

Stress echo, infarction, reperfusion injury and viability

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University Hospital

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Chest pain of recent onset

**Assessment and diagnosis of recent
onset chest pain or discomfort of
suspected cardiac origin**

**This guidance partially updates NICE
technology appraisal guidance 73
(published November 2003)**

NICE clinical guideline 95
Developed by the National Clinical Guideline Centre for Acute and Chronic Conditions

<http://guidance.nice.org.uk/Topic/Cardiovascular/Angina>



**Oslo
University Hospital**

Probability - angina

Table 1 Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors

	Non-anginal chest pain				Atypical angina				Typical angina			
	Men		Women		Men		Women		Men		Women	
	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi
Age (years)												
35	3	35	1	19	8	59	2	39	30	88	10	78
45	9	47	2	22	21	70	5	43	51	92	20	79
55	23	59	4	25	45	79	10	47	80	95	38	82
65	49	69	9	29	71	86	20	51	93	97	56	84
For men older than 70 with atypical or typical symptoms, assume an estimate > 90%.												
For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.												
Values are per cent of people at each mid-decade age with significant coronary artery disease (CAD) ¹ .												
Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).												
Lo = Low risk = none of these three.												
The shaded area represents people with symptoms of non-anginal chest pain, who would not be investigated for stable angina routinely.												
Note:												
These results are likely to overestimate CAD in primary care populations.												
If there are resting ECG ST-T changes or Q waves, the likelihood of CAD is higher in each cell of the table.												

1.3.3 Making a diagnosis based on clinical assessment

1.3.3.1 Anginal pain is:

- constricting discomfort in the front of the chest, or in the neck, shoulders, jaw, or arms
- precipitated by physical exertion
- relieved by rest or GTN within about 5 minutes.

Use clinical assessment and the typicality of anginal pain features listed below to estimate the likelihood of CAD (see table 1):

- Three of the features above are defined as typical angina.
- Two of the three features above are defined as atypical angina.
- One or none of the features above are defined as non-anginal chest pain.

Guidelines – stable angina

Diagnostic testing for people in whom stable angina cannot be diagnosed or excluded by clinical assessment alone:

Likelihood: 61-90%
angiography

Likelihood: 30-60%
non-invasive functional imaging for myocardial ischemia

Likelihood: 10-29%
CT calcium score

Non-invasive functional imaging for myocardial ischaemia:

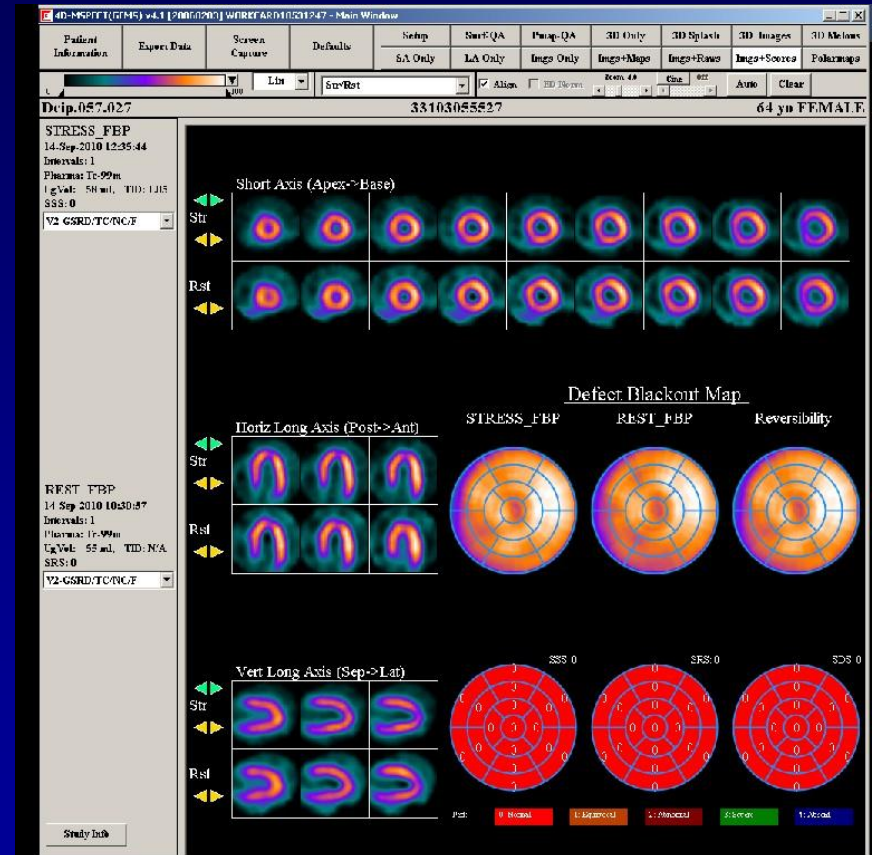
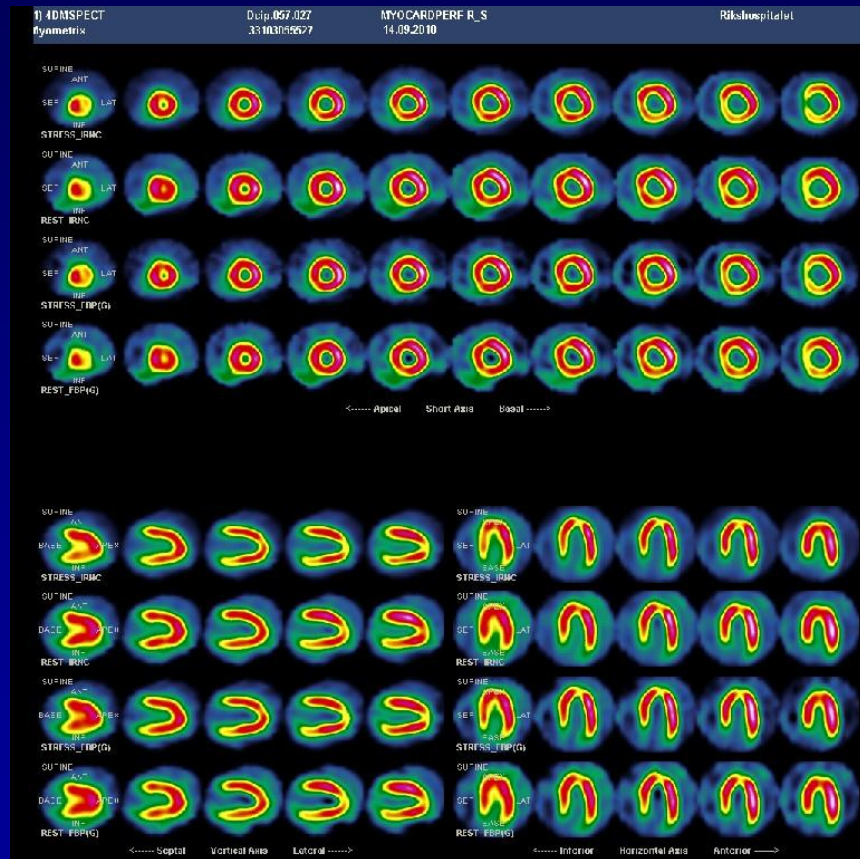
Myokard perfusjons scintigrafi med single photon emisjon computed tomography (MPS med SPECT)

Stress echocardiography

Perfusion MR with stress or stress MR

SPECT

single photon emission computed tomography



Perfusion MR with stress

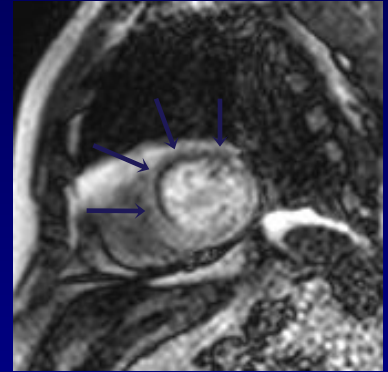
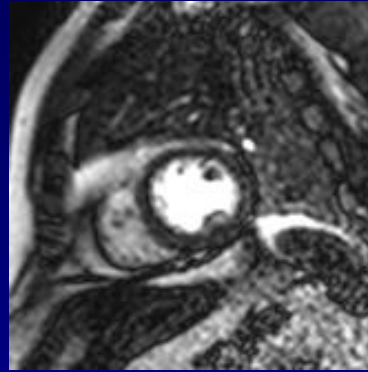
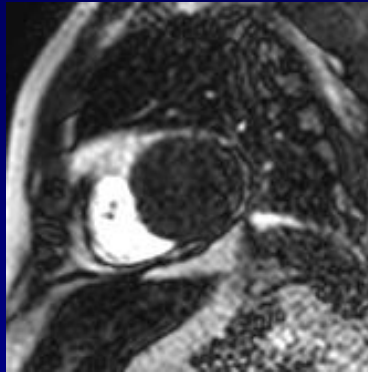
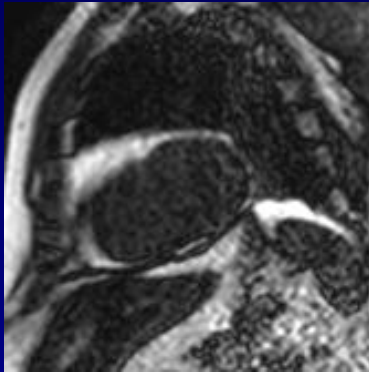
Baseline

RV contrast
uptake

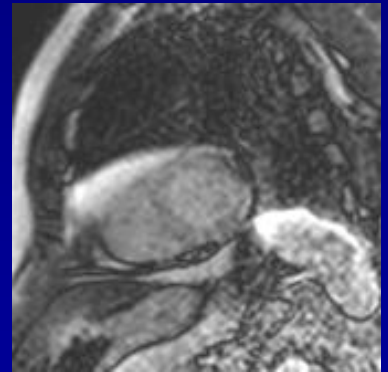
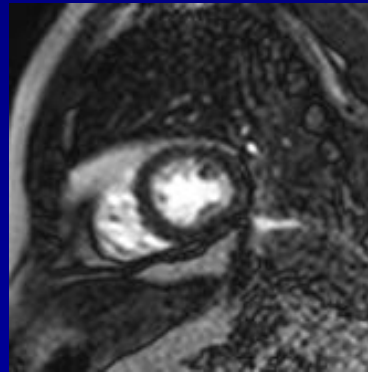
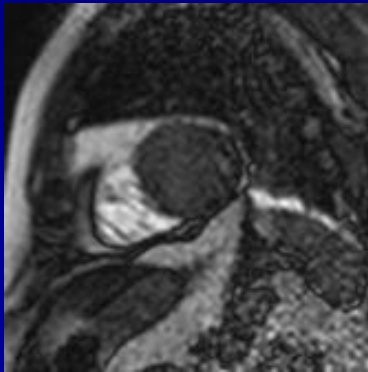
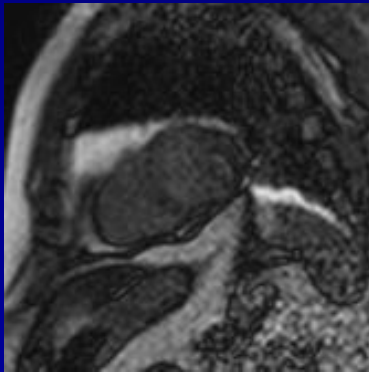
LV contrast
uptake

Myocardial
contrast uptake

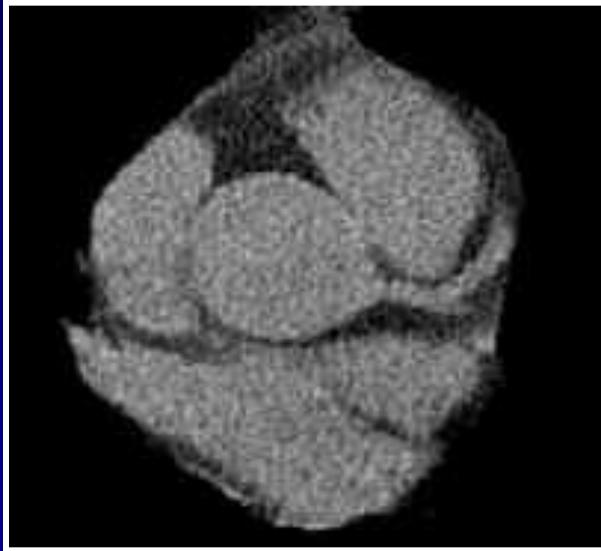
Stress-
Perfusion



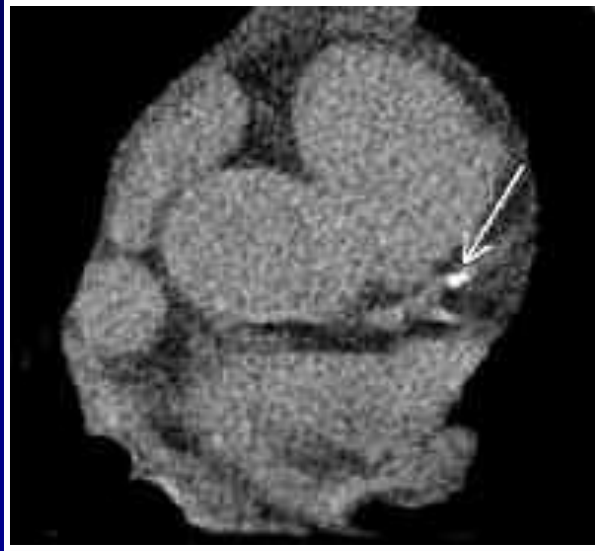
Rest-
Perfusion



Coronary calcium



Zero

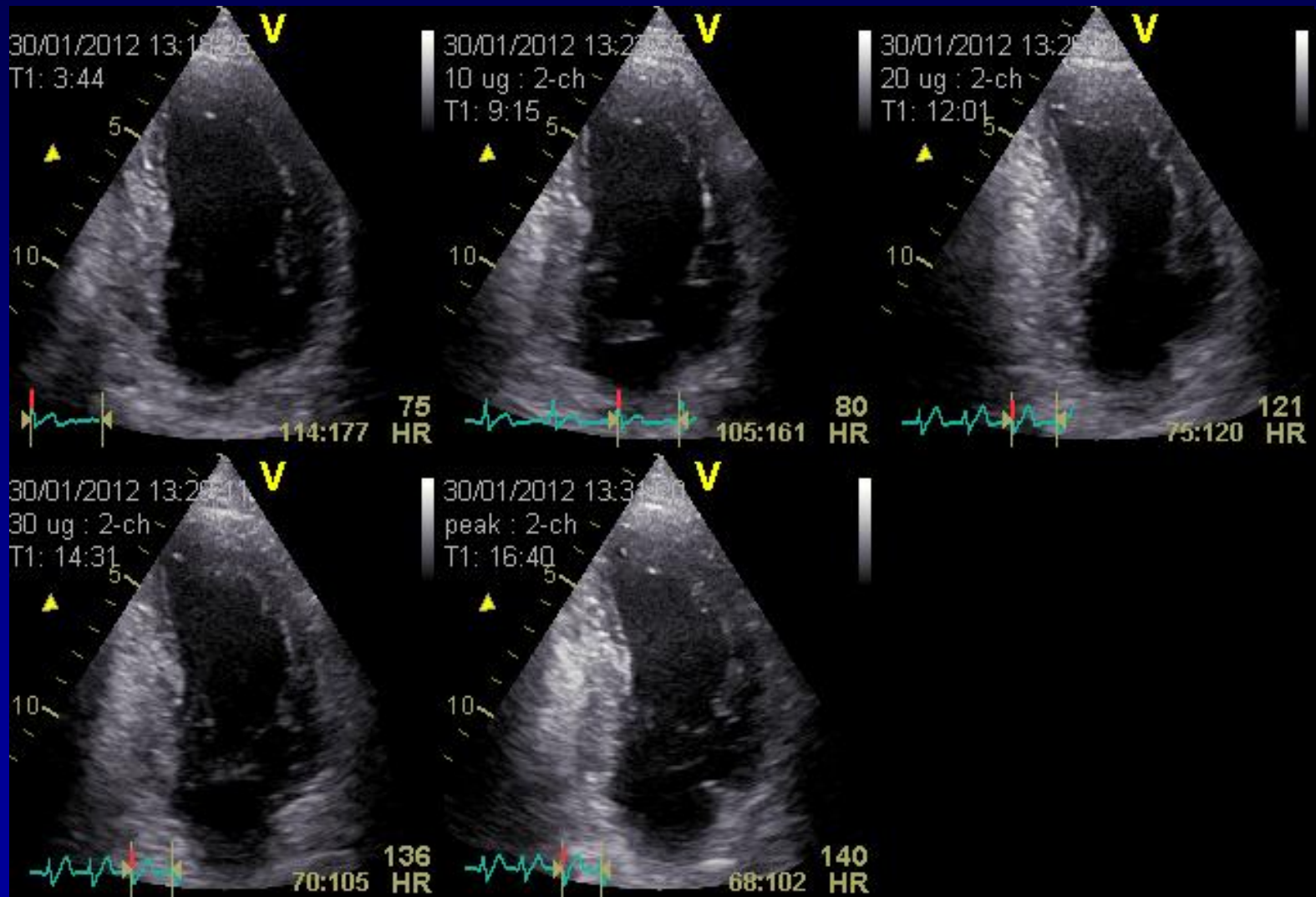


Moderate

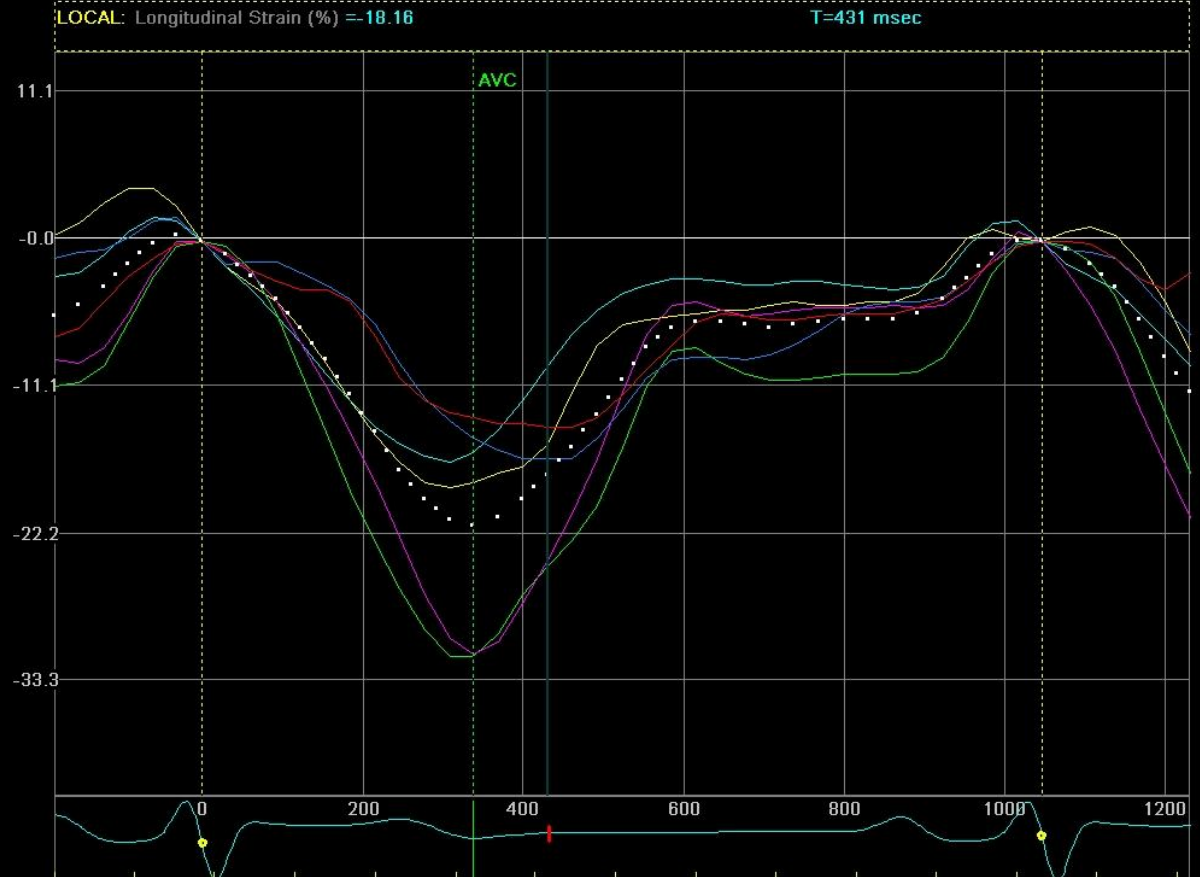
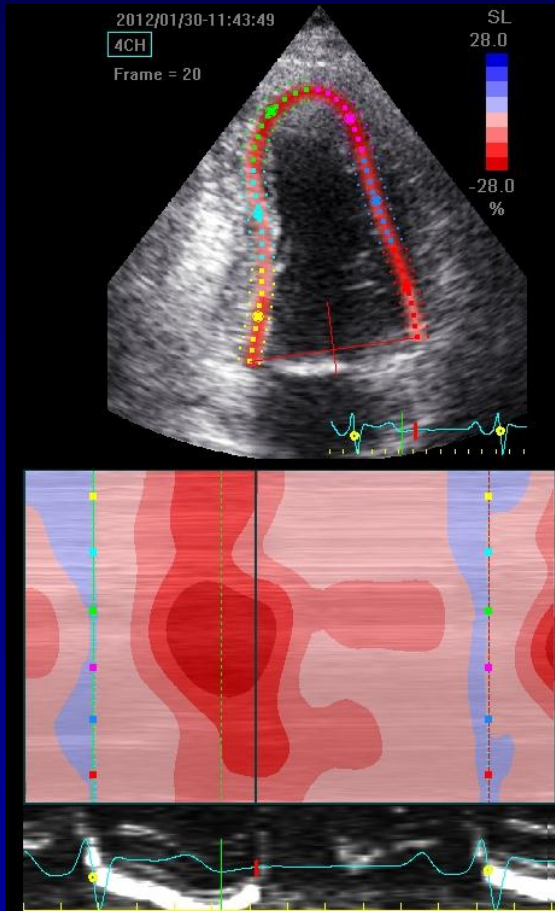


Extensive

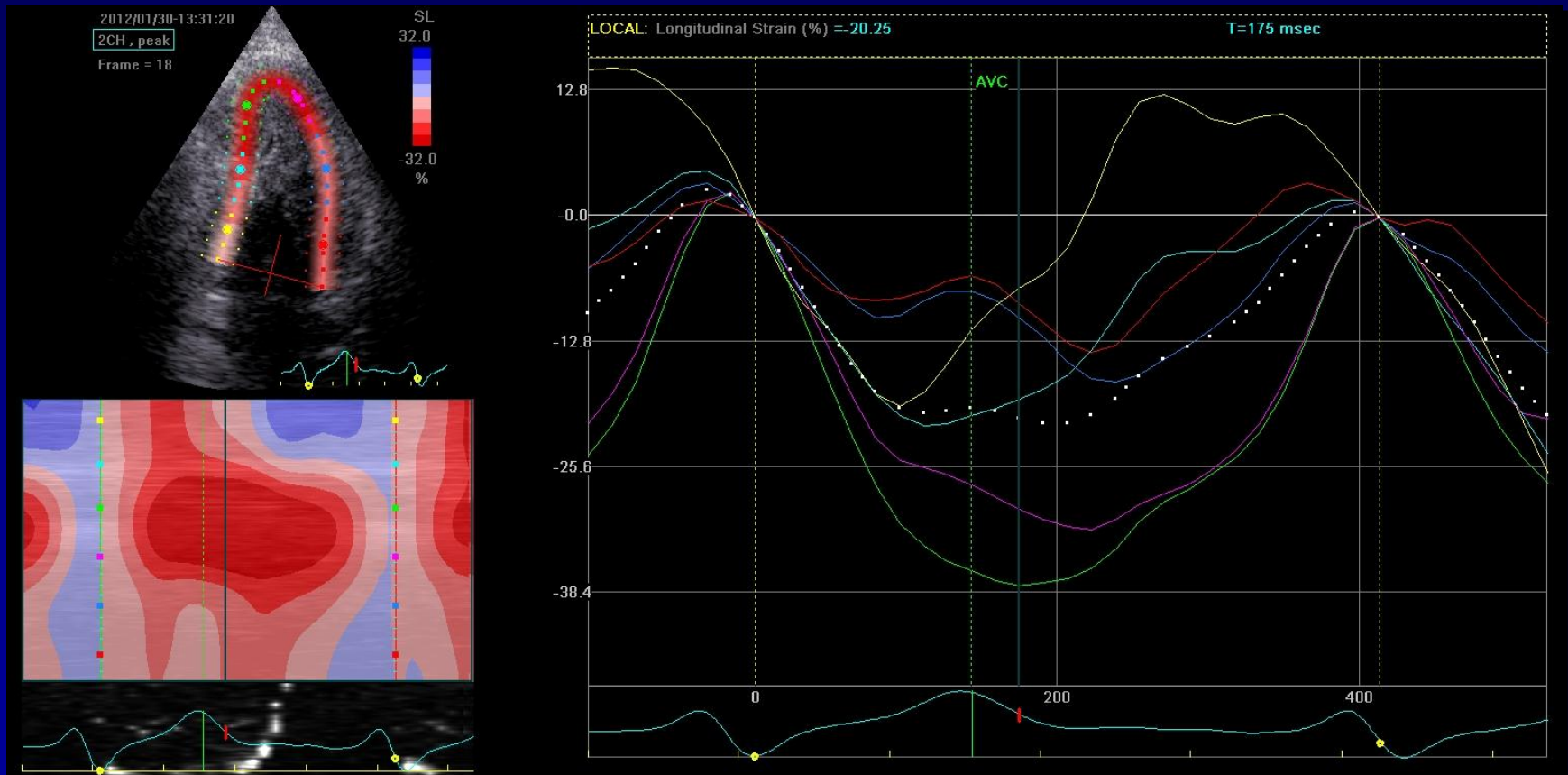
Typical breast pain (50 yo – m)



At rest



At peak stress 40ug/min/kg - Dobutamin



Angiography:

- **75% RCA stenosis**

RAO/LAO: 21.9
CRA/CAU: 1.6



RGA Venstre Kat

Bilde/Serie: 13.02.2012, 08:52:04

Opptak/Scan: 13.02.2012, 08:52:04

Rikshospitalet HF
C: 128.0, W: 256.0



Bilde 15 (64)

Serie

Angiography:

- **75% prox LAD stenosis**

RAO/LAO: 18.8
CRA/CAU: -14.9



Rikshospitalet HF
C: 128.0, W: 256.0



RGA Venstre Kat

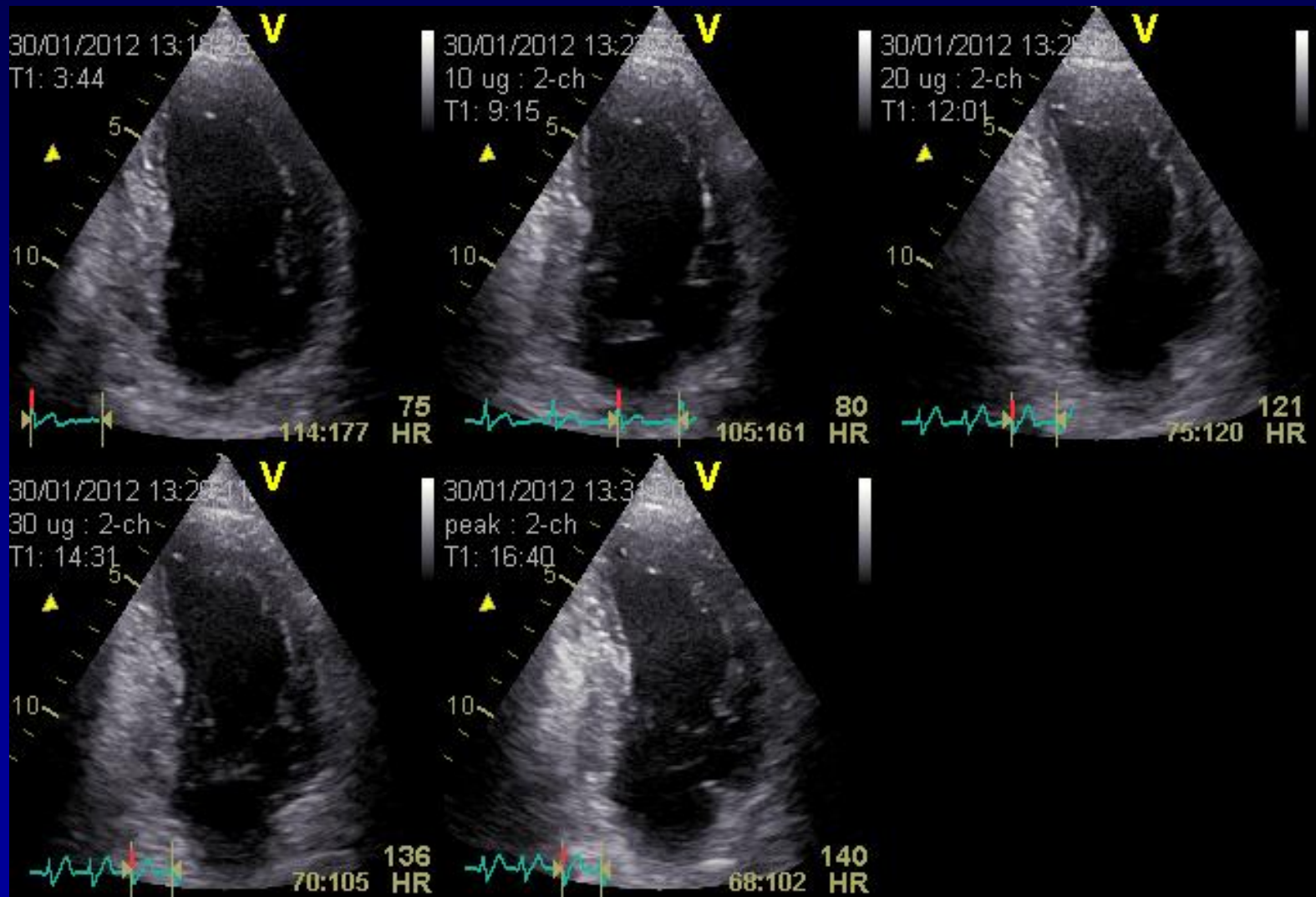
Bilde/Serie: 13.02.2012, 08:48:44

Opptak/Scan: 13.02.2012, 08:48:44

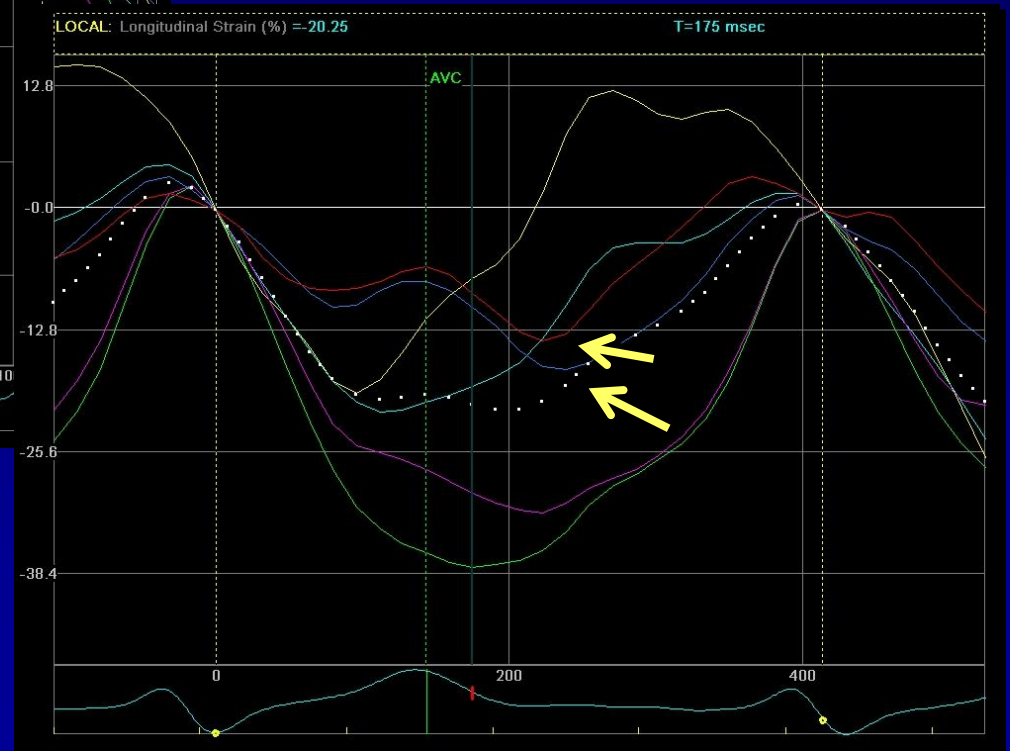
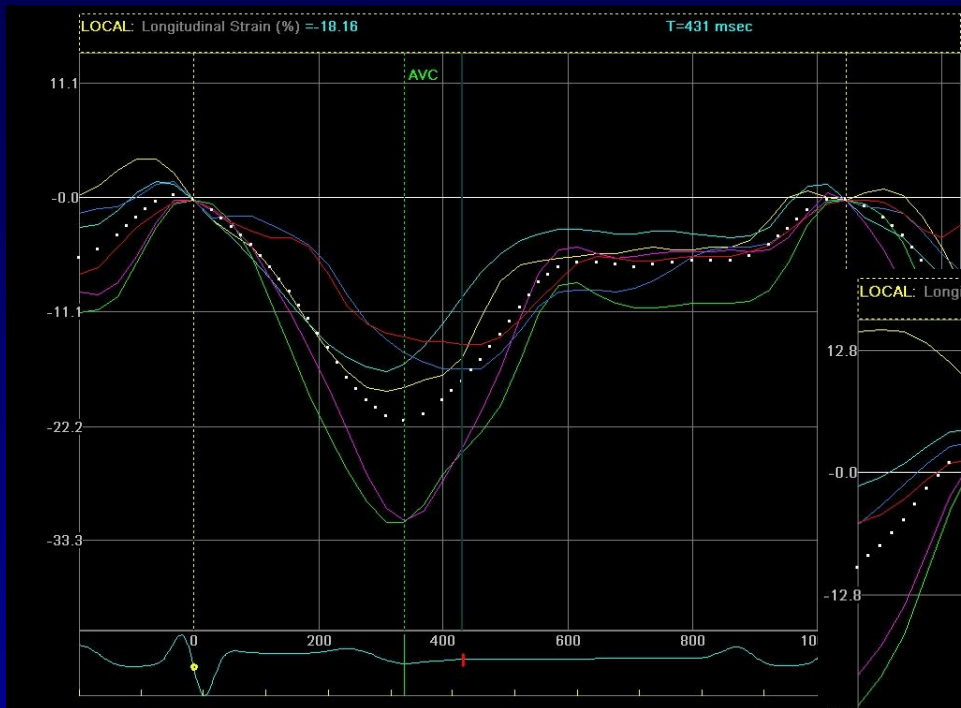
Bilde 40 (78)

Serie

Typical breast pain (50 yo – m)



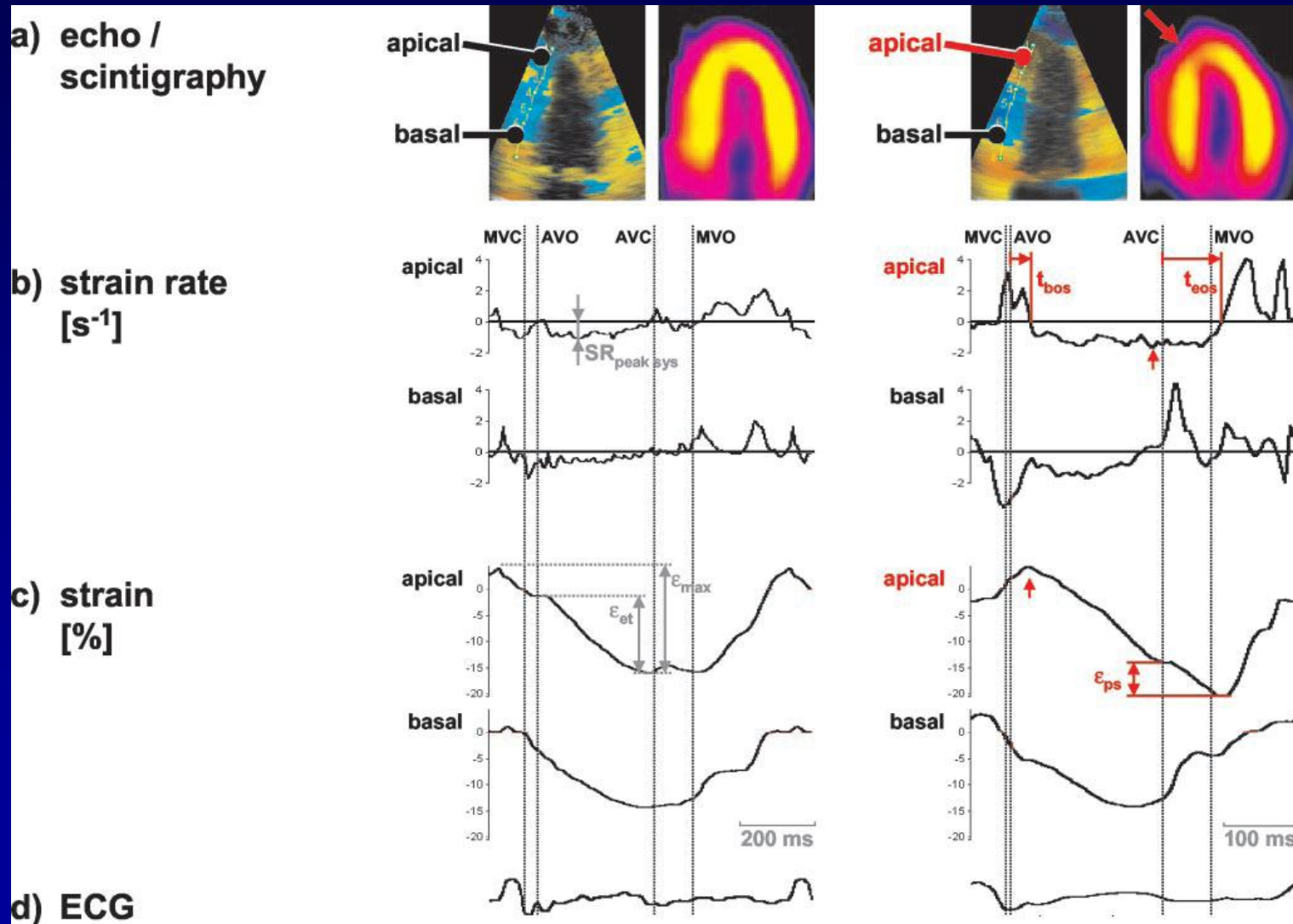
Rest - At peak stress



Strain-Rate Imaging During Dobutamine Stress Echocardiography Provides Objective Evidence of Inducible Ischemia

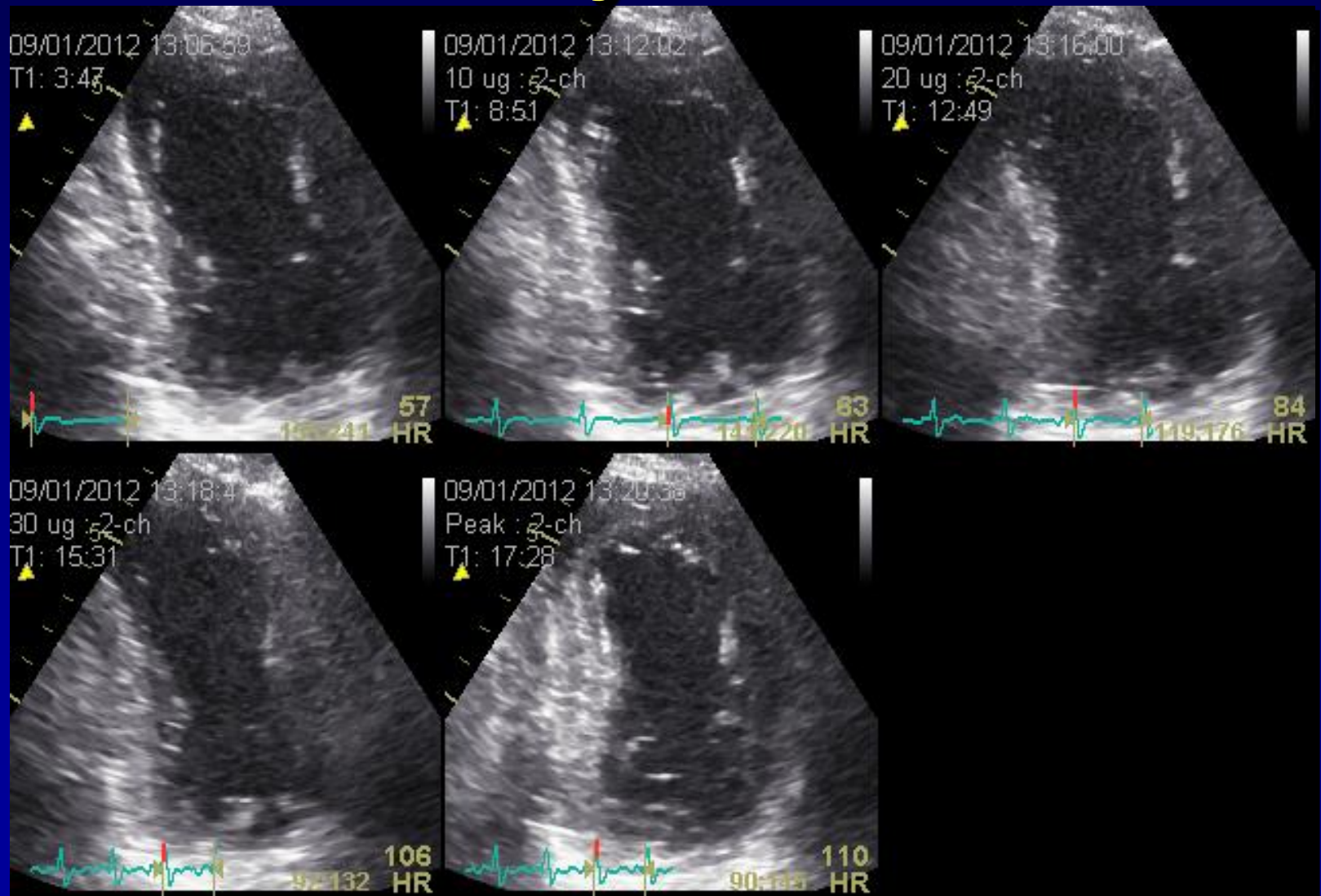
Jens-Uwe Voigt, MD; Bert Exner; Kristin Schmiedehausen, MD;
Cord Huchzermeyer; Udo Reulbach, MD; Uwe Nixdorff, MD, FESC; Günther Platsch, MD;
Torsten Kuwert, MD; Werner G. Daniel, MD, FESC; Frank A. Flachskampf, MD, FESC

(*Circulation.* 2003;107:2120-2126.)



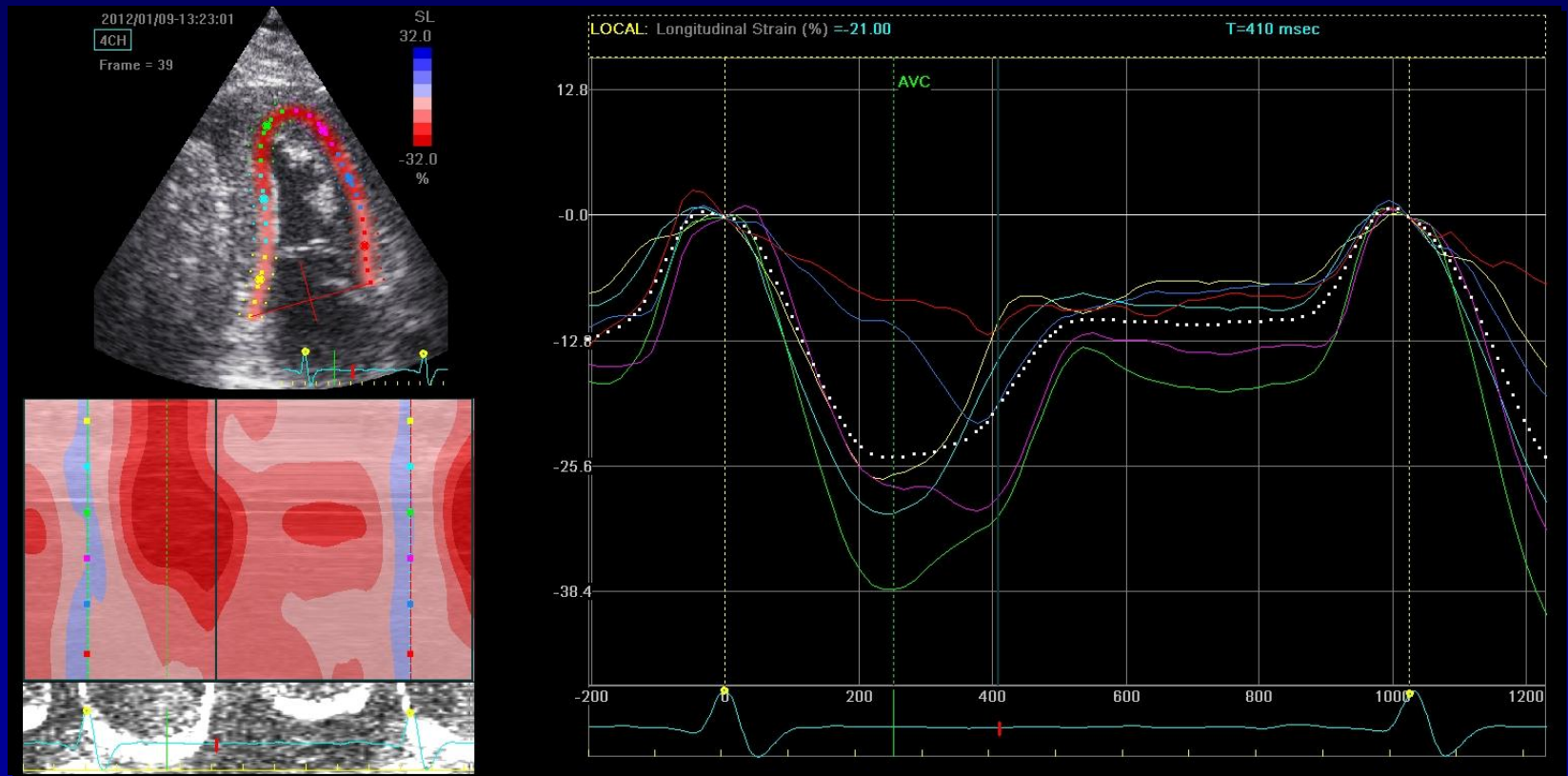
Aypical breast pain

65 yo - m



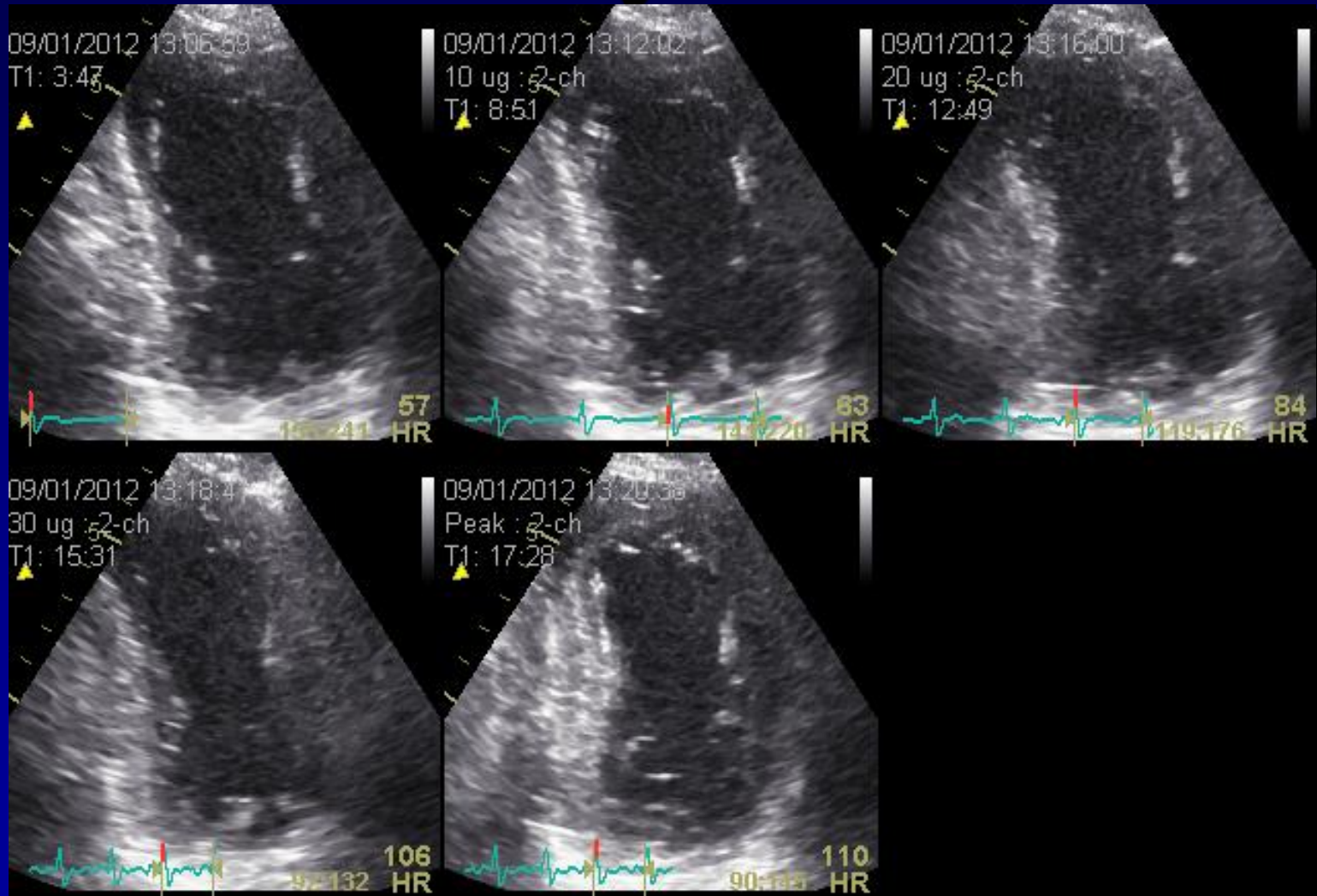
Aypical breast pain

65 yo - m



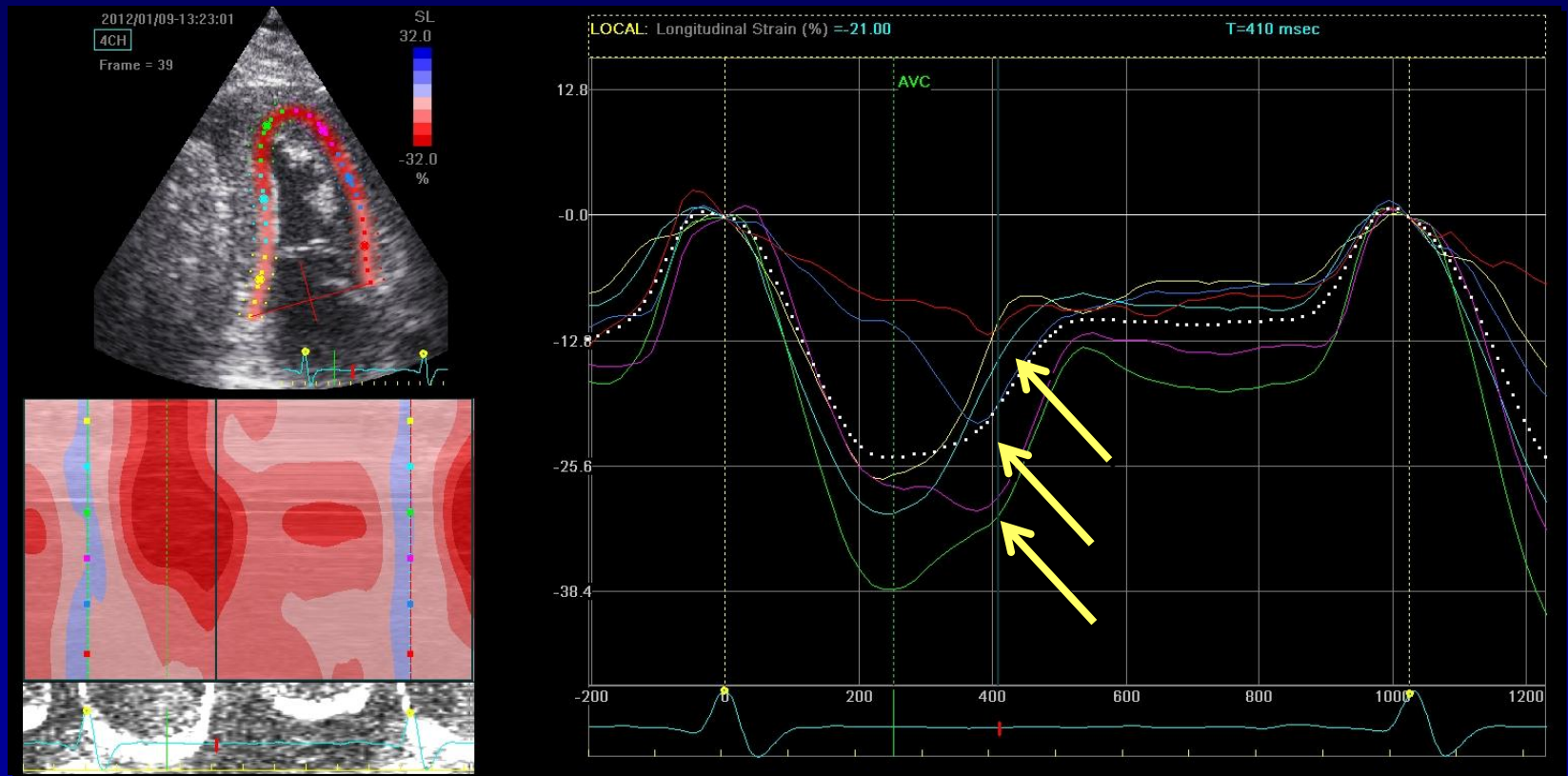
Aypical breast pain

65 yo - m



LAD 90% prox stenosis, RCA OK

Aypical breast pain 65 yo - m

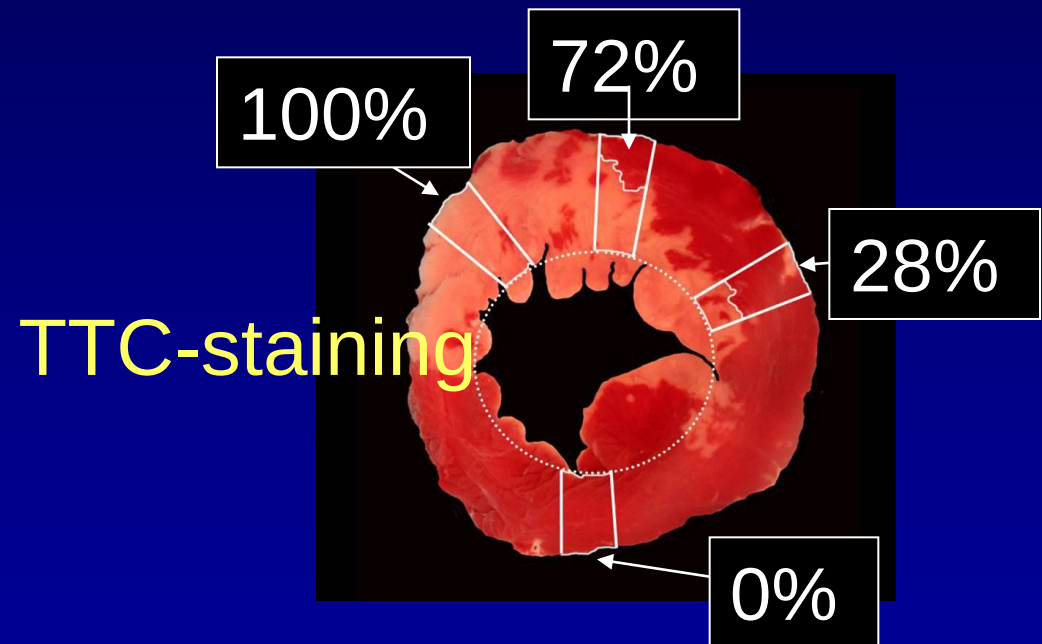
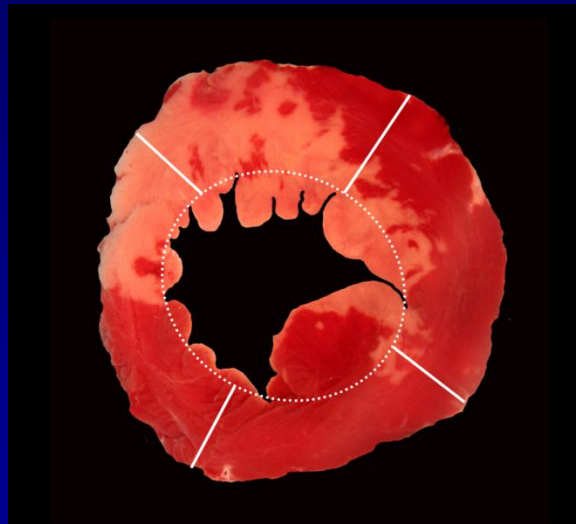


LAD 90% prox stenosis, RCA OK

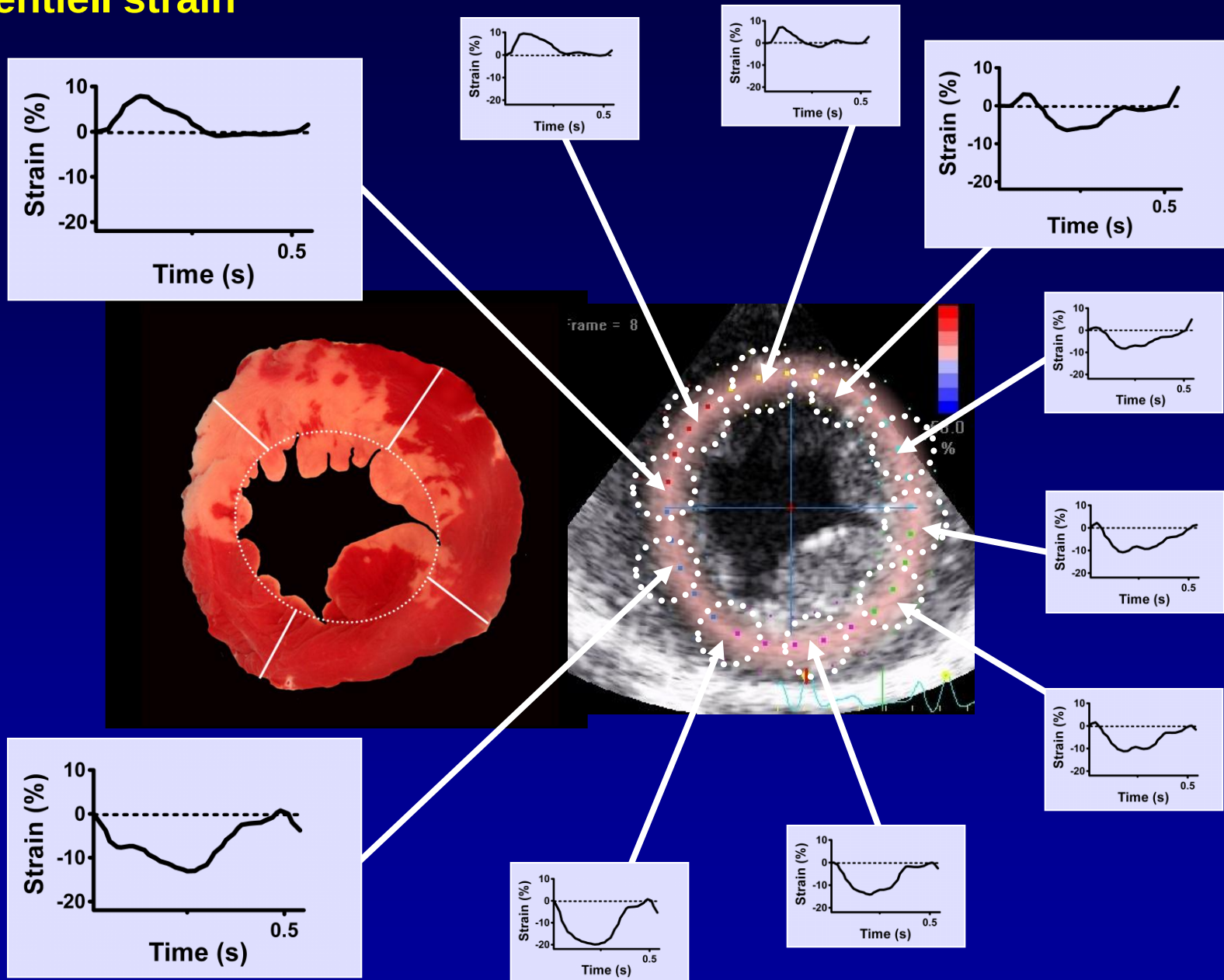
Advices – Stress Echo

- **Ischemia**
- **Stress echo**
 - Use if the likelihood of ischemia is moderate
 - Wall motion score index
 - Hypokinesia / akinesia / dyskinesia
 - Wall motion score index
- **Novel techniques: Strain echocardiography**
 - Use as support / in addition
 - Look for post systolic shortening (PSS)
 - You need GOOD image quality!!

Extension of myocardial infarction

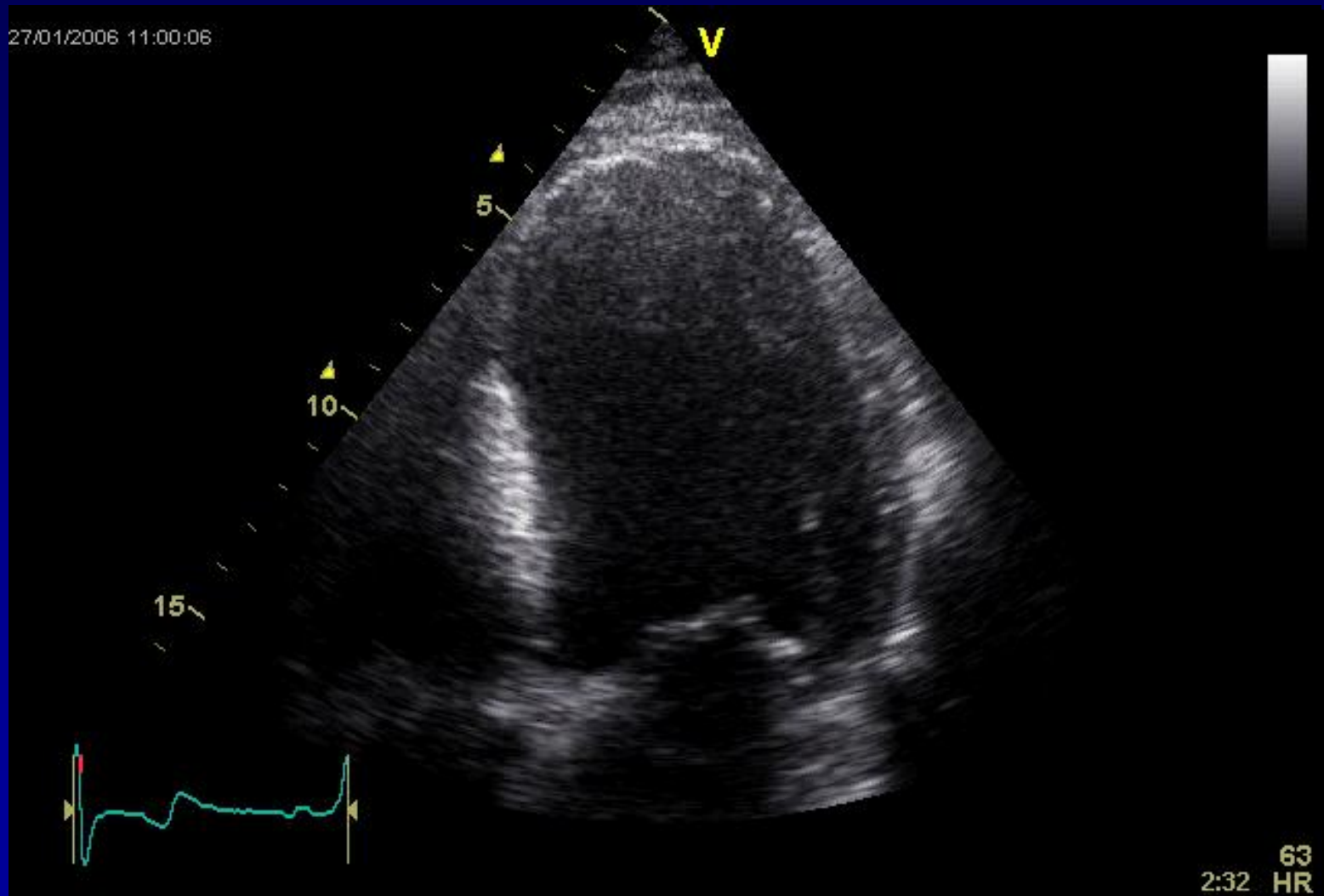


Circumferentiell strain

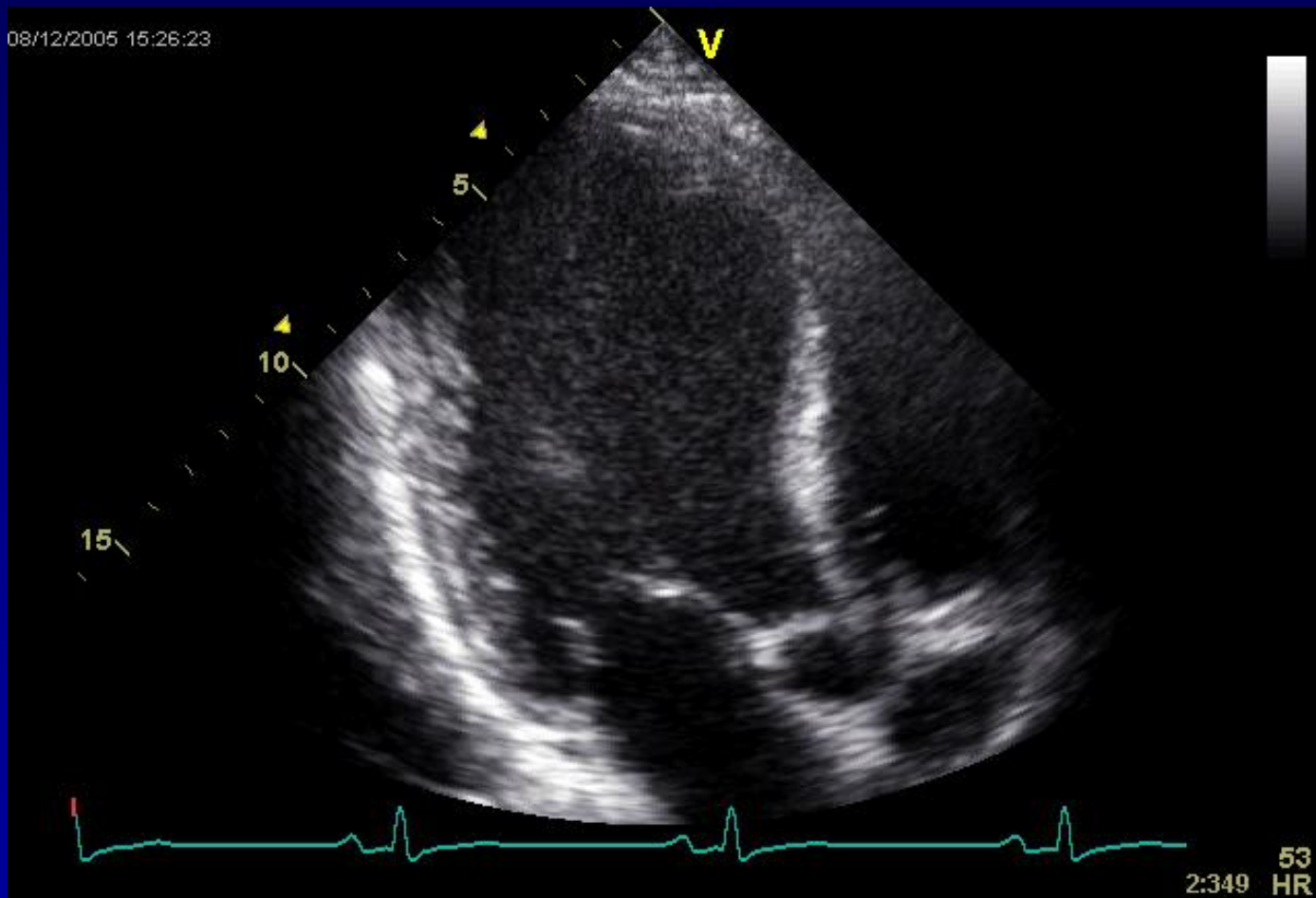


Helle-Valle et al, AHA 2006

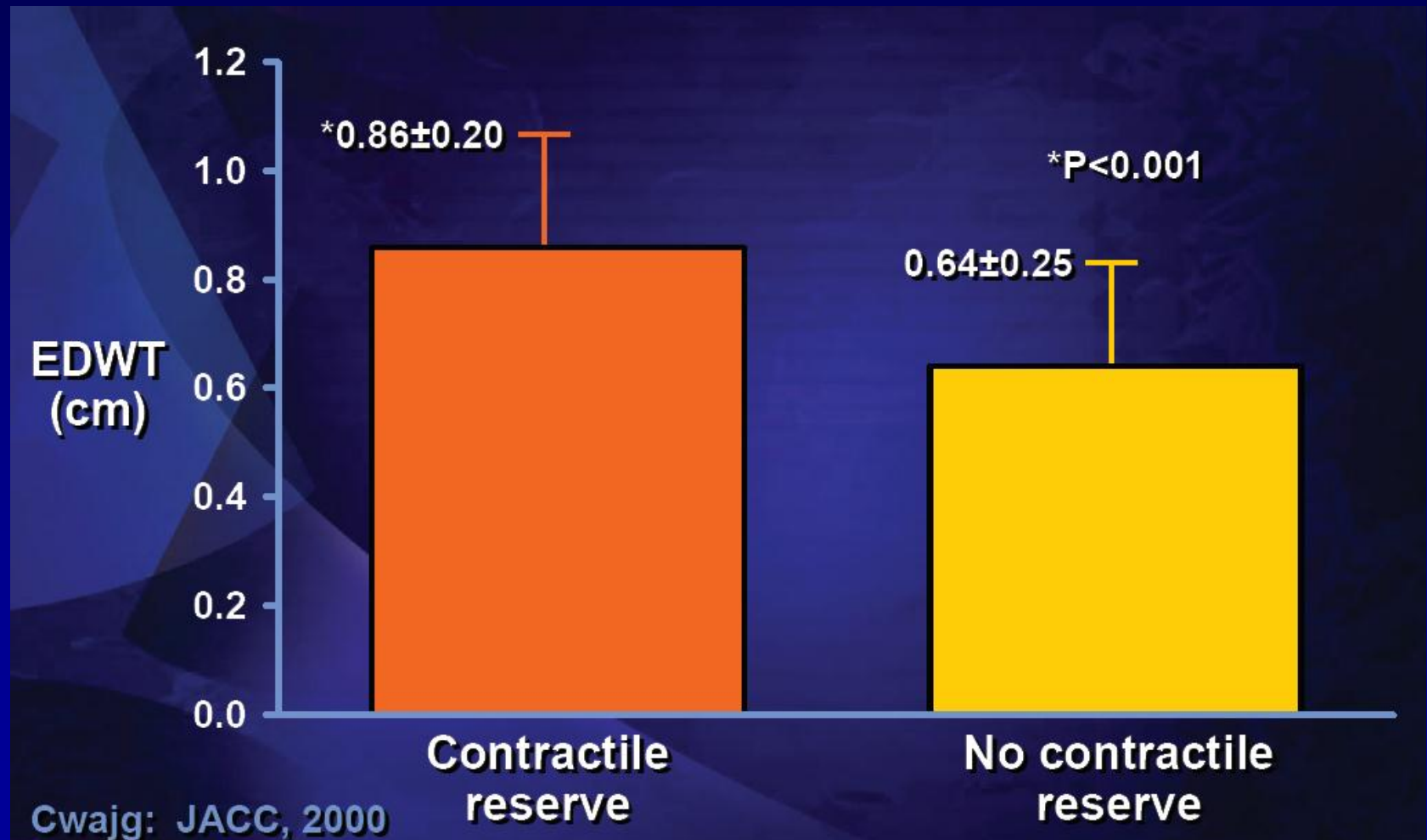
Thin wall / dyskinesia



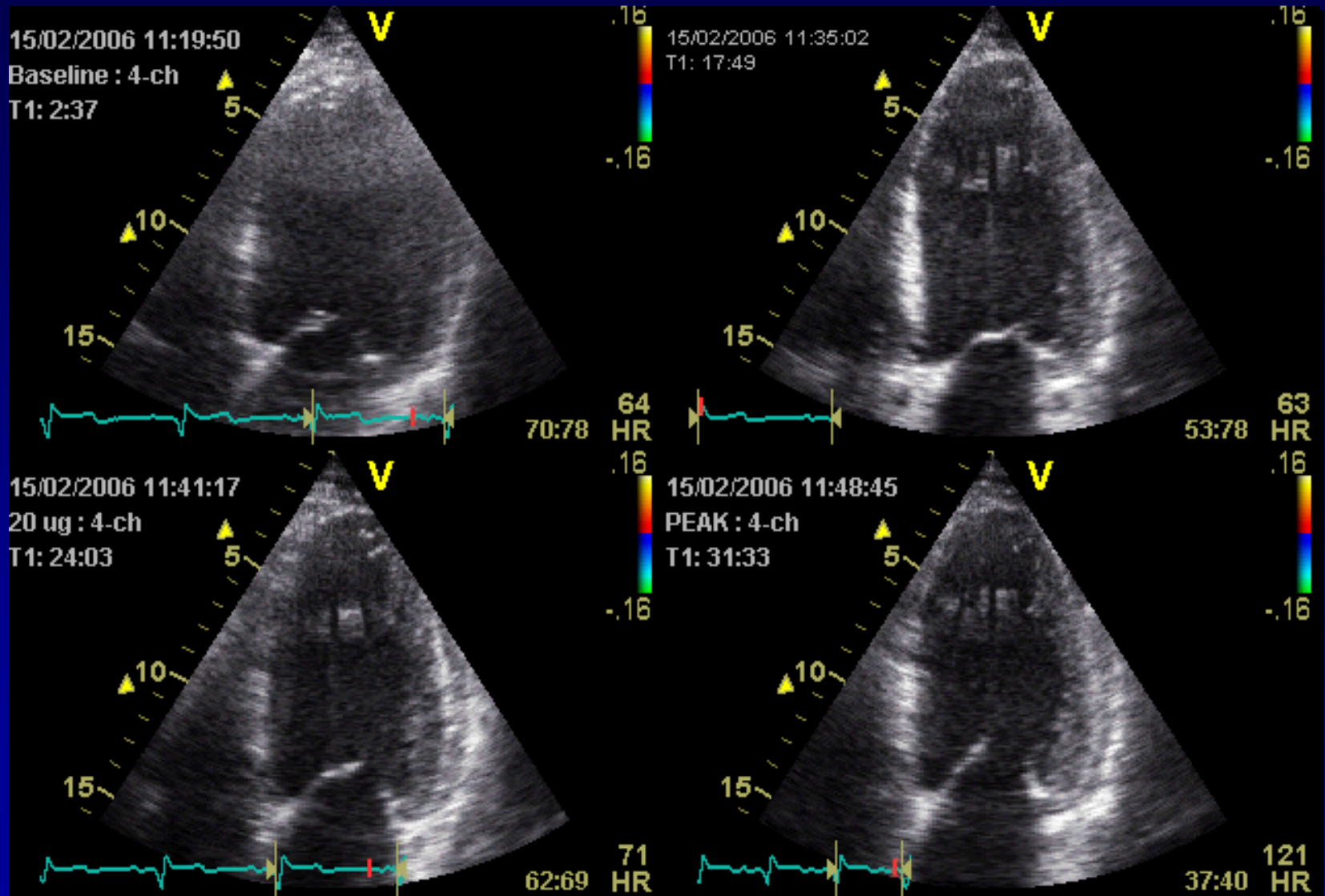
Thin wall / dyskinesia



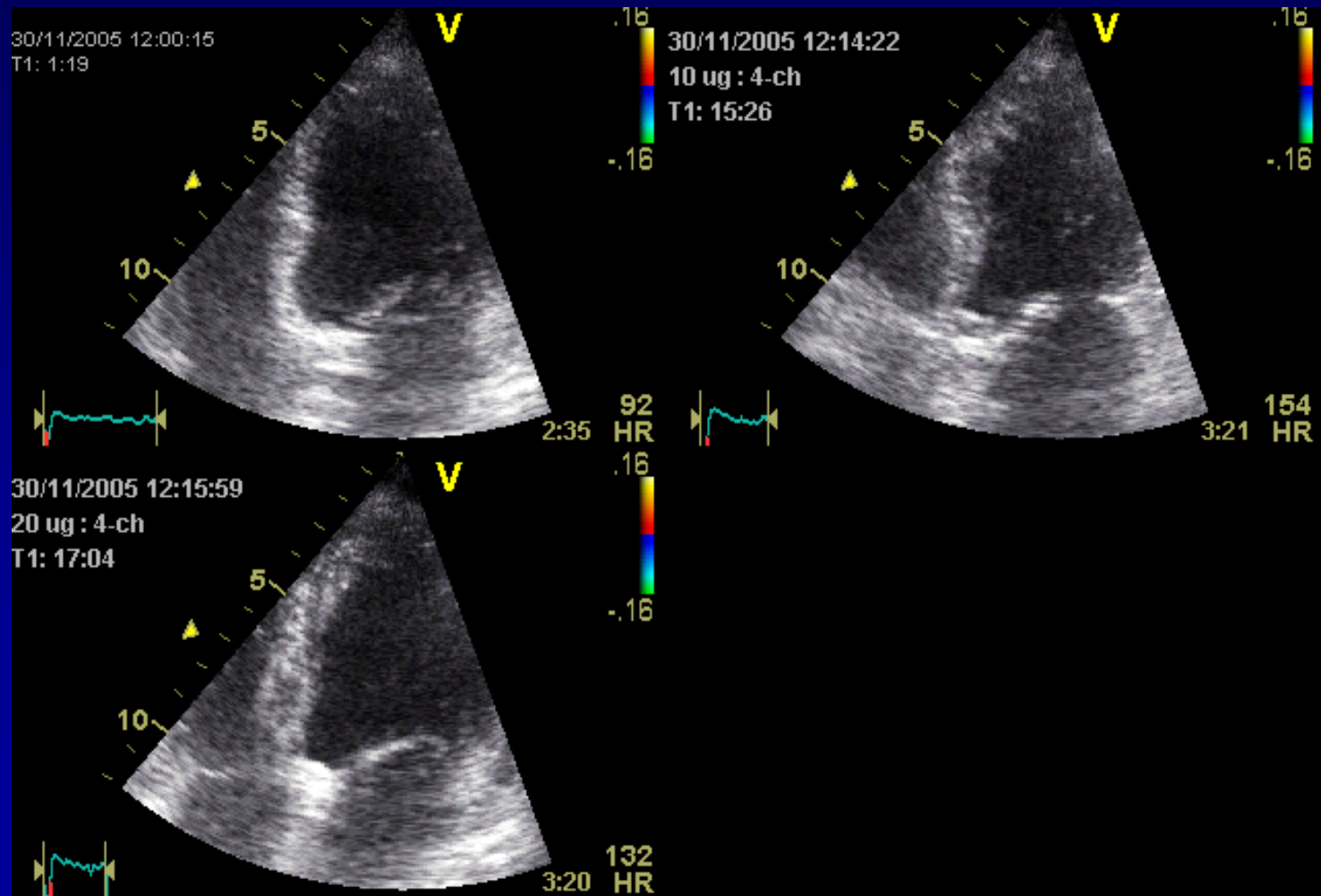
End-diastolic wall thickness vs Dobutamine stress echo



Non-viabel

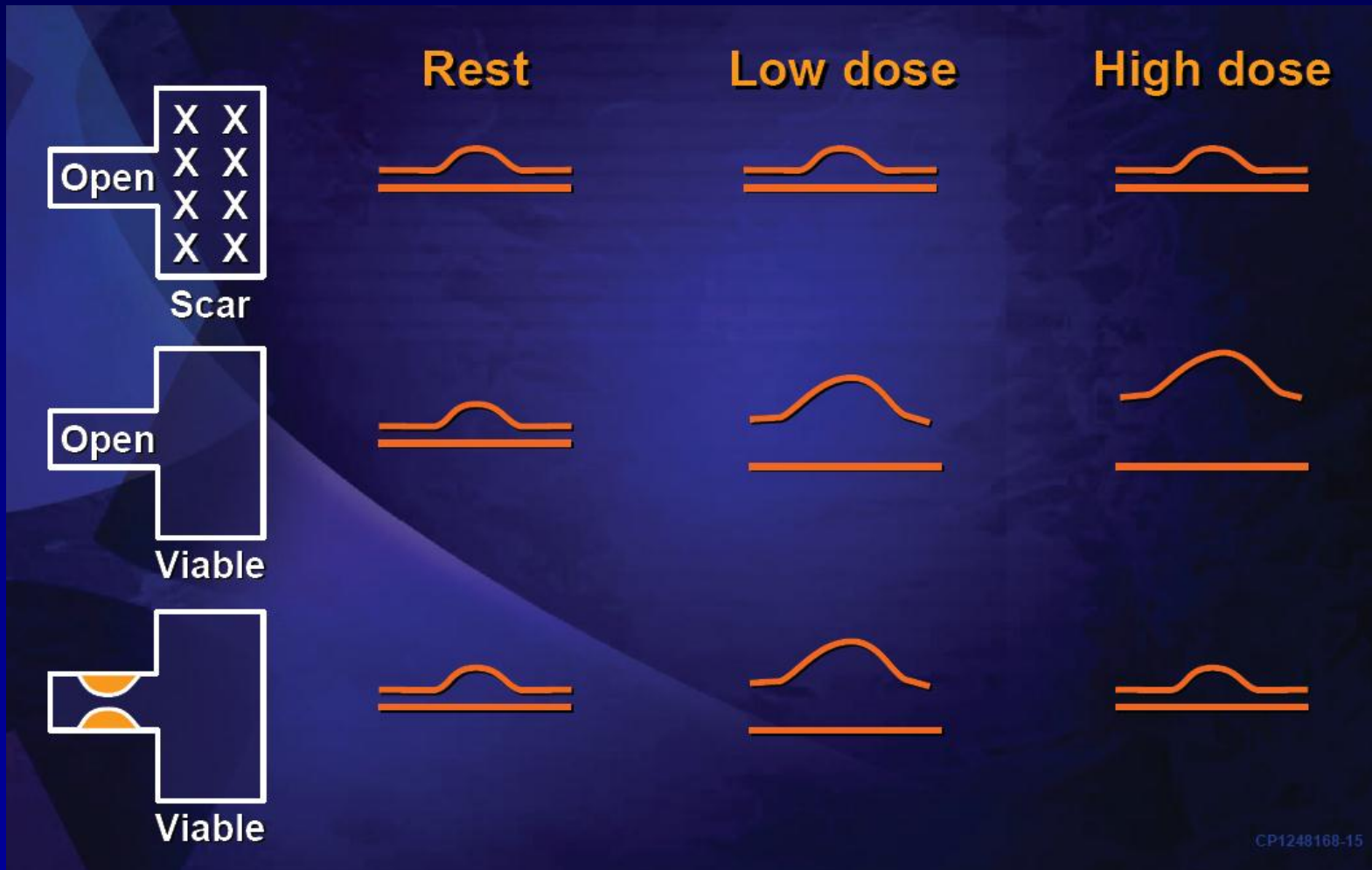


Viabel



Myocardial viability

Dobutamine stress echo



STICH

Surgical Treatment for Ischemic Heart Failure

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Coronary-Artery Bypass Surgery in Patients with Left Ventricular Dysfunction

Eric J. Velazquez, M.D., Kerry L. Lee, Ph.D., Marek A. Deja, M.D., Ph.D., Anil Jain, M.D., George Sopko, M.D., M.P.H., Andrey Marchenko, M.D., Ph.D., Imtiaz S. Ali, M.D., Gerald Pohost, M.D., Sinisa Gradinac, M.D., Ph.D., William T. Abraham, M.D., Michael Yui, M.S., F.R.C.S., F.R.A.C.S., Dorairaj Prabhakaran, M.D., D.M., Hanna Szwed, M.D., Paolo Ferrazzi, M.D., Mark C. Petrie, M.D., Christopher M. O'Connor, M.D., Pradit Panchavinnin, M.D., Lilin She, Ph.D., Robert O. Bonow, M.D., Gena Roush Rankin, M.P.H., R.D., Robert H. Jones, M.D., and Jean-Lucien Rouleau, M.D., for the STICH Investigators*

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Myocardial Viability and Survival in Ischemic Left Ventricular Dysfunction

Robert O. Bonow, M.D., Gerald Maurer, M.D., Kerry L. Lee, Ph.D., Thomas A. Holly, M.D., Philip F. Binkley, M.D., Patrice Desvigne-Nickens, M.D., Jaroslaw Drozd, M.D., Ph.D., Pedro S. Farsky, M.D., Arthur M. Feldman, M.D., Torsten Doenst, M.D., Ph.D., Robert E. Michler, M.D., Daniel S. Berman, M.D., Jose C. Nicolau, M.D., Ph.D., Patricia A. Pellikka, M.D., Krzysztof Wrobel, M.D., Nasri Alotti, M.D., Ph.D., Federico M. Asch, M.D., Liliana E. Favaloro, M.D., Lilin She, Ph.D., Eric J. Velazquez, M.D., Robert H. Jones, M.D., and Julio A. Panza, M.D., for the STICH Trial Investigators*

- 1212 patients
- July 2002 – 2007
- non blinded – randomised
- 127 hospitals – 26 countries
- $EF \leq 35\%$
- Medicine (n=602) / medicine+CABG (n=610)
- 601 tested for viability: Stress echo / SPECT
- Viable = 487 / non-viable = 114
- Death: 178 (37%) / 58 (51%)

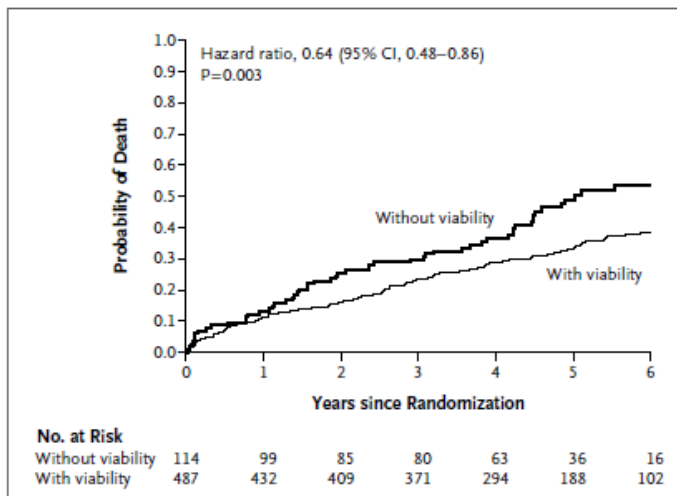
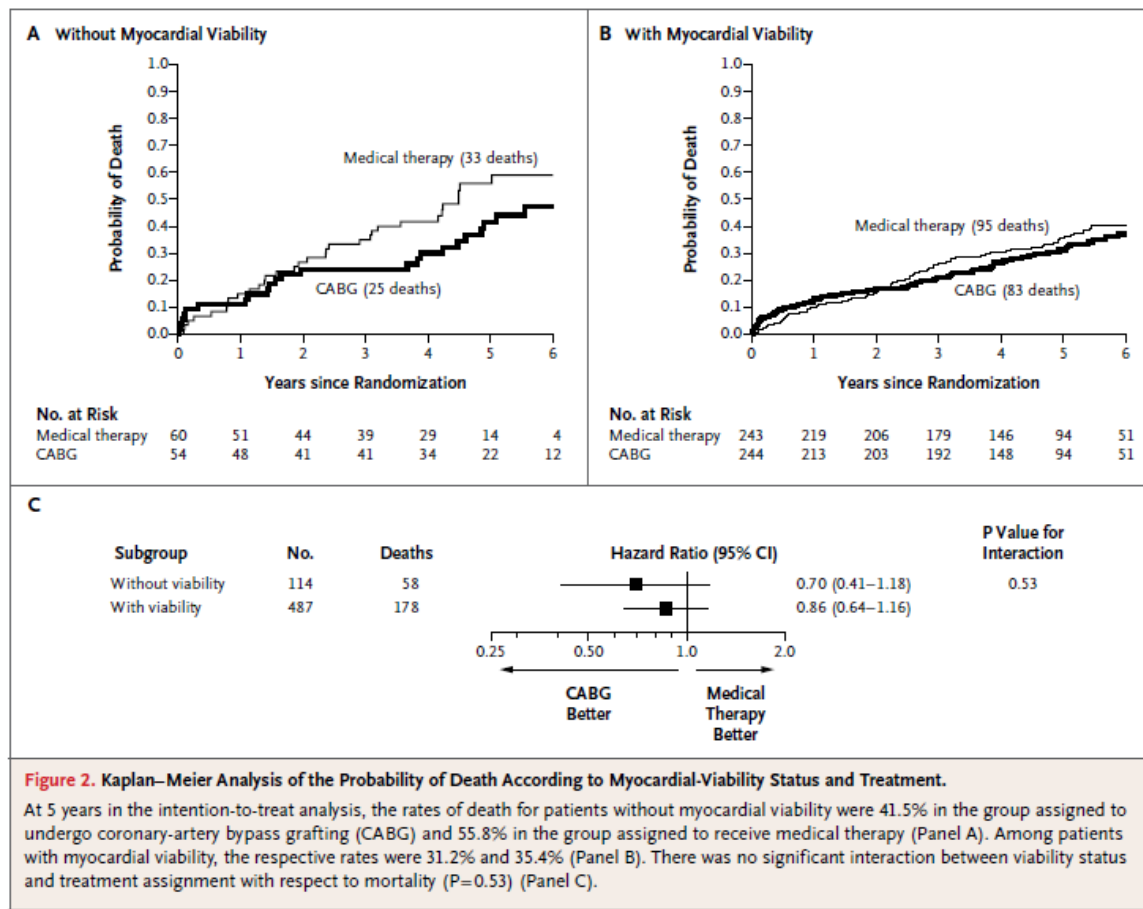


Figure 1. Kaplan–Meier Analysis of the Probability of Death, According to Myocardial Viability Status.

The comparison that is shown has not been adjusted for other prognostic baseline variables. After adjustment for such variables on multivariable analysis, the between-group difference was not significant ($P=0.21$).



Viability

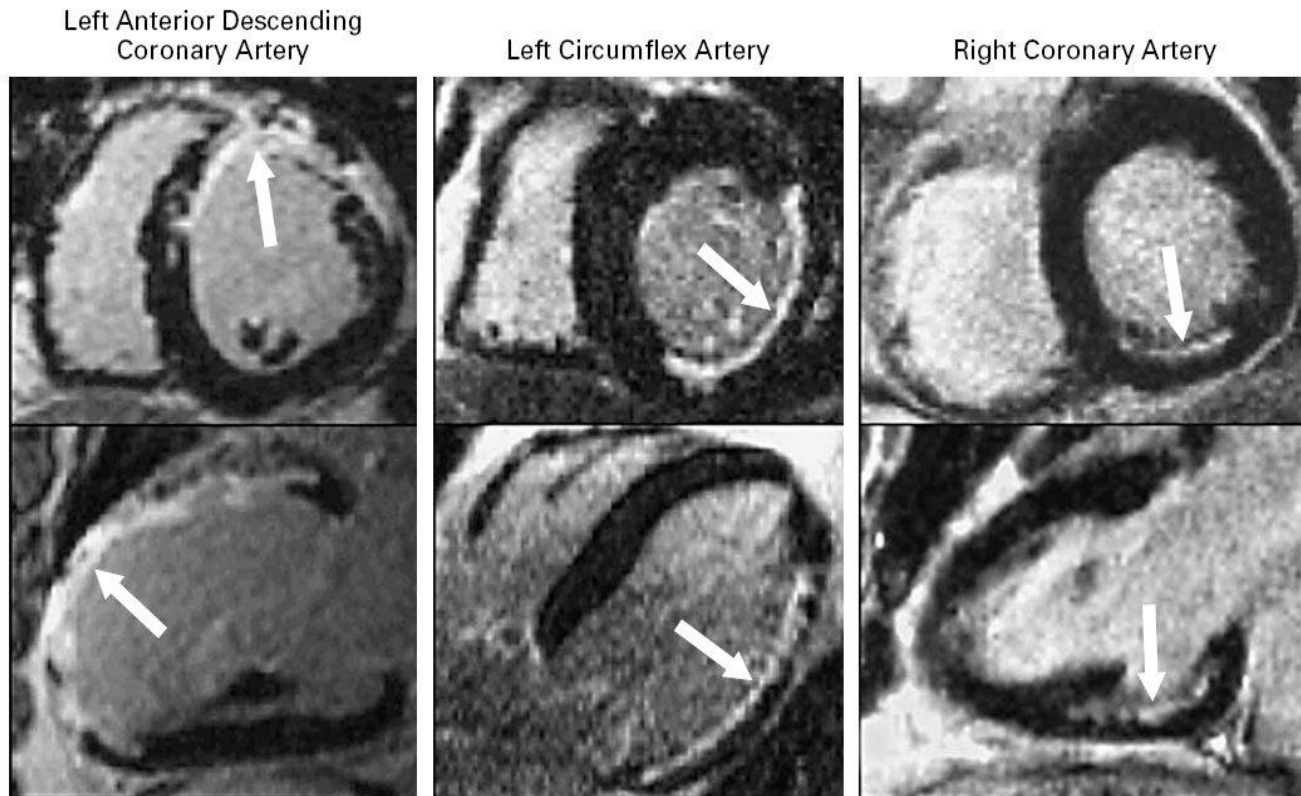


Figure 2. Typical Contrast-Enhancing Images Obtained by MRI in a Short-Axis View (Upper Panels) and a Long-Axis View (Lower Panels) in Three Patients.

Hyperenhancement is present (arrows) in various coronary-perfusion territories — the left anterior descending coronary artery, the left circumflex artery, and the right coronary artery — with a range of transmural involvement.

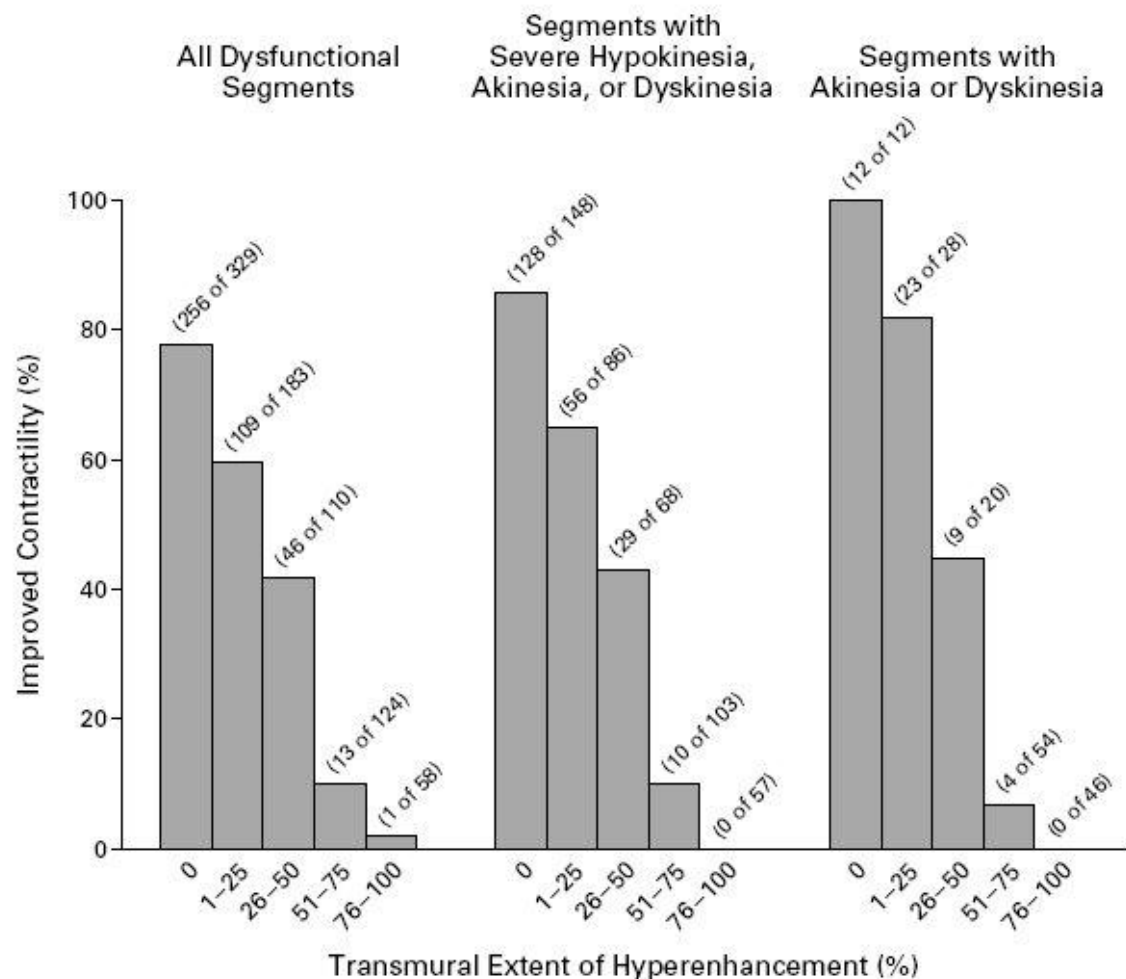
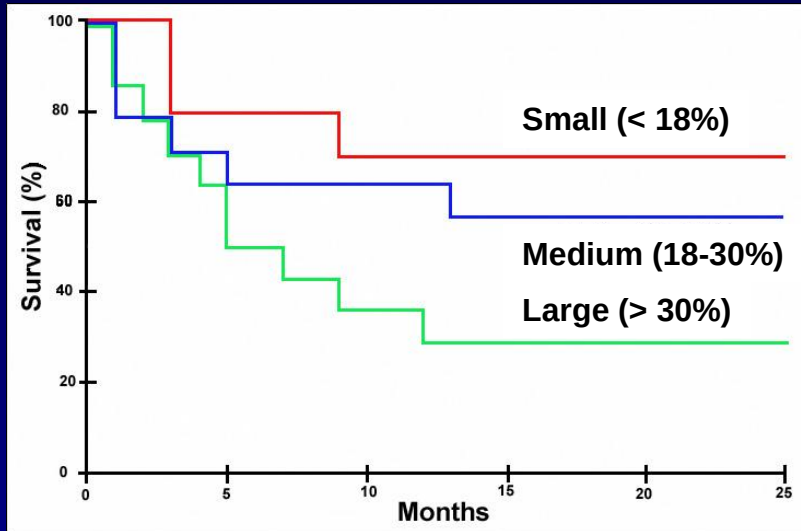


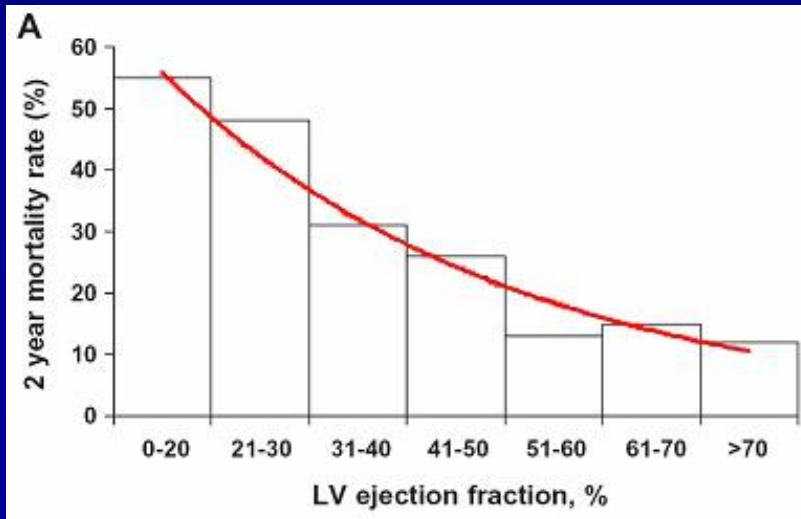
Figure 4. Relation between the Transmural Extent of Hyperenhancement before Revascularization and the Likelihood of Increased Contractility after Revascularization.

Data are shown for all 804 dysfunctional segments and separately for the 462 segments with at least severe hypokinesia and the 160 segments with akinesia or dyskinesia before revascularization. For all three analyses, there was an inverse relation between the transmural extent of hyperenhancement and the likelihood of improvement in contractility.

Infarct size by MR and survival



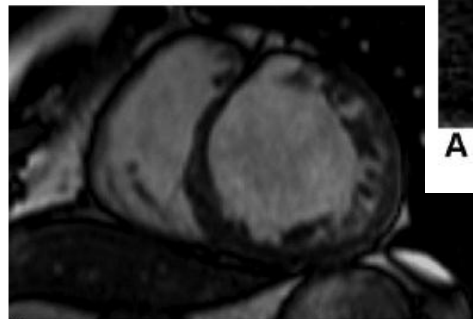
Wu et al. Circ 1998



Møller et al. AHJ 2006

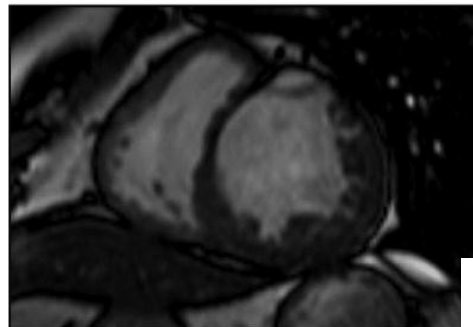
Infarct and remodeling

Ende
diastole

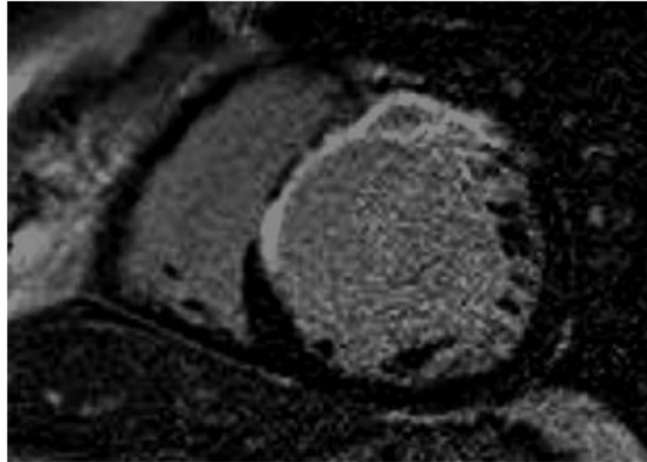


B

Ende
systole



C



A

Table 4

Multivariate linear regression models of the relation between scar characteristics and left ventricular (LV) volumes and function (n = 52)

Adjusted R ² and Model Significance	End-diastolic Volume Index (ml/m ²)		End-systolic Volume Index (ml/m ²)		Ejection Fraction (%)		Stroke Volume Index (ml/m ²)	
	R ² = 0.81, p < 0.0001		R ² = 0.84, p < 0.0001		R ² = 0.59, p < 0.001		R ² = 0.24, p = 0.001	
Variable	Standardized Coefficient	p Value	Standardized Coefficient	p Value	Standardized Coefficient	p Value	Standardized Coefficient	p Value
Scar size (g/m ²)	0.70	<0.0001	0.73	<0.0001	-0.54	<0.0001	0.16	0.30
Nonscarred LV mass (g/m ²)	0.35	<0.001	0.26	<0.001	-0.18	0.08	0.40	0.004
Transmurality (%)	-0.12	0.09	-0.04	0.54	-0.18	0.08	-0.29	0.04
Localization	0.06	0.36	0.13	0.03	-0.19	0.05	-0.19	0.14
Ischemia	0.19	0.005	0.19	0.002	-0.18	0.08	0.47	0.64

Effect of Left Ventricular Scar Size, Location, and Transmurality on Left Ventricular Remodeling With Healed Myocardial Infarction

Stein Ørn, MD^{a,d,*}, Cord Manhenke, MD^{a,d}, Inder S. Anand, MD, PhD^{c,d}, Iain Squire, MD^{b,d}, Eike Nagel, MD, PhD^{e,d}, Thor Edvardsen, MD, PhD^{b,d}, and Kenneth Dickstein, MD, PhD^{a,d}

AJC 2007

Summary – Viability

- **Viability**
- Thin walls / dyskinesia
- Low dose dobutamine stress ekko (LD DSE)
- Preferred modality:
- Contrast MR and visual assessment of wall motion