Imaging and heart failure

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Severe heart failure

Patient tailored approach

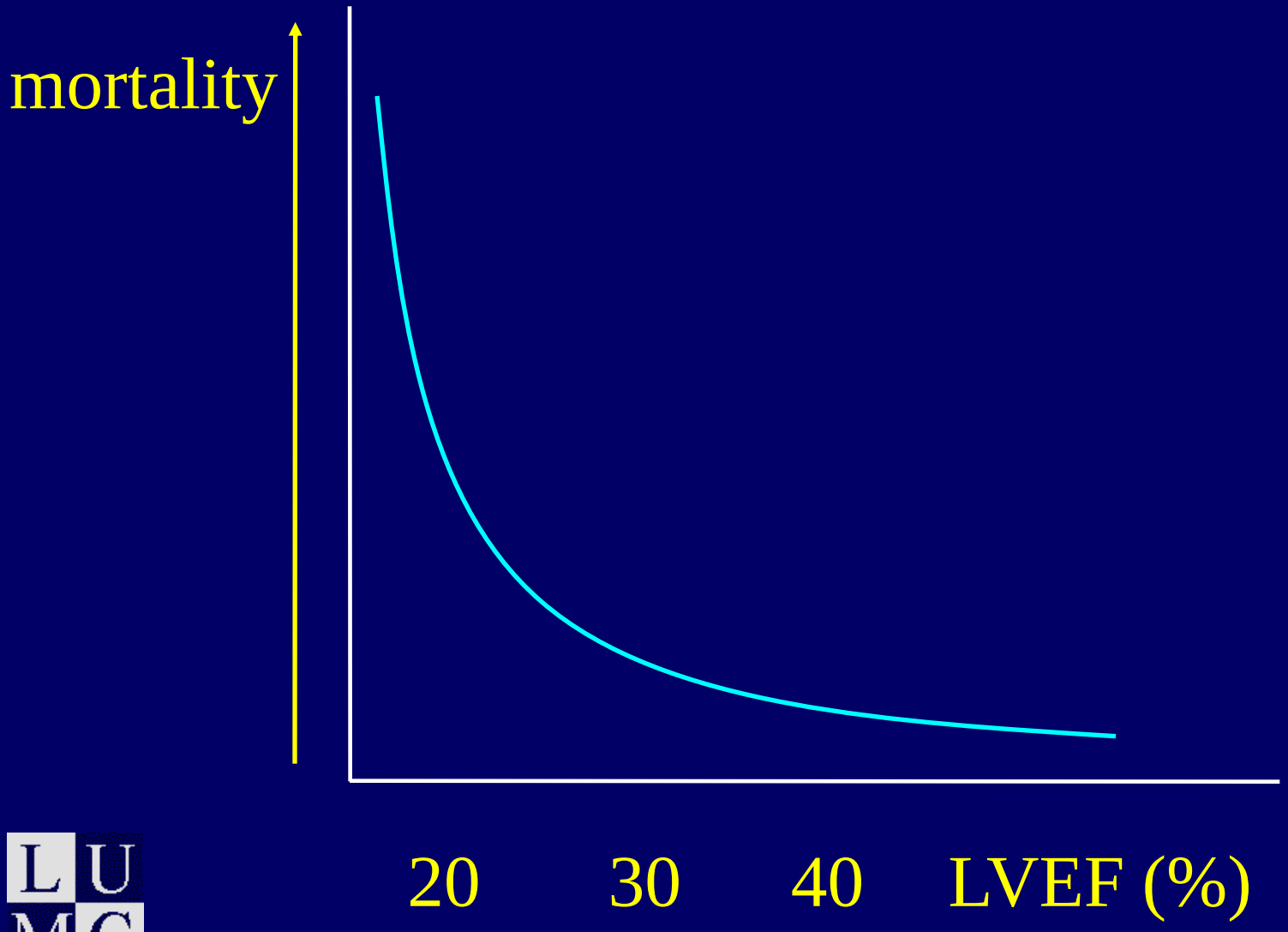
LV function and size?

CAD: yes or no?

CAD: ischemia? viability?

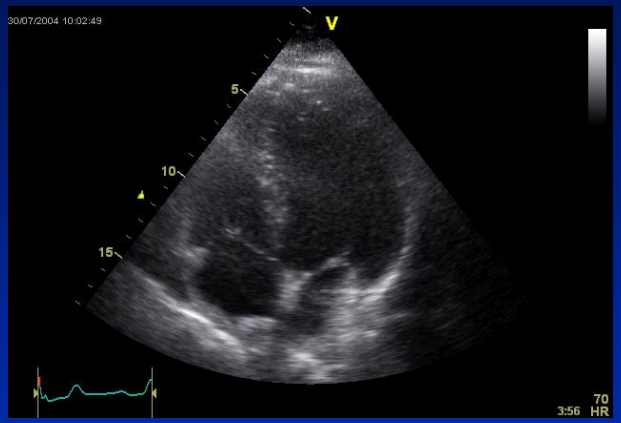
Severe MR?

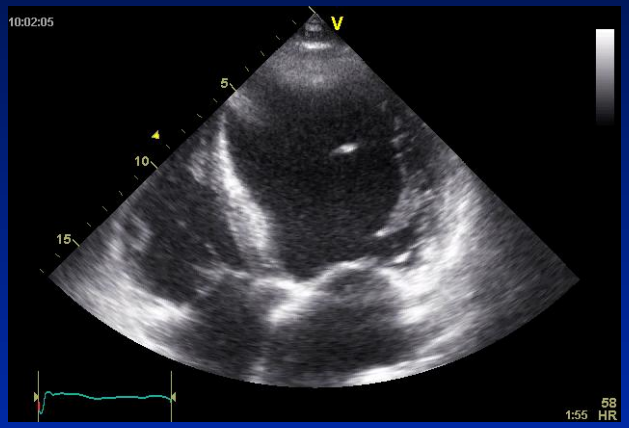
LV function and size?



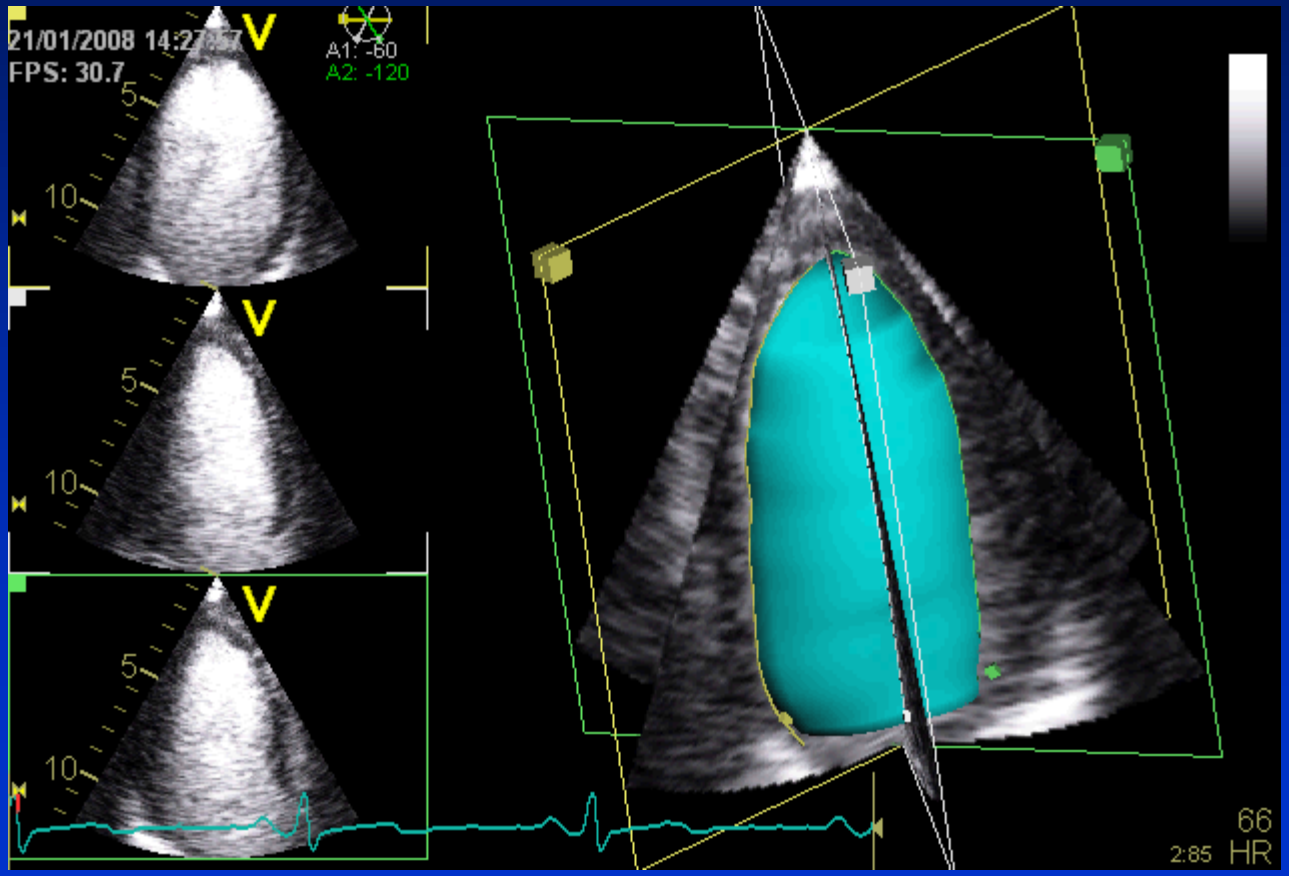
Adapted from White et al. NEJM 1986

LV function and size?
First choice: echo

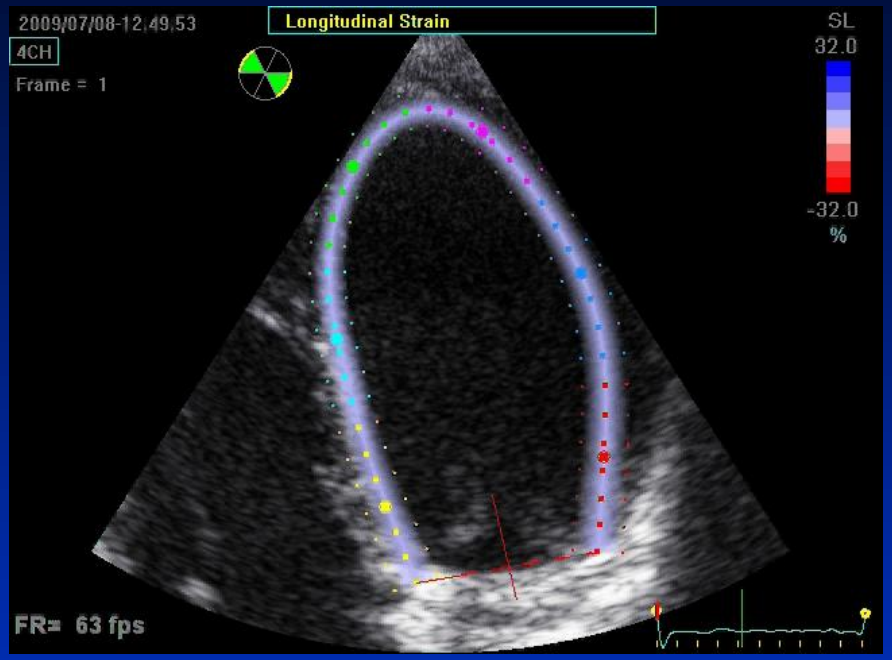


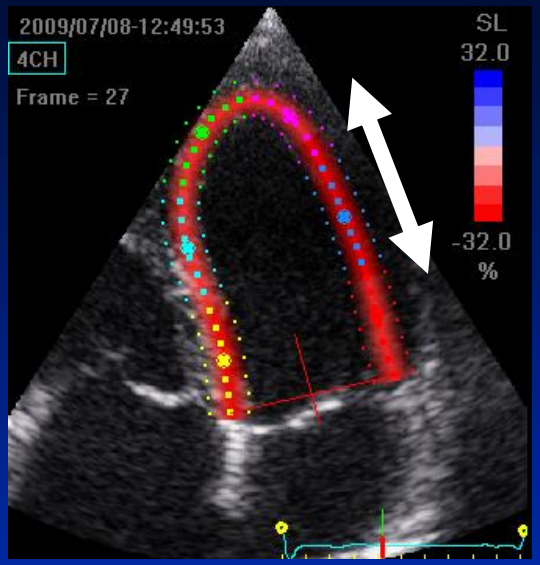


LV function and size? Towards 3D imaging?



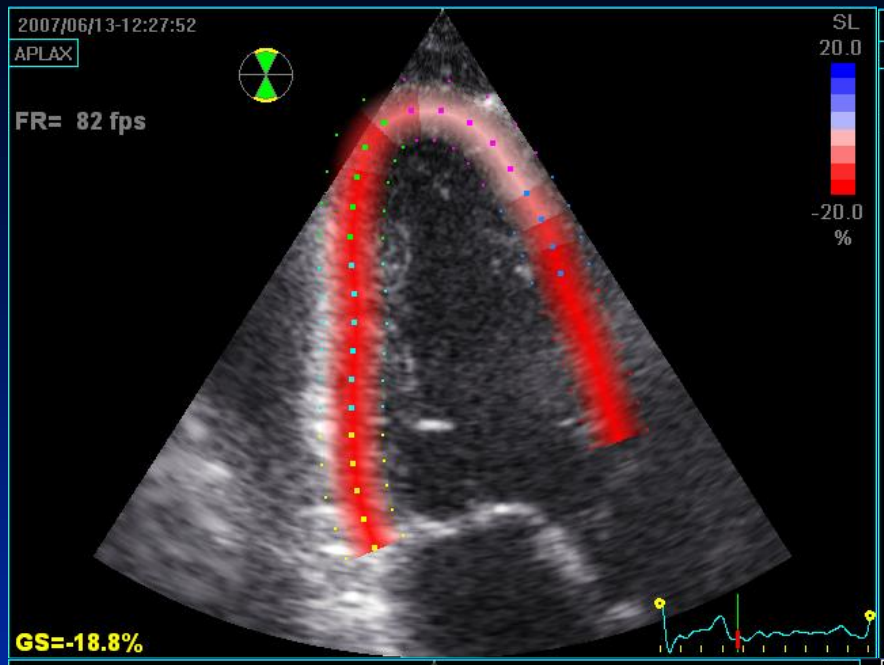
Advanced LV function assessment

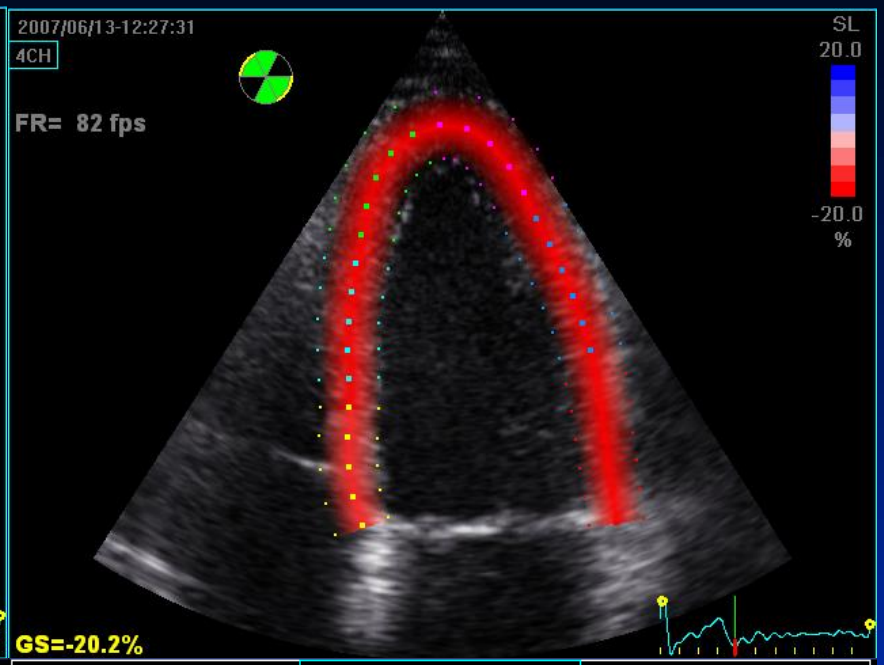


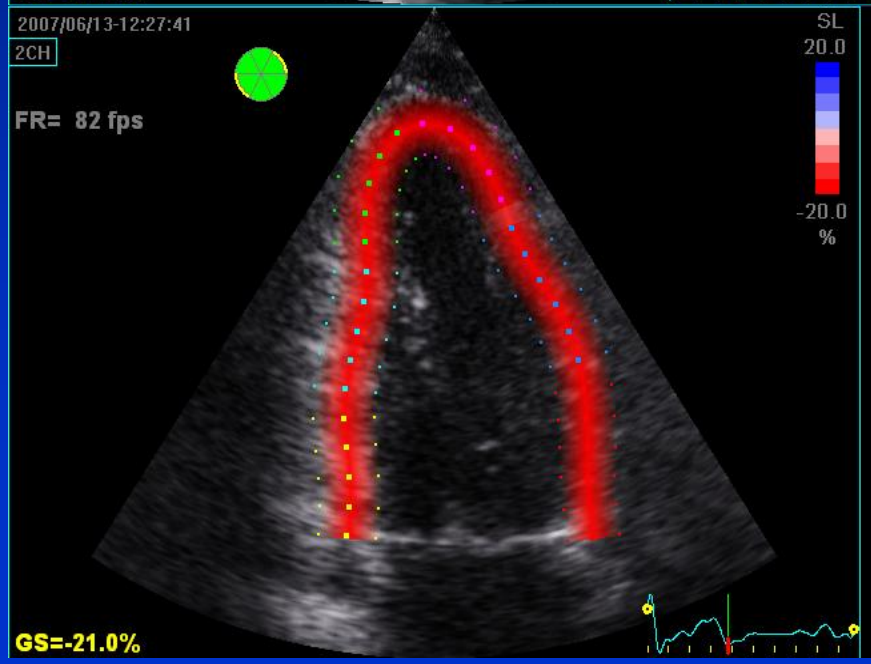


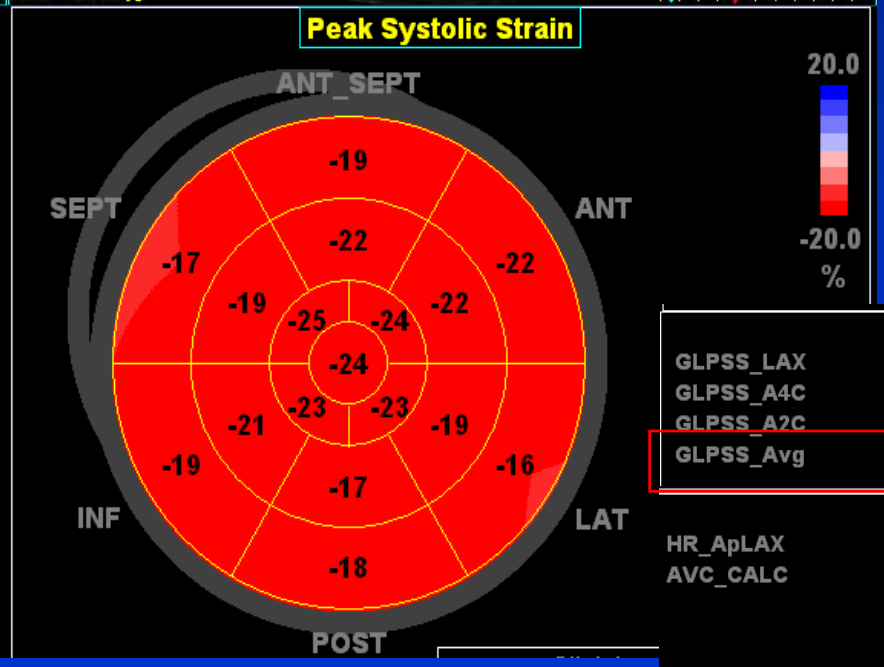
Longitudinal strain

From regional to global LV strain

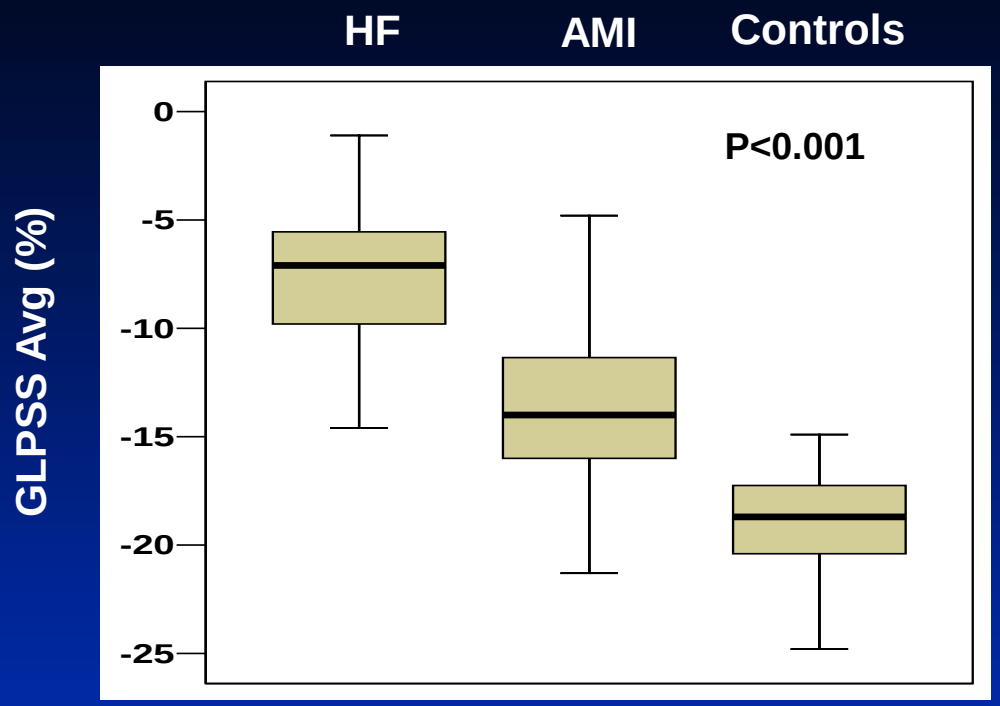








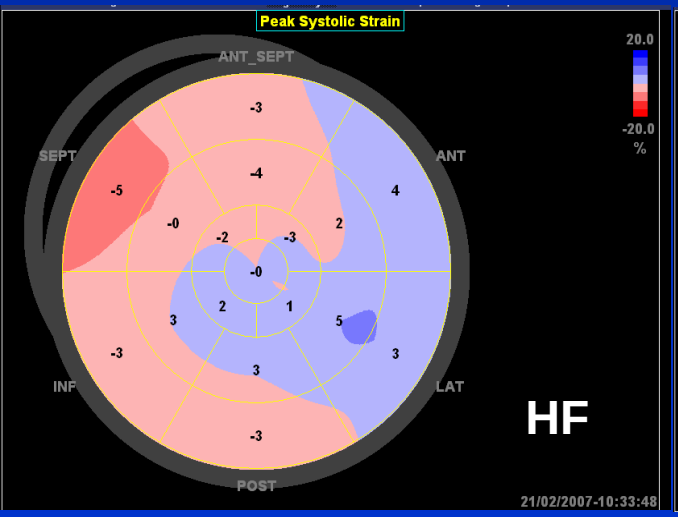
Global strain maps: HF, infarction, and normal

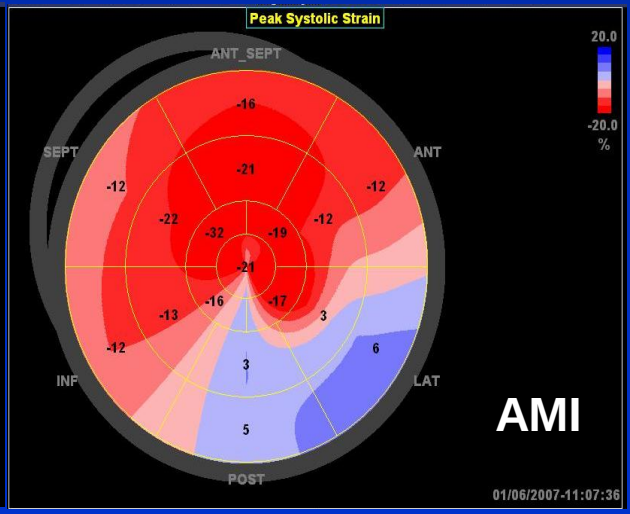


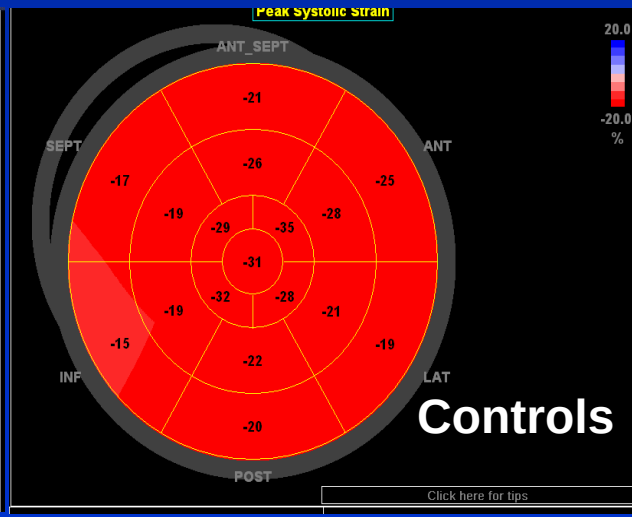
GLPSS Avg: -7.3 ± 3%

GLPSS Avg: -13.8 ± 3.3%

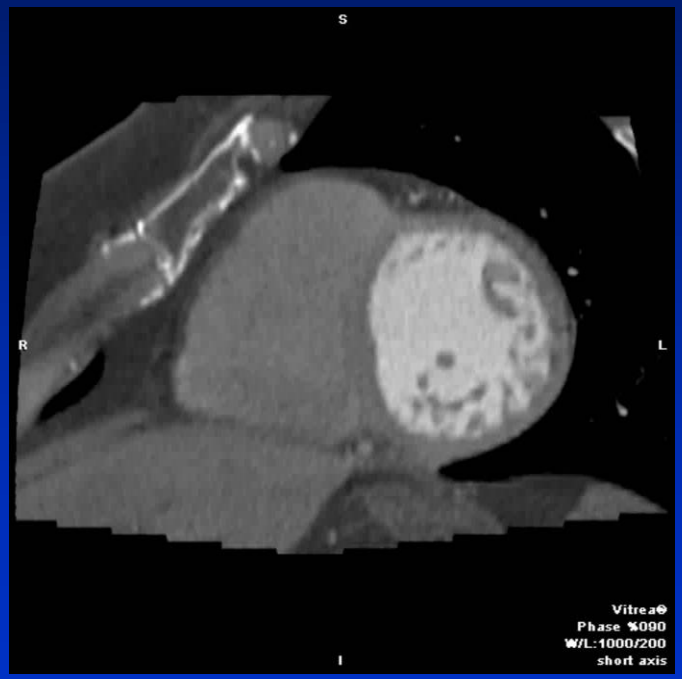
GLPSS Avg: -19.1 ± 3.1%

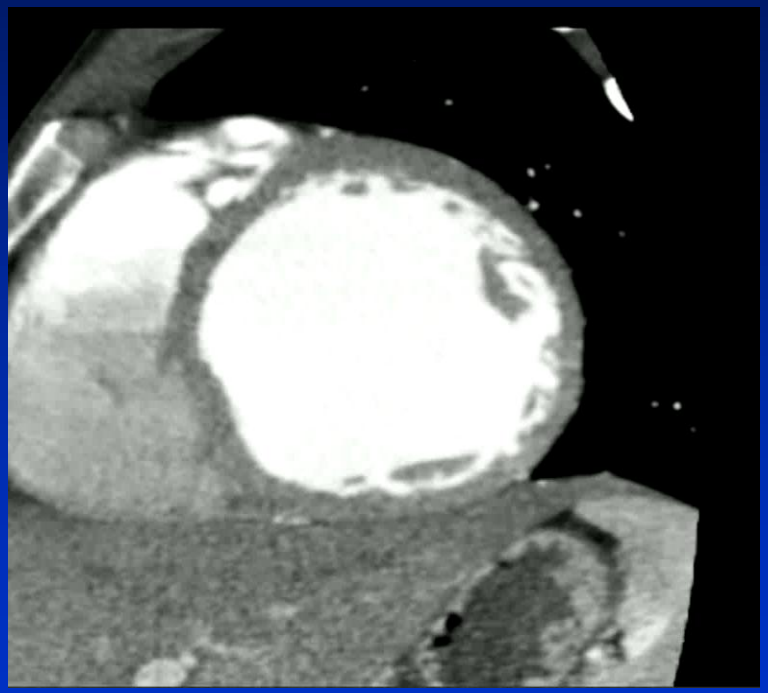




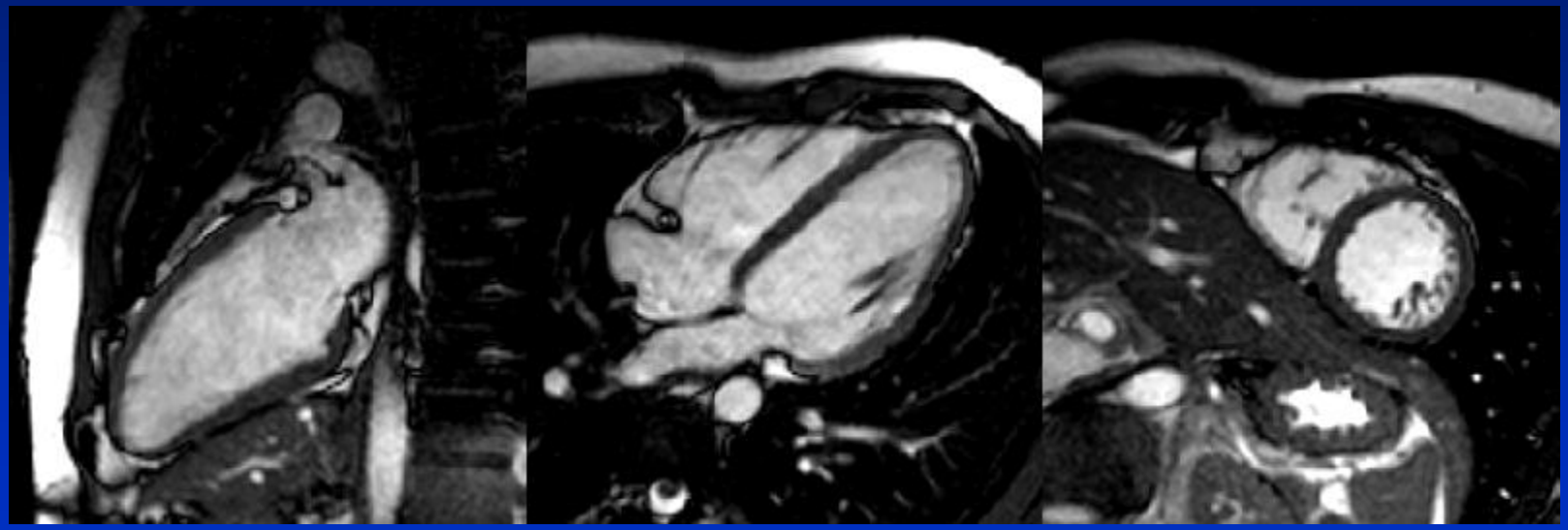


LV function and size?
Other techniques?

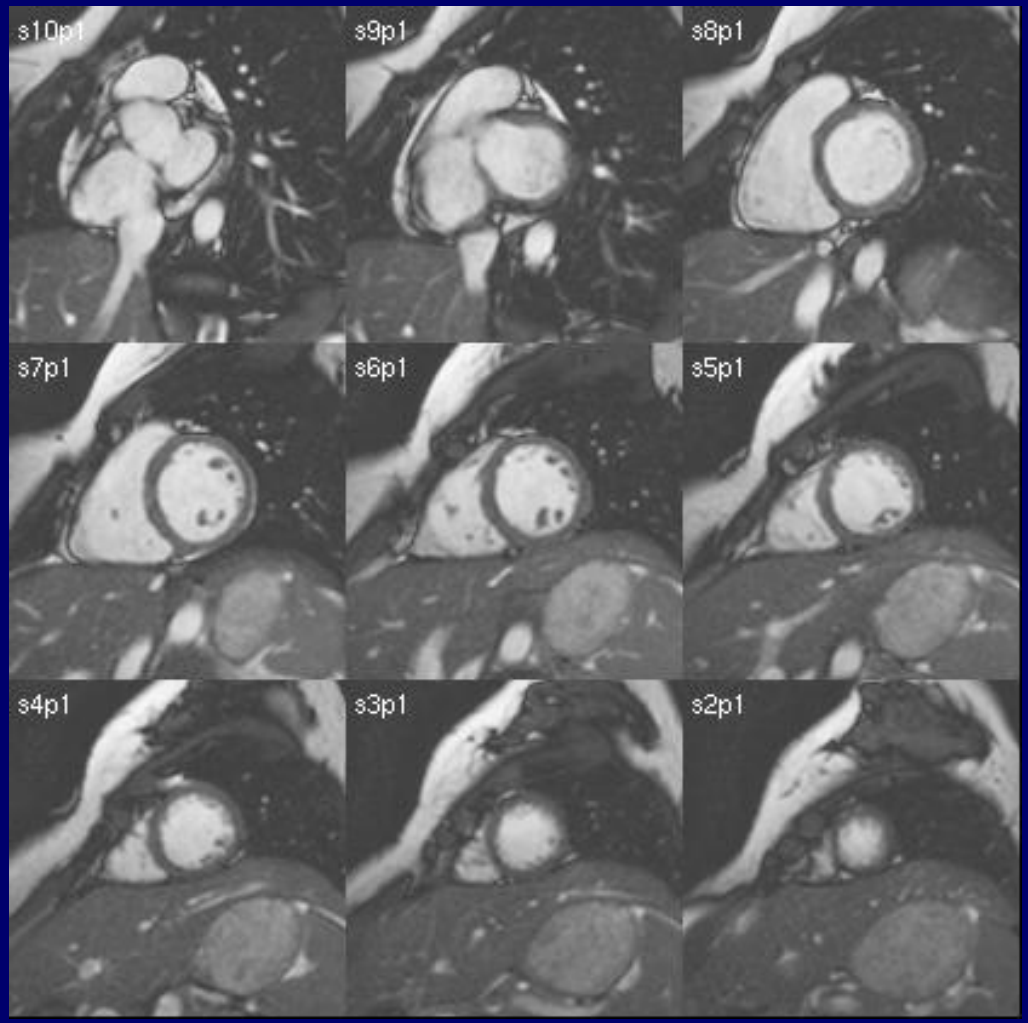




LV function and size?
Other techniques?

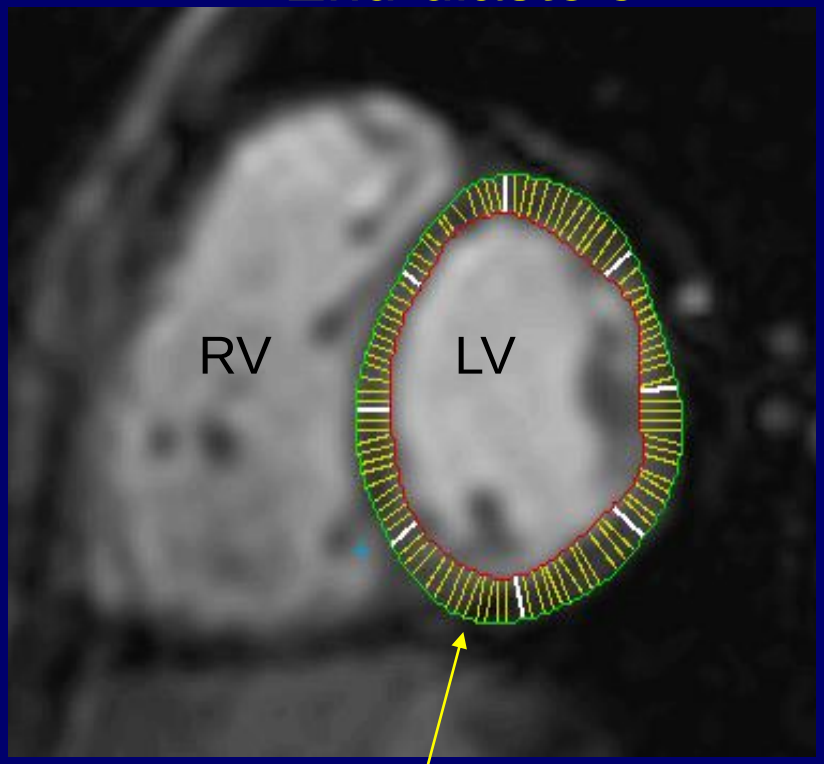


Center-line method to quantify LVEF and volumes



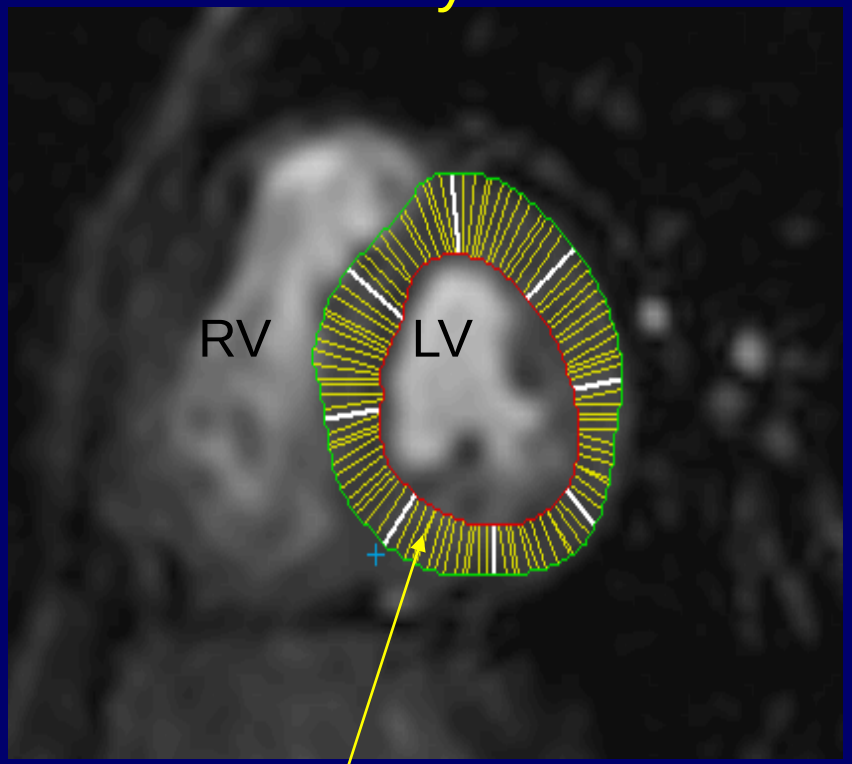
Center-line method to quantify LVEF and volumes

End-diastole



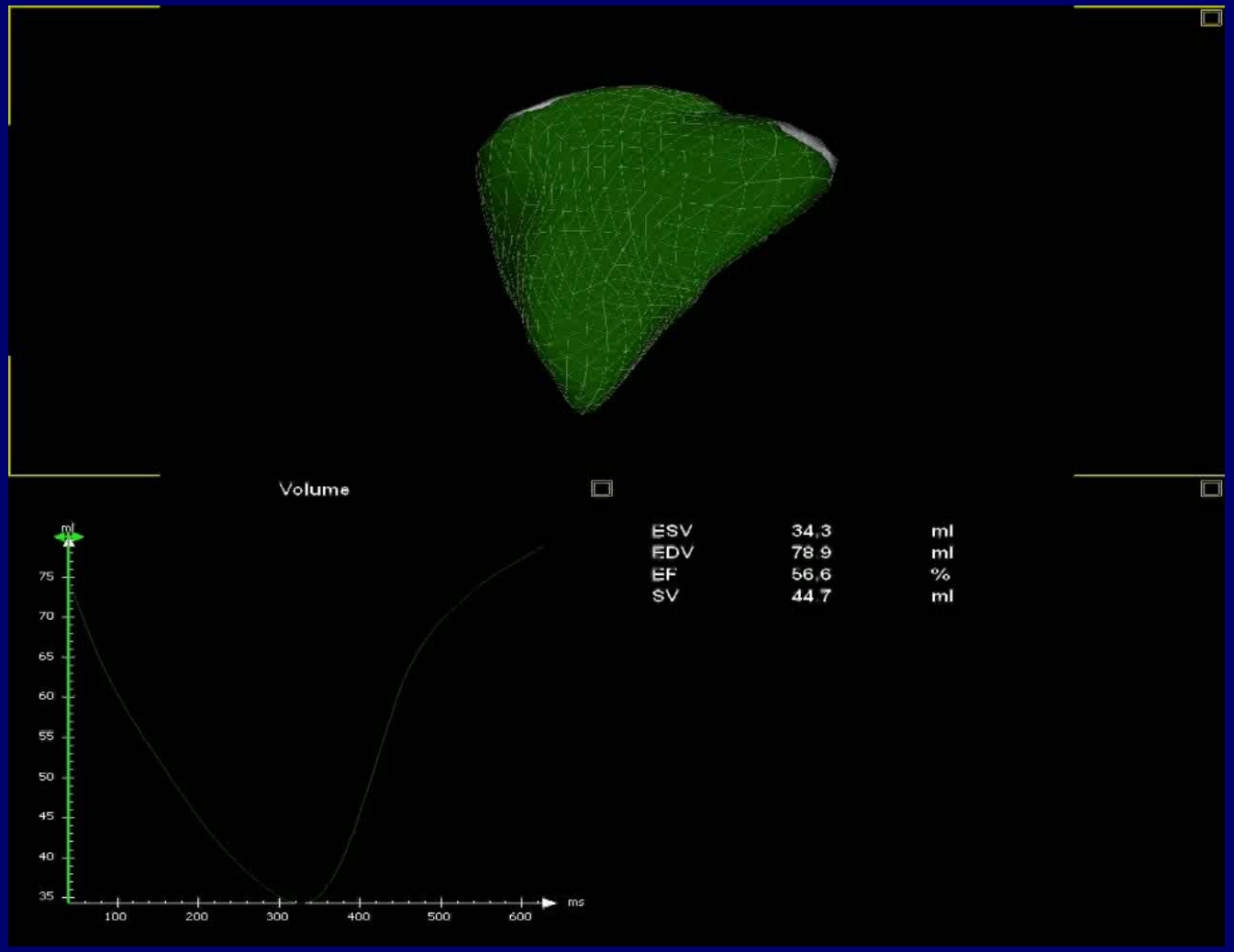
Epicardial contour

End-systole

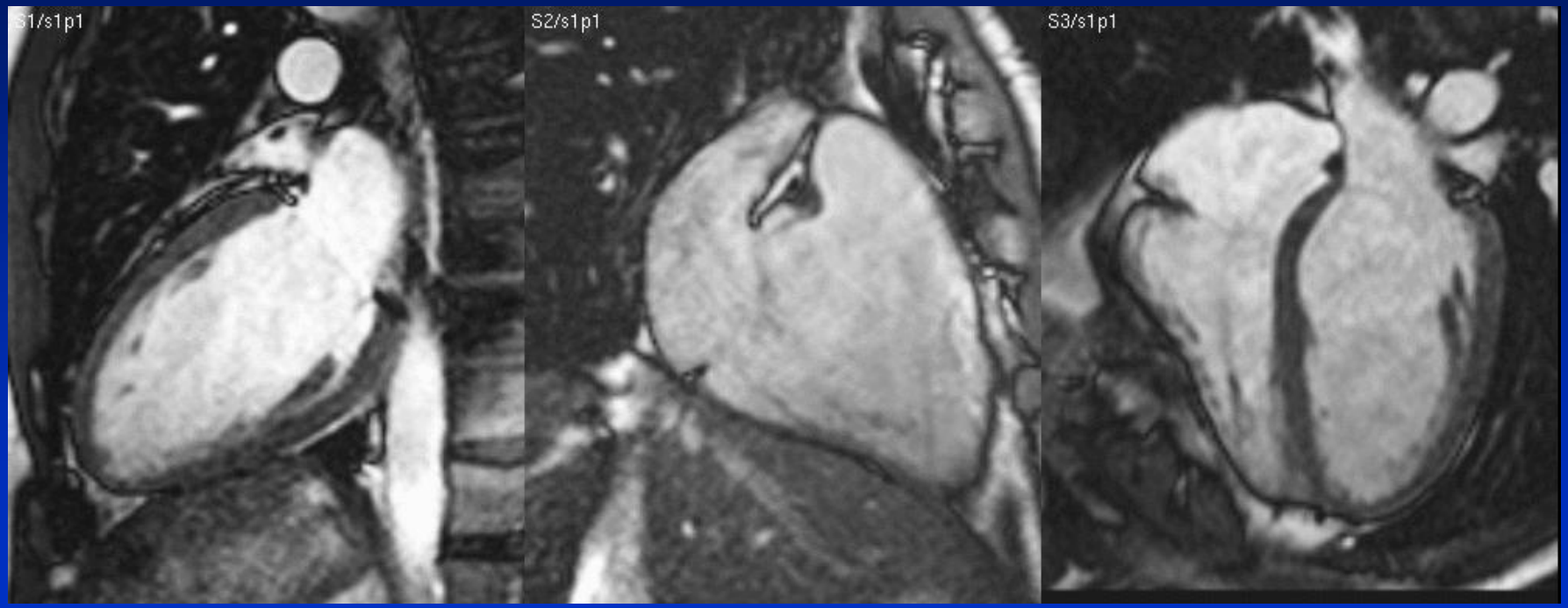


Endocardial contour

RV function and size



RV function and size



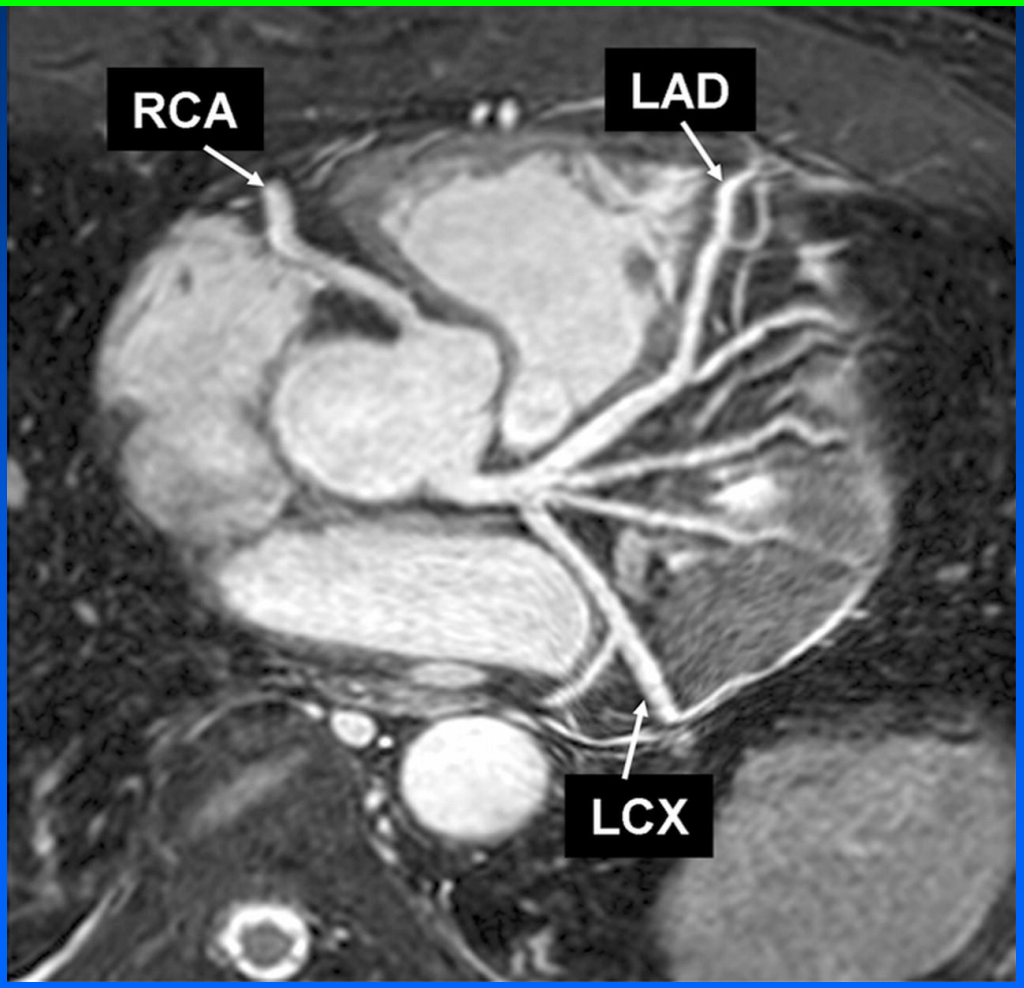
LV function and size?

- We need:
- Highest resolution images in every patient
- Assessment of LVEF but also
  - LV dimensions : LVESD, LVEDD
  - LV volumes: LVESV, LVEDV

- Exact quantification – prognosis but also for justification of ICD therapy

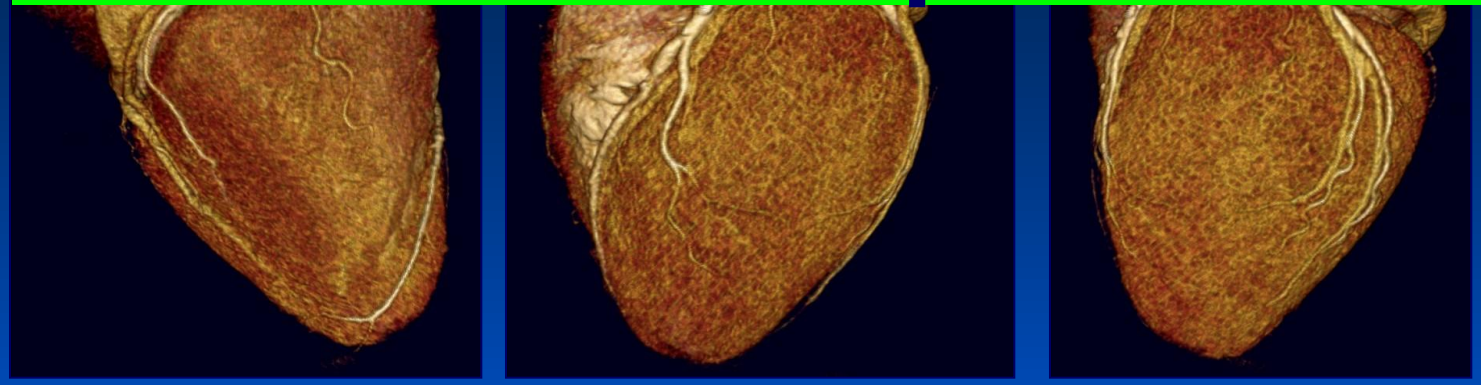
CAD: yes or no?
First choice: invasive angio

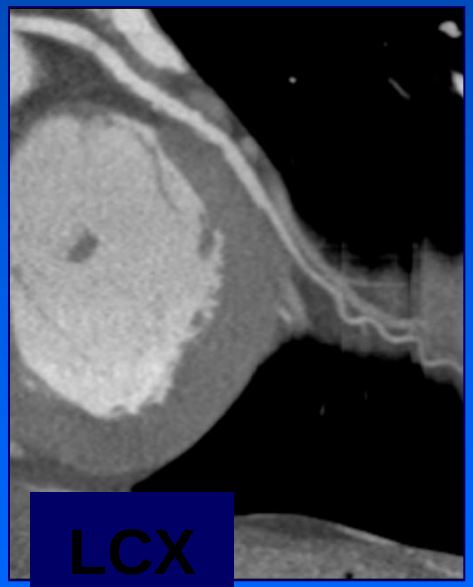
CAD: yes or no?
Other options?



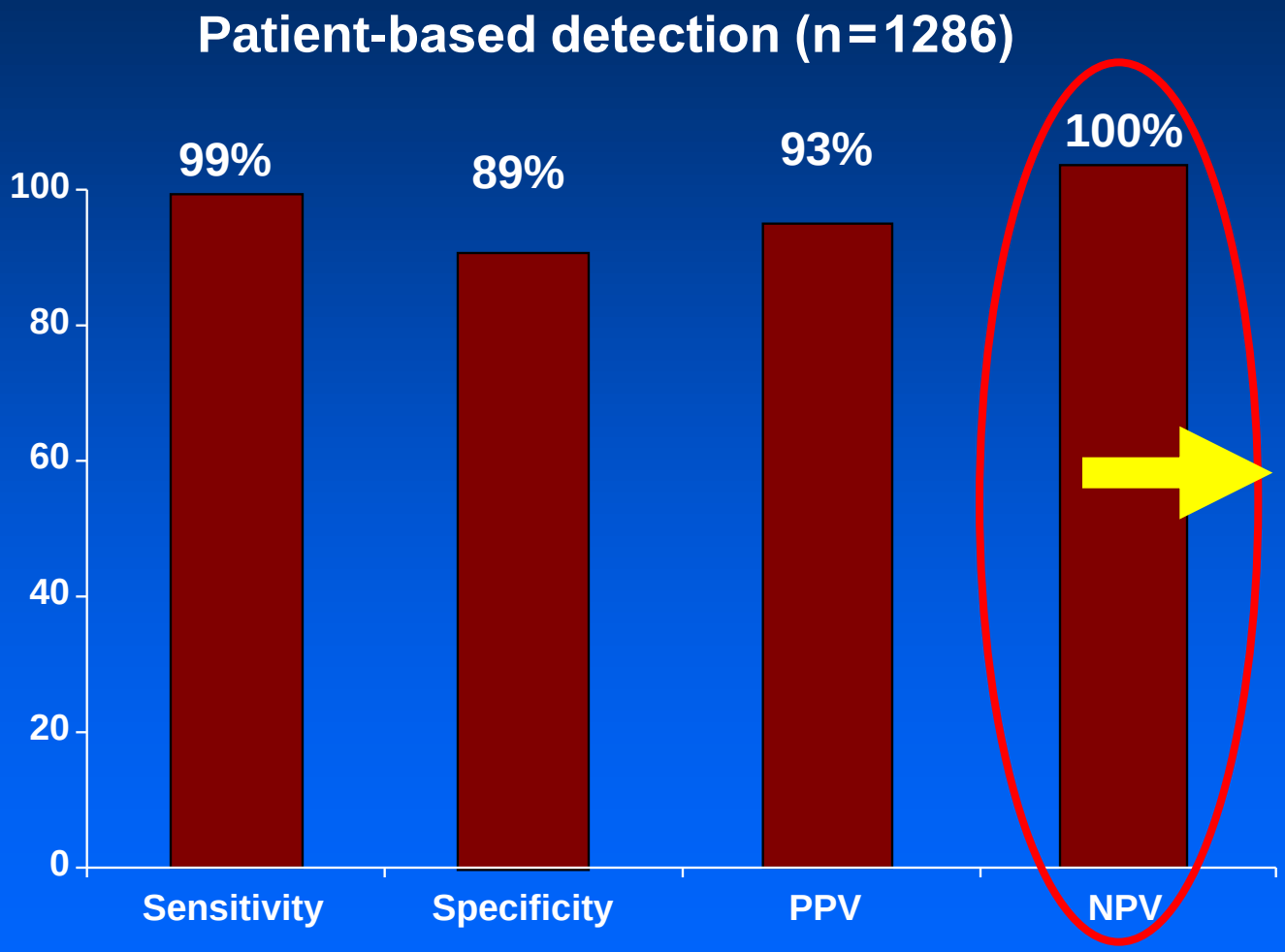
Sakuma et al. Radiology 2005

CAD: yes or no?
Other options?





Meta-analysis 64-slice CT



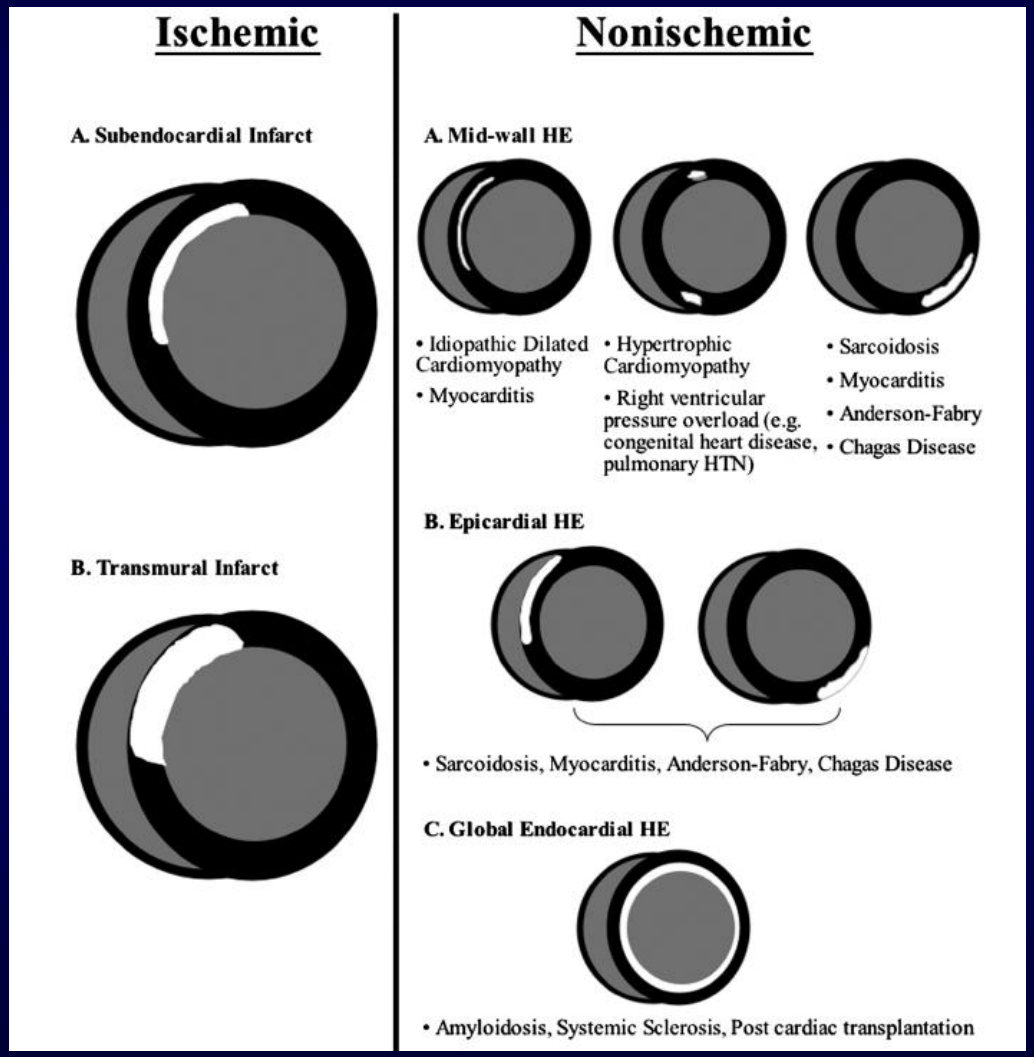
Rule out CAD

Mowatt et al *Heart* 2008

CAD: no

- We need information:
- On the myocardium:
  - edema, inflammation, fibrosis: myocarditis, amyloidosis?

Myocardial disease: MRI makes the difference

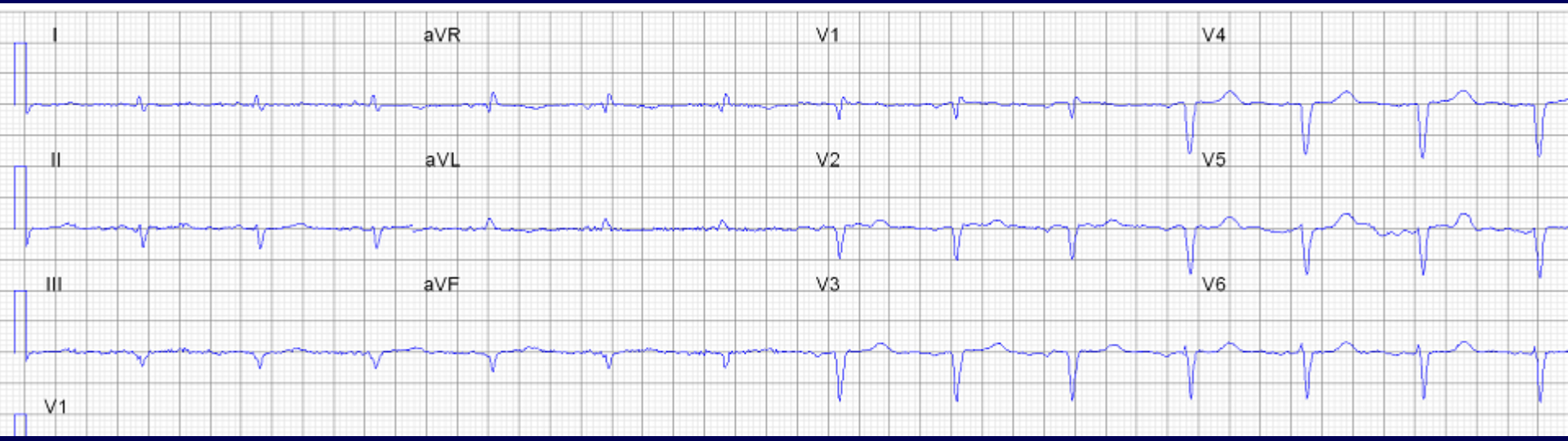


Mahrholdt, Eur Heart J 2005

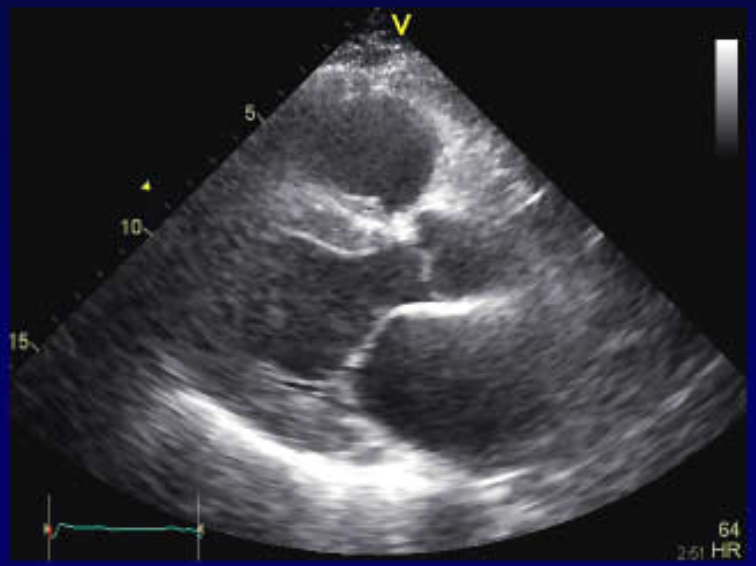
Dyspnea

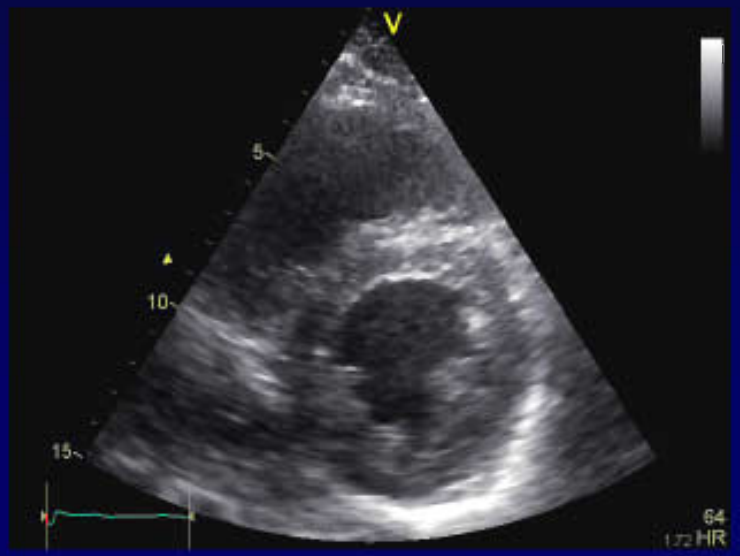
Female 65 years

- History M Waldenstrom
- Progressive dyspnea, NYHA class 3
- Coronary angiography: normal



Suggestive of cardiomyopathy


V
5
10
15
64
HR


V
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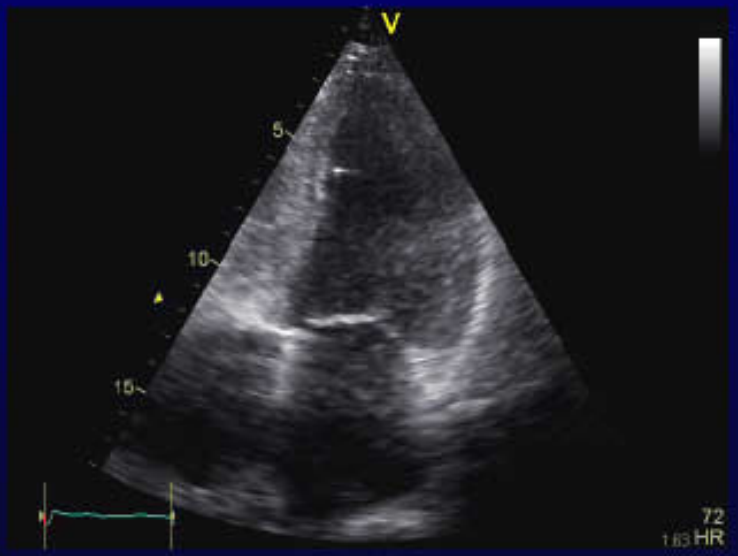
V
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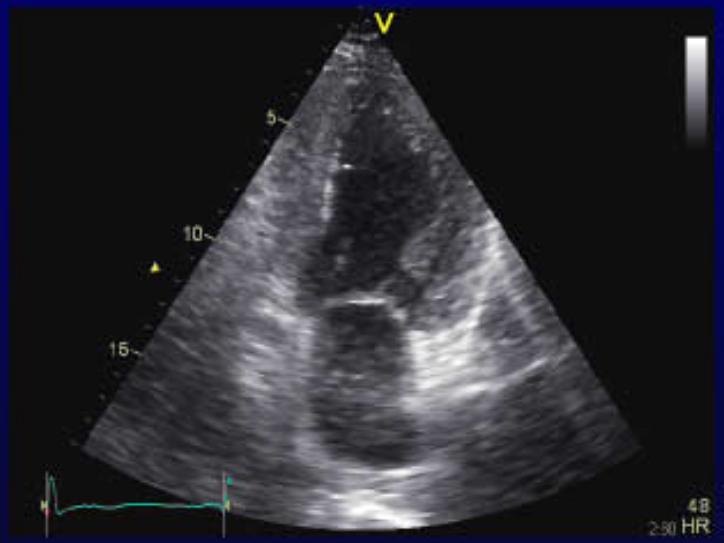
72
HR


V
5
10
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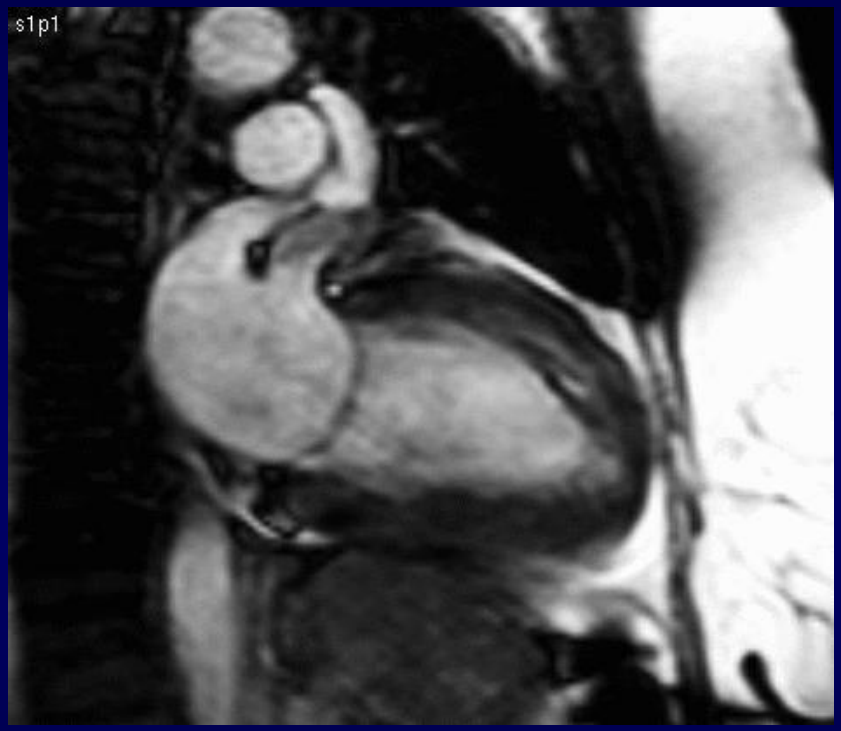
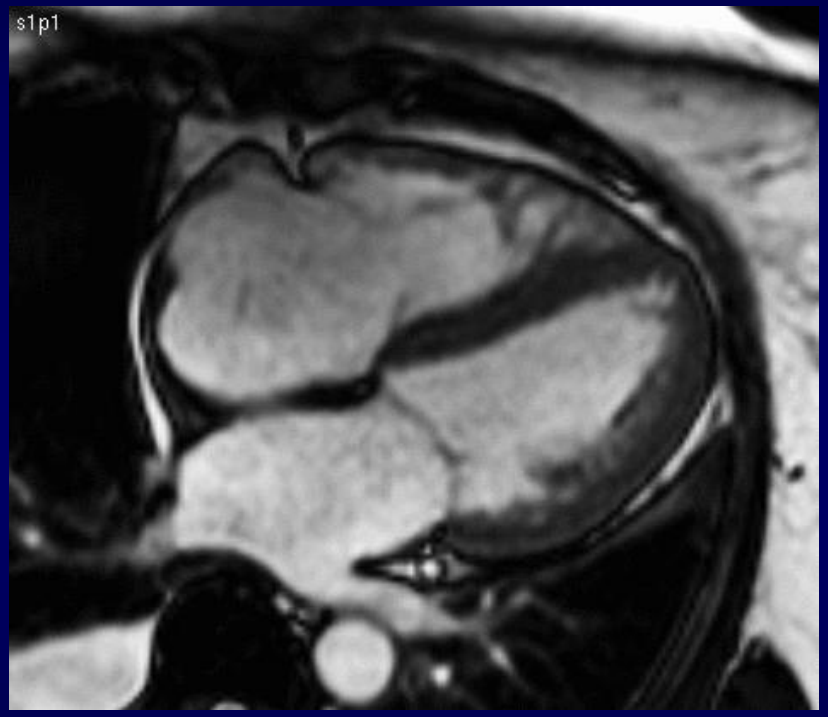
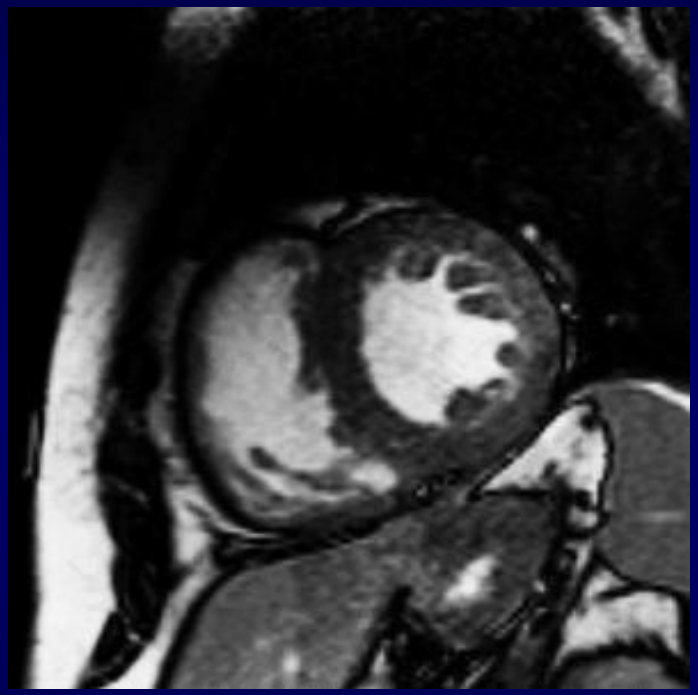
48
HR



2-chamber

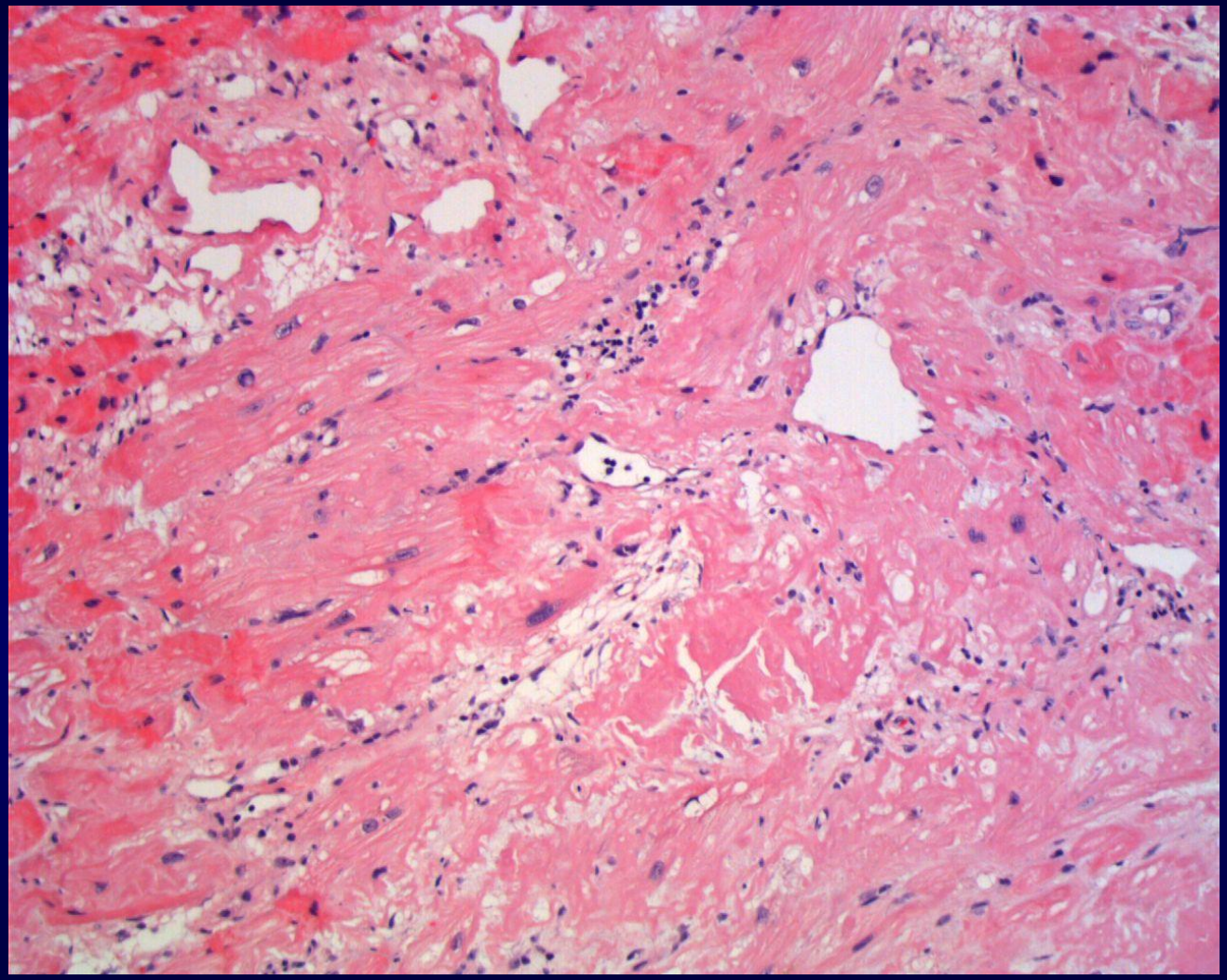


4-chamber



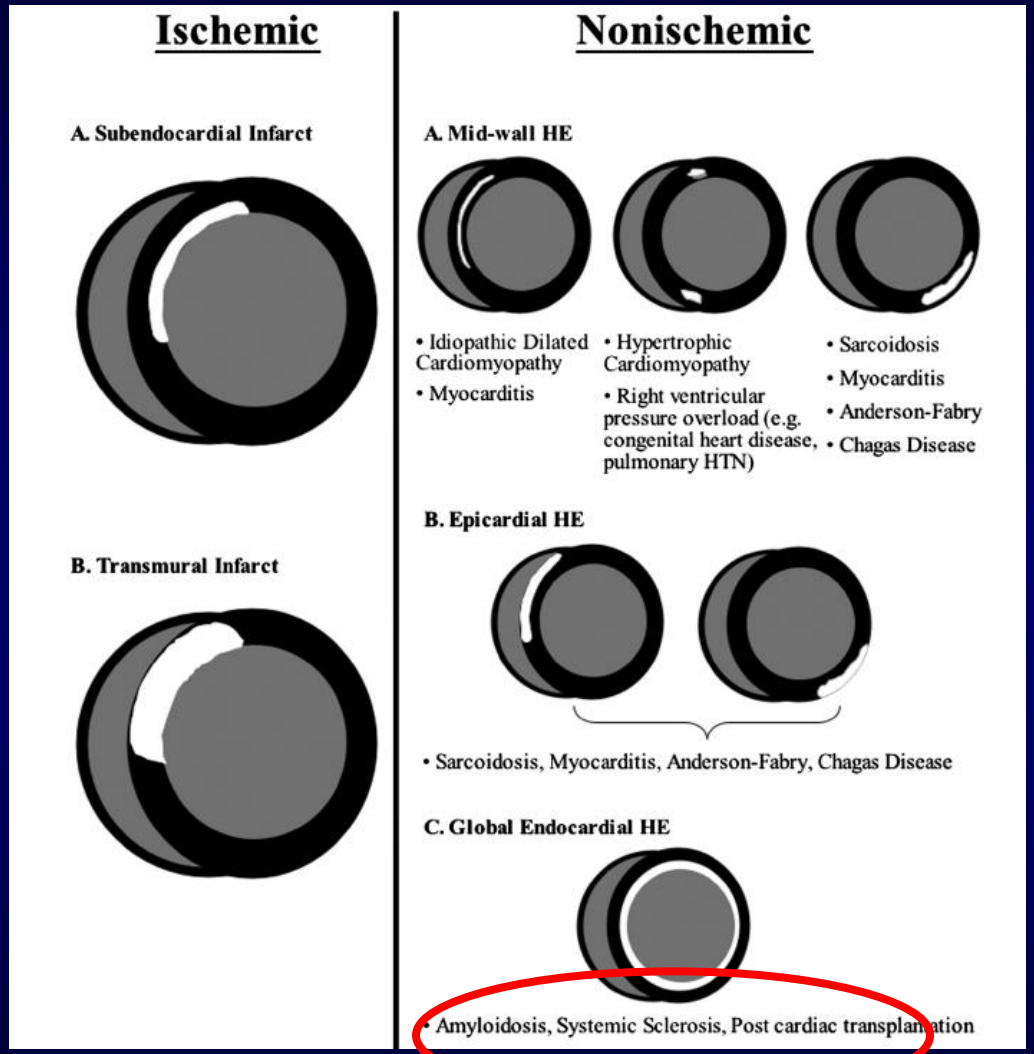
Cine SA-mid

DE SA-mid



AL amyloidosis. Pt died 3 months after diagnosis

DE Patterns



Mahrholdt, Eur Heart J 2005

Male 25 years

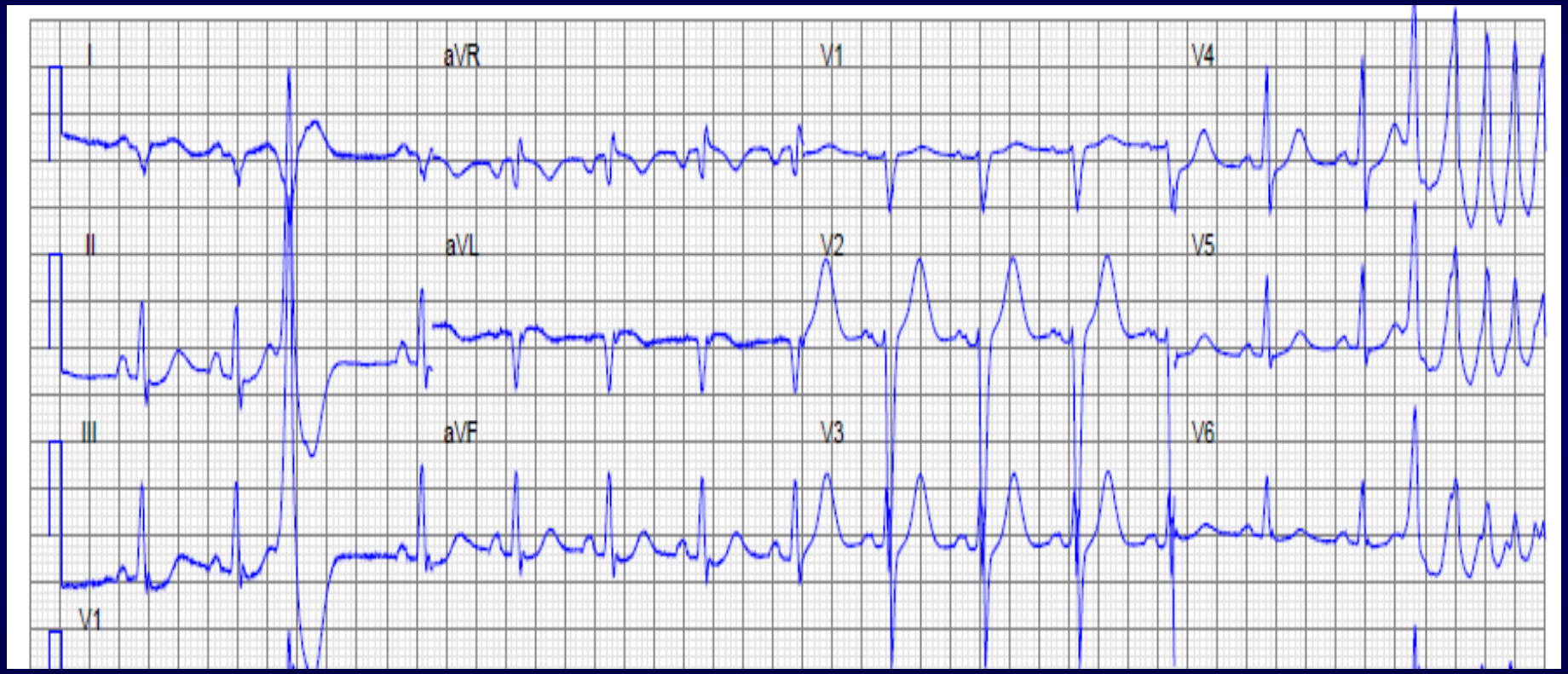
Out of hospital cardiac arrest: ventricular fibrillation

Resuscitation, defibrillation, intubation

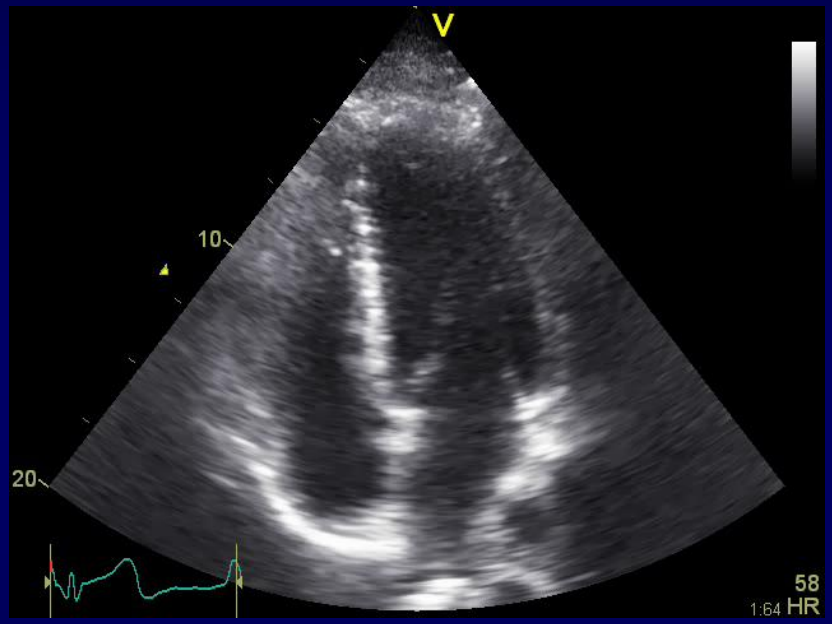
Medical history

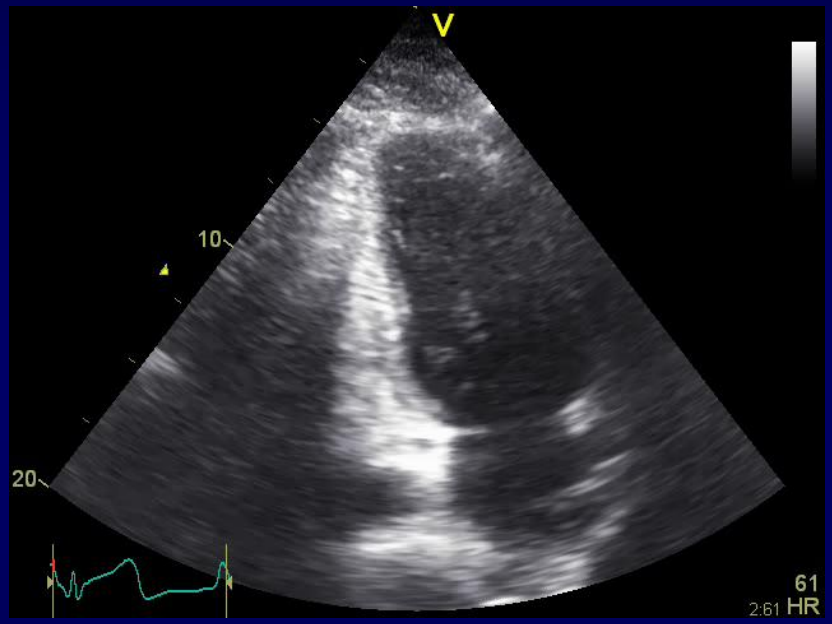
- Riskfactor CAD: smoking
- 5-6 days before not feeling well, gastro-enteritis?

ECG at IC

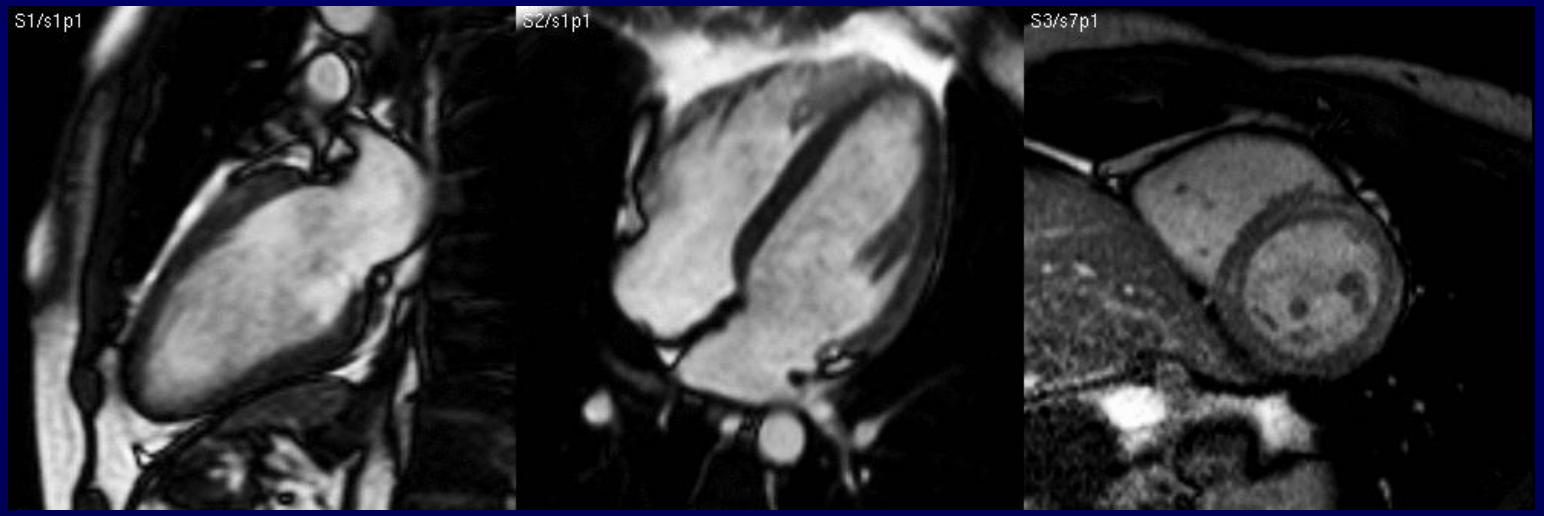


Echocardiography day 1





MRI day 5

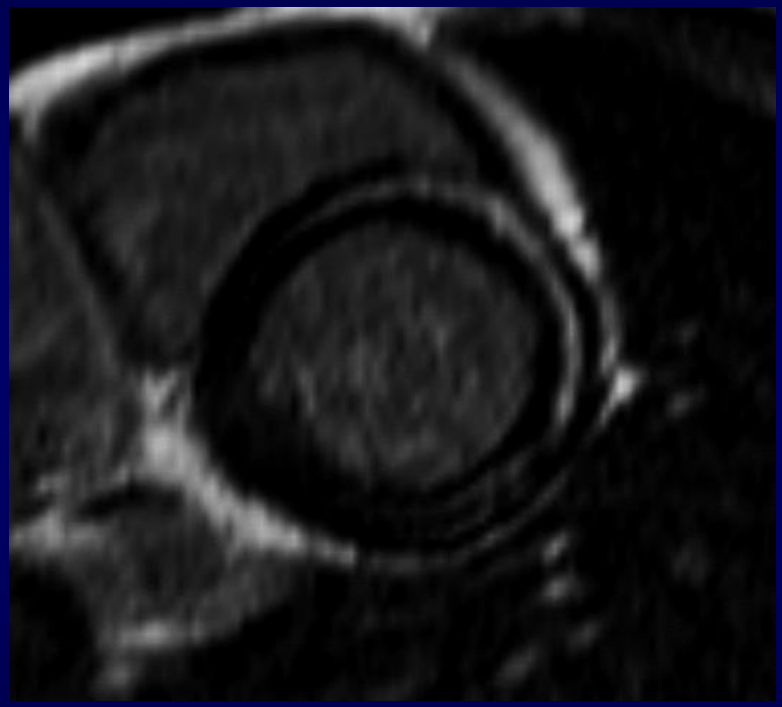


Coronary angiography:

No significant stenosis, 30% stenosis on proximal LAD

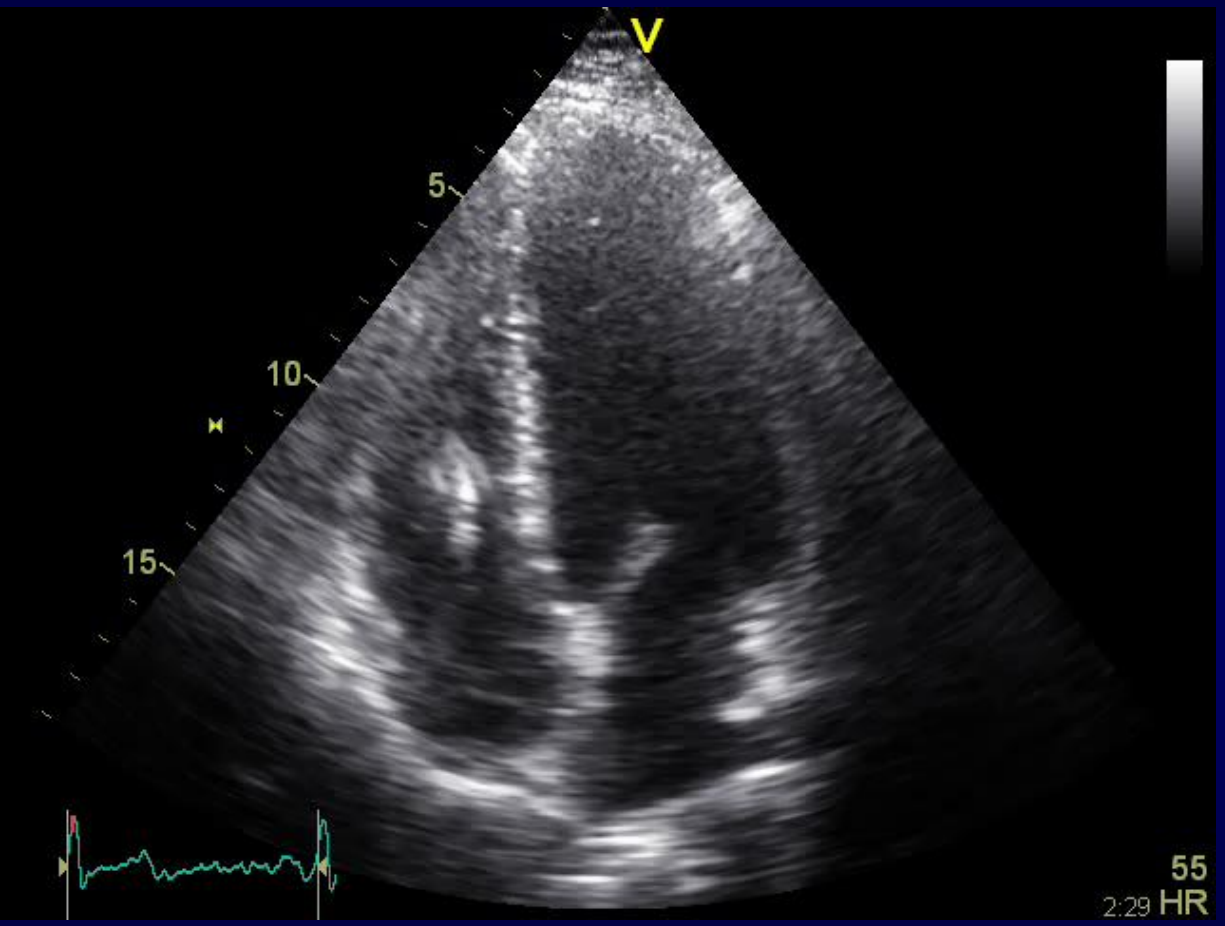
MRI DE

DE SAX



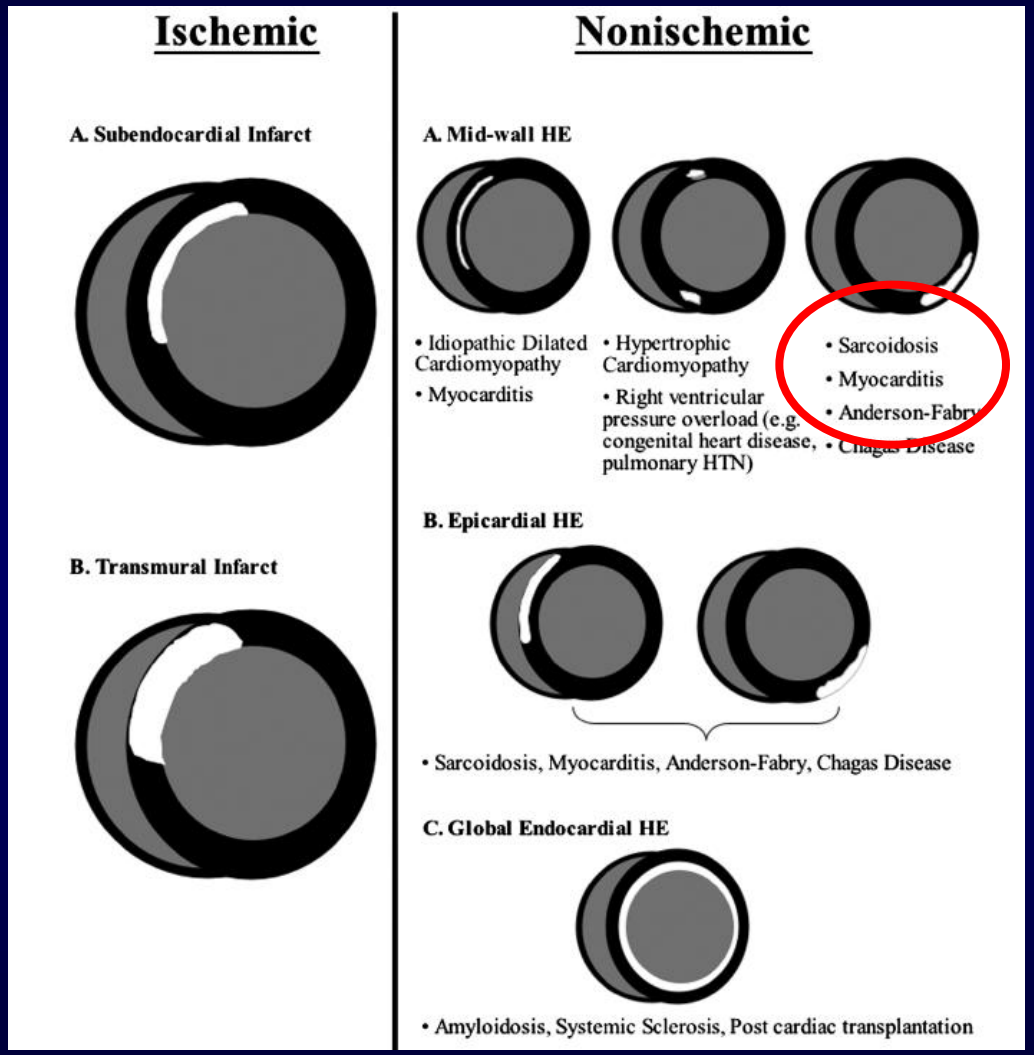
DE SA basal

Echo at 5 months



- **Positive IgG and IgM for HHV-6** (previous gastro-enteritis)
- **No biopsy**

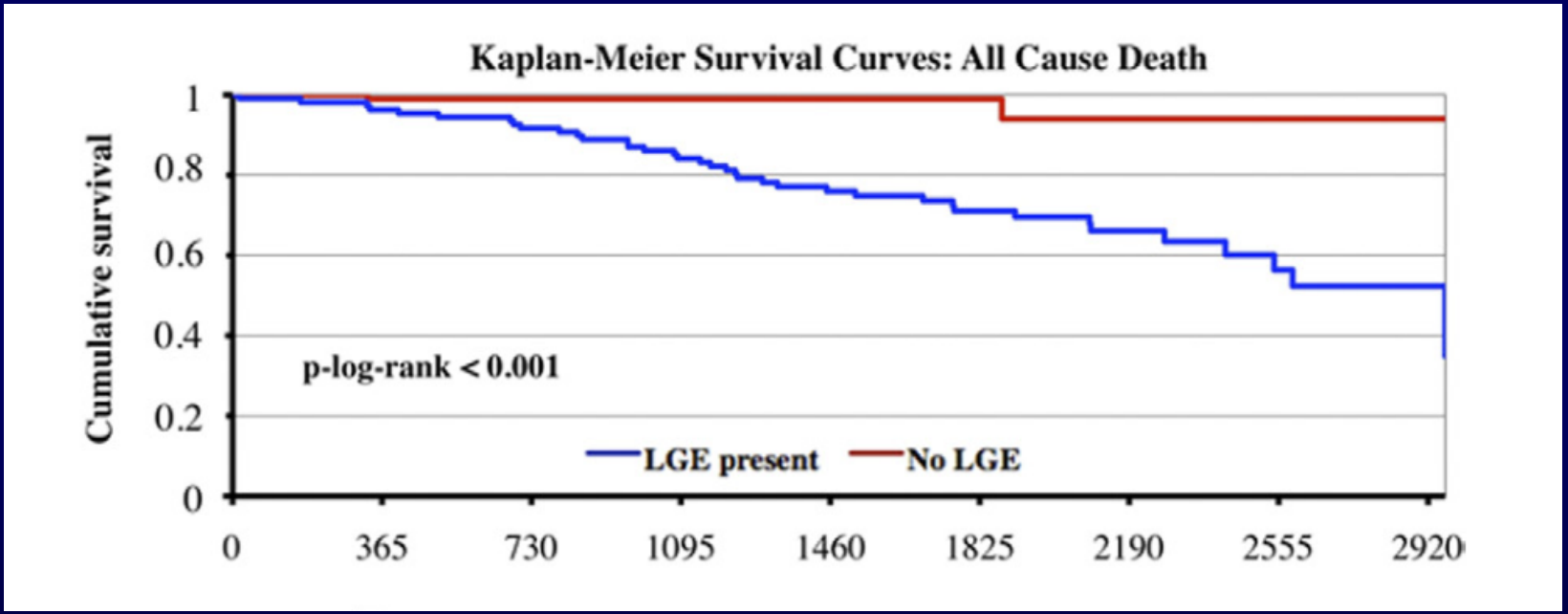
DE Patterns



Mahrholdt, Eur Heart J 2005

Prognostic value of LGE-CMR in myocarditis

N = 222 patients with biopsy proven myocarditis

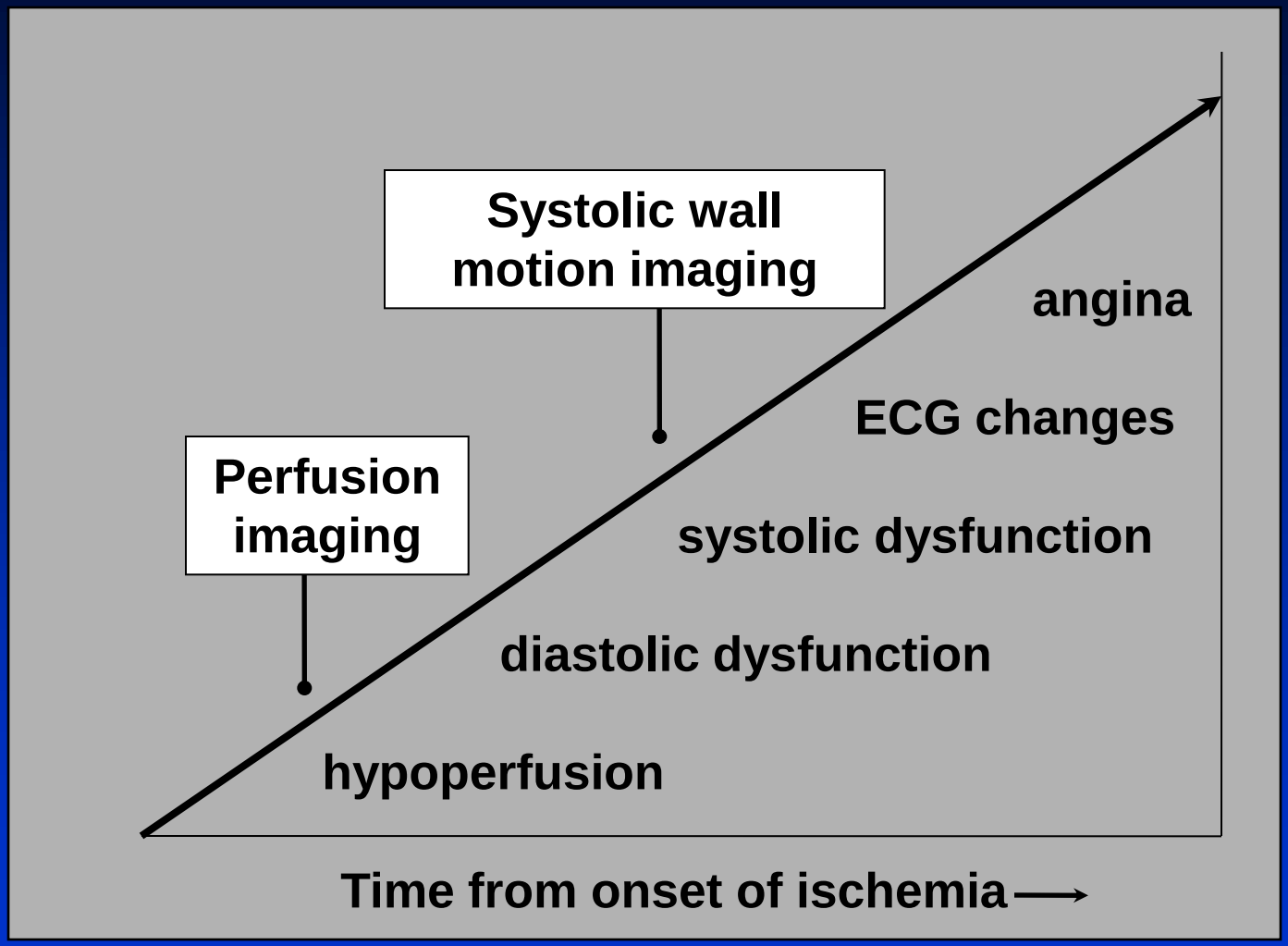


Grun JACC 2010

CAD: yes

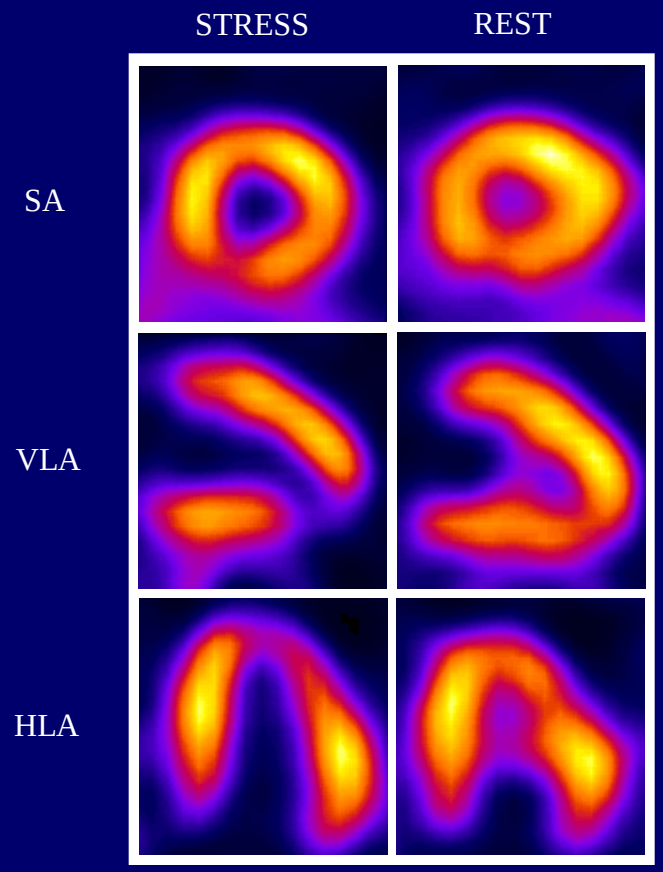
- We need ischemia demonstration to justify revascularization
- We need viability demonstration to justify revacularization

Is there ischemia?

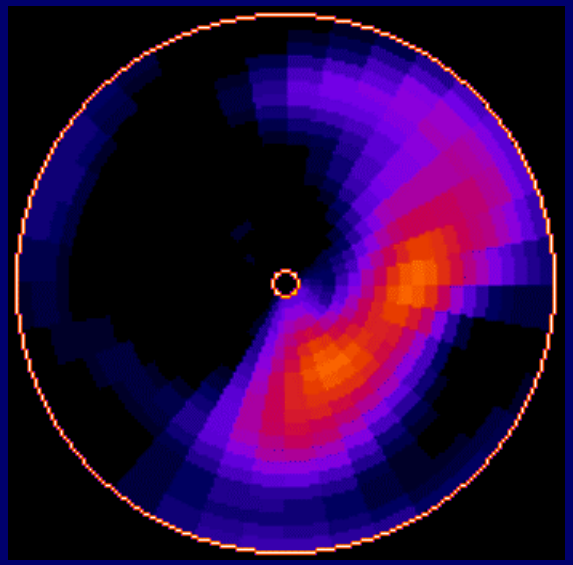


Schinkel et al. EHJ 2003

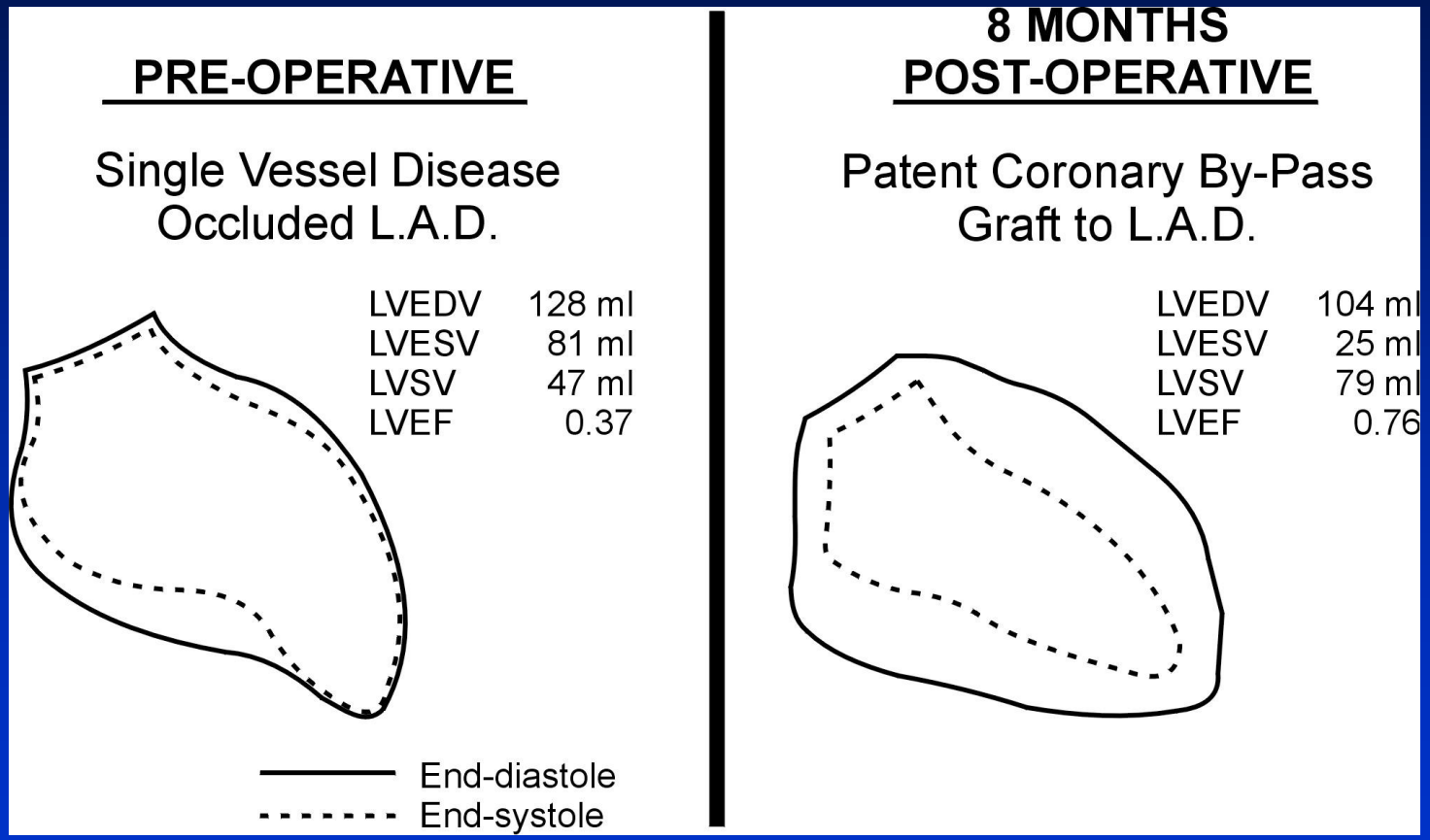
Nuclear perfusion imaging, SPECT



POLAR MAP TO QUANTIFY
EXTENT AND SEVERITY OF ISCHEMIA

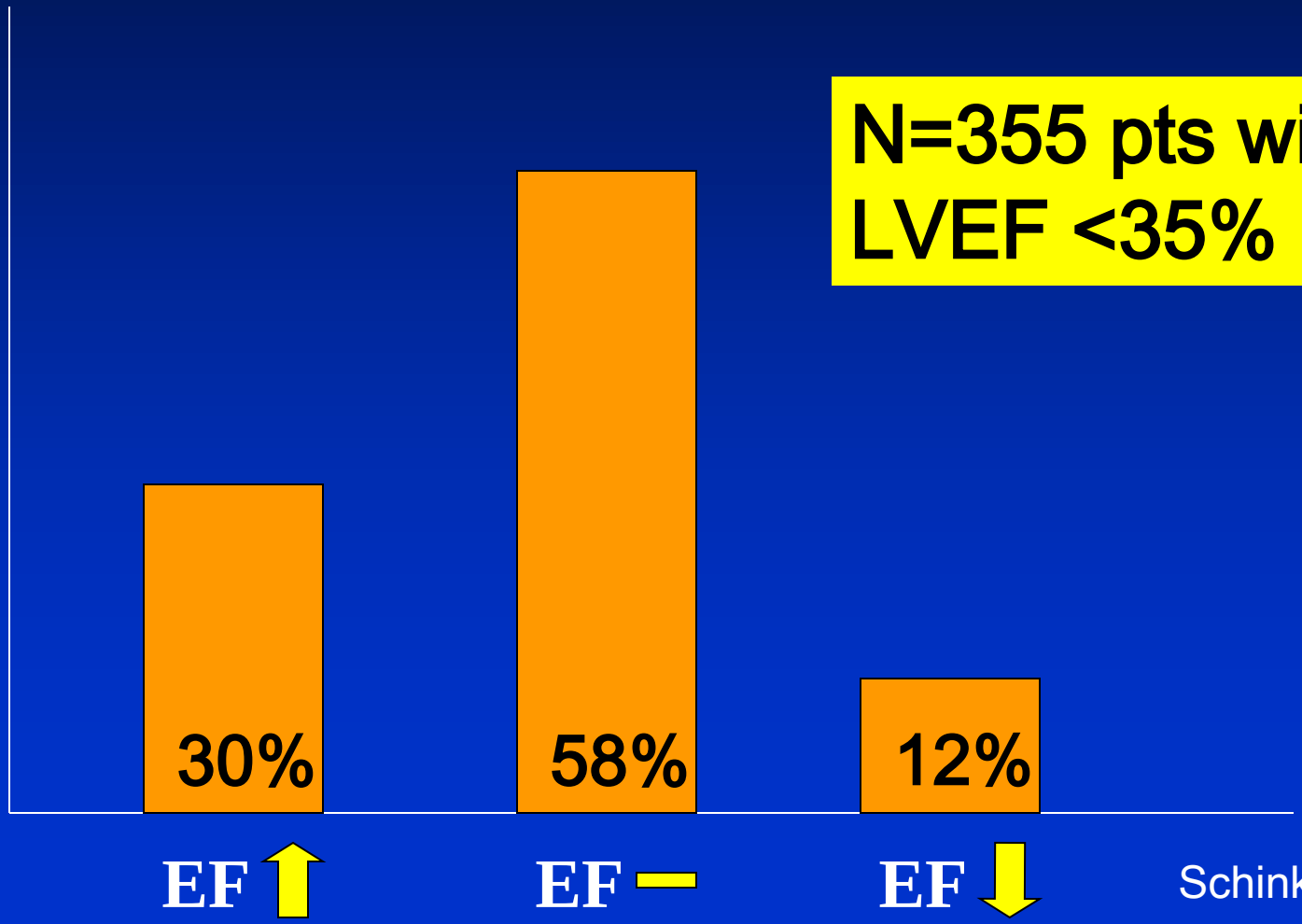


Is there viability?



Rahimtoola SH. AHJ 1975

Revascularization versus change in LVEF



Schinkel et al. AJC 2004

Is there viability?

- Clinical goal:

-identify patients:

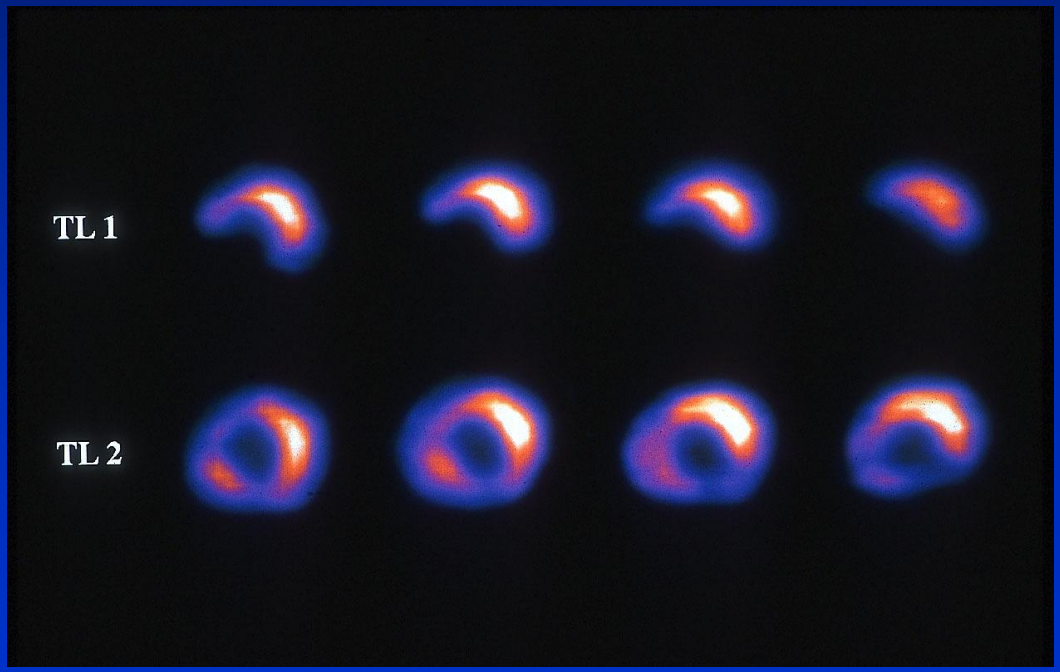
with **dysfunctional** but **viable** tissue

-with potential to recover function

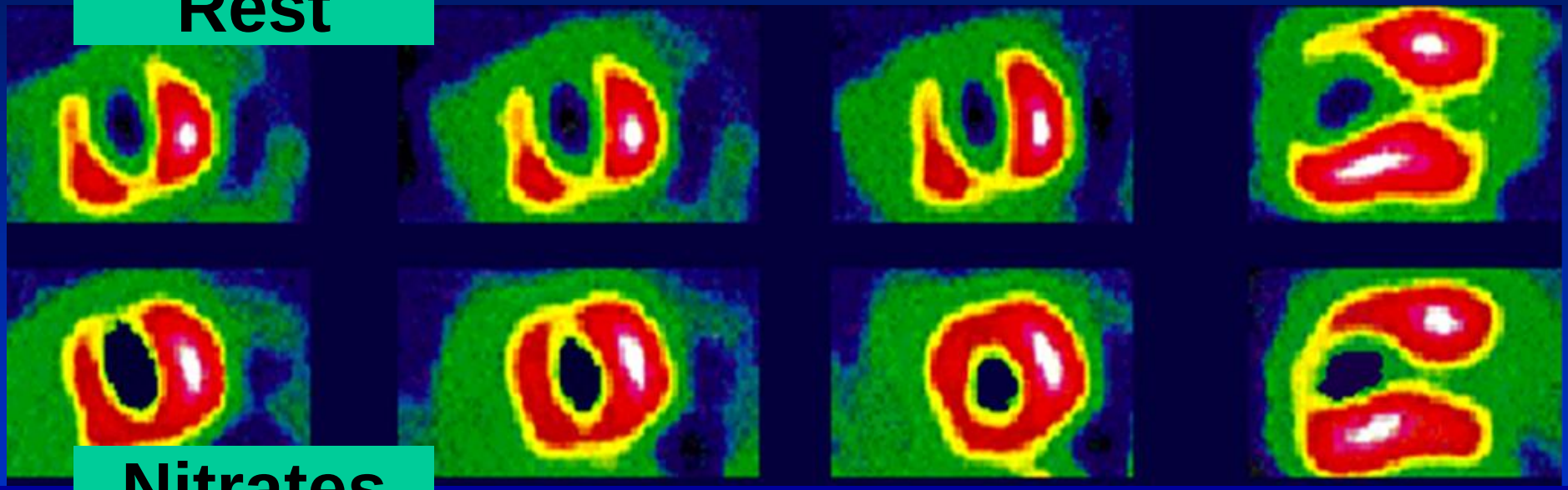
-to justify enhanced surgical risk

Nuclear: thallium-201

- Early uptake is perfusion
- Late uptake is cellmembrane integrity

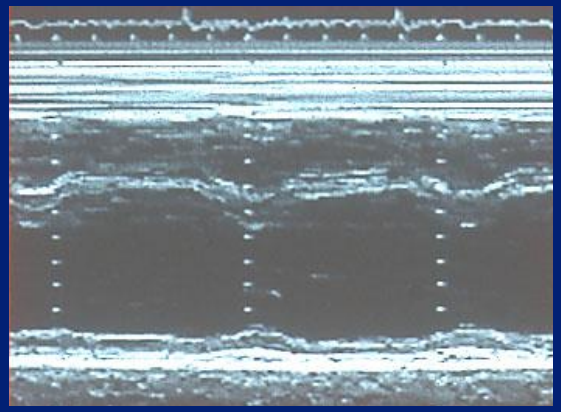


Nuclear: MIBI

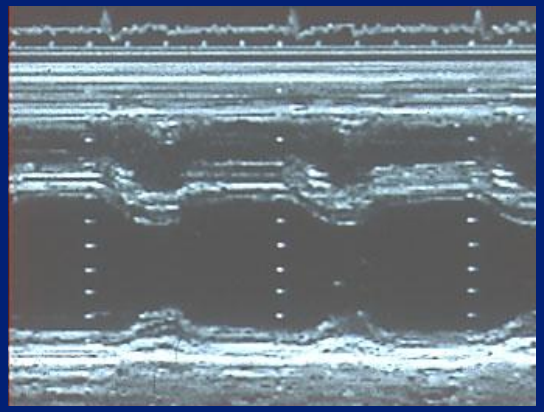


Courtesy A Cuocolo

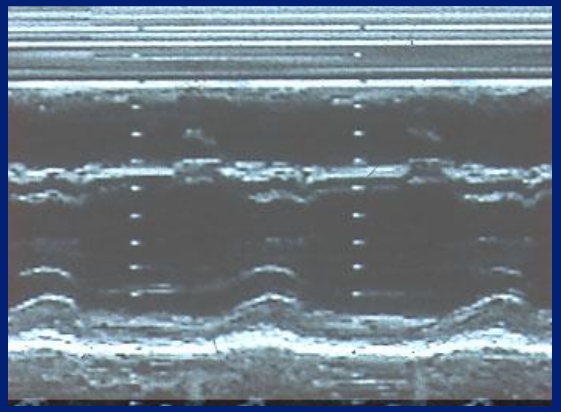
Echo: low-dose dobutamine



rest



low-dose



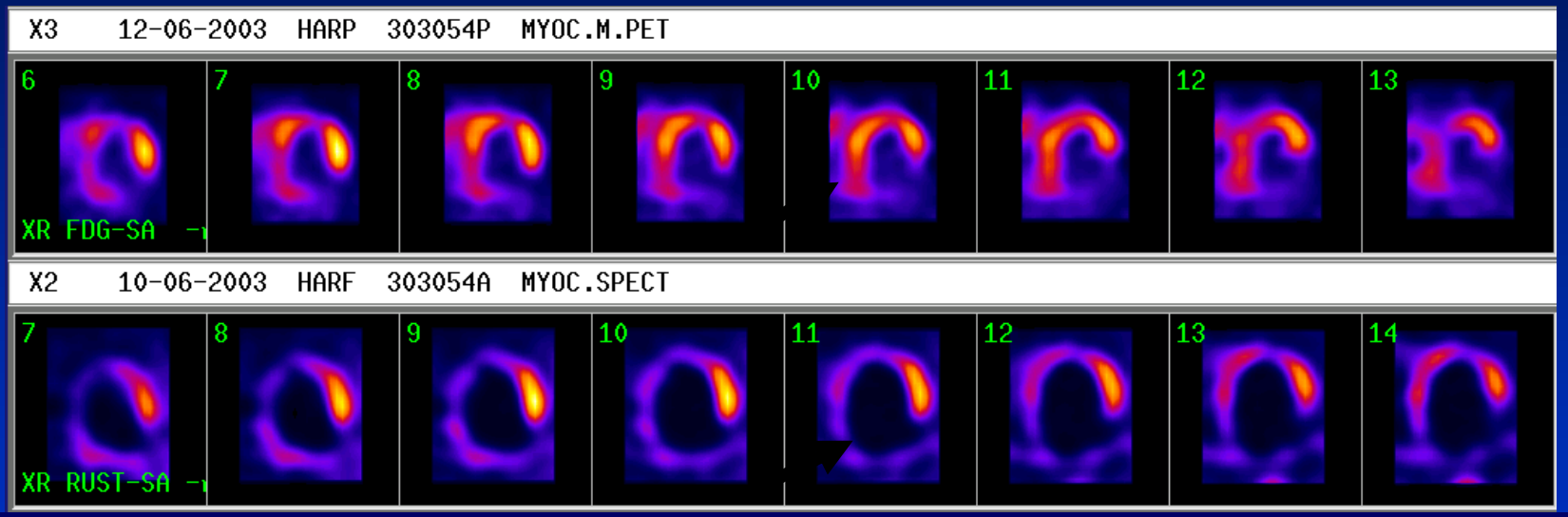
post-revasc

Courtesy JH Cornel

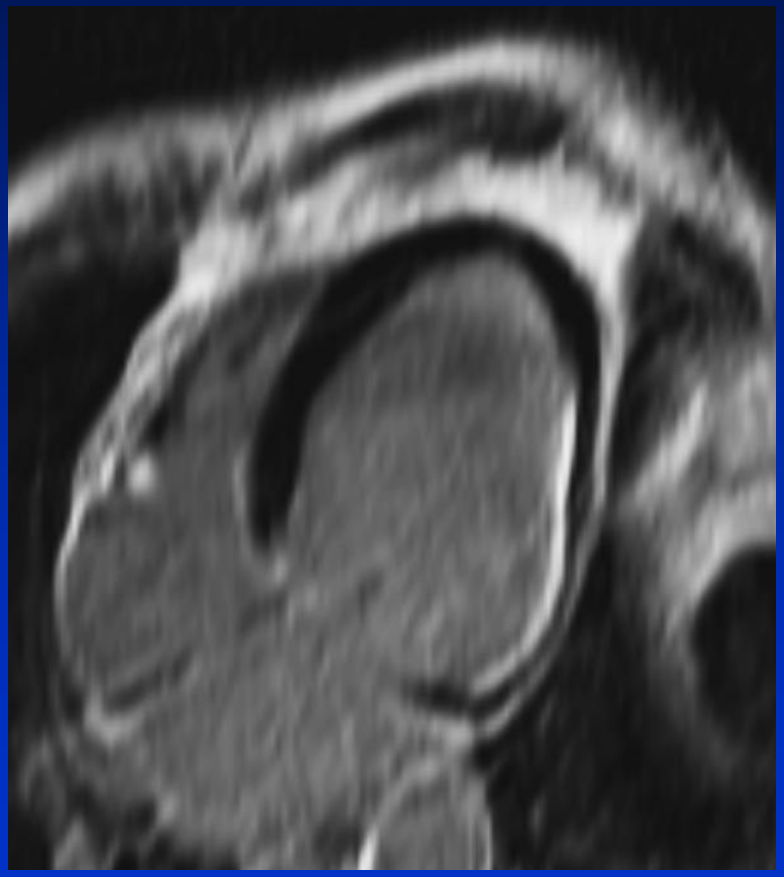
Nuclear: FDG

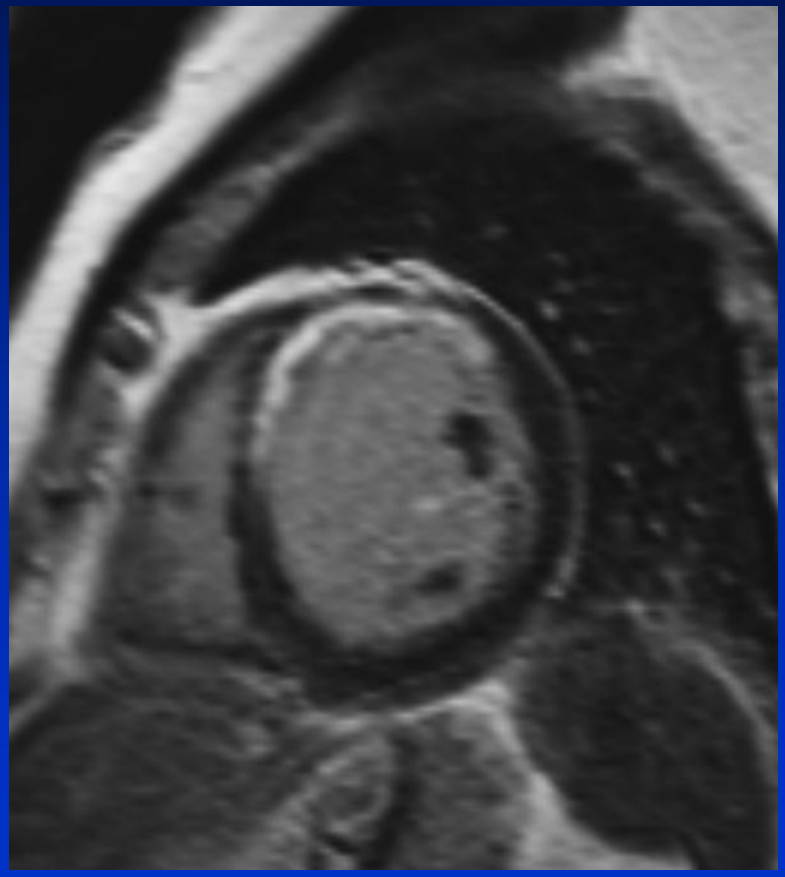
FDG

Perf



MRI: DE ---- scar!





Myocardial revascularisation in chronic heart failure (CHF)

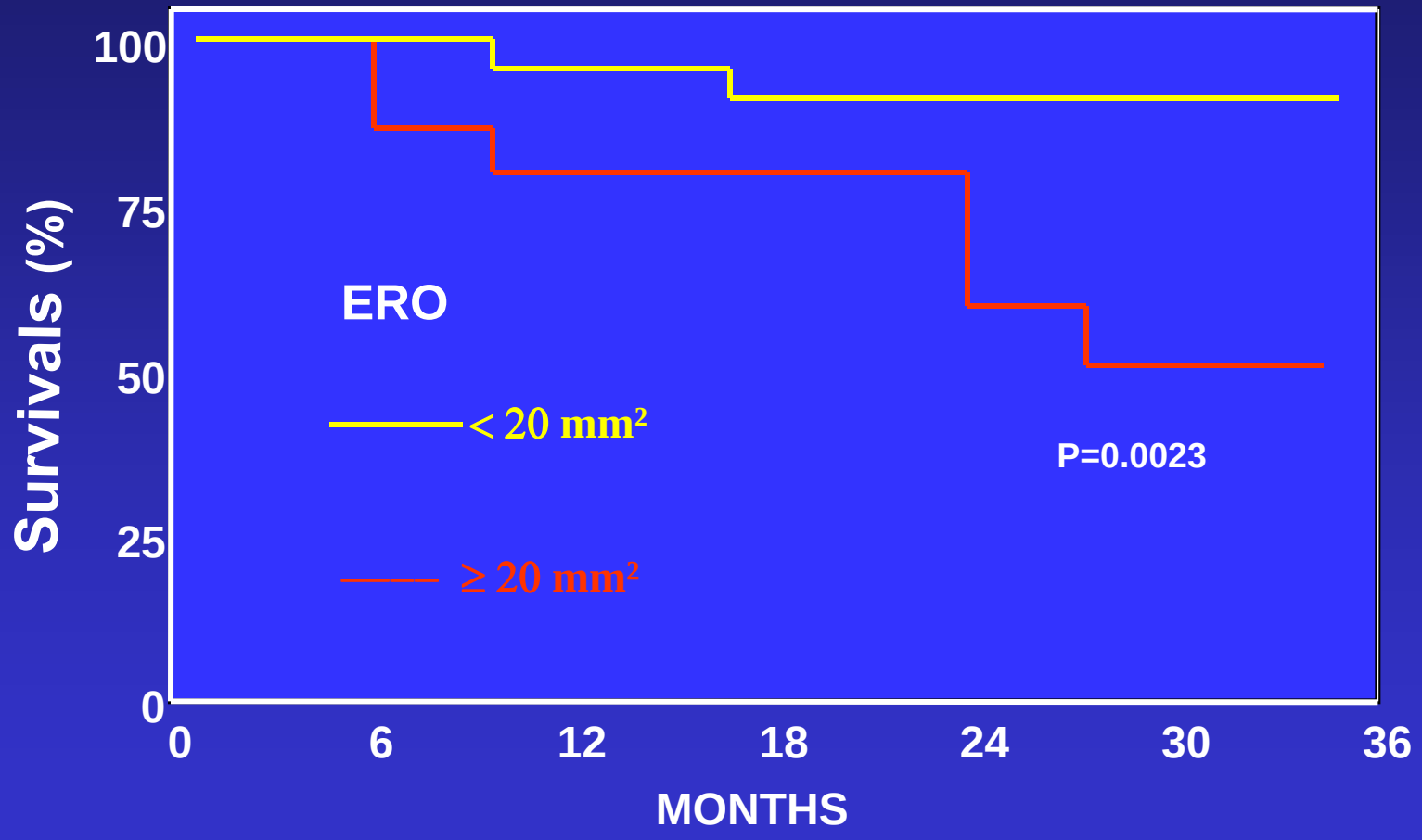
Recommendations for patients with CHF and systolic LV dysfunction (EF < 35%), presenting predominantly with HF symptoms (no or mild angina: CCS 1-2)

	Class	Level
LV aneurysmectomy during CABG is indicated in patients with a large LV aneurysm.	I	C
CABG should be considered in the presence of viable myocardium, irrespective of LVESV.	IIa	B
CABG with SVR may be considered in patients with a scarred LAD territory.	IIb	B
PCI may be considered if anatomy is suitable, in the presence of viable myocardium.	IIb	C
Revascularisation in the absence of evidence of myocardial viability is not recommended.	III	B

SVR: surgical ventricular reconstruction.

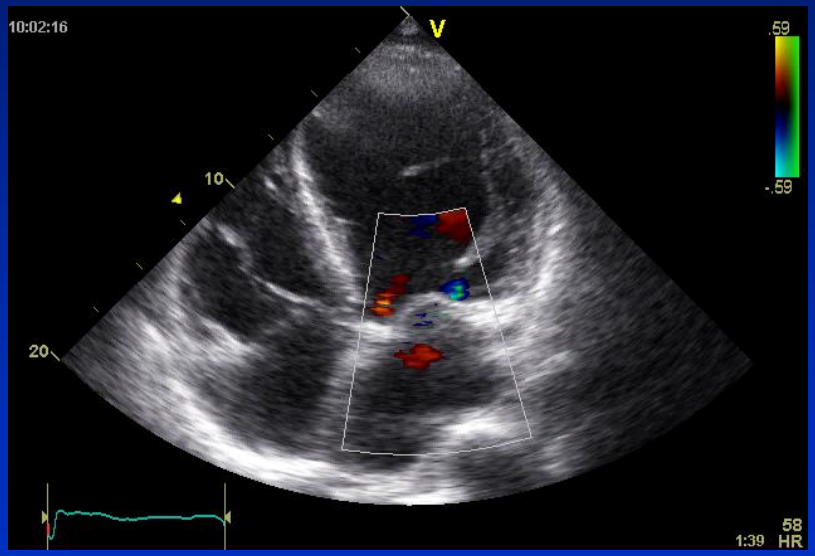
European Heart Journal (2010) 31, 2501–2555
European Journal of Cardio-thoracic Surgery (2010) 38, S1-S52

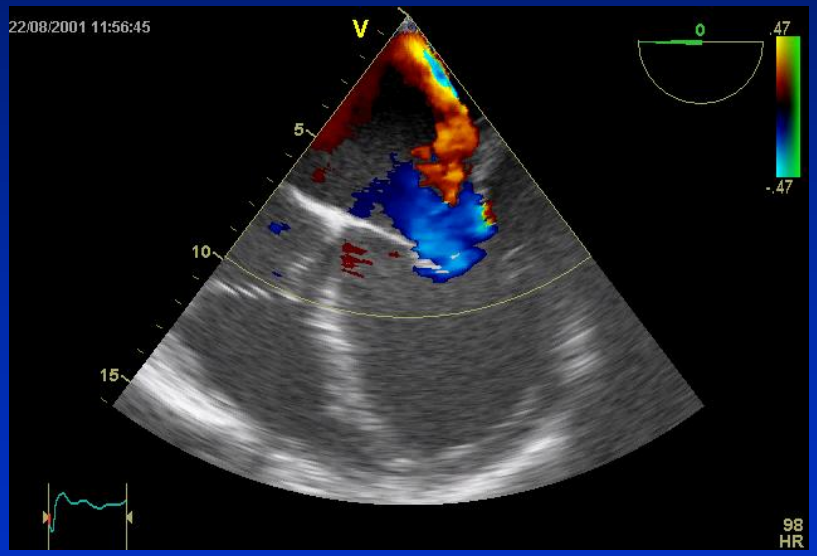
Severe MR?



Lancellotti et al. Circ 2003

Severe MR?
First choice: echo

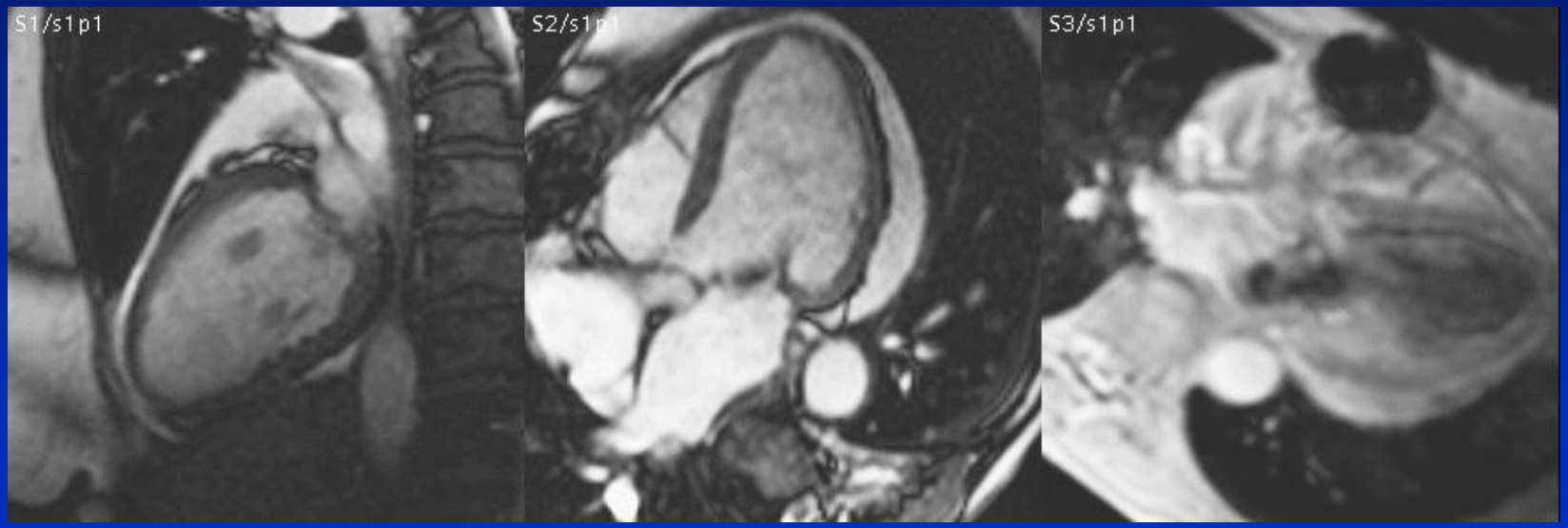




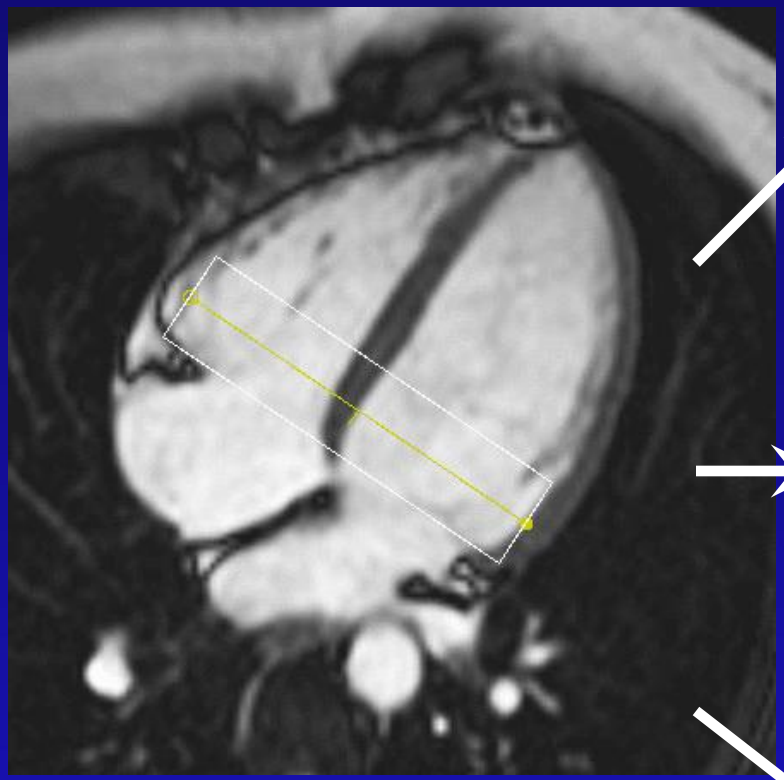
TTE

TEE

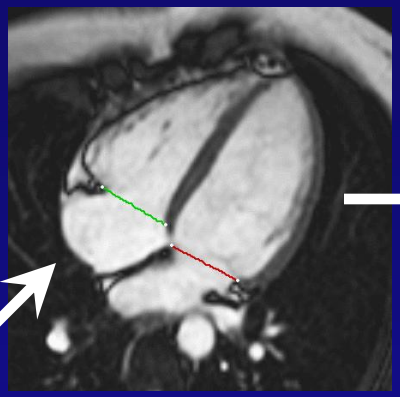
Severe MR?

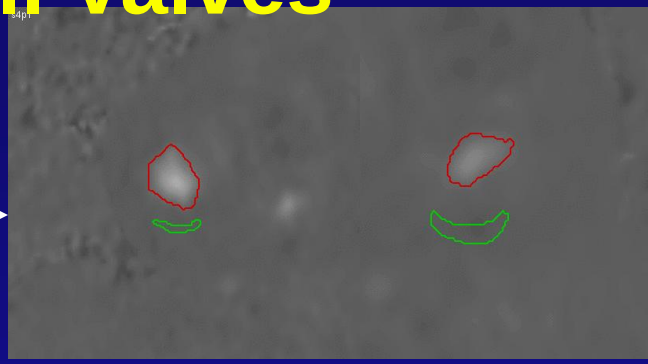


3D Flow Quantification in All Valves

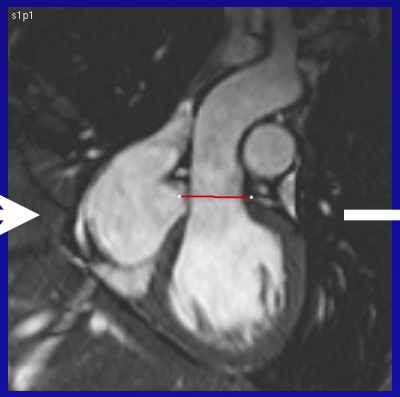


3D volume scan /w 3-dir velocity encoded MRI

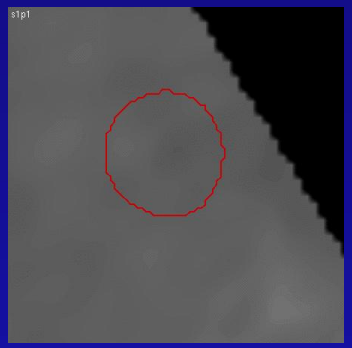


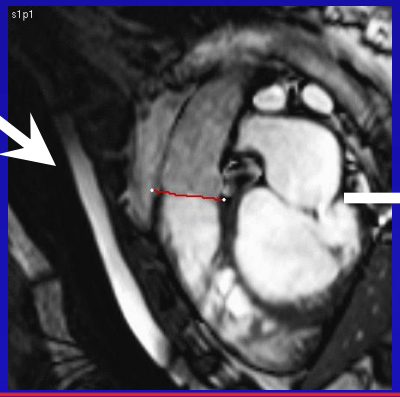


MV & TV



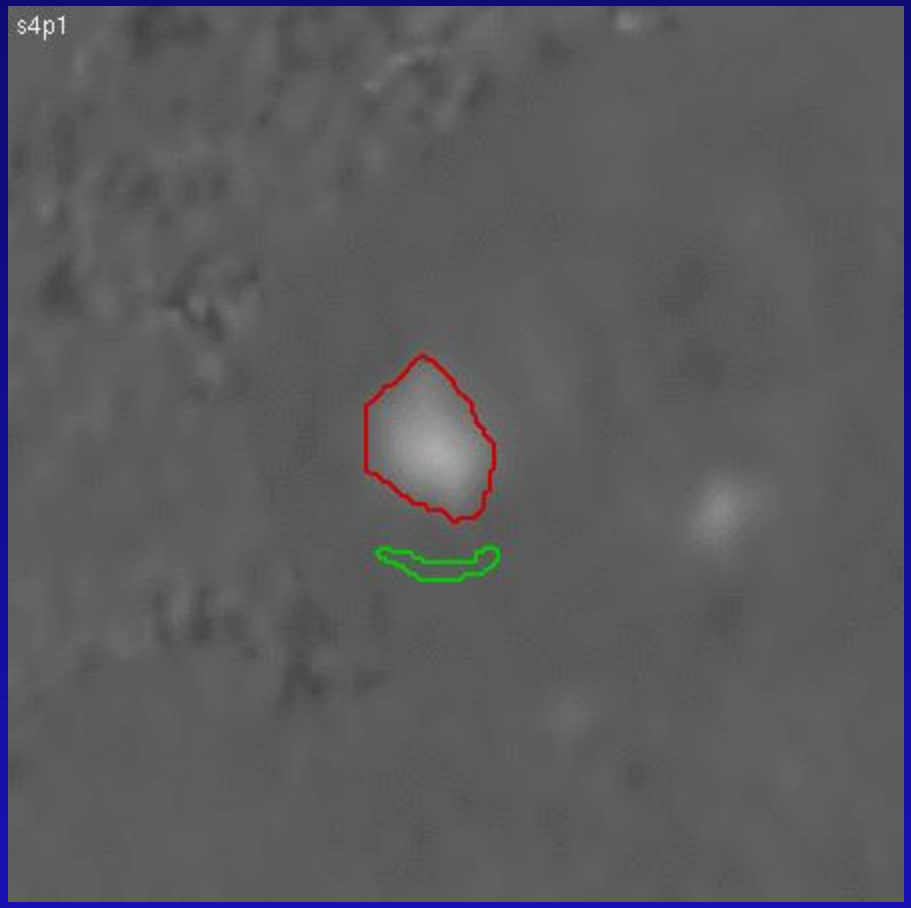
AV



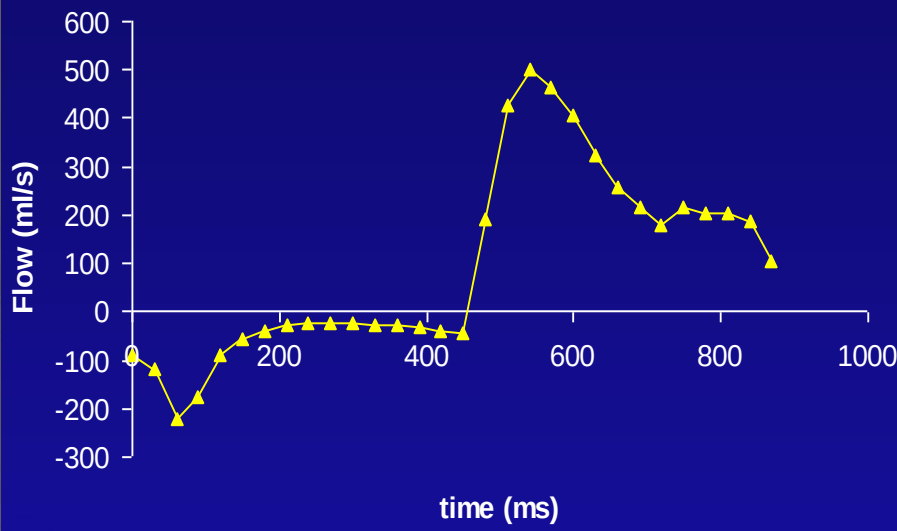


PV

3D Flow Quantification in All Valves



MV flow



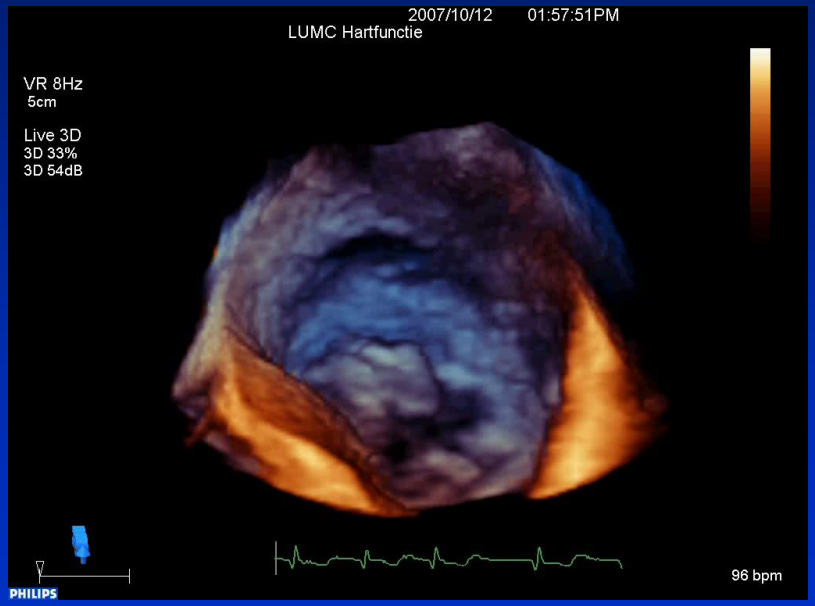
$V_{forward}$ = 116 ml

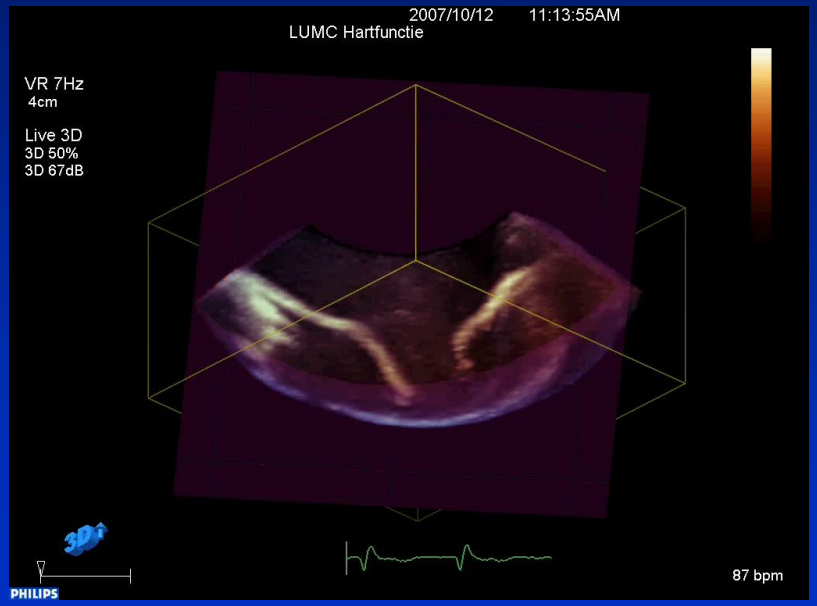
V_{back} = 32 ml

V_{eff} = 84 ml

Regurg. Fraction = 27%

Importance of MV anatomy
Is surgical repair feasible?

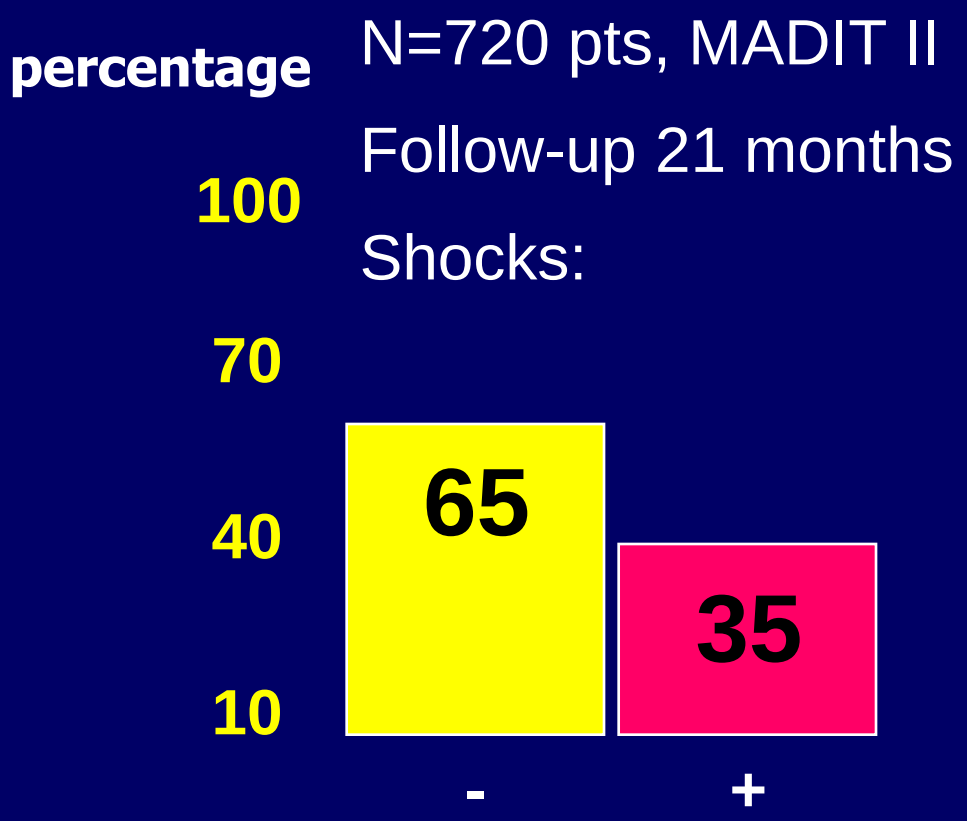




3D TEE

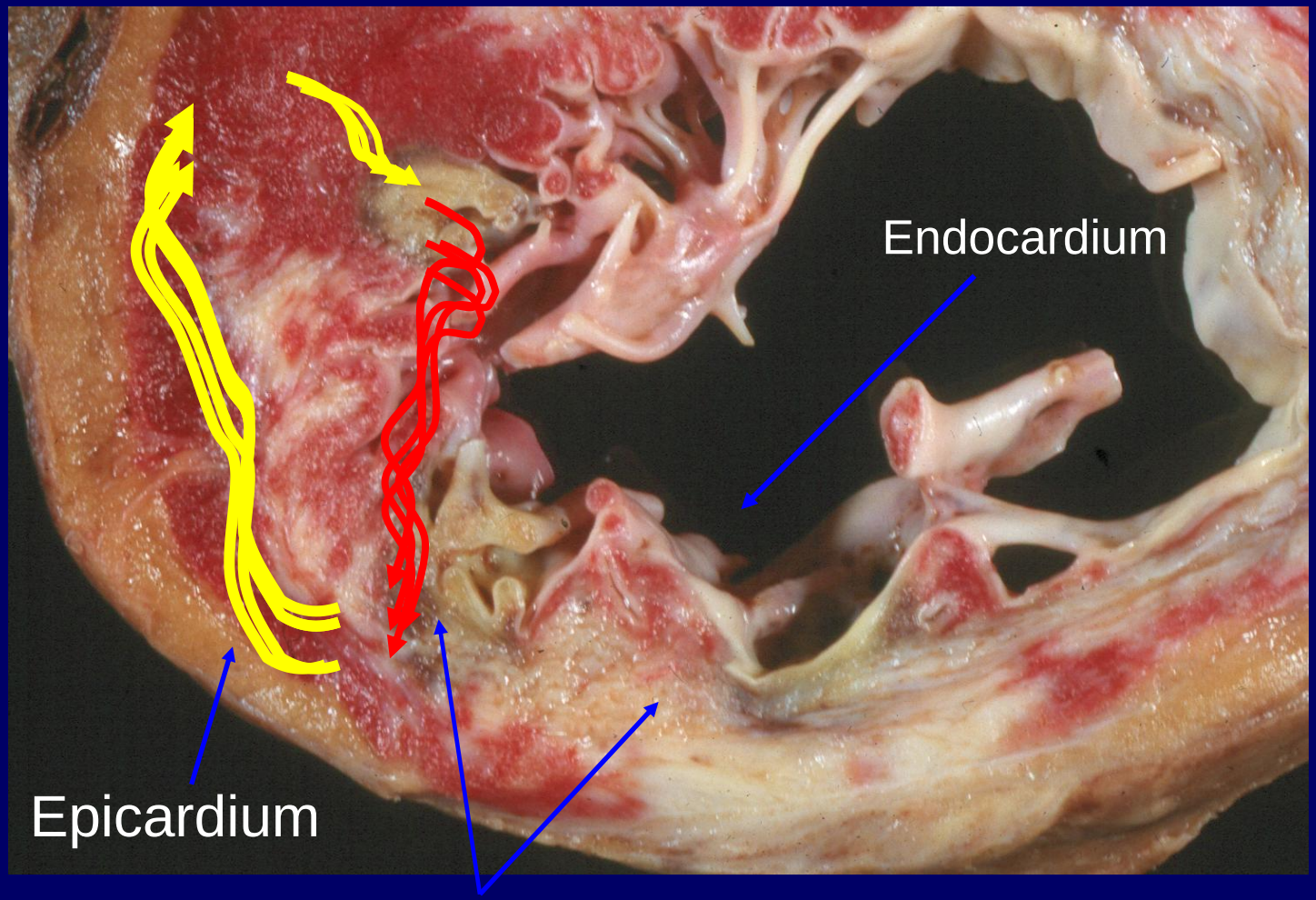
ICD needed?

ICD shocks in primary prevention



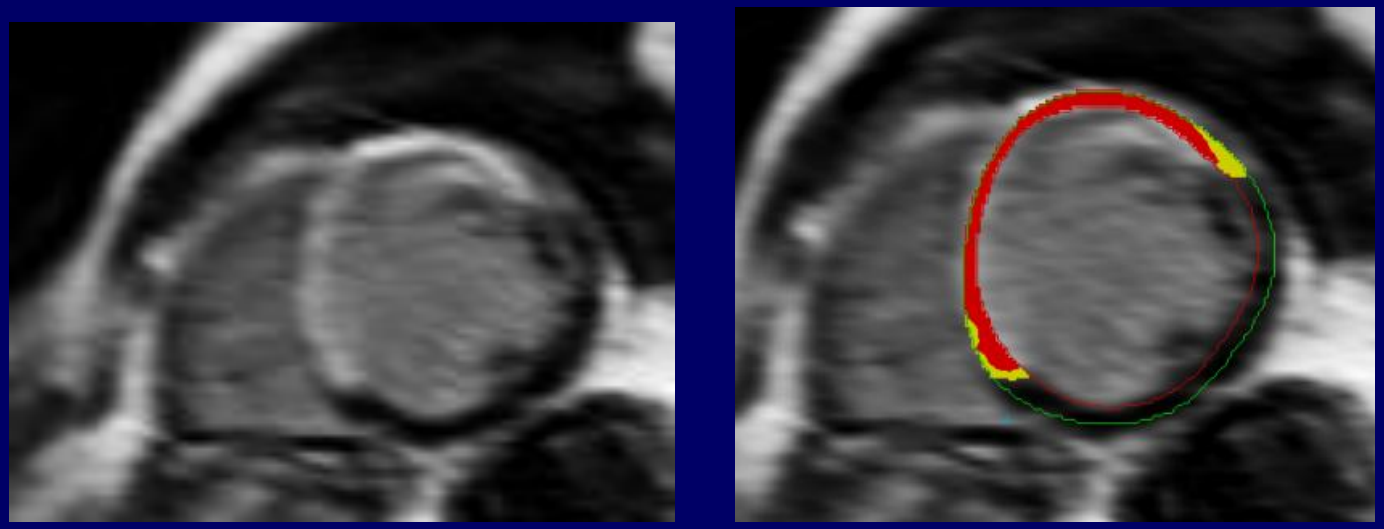
Moss et al. Circ 2004

What is the pathophysiological substrate for SCD in CAD?



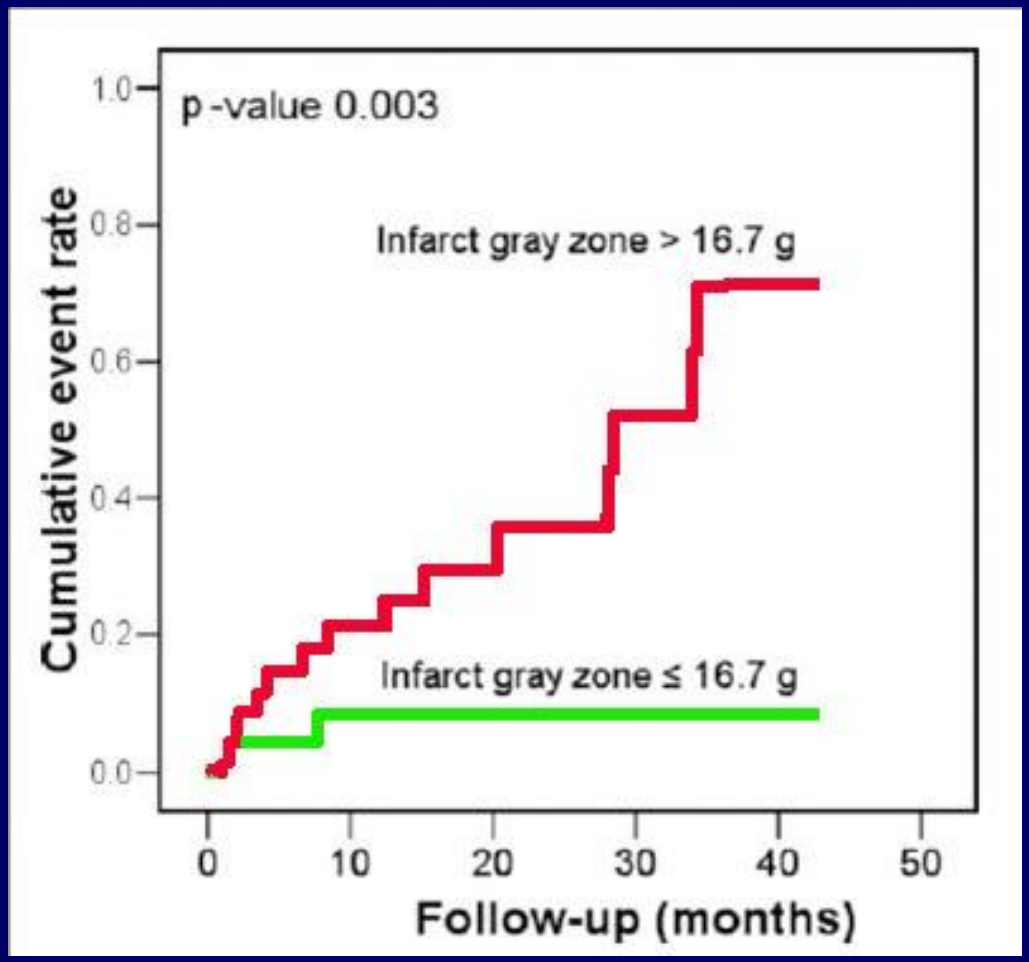
Courtesy W Stevenson

MRI to assess arrhythmogenic substrate:



- Late-gadolinium enhancement: scar area and peri-infarct zone

Value of border zone to predict VTs



HR (95%CI): 1.47 (1.04 to 2.08)
P = 0.003

Roes et al. Circ Cardiovasc Imaging 2009

Severe heart failure patient

Complex information is needed to determine therapy

Can be provided by multi-modality imaging