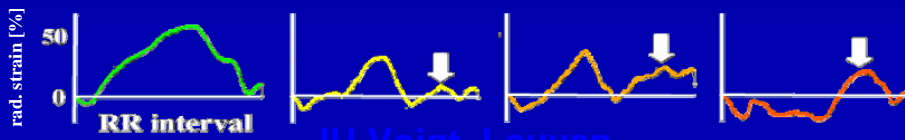
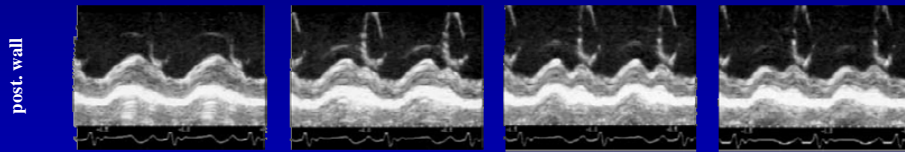
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Jamal, J Am Soc Echo 2001

Regional Ischemic Response



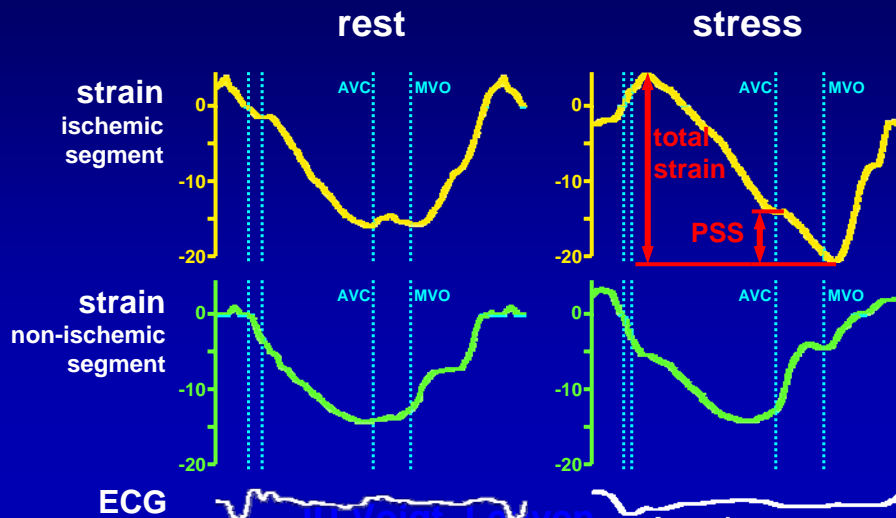
→ **baseline**
 → **5s ischemia**
 → **10s ischemia**
 → **20s ischemia**



JU Voigt, Leuven

Jamal, J Am Soc Echo 2001

Strain Rate Imaging in Stress Echo

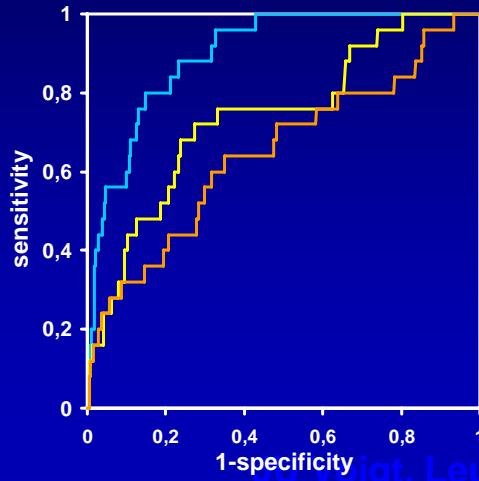


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Voigt et al., Circulation 2003

Quantitative Criteria

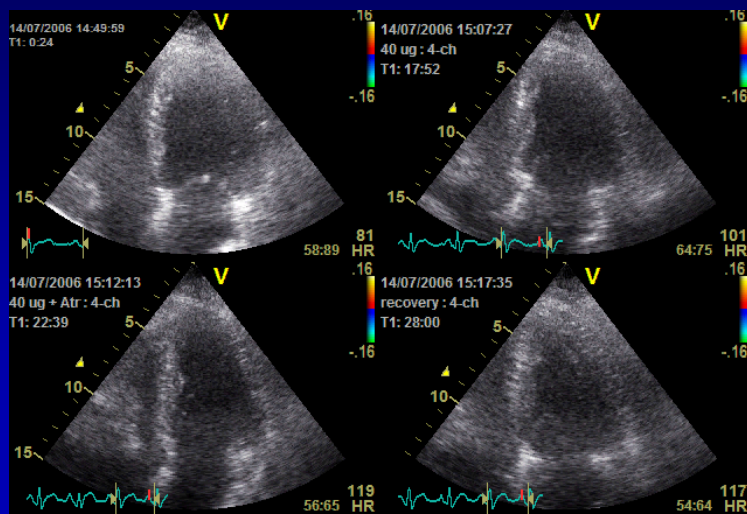
ROC - Analysis



| parameter | AUC |
|-----------------------------|-------------|
| PSS | 0.90 |
| systolic strain rate | 0.74 |
| systolic strain | 0.65 |

Voigt et al., Circulation 2003

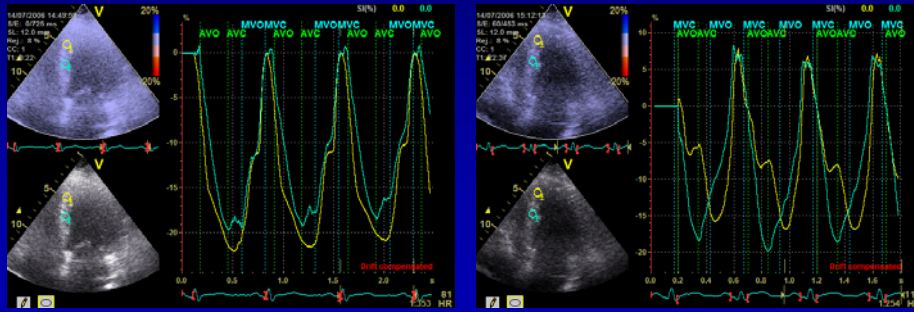
Case: Dobutamine Stress Echo, 4CV



Case: Quantitative Assessment

baseline

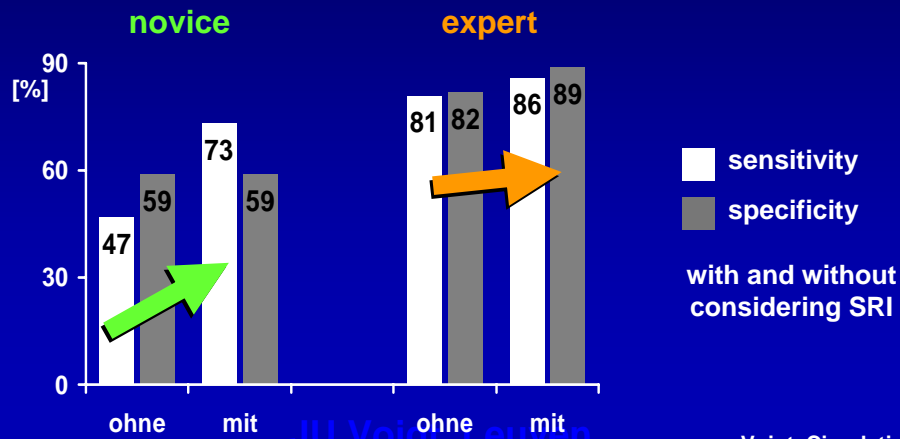
peak stress



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Strain Rate im Stress Echo

accuracy improvement depends on experience

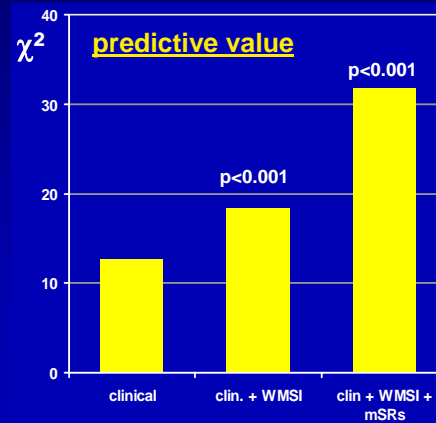
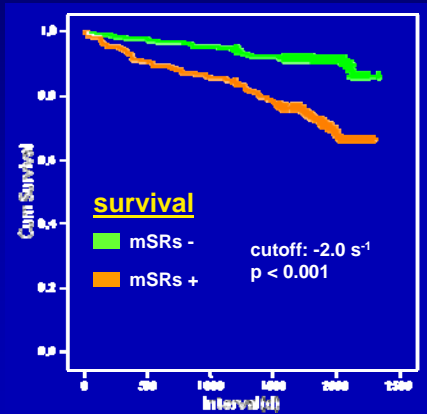


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Voigt, Circulation 2003

Strain Rate Stress Echo for Prognosis

dobutamine stress, 646 pts., 7 ys. follow up



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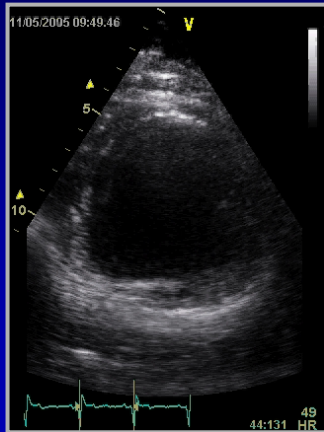
Björk-Ingul, Circulation 2007

Stress Testing in CAD

Viability

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Concept of “Viability”



CASS - Study

5 year survival rate:

| | med. | OP |
|--------|------|--------|
| EF<35% | 54% | 68% ** |
| EF<26% | 43% | 63% ** |

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CASS: Alderman et. al.,Circ 1983

Concept of “Viability”

reperfusion therapy

relieves symptoms
improves LV function
improves prognosis



dysfunction \neq irreversible myocardial damage !

“viable myocardium”

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Concept of “Viability”

stunning: contractile dysfunction
after short ischaemia
despite restored perfusion
Heyndrickx et al., J Clin Invest 1975
(to render sb. senseless or dizzy)
restitutio ad integrum



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Concept of “Viability”

stunning: contractile dysfunction
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Heyndrickx et al., J Clin Invest 1975
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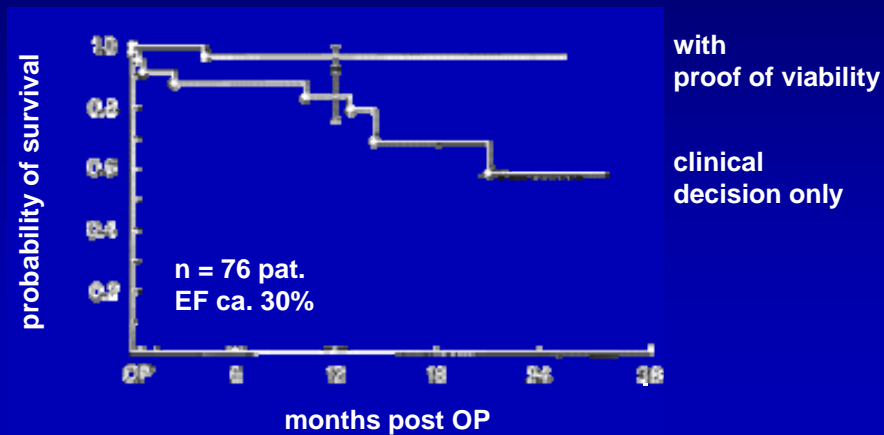
hibernation: reduced contractile function with
proportionally reduced perfusion
Diamond et al., Am Heart J 1978
(to lethargically pass the winter)
restitutio ad integrum ?



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Decision to Revascularize

CABG in pat. with LV dysfunction



Haas et al., JACC 1997

Decision to Revascularize

CABG without proof of viability

more adverse events due to perioperative mortality (11-15% !)

worse prognosis than with med. therapy

(Haas et al., JACC 1997)

(Anselmi et al., Am J Cardiol 1998)

(Pasquet et al., Circ 1999)

(Senior et al., J Am Coll Cardiol 1999)

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How to Test for Viability ?

scintigraphy: **SPECT, PET**
perfusion / metabolism mismatch

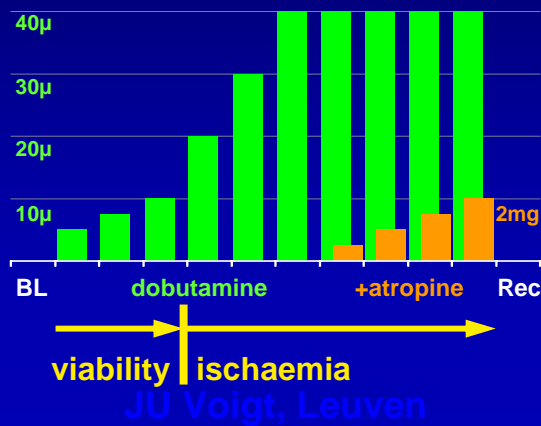
echocardiography: **dobutamine stress**
inotropic stimulation

MRI: **dobutamine stress**
inotropic stimulation
contrast MRI
delayed enhancement

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Stress Echocardiography

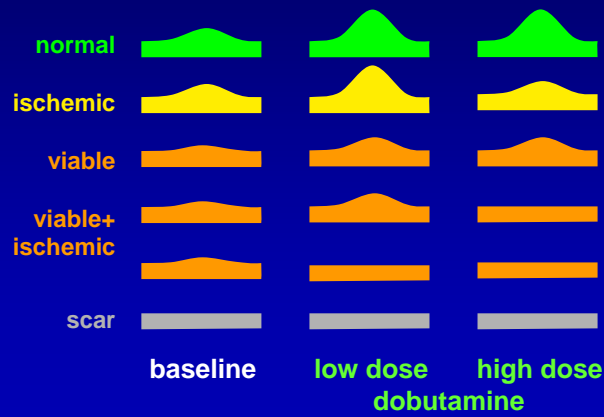
dobutamine protocol



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Stress Echocardiography

regional wall motion

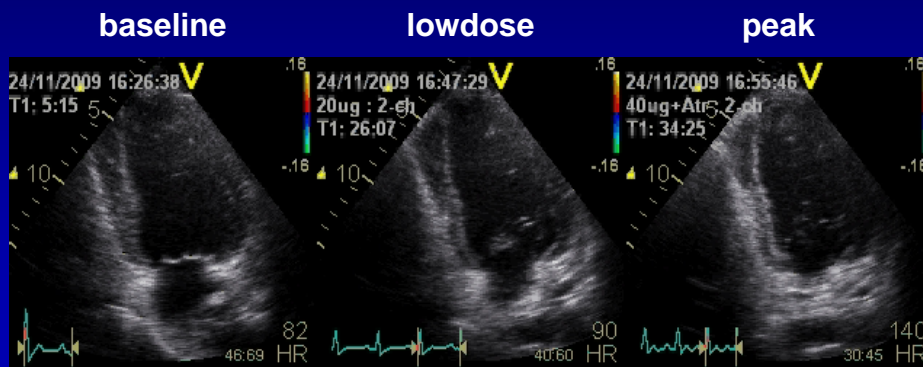


JU Voigt, Leuven

Afridi et al., Circ 1995

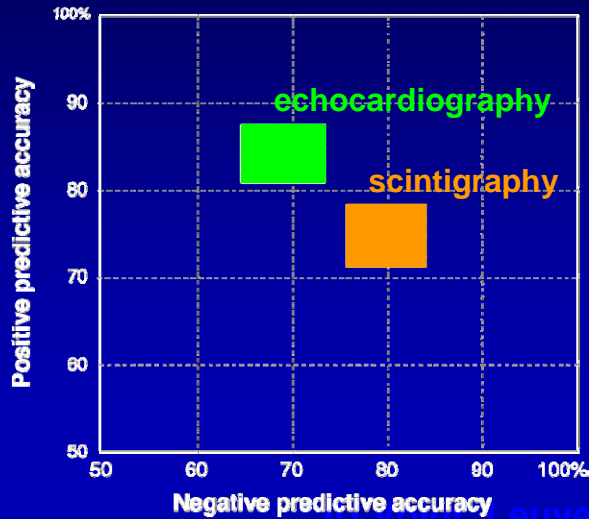
Case: Low Dose Dobutamine

biphasic response



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DSE vs. Scintigraphy



meta-analysis

data from
studies with
direct comparison
of methods

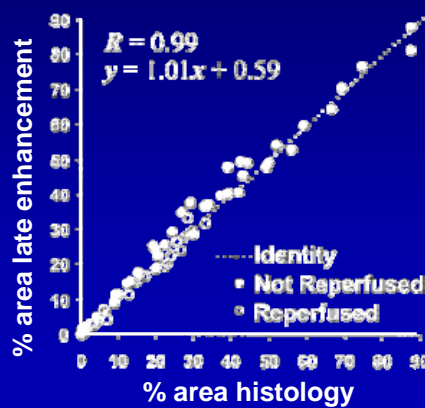
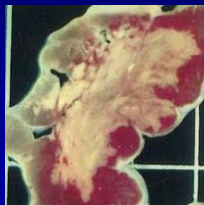
11 studies

325 patients

Bax et al., Curr Probl Cardiol 2001

Viability in MRT

“delayed enhancement” vs. histology

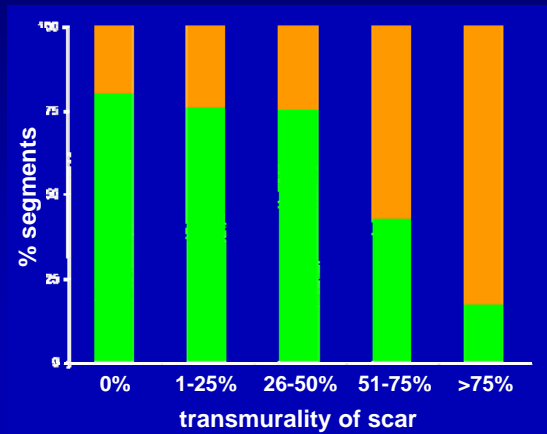


JU Voigt, Leuven

Kim, Circulation 1999

Viabile Rimb

contractile reserve vs. transmuralità di scar



n= 48 patients

late enhancement vs.
dobutamin - MRT

■ w/o } contractile
■ w } reserve

ven Kaandorp et al., Am J Cardiol 2004

Which Test for Viability ?

ESC Study Group Report

| modality | Scinti | Echo | MRI (stress) | MRI (contrast) |
|------------------|--------|------|--------------|----------------|
| indication class | 1 | 1 | 1 | 1 |

- Most questions of myocardial viability and hibernation will be answered by echocardiography and myocardial perfusion scintigraphy.
- Myocardial perfusion scintigraphy and stress echocardiography have similar capabilities for the detection of viable and hibernating myocardium.

In many centres the choice will depend upon availability and local expertise,

JU Voigt, Leuven Underwood et al., Eur Heart J 2004

Case

**M.Pf., m, 67 yeras
decompensated HF, NYHA III-IV**

Hx silent posterior infarction

Hx PTA of A. femoralis

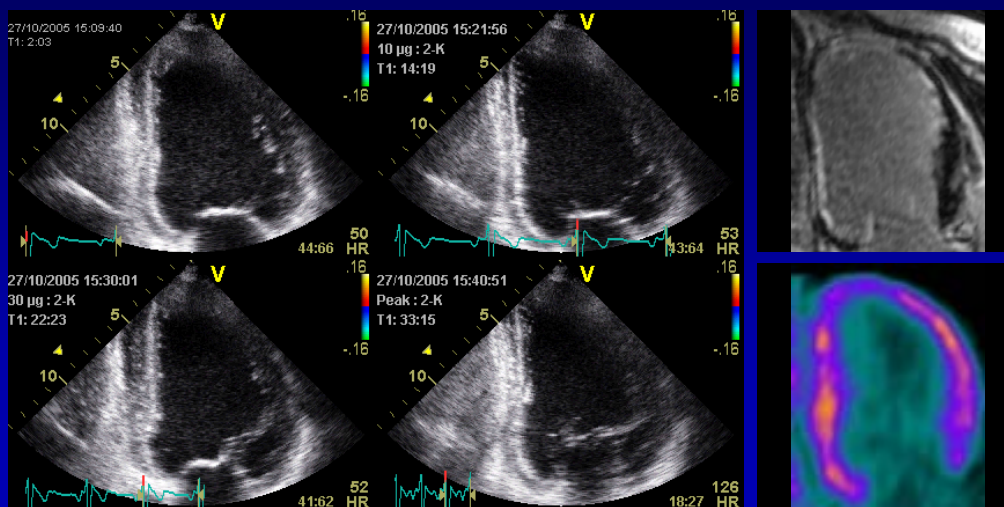
risik faktors: hypertension
diabetes mellitus II
hyperlipidaemia
ex smoker

EF ca. 25%

LAD occluded, CX and RCA stenotic

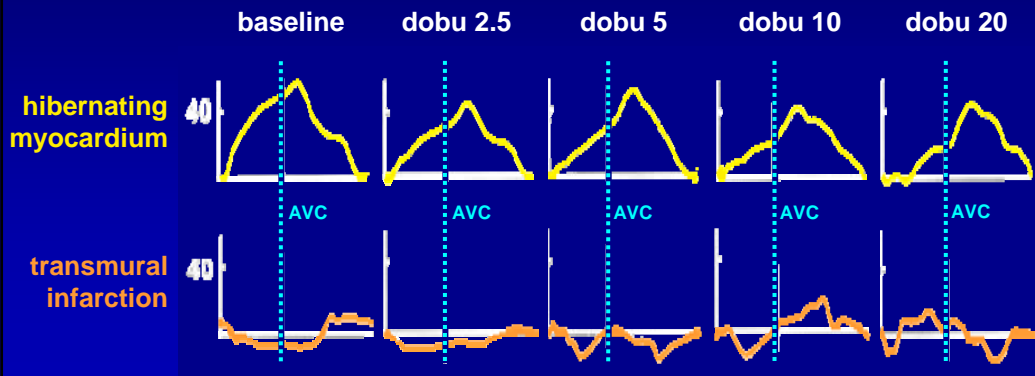
JU Voigt, Leuven

Case: Multimodality Approach



Strain for Viability Testing ?

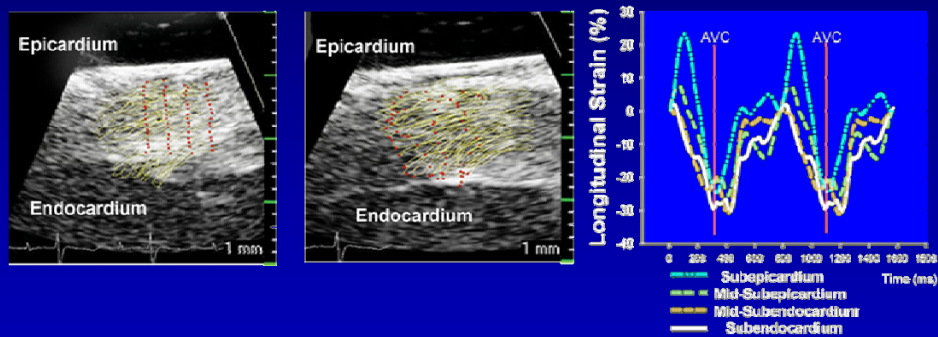
radial strain during low dose dobutamine
after non-transmural / transmural infarction



JU Voigt, Leuven Weidemann et al., Circulation 2003

Strain for Viability Testing ?

layer specific assessment



JU Voigt, Leuven

Rösner et al., JASE 2010

EAE Consensus Statement



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

EAE GUIDELINES

Stress echocardiography expert consensus statement

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

Rosa Sicari^{1*}, Petros Nihoyannopoulos², Arturo Evangelista³, Jaroslav Kasprzak⁴,
Patrizio Lancellotti⁵, Don Poldermans⁶, Jens-Uwe Voigt⁷, and Jose Luis Zamorano⁸ on behalf of the
European Association of Echocardiography

¹Institute of Clinical Physiology, Via G. Moruzzi, 1, 56124 Pisa, Italy; ²Hammersmith Hospital, NHLI, Imperial College London, UK; ³Hospital Vall d'Hebron, Barcelona, Spain; ⁴Department of Cardiology, Medical University of Lodz, Lodz, Poland; ⁵Department of Cardiology, University Hospital Sart Tilman, Liège, Belgium; ⁶Erasmus Medical Center, Rotterdam, The Netherlands; ⁷Instituto Cardiovascular, Catholic University, Leuven, Belgium; and ⁸Hospital Clinico San Carlos, Madrid, Spain

JU Voigt, Leuven

Sicari et al., EHJ 2008