

Dilated Cardiomyopathy

Diagnosis, Prognosis, F/U: The Role of Echo ?



Клинично-болнични центар
З Е М У Н
Б Е О Г Р А Д

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Наставна база
Медицинског факултета
у Београду

Echo in DCM

- Diagnosis
- Assessment of functional MR
- CRT
- Prognosis

Echo in DCM

- Diagnosis
- Prognosis

MI: 8.7

2.5/2.8-5/M

08 APR 98

11:16:28

PROC 2/8/E

"DEDINJE"

HP Adult

GRUJIC

GRUJICA

1:27:27

GAIN100

COMP 78

117BPM

16CM

25HZ

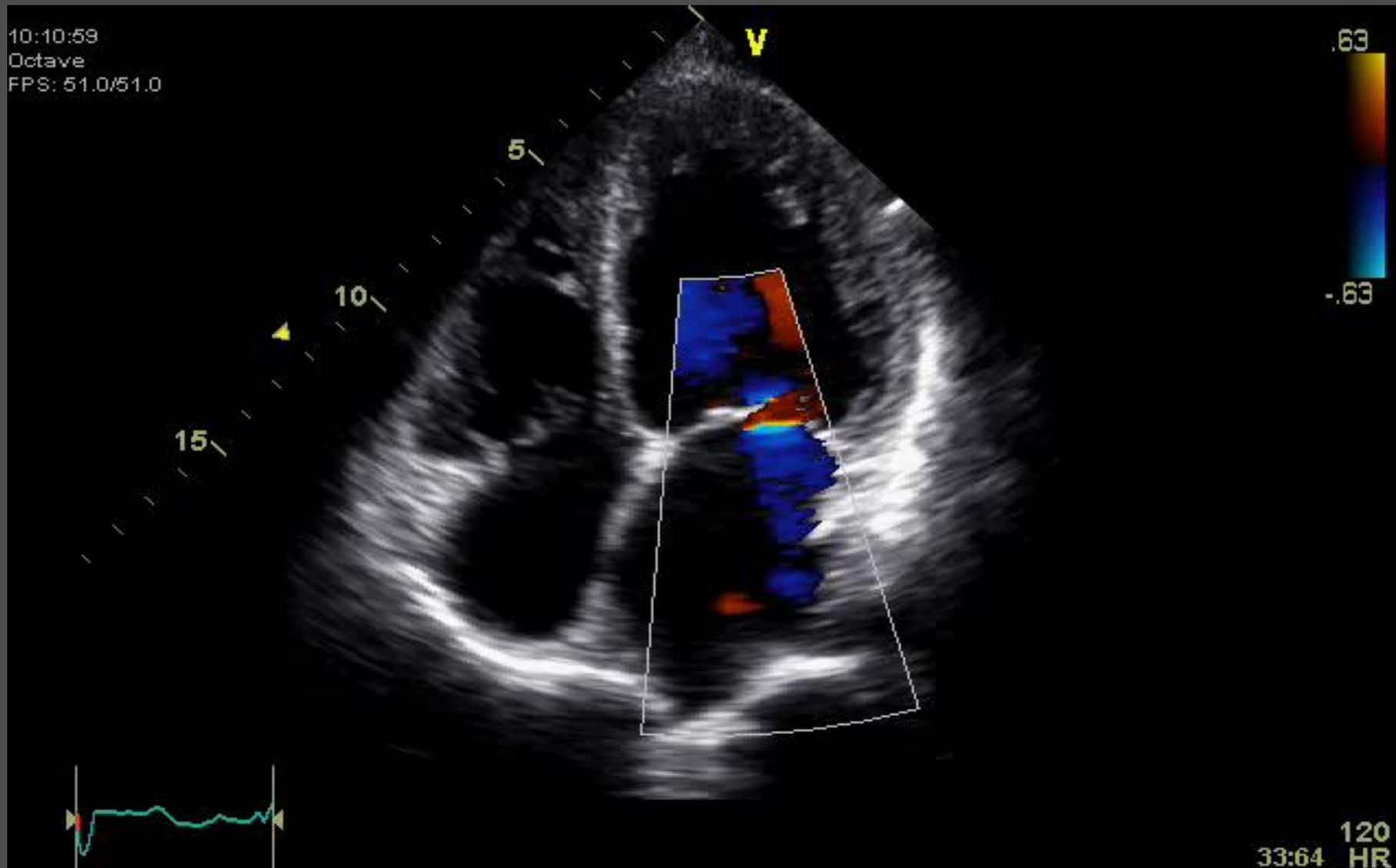
1:56

5MCG

LOW LAX



10:10:59
Octave
FPS: 51.0/51.0



.63
-.63

33:64 120
HR

Echo Findings in DCM

- Dilatation of LV (or both ventricles)
- Generalized LV hypocontractility
- Poor LV Function
- Dilatation of atria
- Mitral regurgitation
- Tricuspid regurgitation; pulm. hypertension
- Diastolic dysfunction
- “Smoke” sign; LV thrombus

EDD > 60 mm

LVEF < 35%

No CAD

Echo in DCM

- o Diagnosis
- o Prognosis

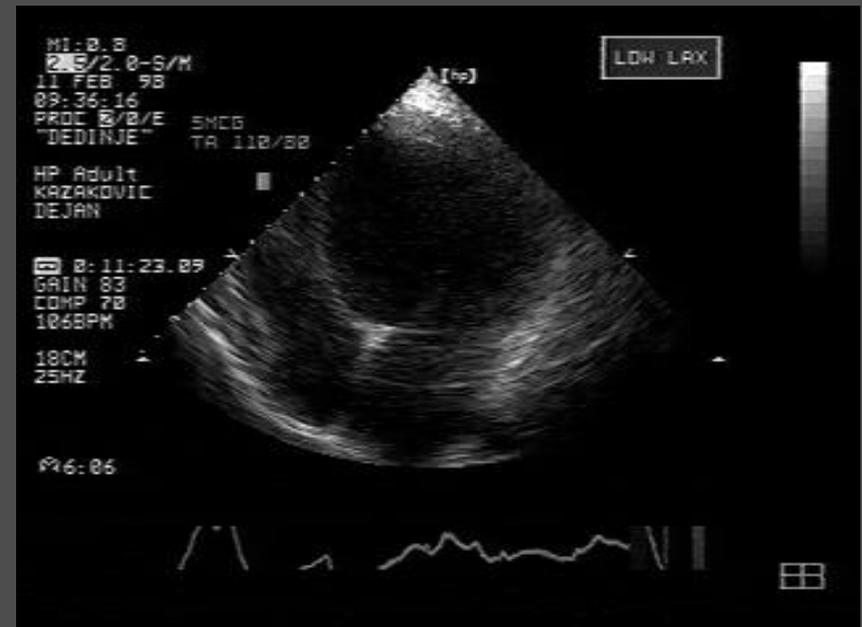
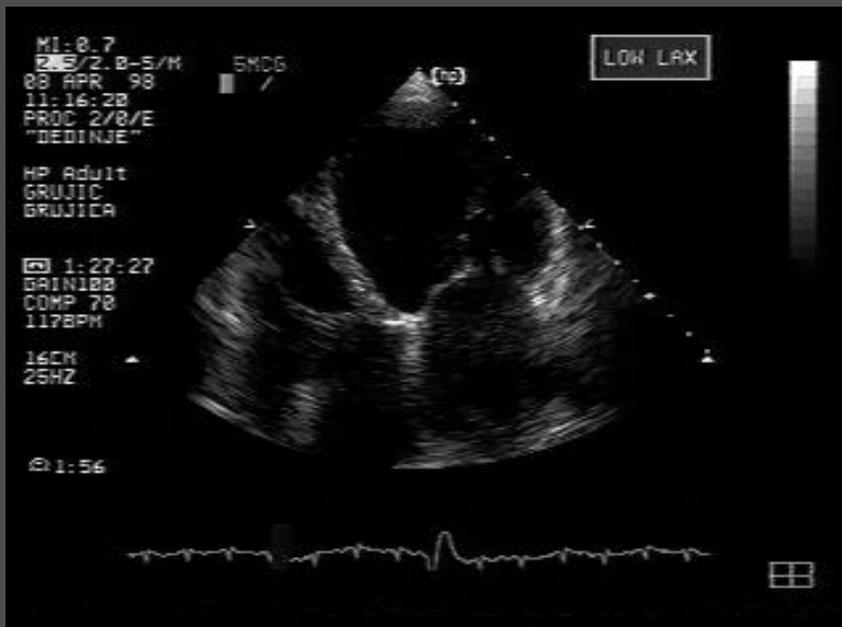
Deterioration Rate in HF

Highly variable !

- Cause
- Nature of the overload
- Age
- Therapy
- ...many other factors

The goal: to identify high-risk subsets of pts !

Who will do better ?



Q

Do we have enough
predictors of prognosis in
pts with DCM ?

Predictors of Outcome in DCM

- NYHA
- Age ↑
- LVEF ↓
- LV volume ↑
- VO2 < 11ml/kg/min
- Intraventricular conduction delay
- Complex ventricular arrhythmias
- Late QRS potentials
- Serum catecholamines ↑
- Decreased HR variability
- Down regulation of beta-receptors
- VT/complex arrhythmias with LVEF ↓
- Troponin T, BNP, MB₂/MB₁
- LV mass ↓
- WMSi ↑
- MR ≥2
- LA size ↑
- RV enlargement
- RV EF ↓
- High E
- Short DT

Why
so many?

Why So Many ?

- Different patient populations
- Different prognostic aspects
- Different techniques
- Special circumstances / extrapolations
- Statistical “analyses” ...

Prognosis in DCM

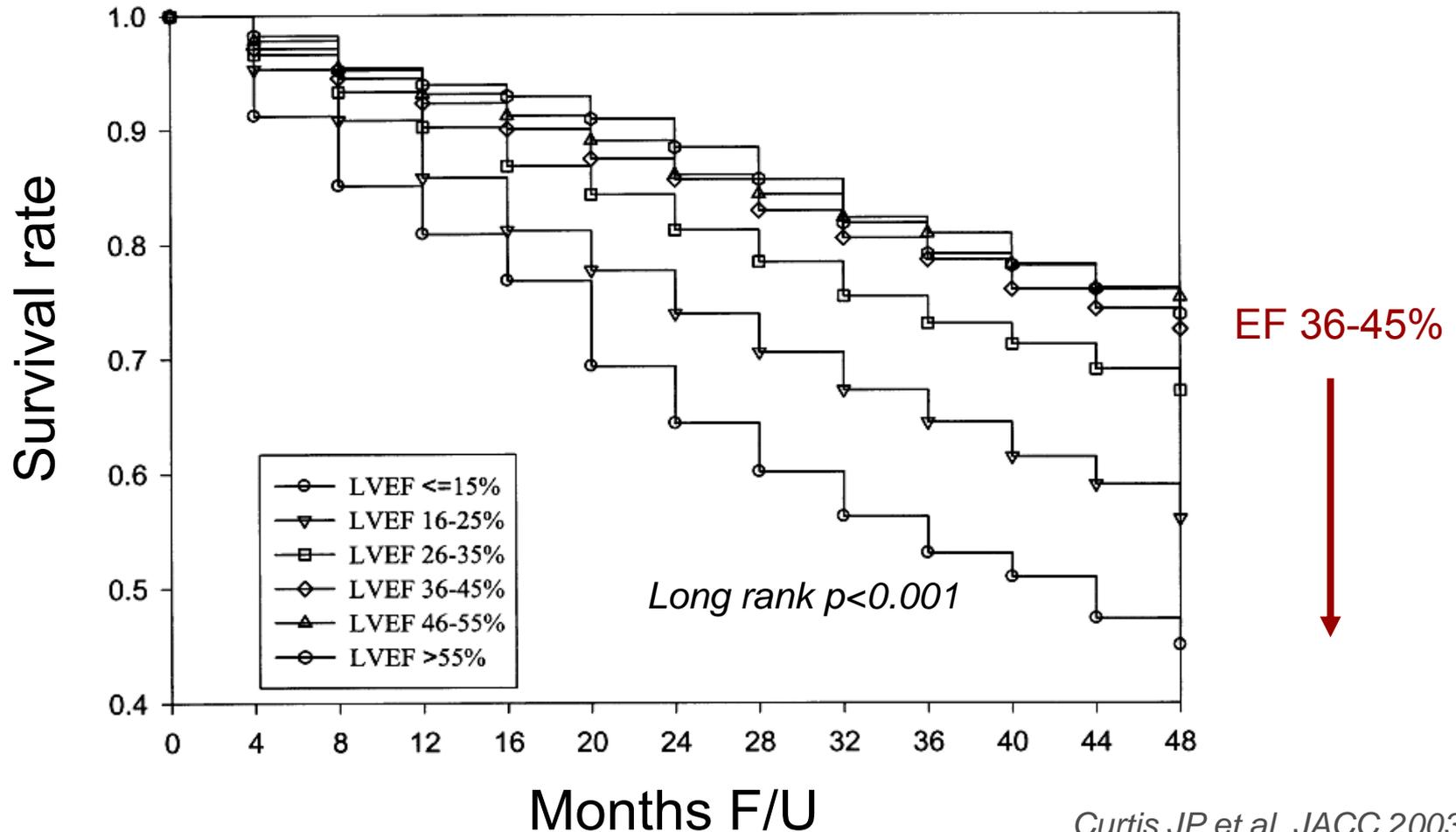
EF

Limitations of the previous studies on prognostic value of EF in HF:

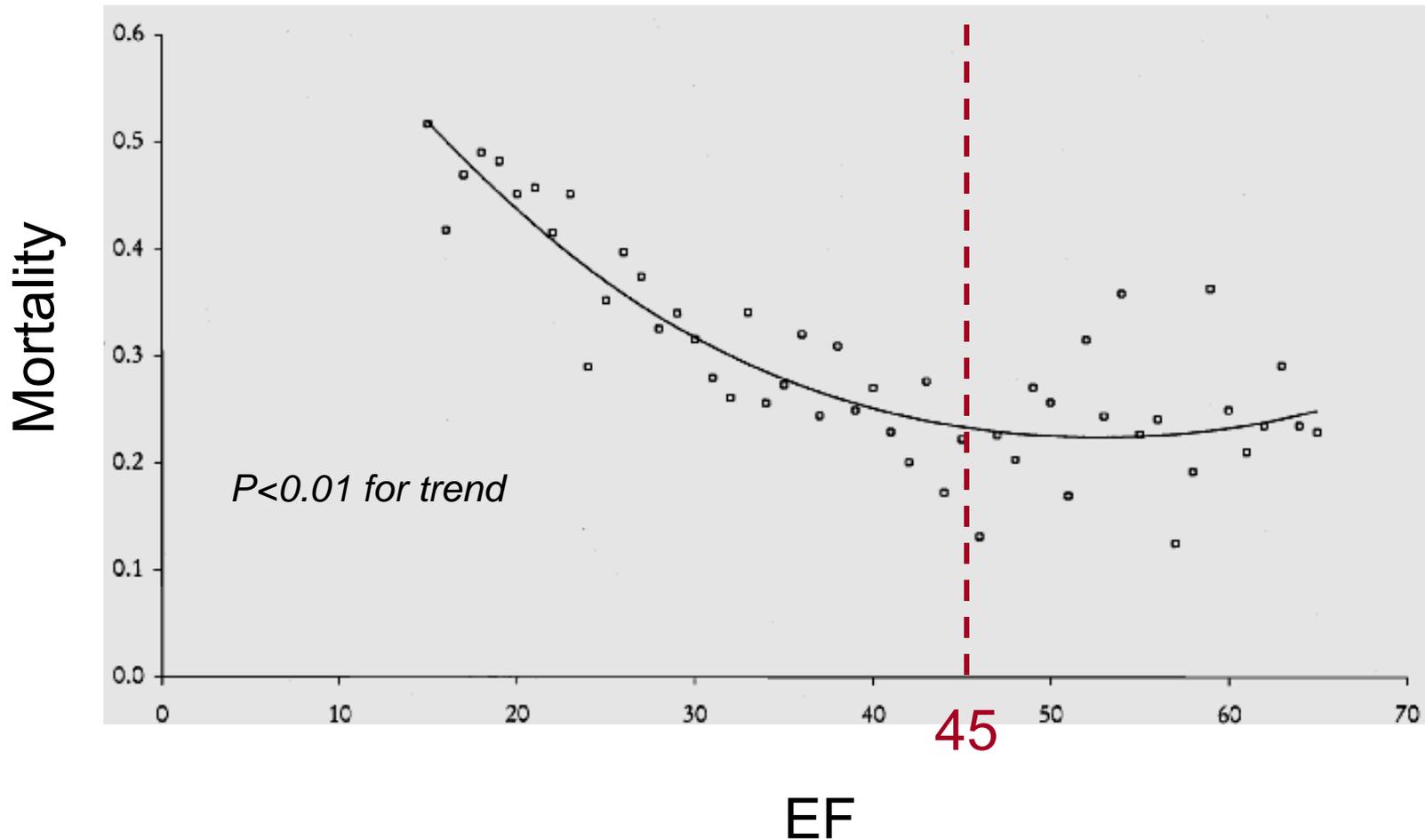
- Small numbers of pts
- Limited to high-risk populations
- Some studies failed to predict risk ?
 - *Different patient populations*
 - *Outmoded echo technology*
 - *Competing of other echo variables in multivariate predictive models*
- No data on association of LVEF and mortality across the **full range** of LVEF (expressed as continuous instead of dichotomous variable)

EF and Mortality in Stable Outpatients With Heart Failure

- LVEF and outcomes among 7,788 stable HF pts (DIG trial)
- F/U 37 months



EF and Mortality in Stable Outpatients With Heart Failure

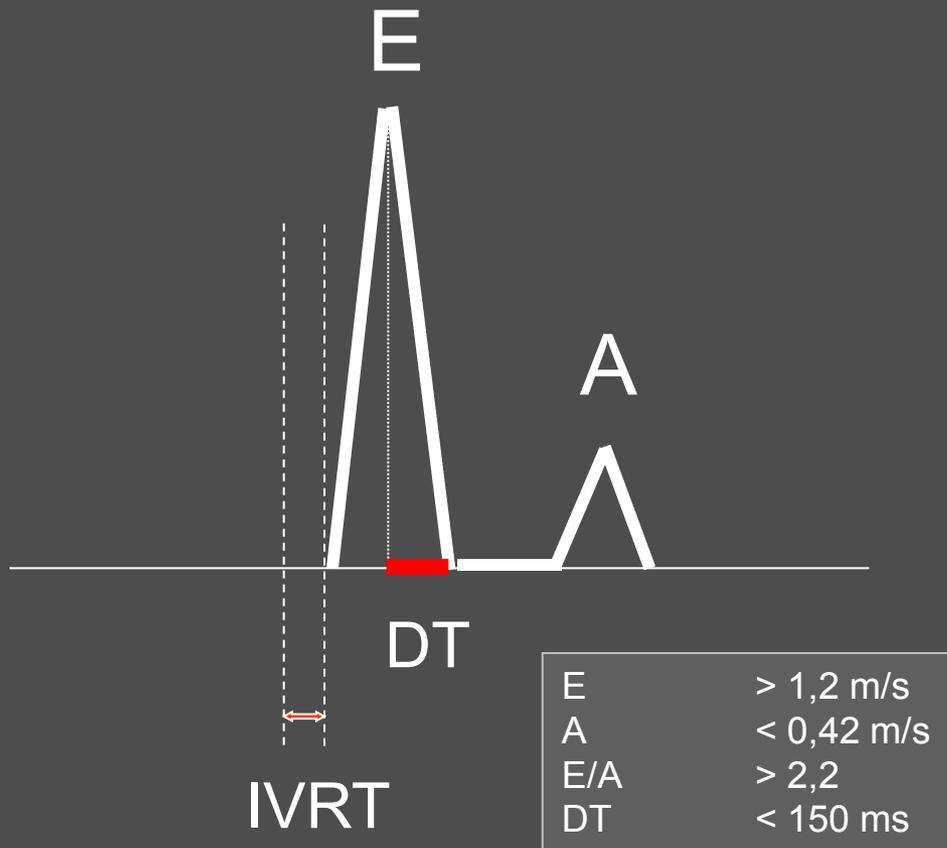


Prognosis in DCM

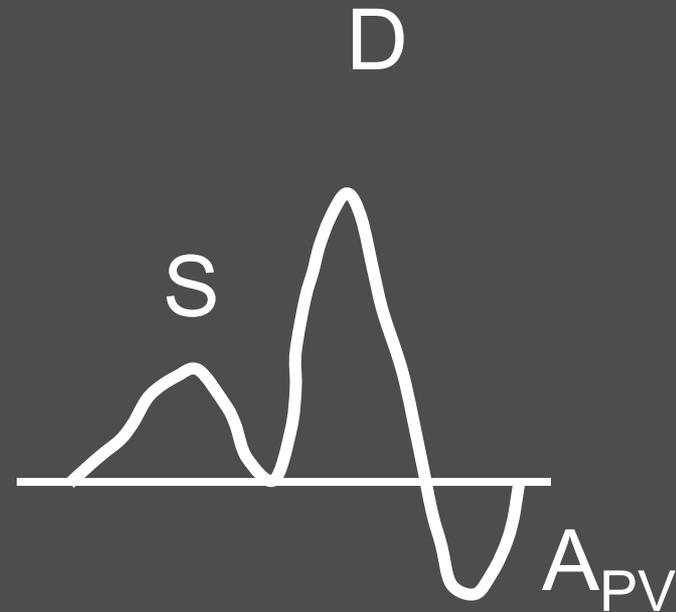
Restrictive Filling

Restrictive Filling

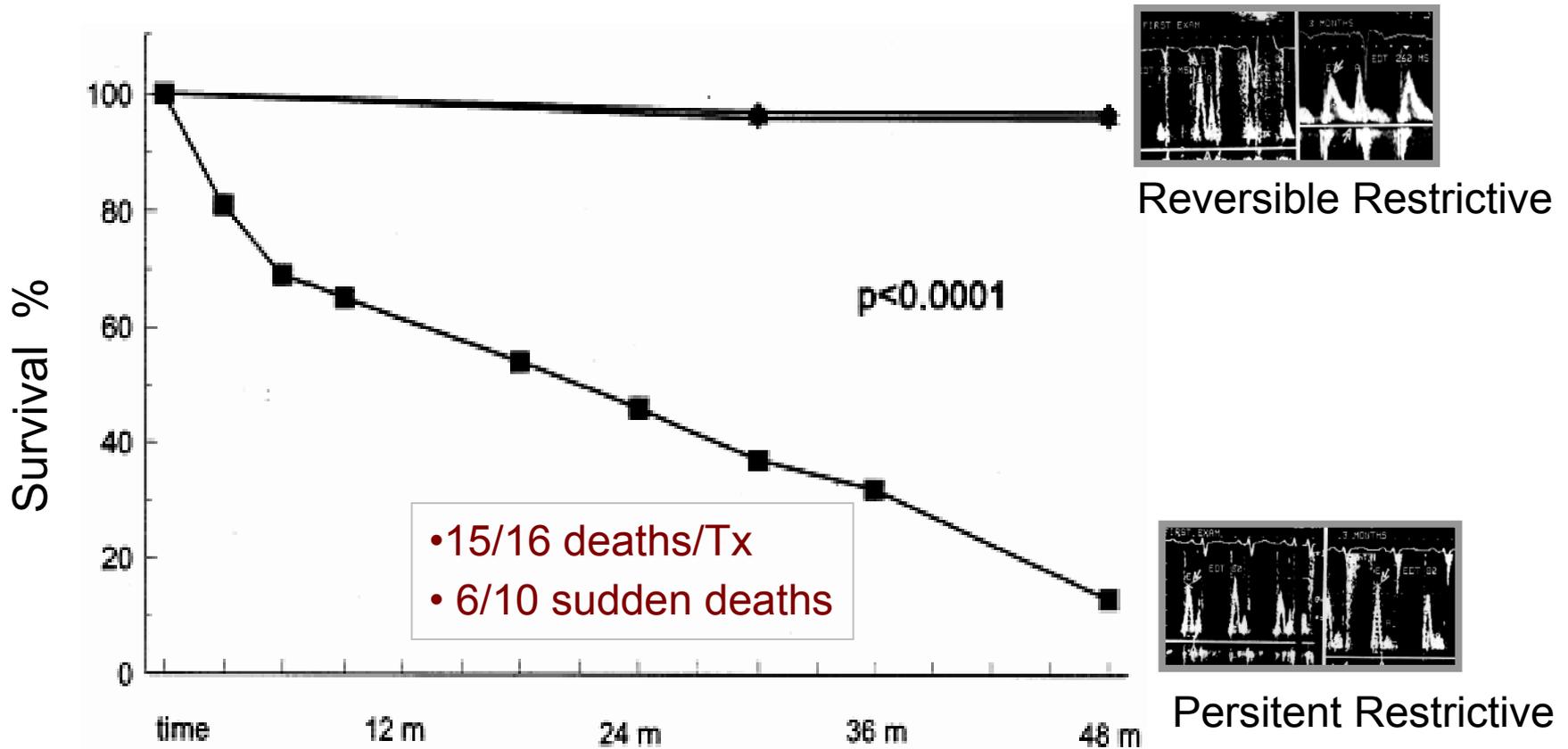
Mitral Inflow



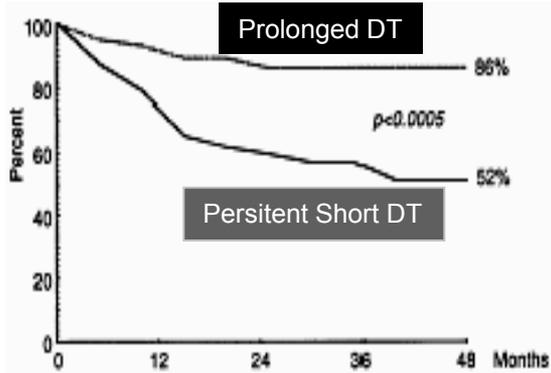
Pulmonary Vein Inflow



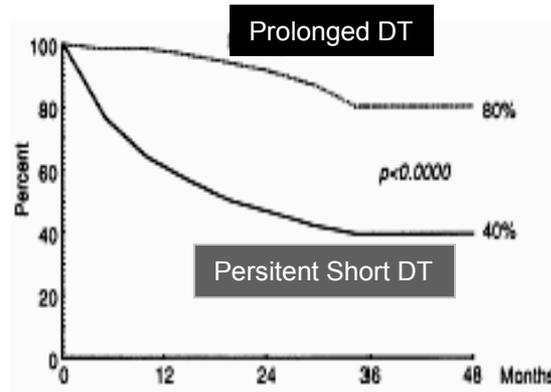
Survival Free of Death and Transplantation in pts with DCM



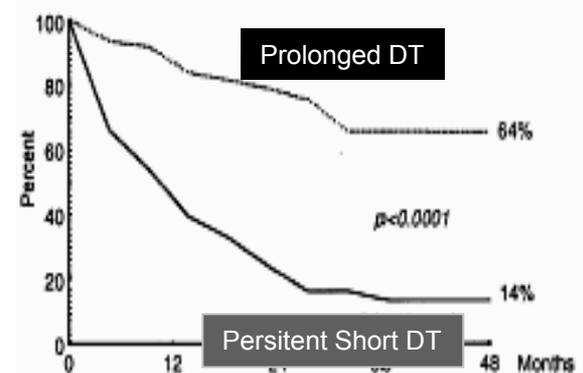
Prolongation of Short DT after Optimized Oral Therapy for CHF and Survival



Cardiac Mortality



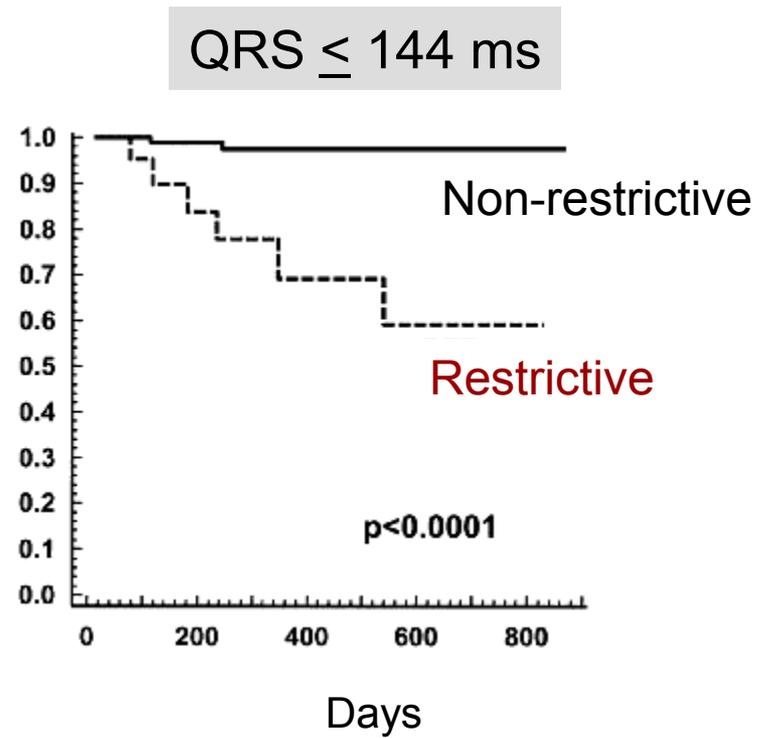
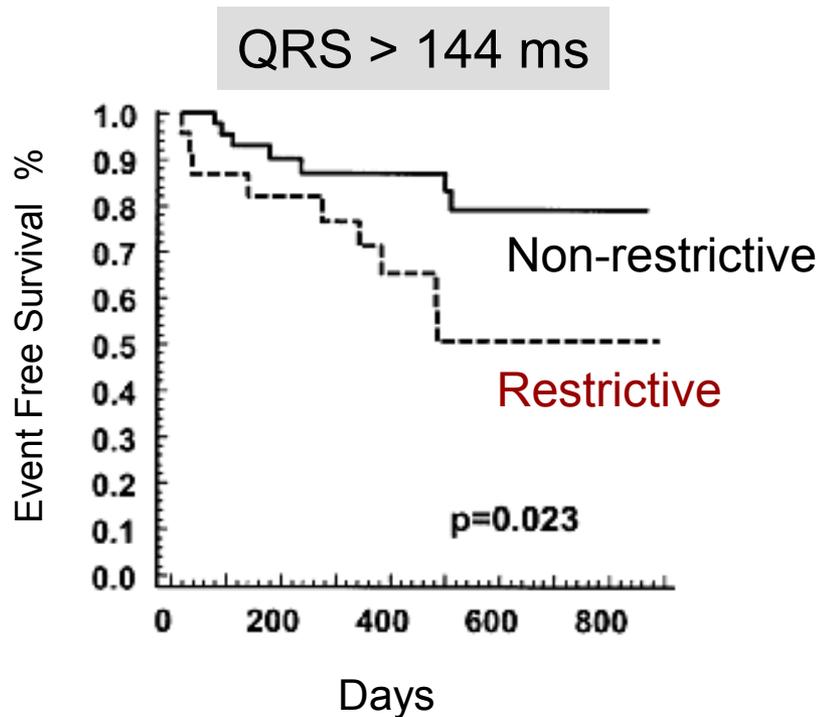
Free of Admission
for CHF



All Events
(death, Tx, CHF)

Incremental Prognostic Value of Restrictive Filling Pattern in pts With Chronic HF

- 193 HF pts, EF <40%
- F/U 385±270 days for cardiac death and urgent Tx



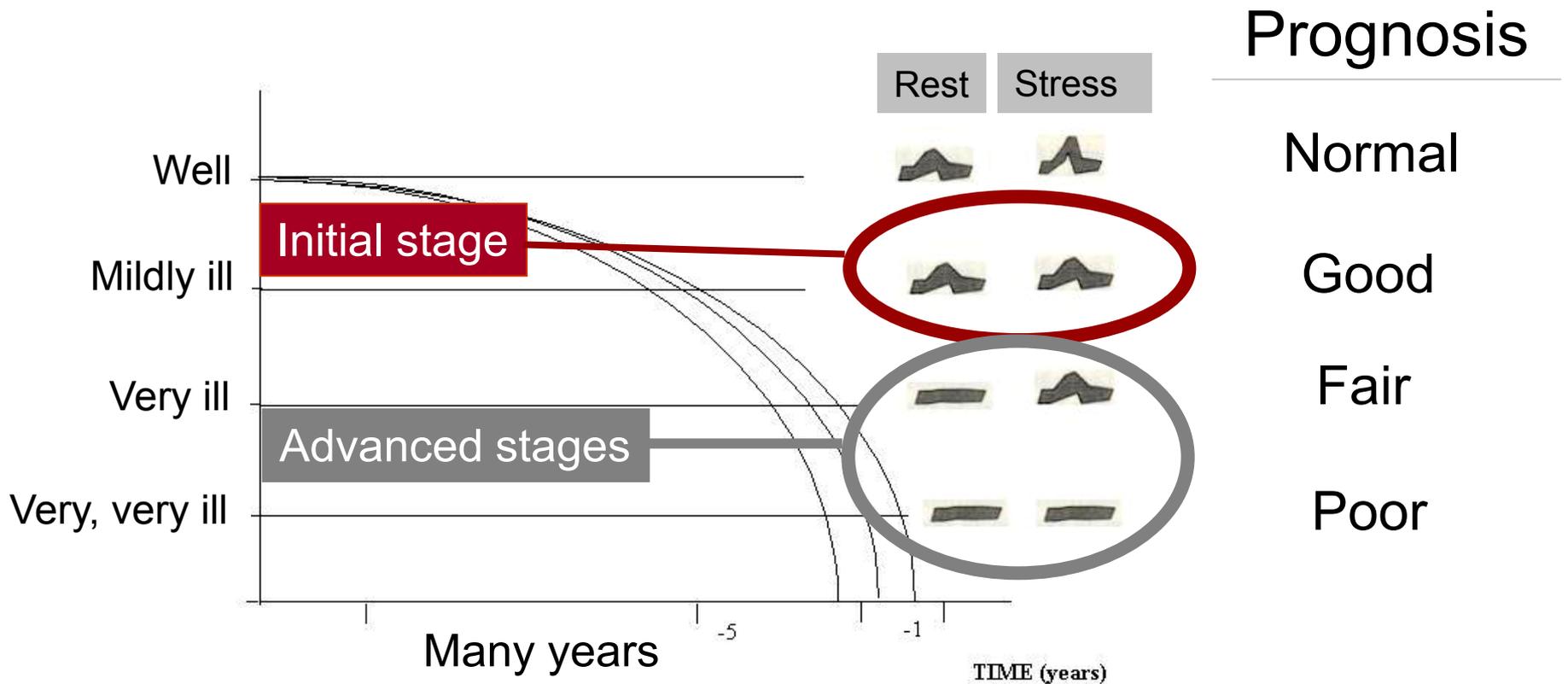
Novel Echo Predictors of Prognosis in DCM

- Contractile reserve
- Coronary flow reserve
- Long axis LV function
- DTI: S_m , E' , E/E'
- Longitudinal rotation ?

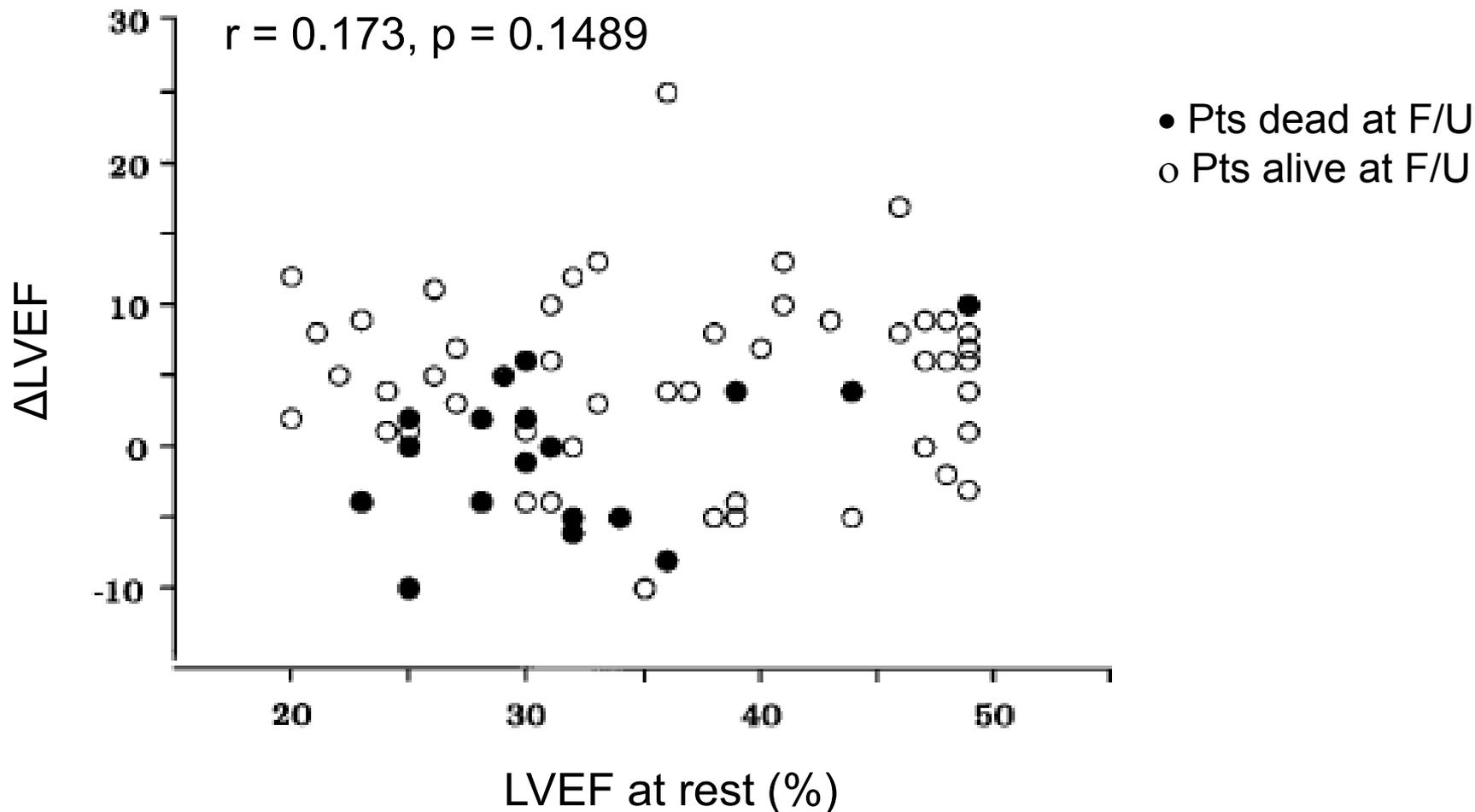
Prognosis in DCM

Contractile Reserve

Stress Echo in DCM



Relationship Between Resting LVEF and Exercise-Induced Δ LVEF in NYHA I Pts with IDCM



Response to Dob/Dip in DCM

Contractile Reserve

peak DOB/DIP value – basal value

Predictors

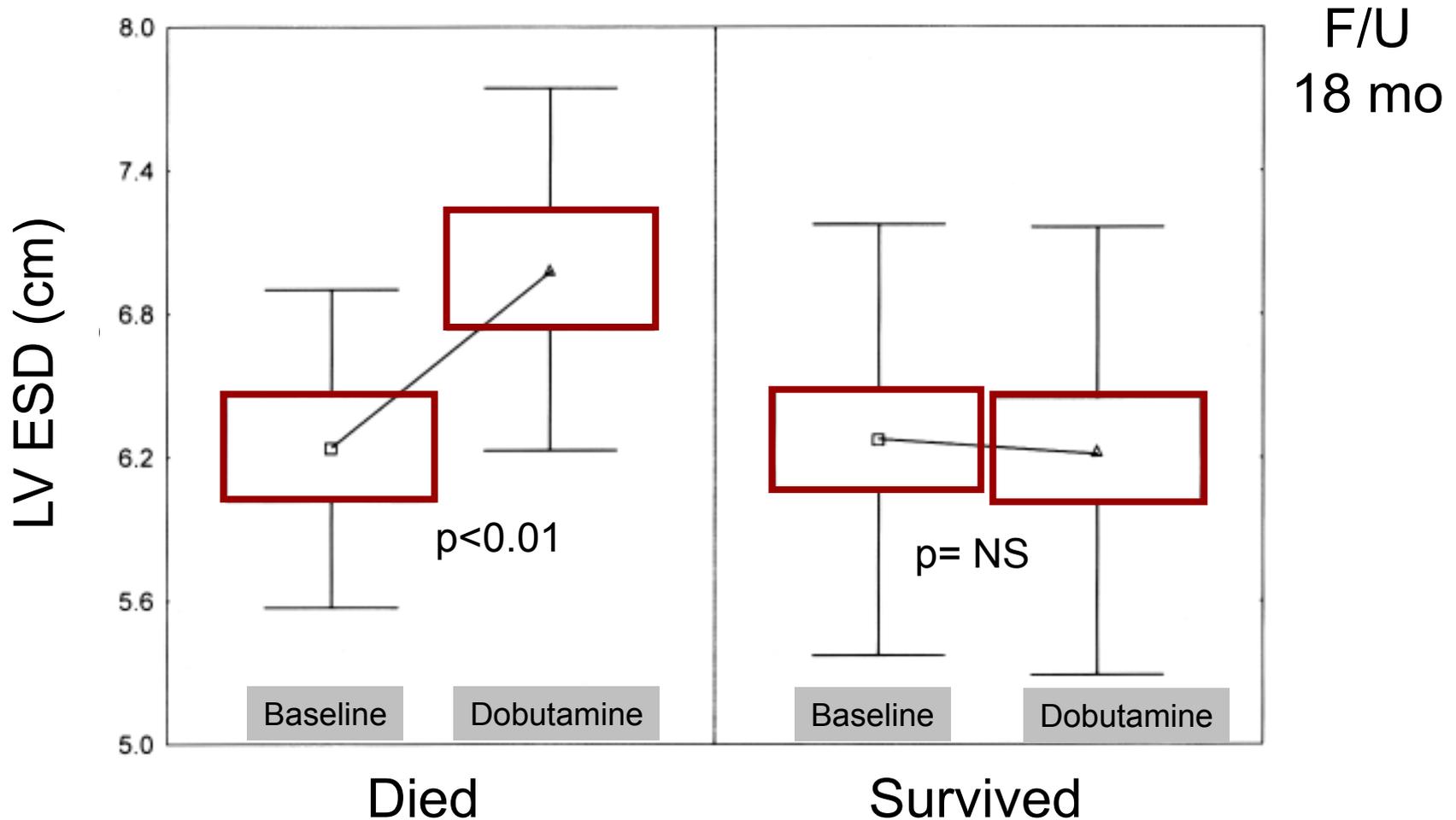
- EF
- WMSi
- Rate of LV pressure rise
- ESD
- ESV

End-points

- LV function
- Peak VO₂
- **Survival**

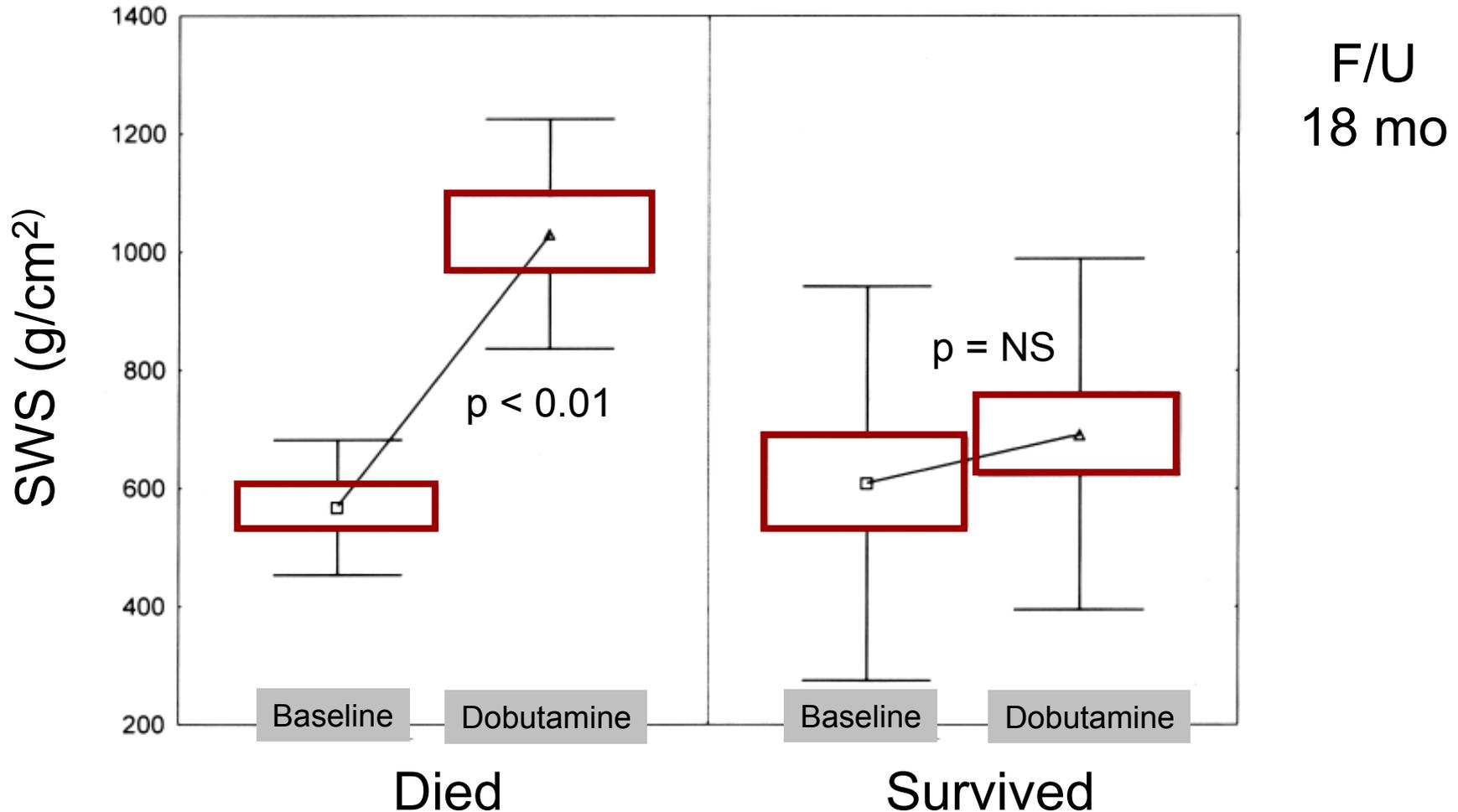
LV ESD Response to DOB and survival

27 pts; "gray zone" VO_2max (10-14 ml/kg/min)



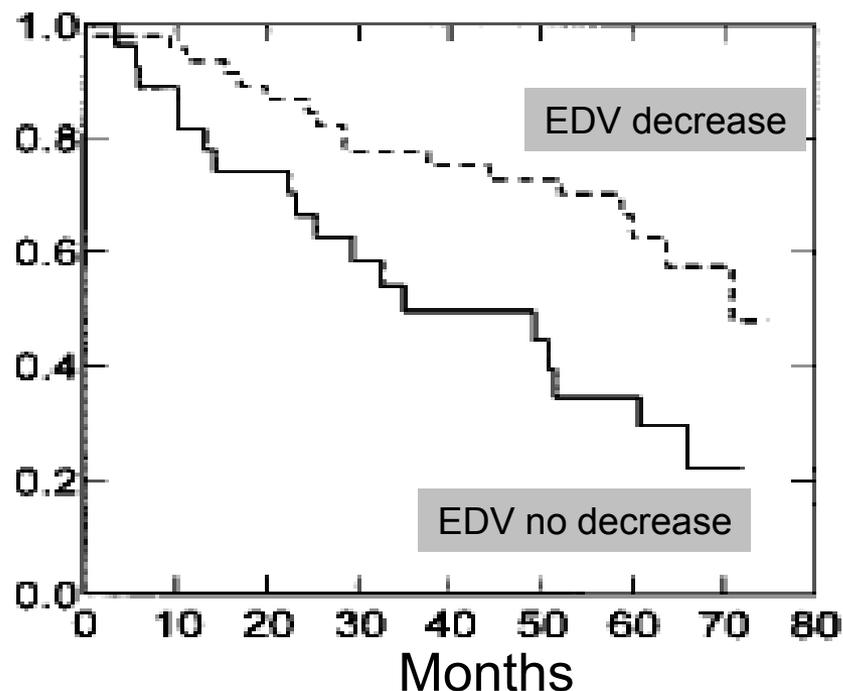
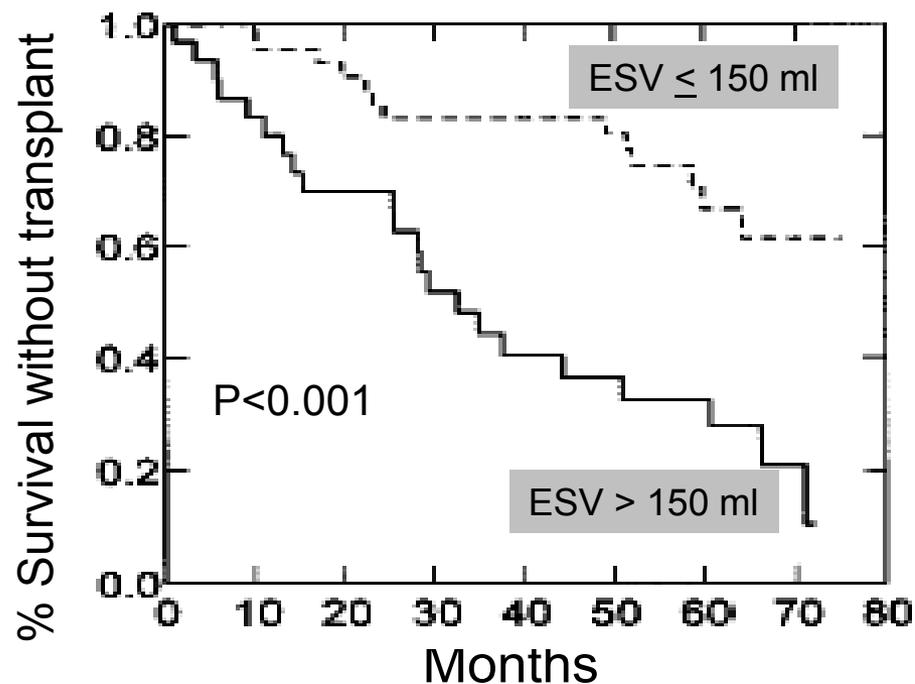
ESWS Response to DOB and Survival

27 pts; "gray zone" VO_2max (10-14 ml/kg/min)

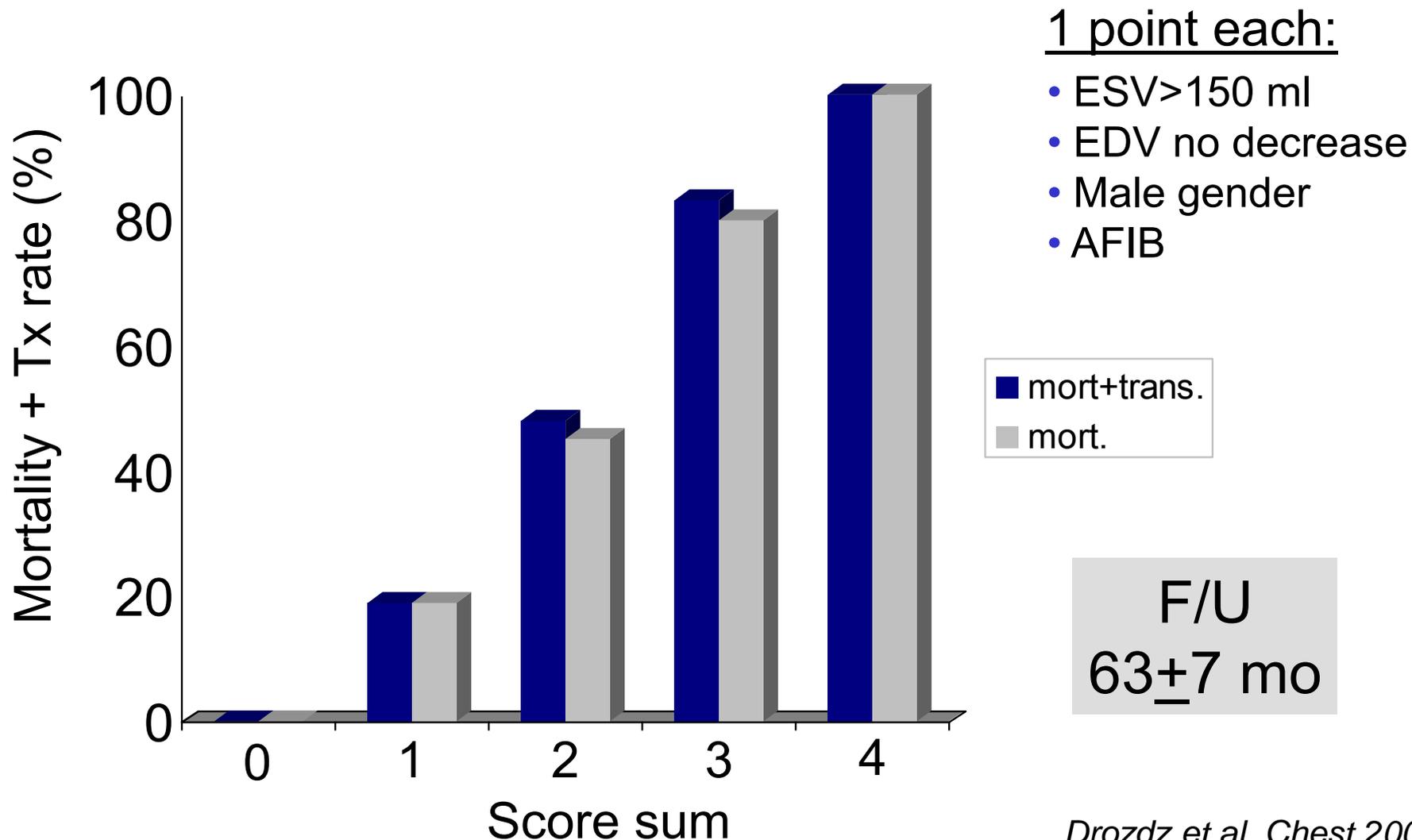


Survival in Pts with DCM According to Improvement of LV Function During DOB echo

- 77 pts with idiopathic DCM
- Low dose DOB-echo (up to 10 mcg/kg/min)
- F/U 63±7 months for death and Tx

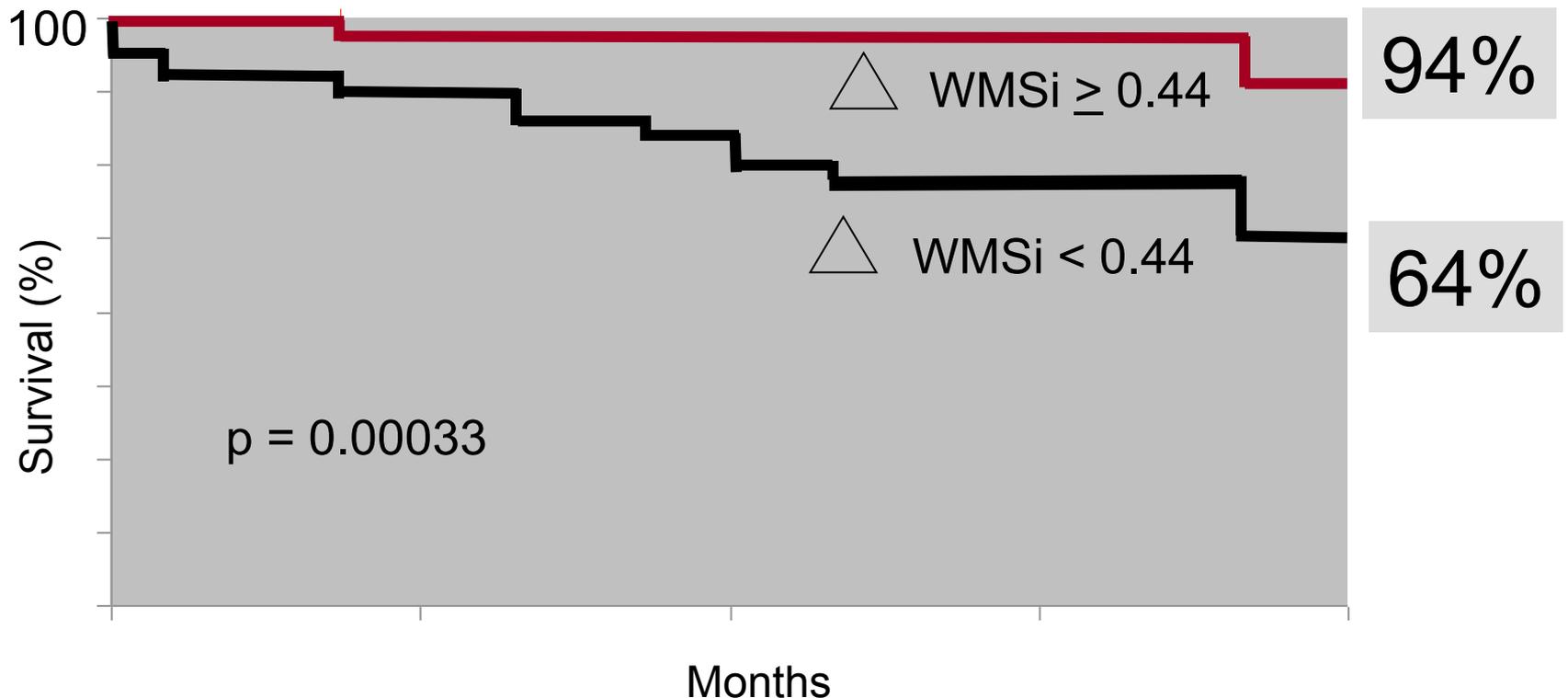


Mortality and Need for Heart Transplantation in DCM



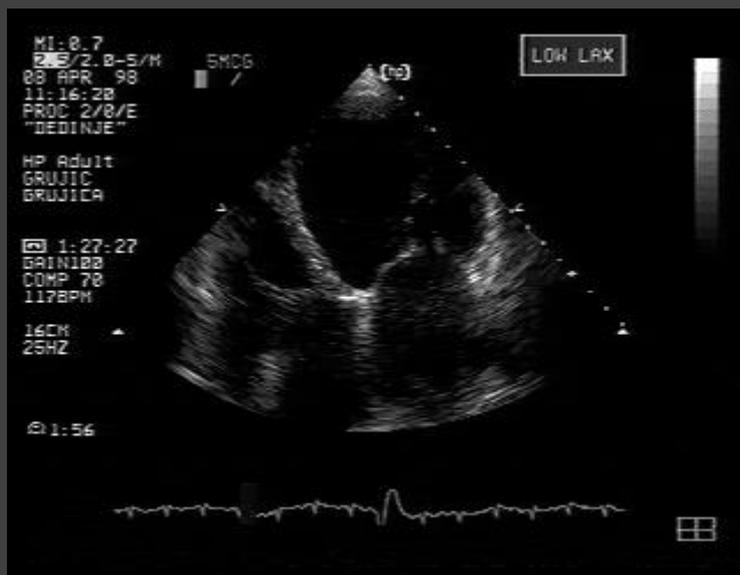
Contractile Reserve by High-Dose DOB-Echo and Cardiac Death in Idiopathic DCM

- Multicenter international trial, 186 pts with idiopathic DCM
- High-dose DOB-echo (up to 40 mcg/kg/min)
- F/U 15±13 months for cardiac death

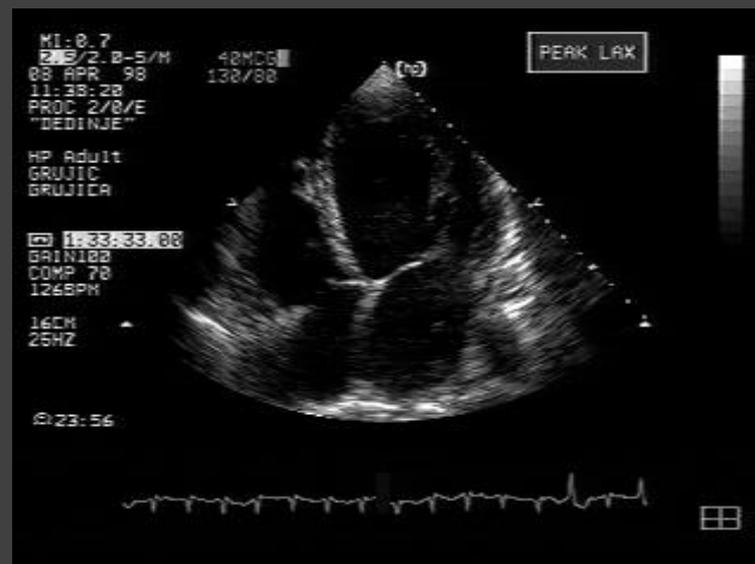


Dob-Echo in Idiopathic DCM

Low



Peak



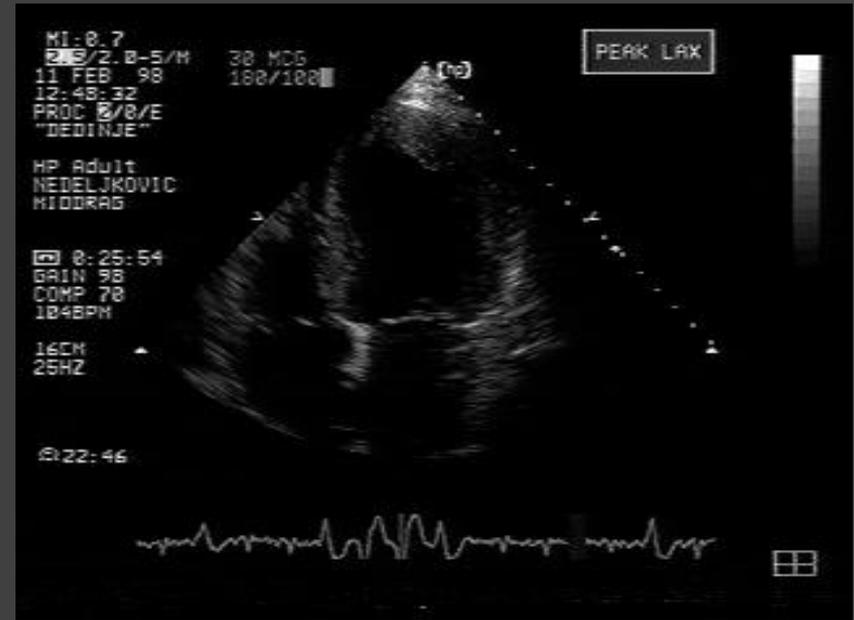
Poor LV and RV contractile reserve

Dob-Echo in Idiopathic DCM

Low



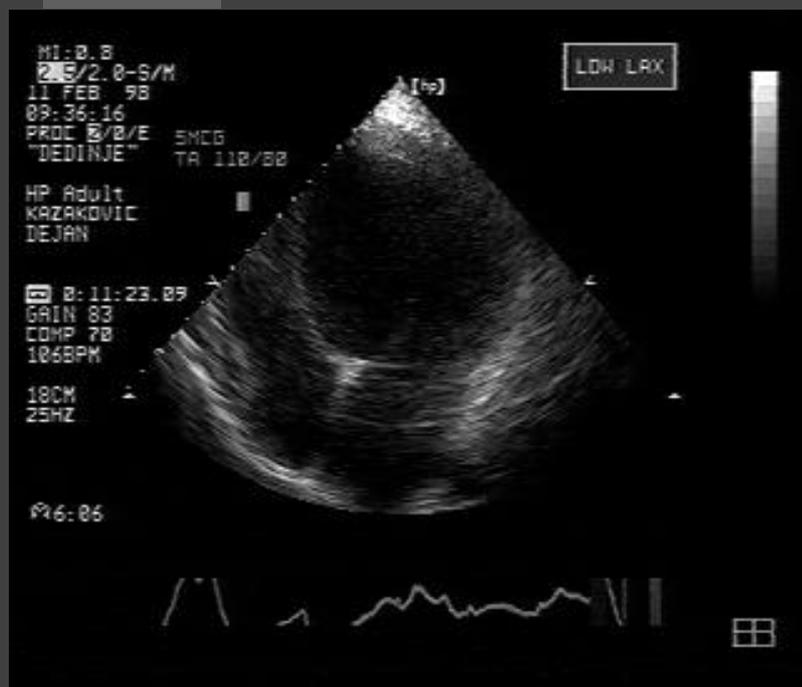
Peak



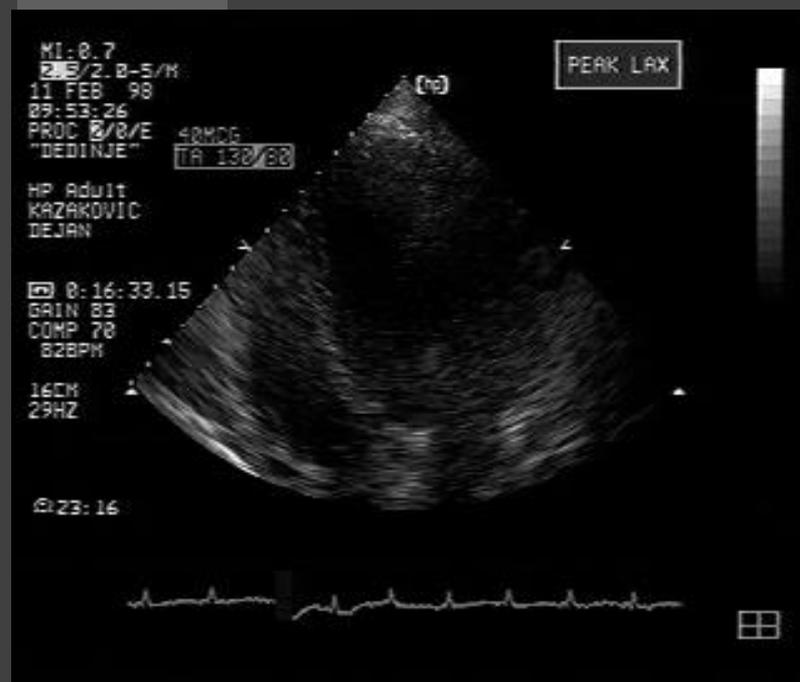
Preserved LV contractile reserve

Dob-Echo in Idiopathic DCM

Low

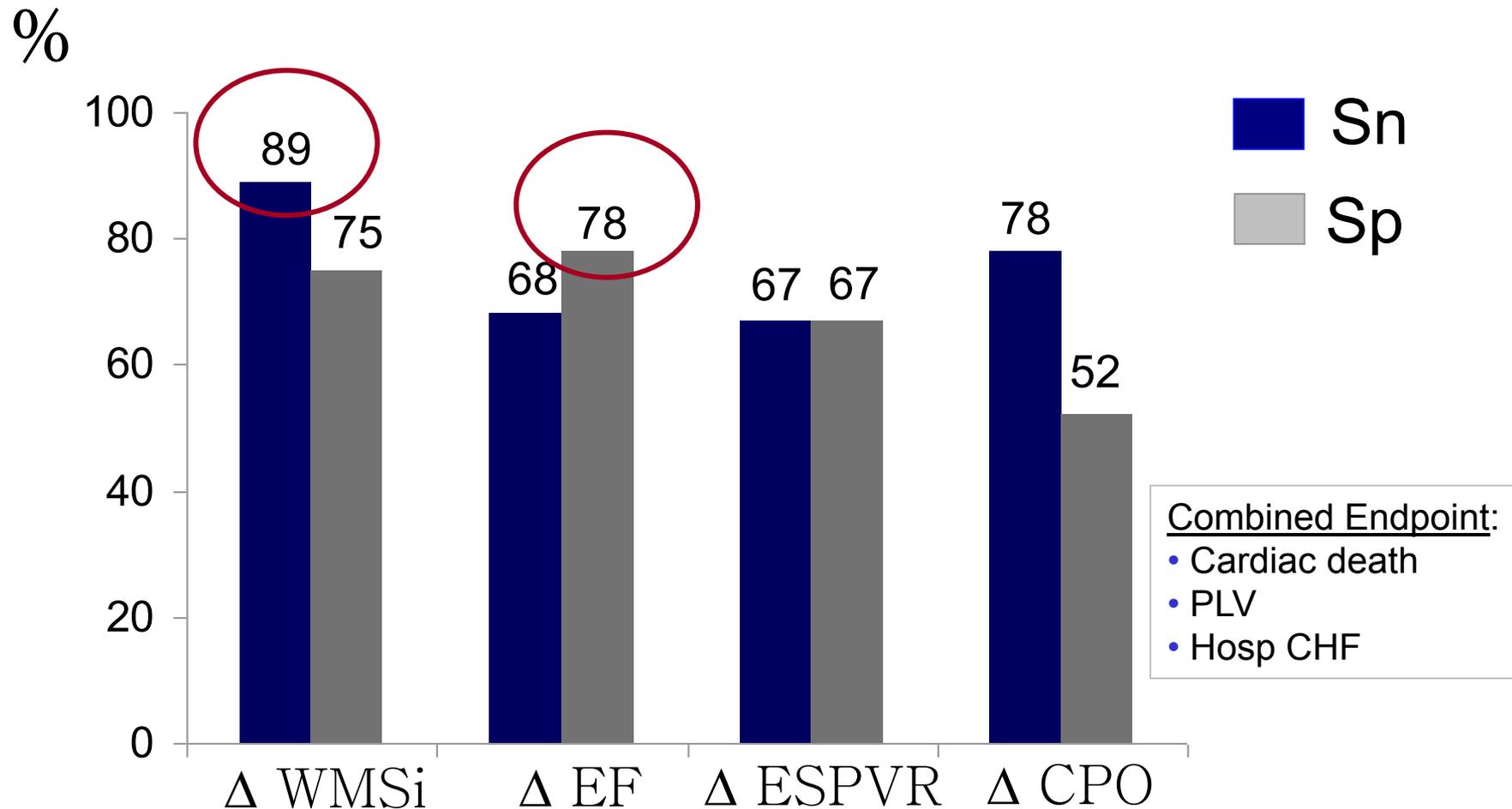


Peak

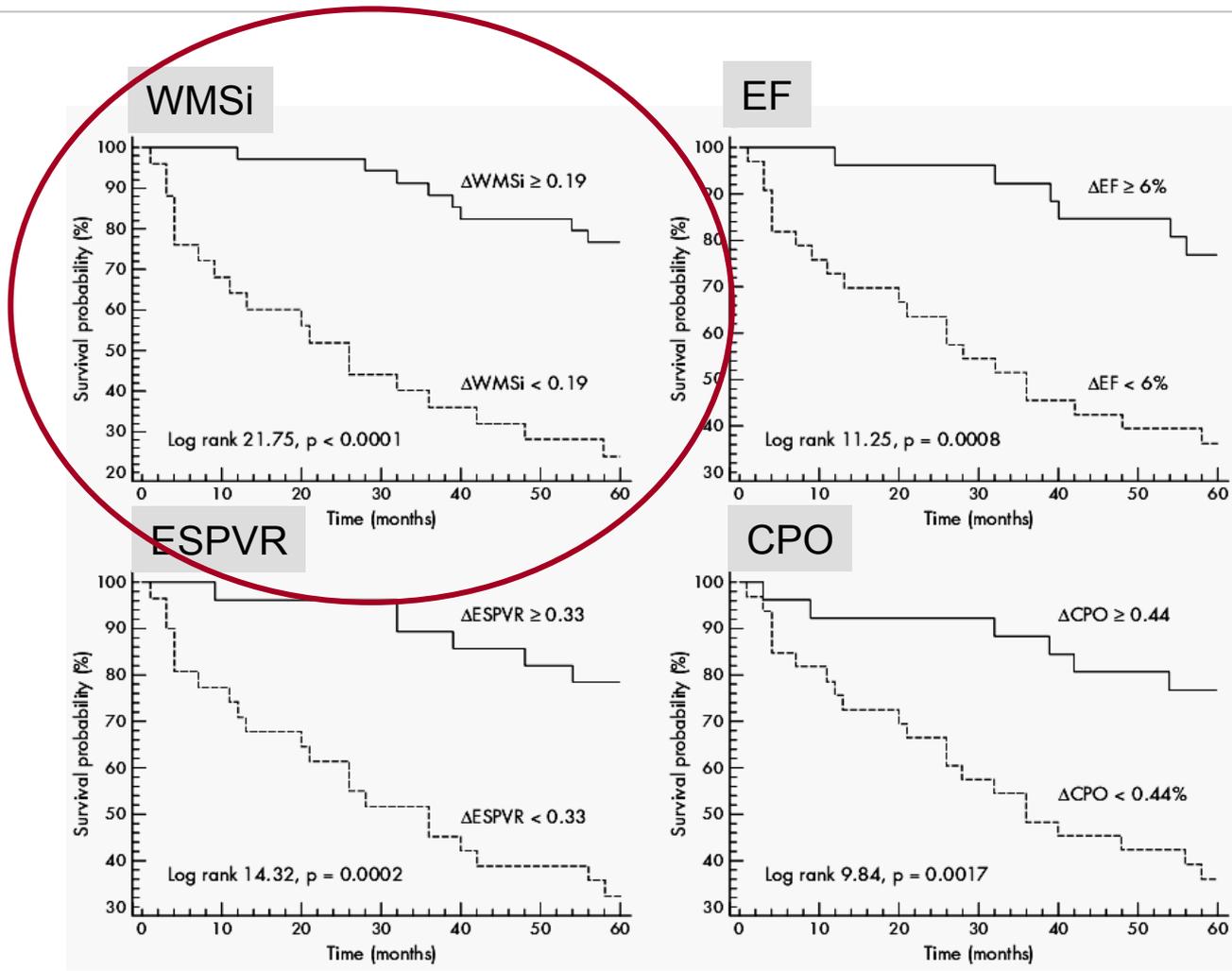


Preserved RV contractile reserve

Different LV Contractile Reserve Indices in Predicting Combined Endpoint in DCM

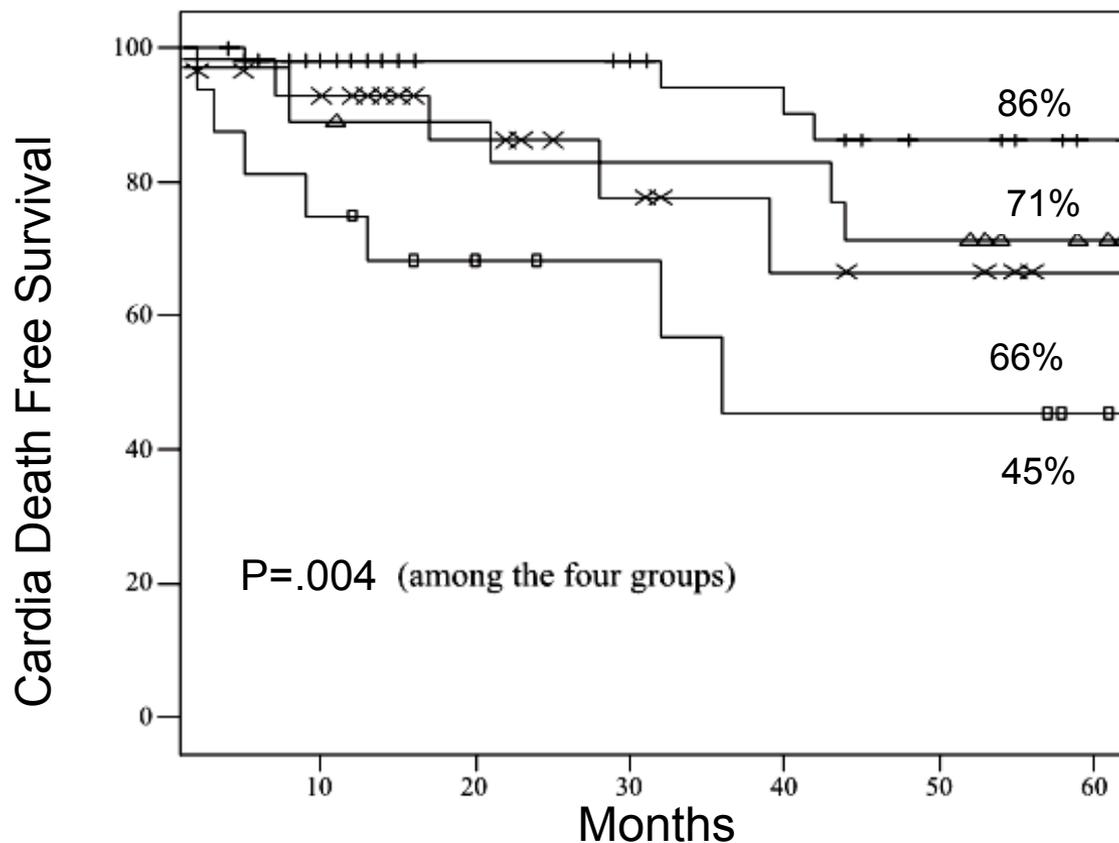


Survival According Different Indices of LV Contractile Reserve in DCM



Additive Prognostic Value of Restrictive Pattern and Dipyridamole-Induced Contractile Reserve in DCM

- 116 pts with DCM
- DIP-Echo (0.84 mg/kg/10min) for CR; restrictive=DT<140ms +E/A>2
- F/U 26.5 months for cardiac mortality



DIP (+) Restr (-)

DIP (+) Restr (+)

DIP (-) Restr (-)

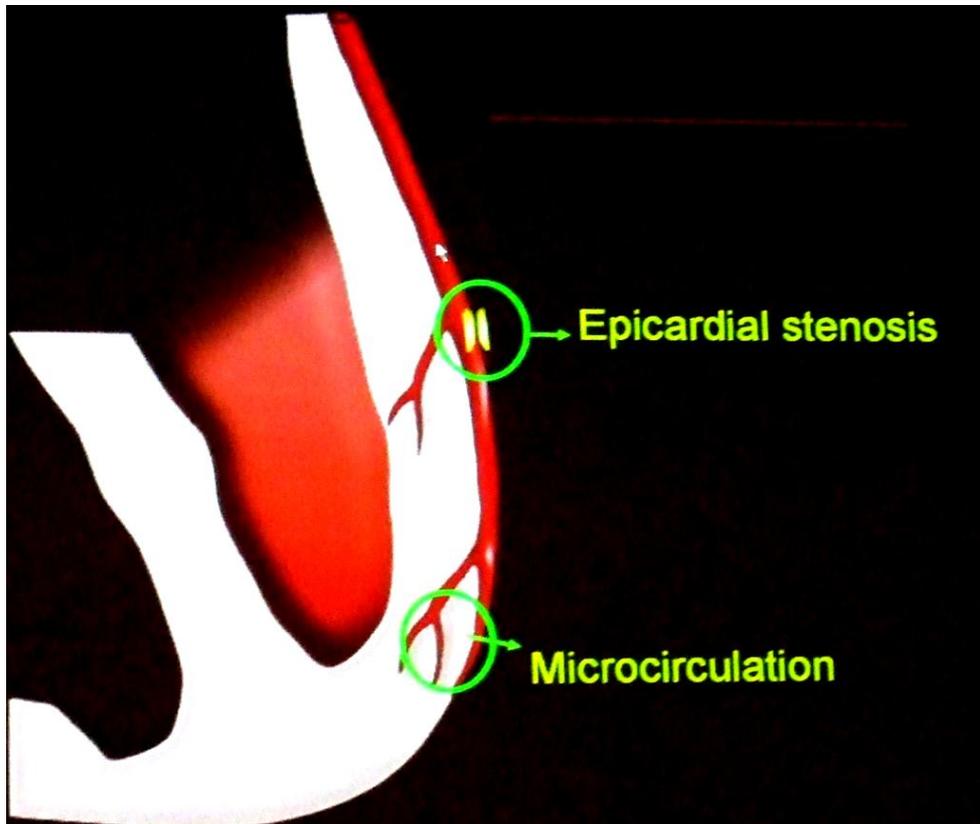
DIP (-) Restr (+)

Prognosis in DCM

Coronary Flow Reserve

Coronary Flow Reserve

Determinants of CFR:



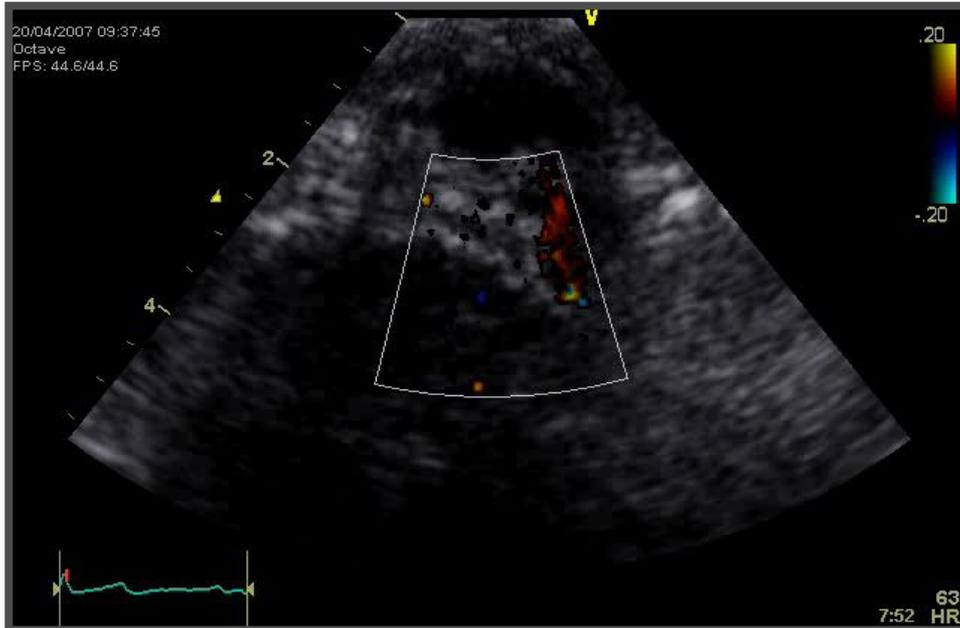
Normal CFR >2

Altered in:

- CAD
- HOCM
- DCM
- Diabetes
- Hypertension
- Sy X...

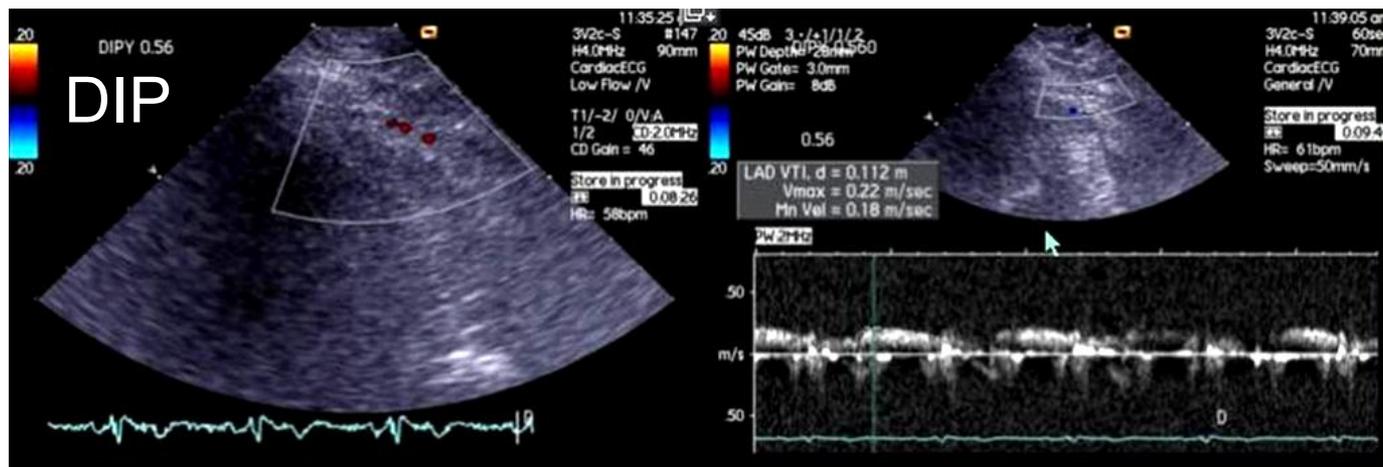
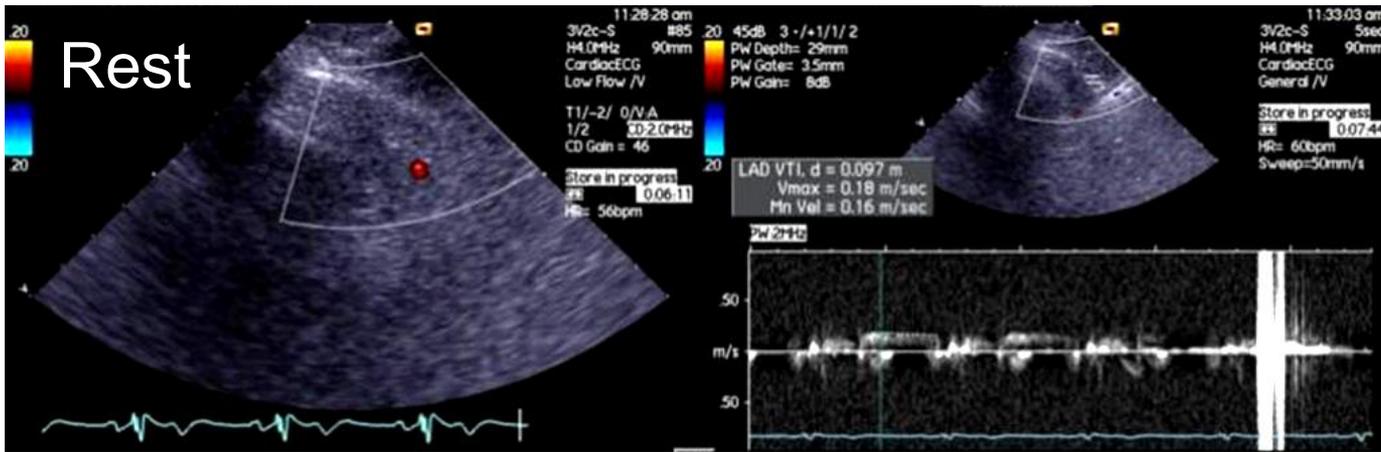
Coronary Flow Reserve

How to obtain CFR ?



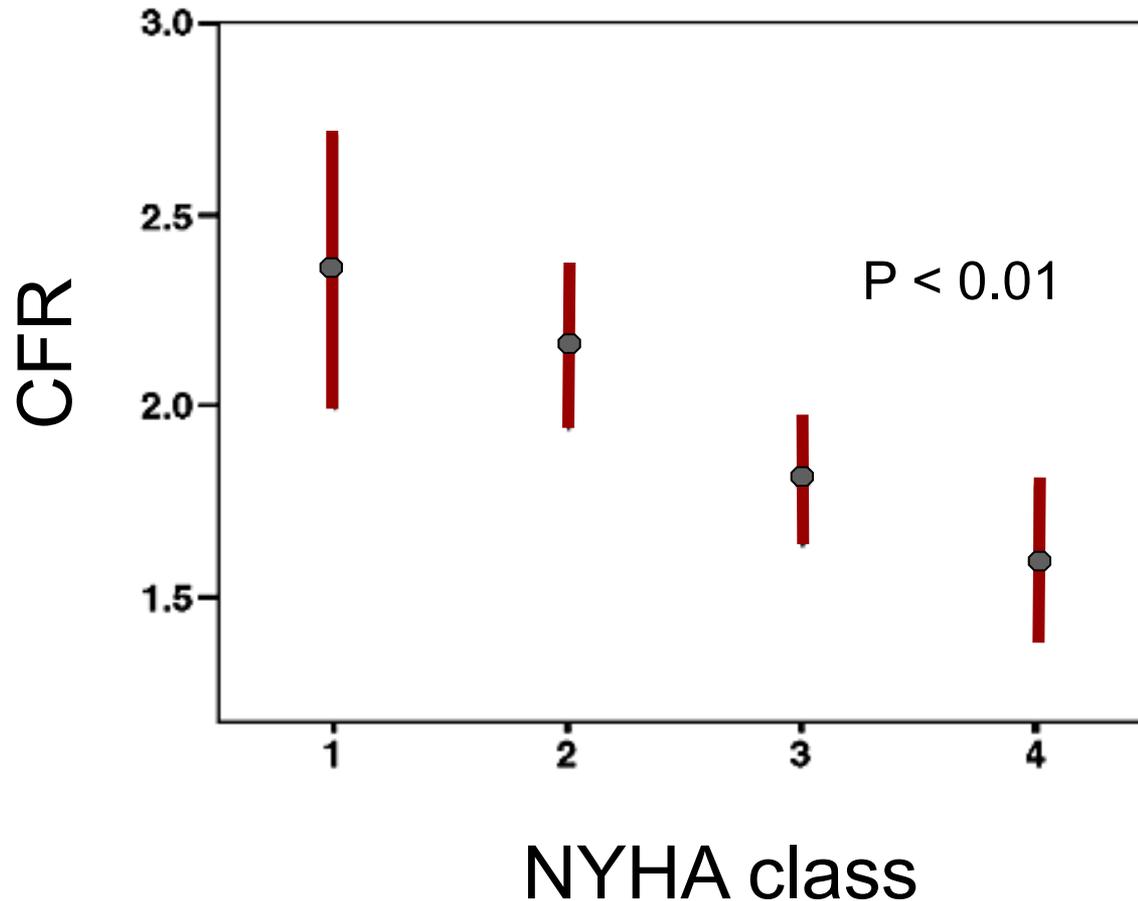
- Transthoracic
- Probe: broad band HF (5-12 MHz) or 3.5-7 MHz with second harmonic
- Mid-distal LAD
- Low parasternal LAX
- Color-D guidance
- Semi-simultaneous imaging of both WMA and LAD flow
- High-dose DIP (0.84 mg/10 min)

Impaired CFR



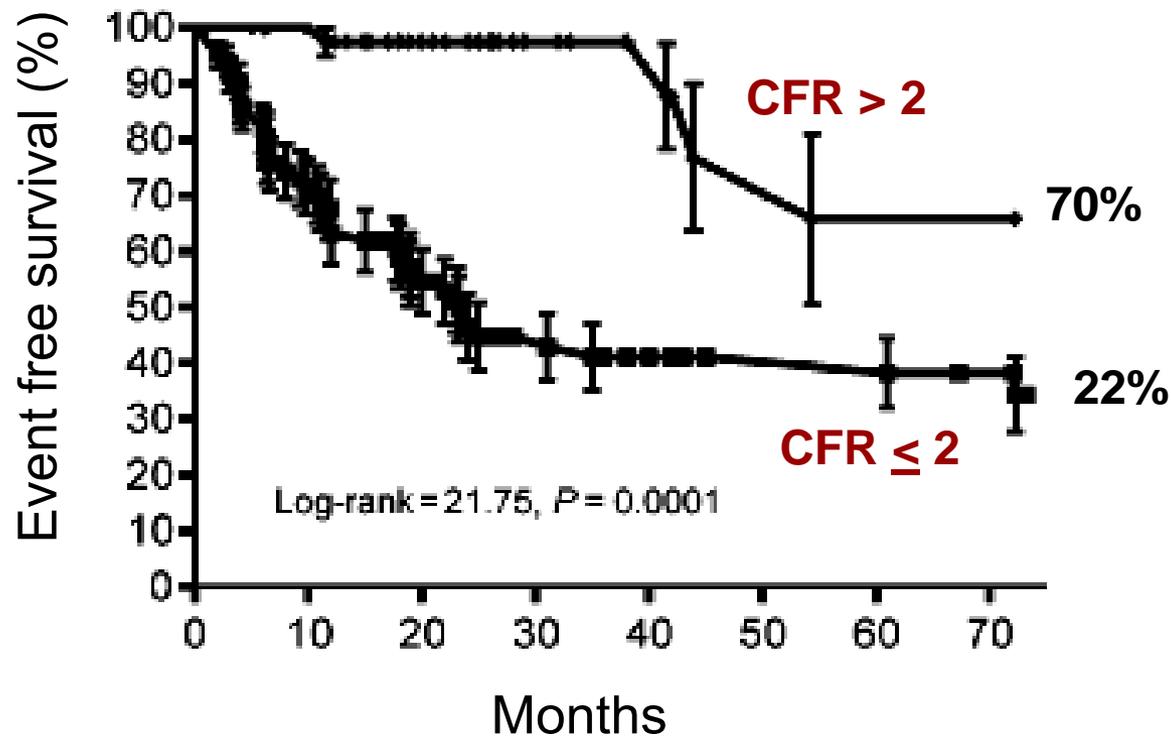
CFR 1.15

Relationship Between CFR and NYHA Class in DCM



Prognostic Impact of CFR Assessed by Doppler Echo in Non-ischemic DCM

- 129 DCM pts, EF <40%
- Transthoracic DIP ECHO (0.84mg/kg in 10 min)
- CFR on LAD by PW Doppler
- F/U 22 months (death, worsening HF)

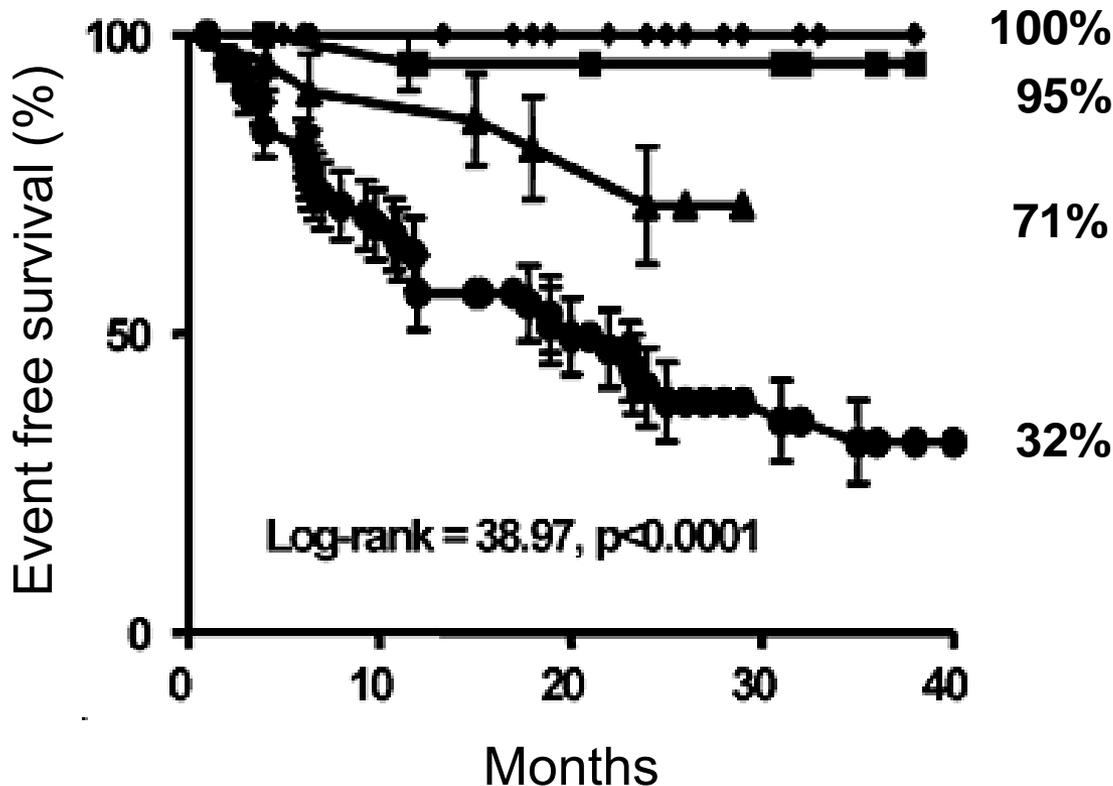


Cox Regression Independent predictors of survival

- MR severity (HR 1.9)
- CFR ≤ 2 (HR 4.0)
- Rest WMSi (HR 6.9)

Additive Prognostic Impact of Contractile Reserve and CFR in DCM

- 132 DCM pts, EF <40%
- Transthoracic DIP ECHO (0.84mg/kg in 10 min)
- CFR on LAD by PW Doppler
- F/U 24 months (death, worsening HF)



Cox Model
independent predictors of survival

- MR (HR 1.7)
- NYHA (HR 2.0)
- **CFR ≤ 2** (HR 2.8)
- Rest WMSi (HR 3.5)
- **Absence of CR** (HR 2.3)

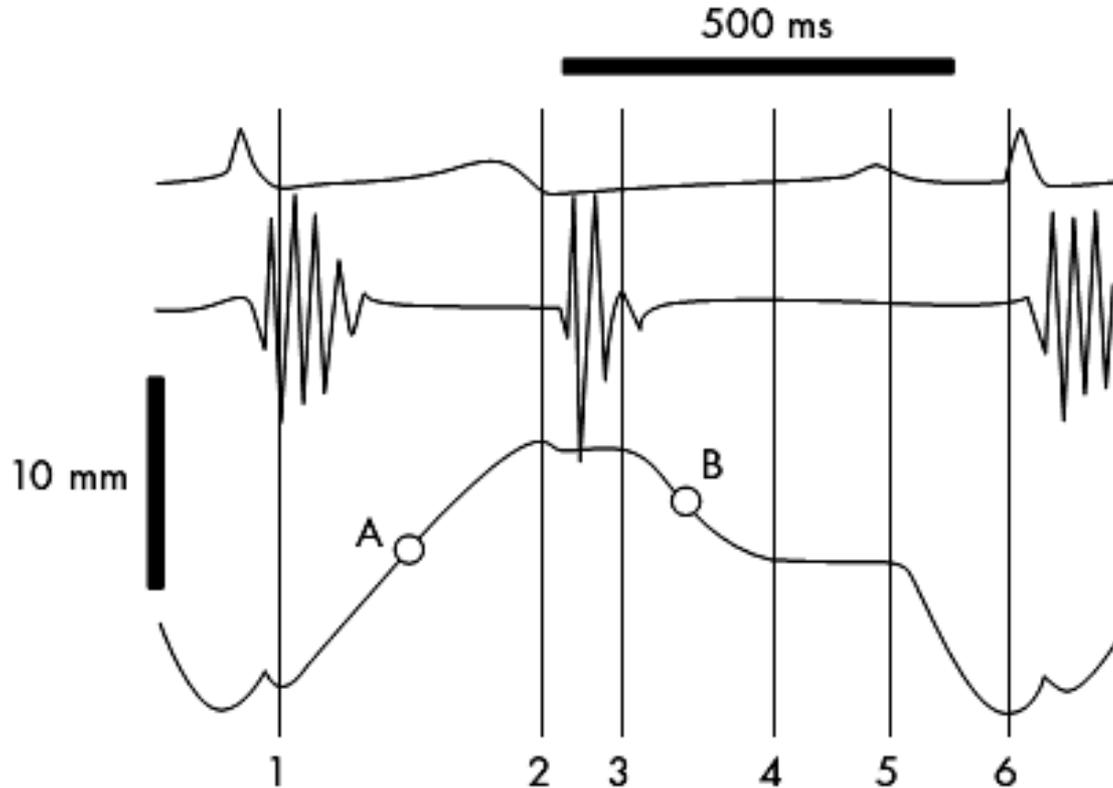
Prognostic Value of CFR in DCM

- Abnormal CFR identifies high-risk DCM pts, prone to clinical deterioration or death
- CFR and contractile reserve has additive and complementary prognostic value
- Advantages
 - ✓ *2D/Doppler combination (function-perfusion link)*
 - ✓ *Widespread, low cost, ionizing free, repeatability*

Prognosis in DCM

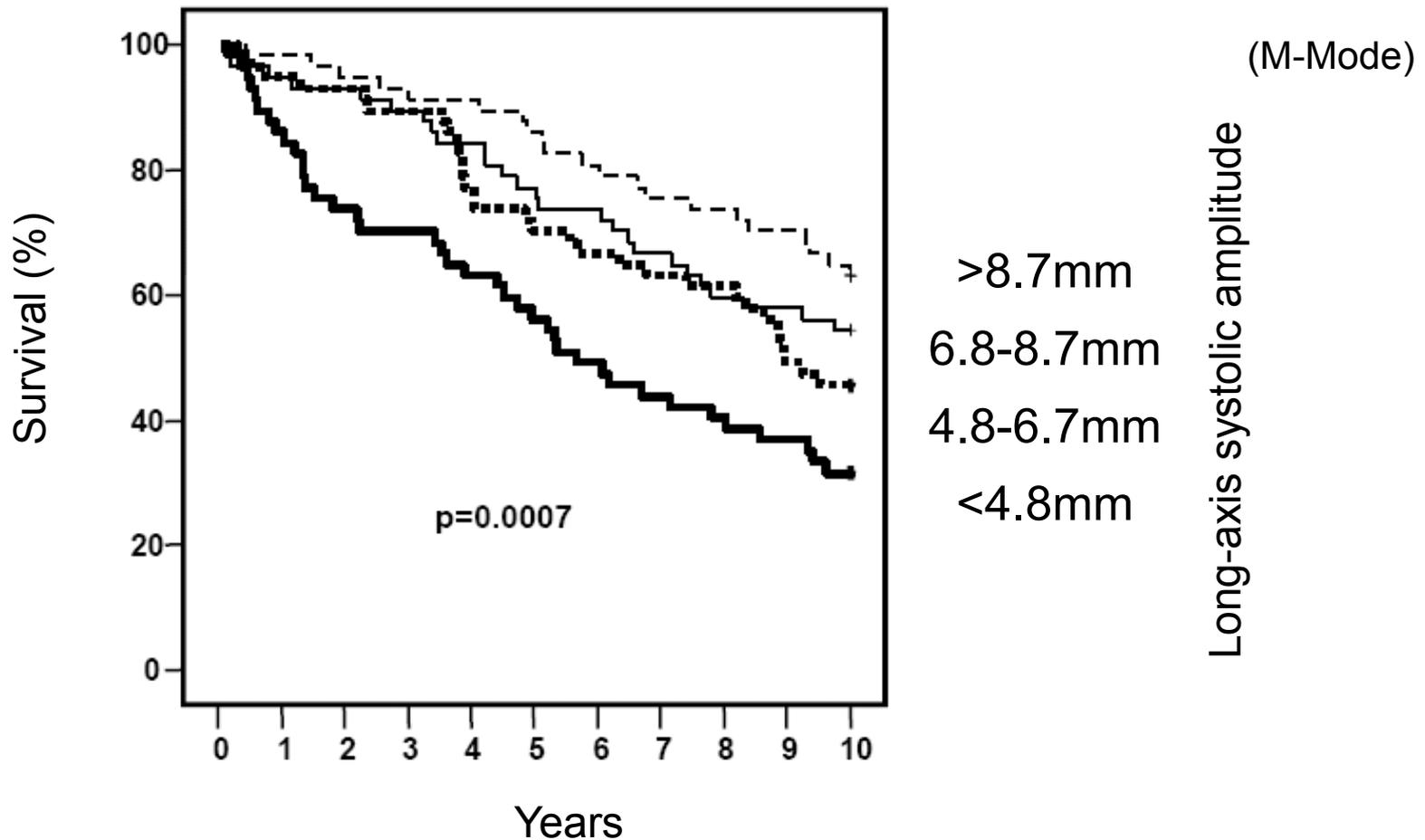
Long Axis Function

Long Axis LV Function by M-Mode



Long axis systolic
amplitude of the movement of
mitral annulus towards apex

10-year Survival in HF Pts and Long-Axis Function

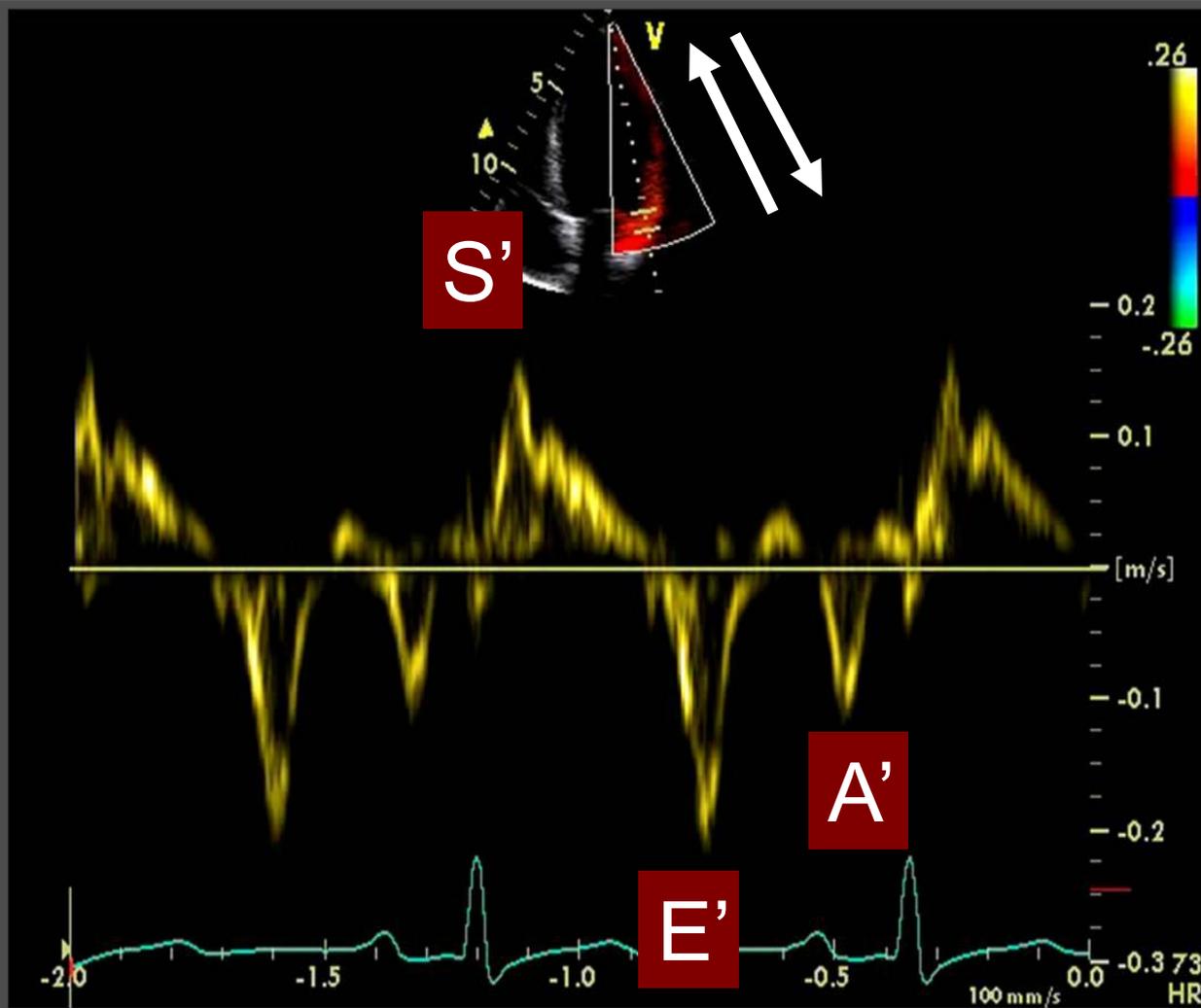


Prognosis in DCM

DTI

S', E', E/E'

Mitral Annulus PW DTI: Global LV Function

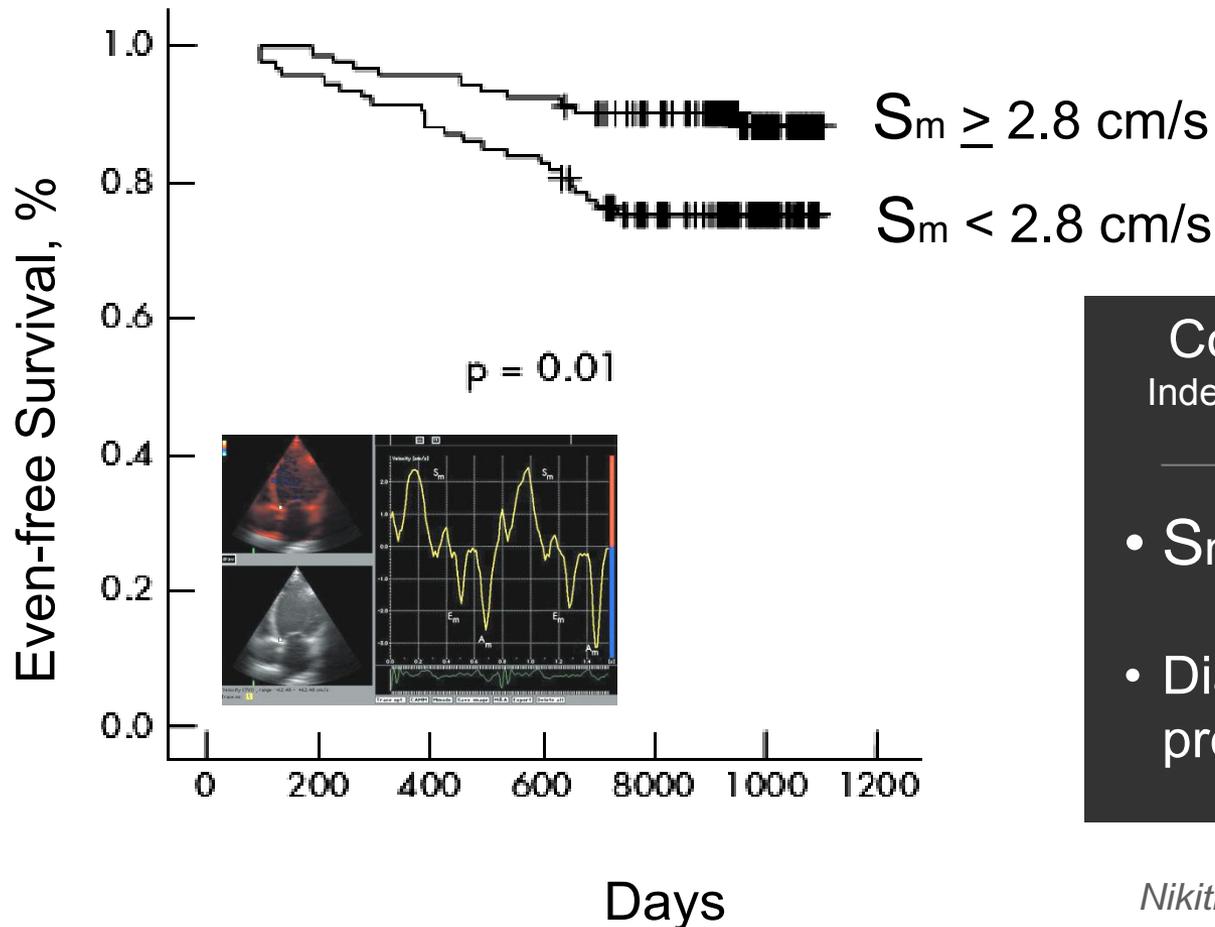


- PW DTI sample placed at the medial or lateral corner of the mitral annulus
- Direction and velocity of annulus movement during cardiac cycle

All waveforms have been tested for prognosis in HF patients.

Prognostic Value of S_m in Pts with Chronic HF Caused by LV Dysfunction

- S_m (systolic mitral annular velocity by DTI in 185 LVEF <45% pts
- F/U 32 months for death and cardiac Tx

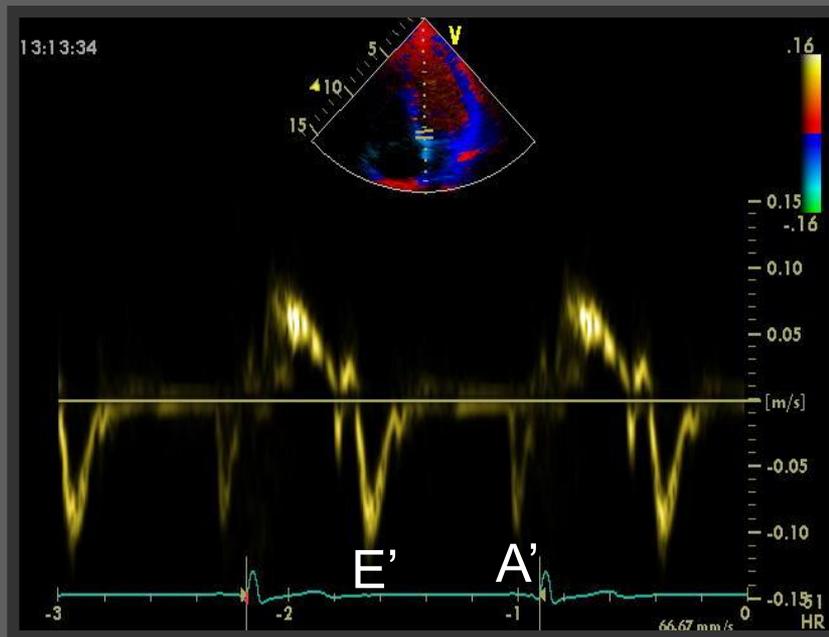


Cox Regression
Independent predictors of
event-free survival

- S_m (HR 0.65)
- Diastolic arterial pressure (HR 0.97)

Mitral Annulus PW DTI: Global Diastolic Function

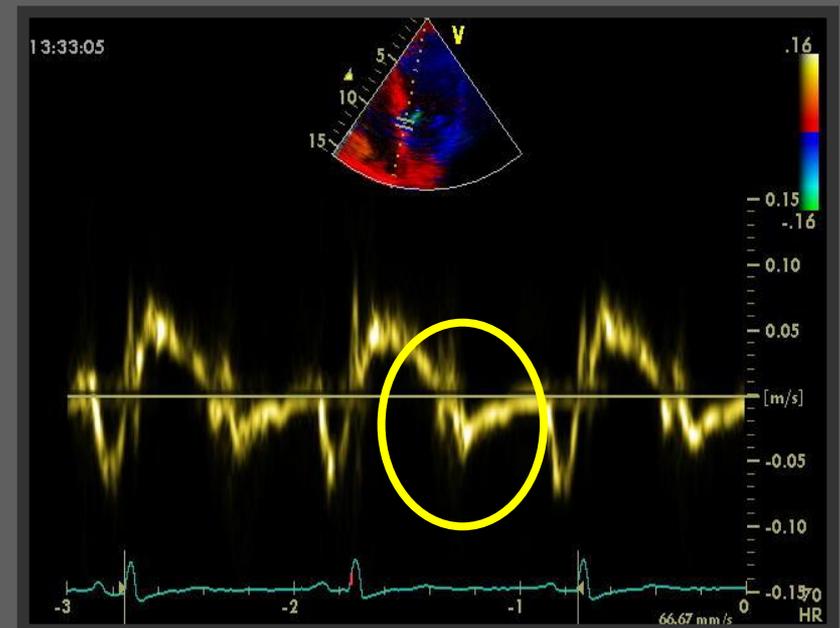
Normal LV Filling



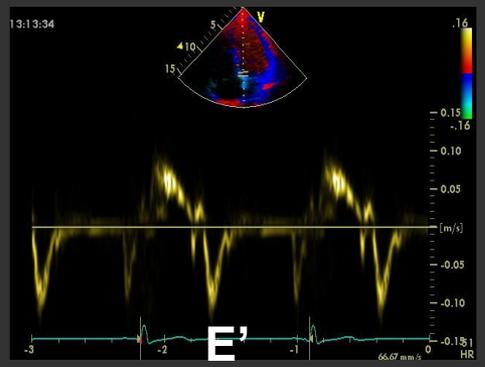
$E' > 10$ cm/s, young adults

$E' > 8$ cm/s, older adults

Abnormal relaxation



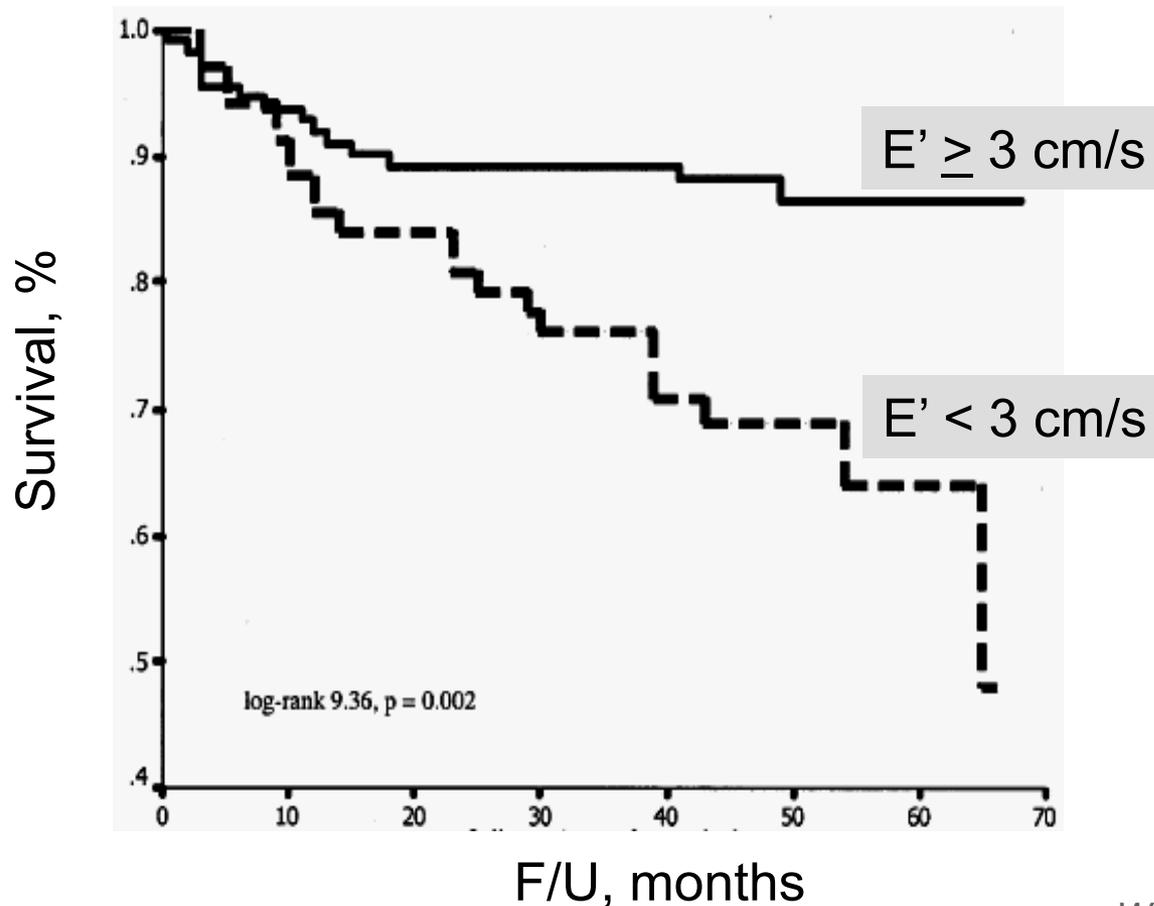
- $E' \downarrow$ in diastolic dysfunction
- Does *not* pseudonormalize !



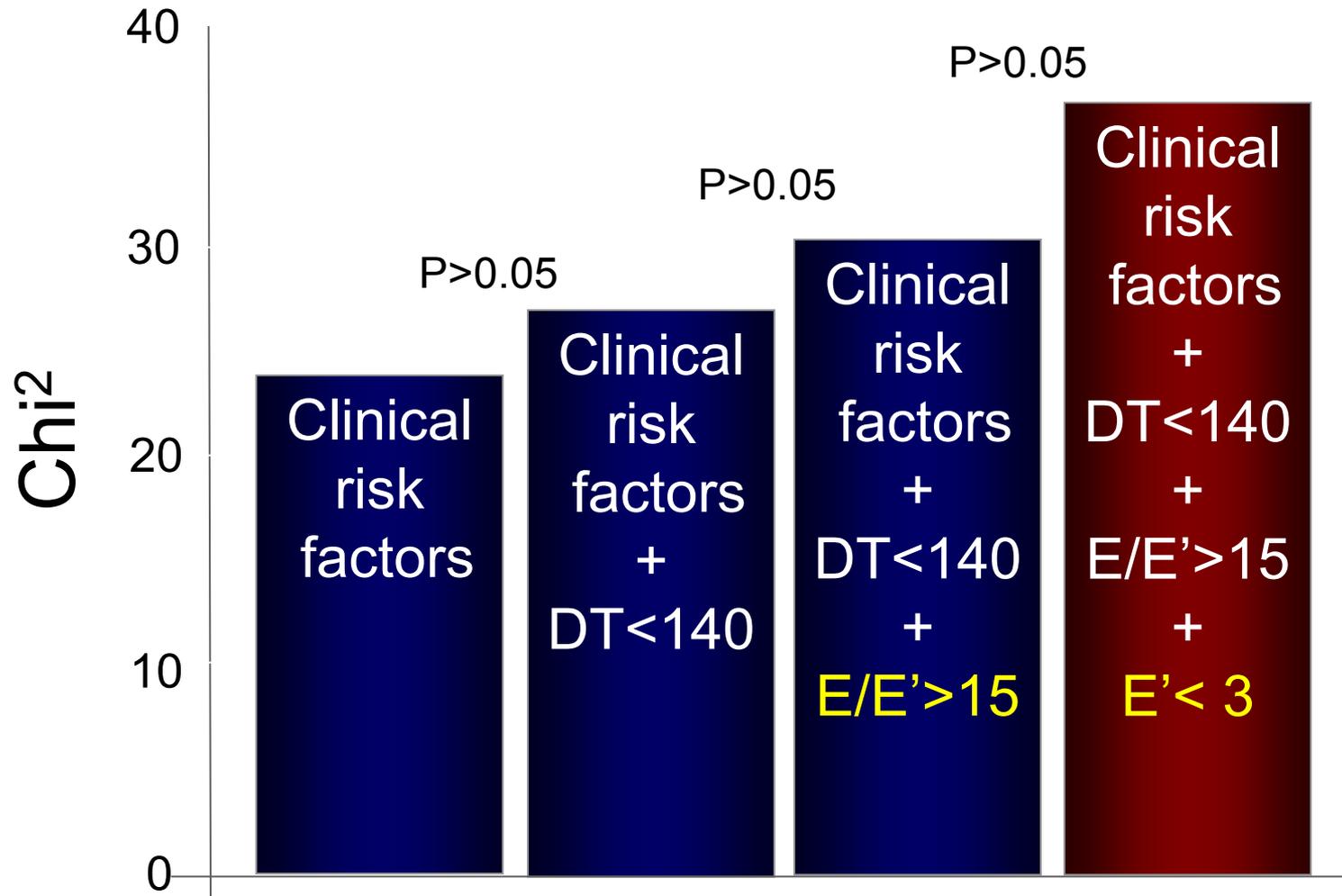
- Reflects ventricular relaxation itself
(proportional to τ)
- Relatively load independent
(in pts with mild to severe myocardial dysfunction;
probably not in normals)
- $E' \downarrow$ with age
- $E' \downarrow$ early in diastolic dysfunction
(does not pseudonormalize)

Cardiac Mortality According to E' in Pts With LV Dysfunction

- Echo (including mitral annular DTI) in 182 pts
- Variety of pts with LV dysfunction (EF <50%)
- F/U 48 months for cardiac mortality



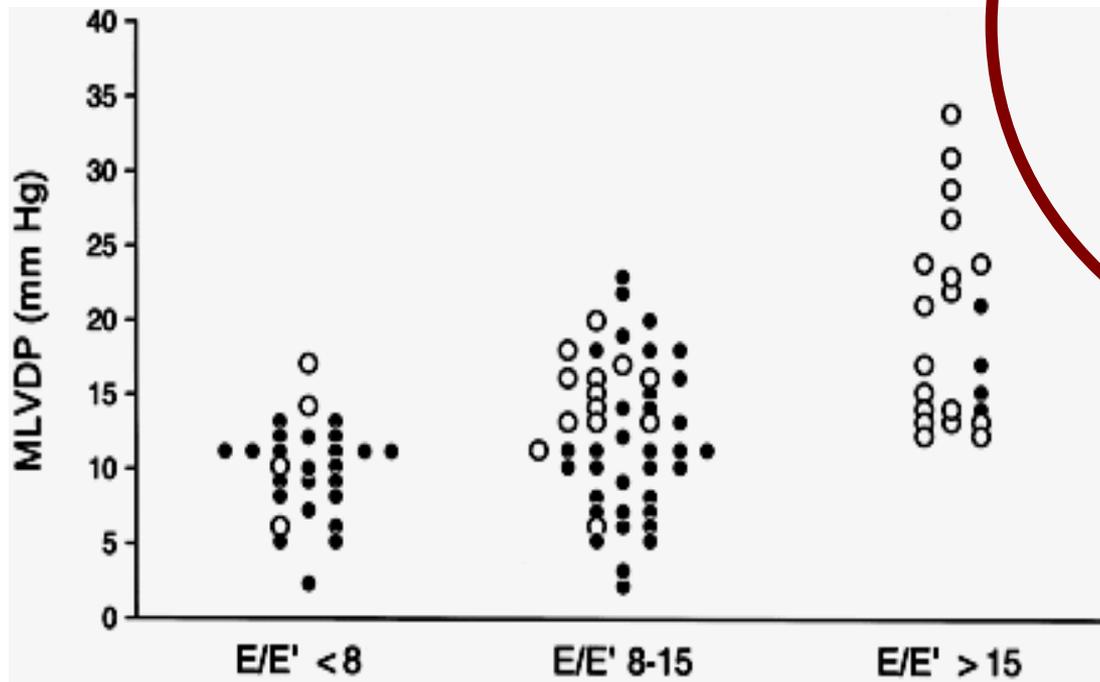
Incremental Value of E' and E/E' in Predicting Long-Term Cardiac Mortality*



* F/U 48 months

LVEDP vs. E/E'

- *Simple*
- *Doable*
- *Essential information*



E/E' ratio > 15

↑ LA pressure

E/E' ratio < 8

↓ LA pressure

E/E' ratio 8-15

useless

Prognostic Implications of E/E' in Pts with DCM

- 33 DCM pts, mean EF 31%
- TDI, pro-BNP, VO2max
- F/U 12±4 months for cardiac death

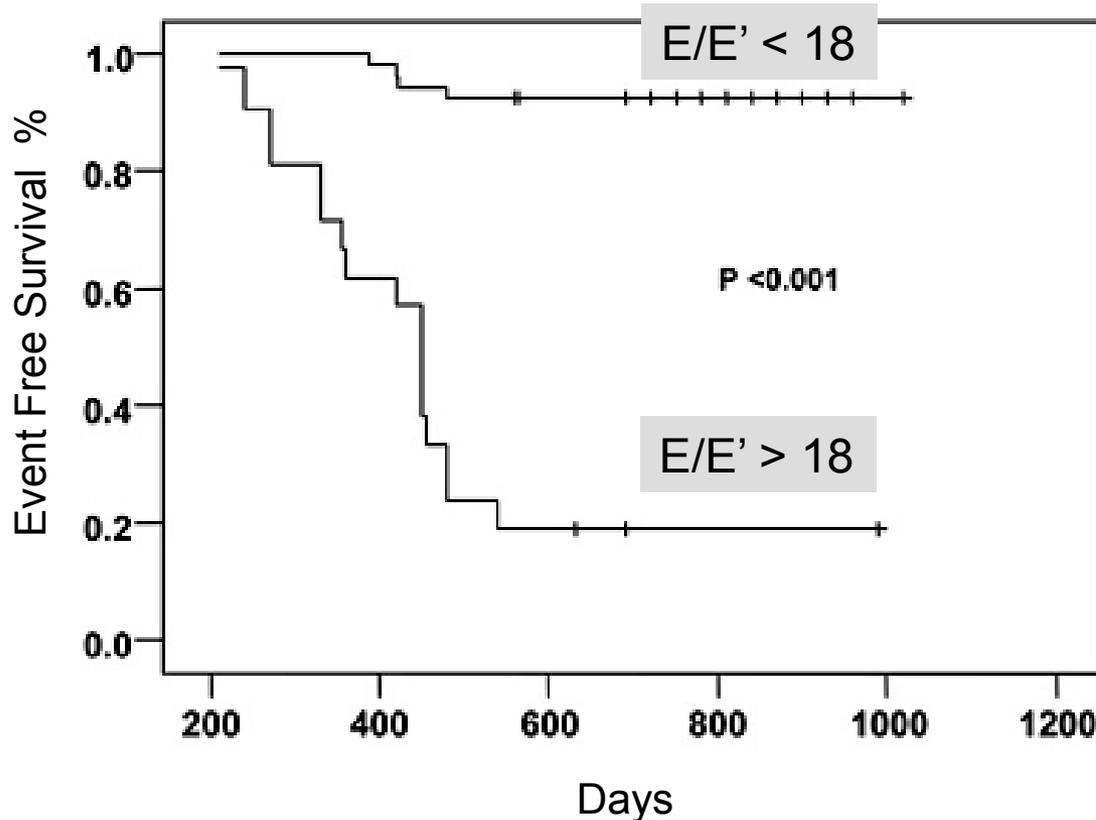
	E/E' ≥ 15	E/E' < 15	P value
• Sm (cm/s)	4.46	7.19	.00001
• Pro-BNP (pg/ml)	5622	1254	.004
• VO2max (ml/kg/min)	17.6	22.8	.004
• Death	9/15 (60%)	2/18 (11%)	.004

Baseline Predictors of Cardiac Events after CRT in Pts with Ischemic and Non-ischemic HF

- 74 pts with CRT
- Baseline clinical, 2D, Doppler, TDI variables
- F/U 720 days (median) for cardiac events

Consistent predictors in CRT pts:

- Restrictive filling
- RV pressures

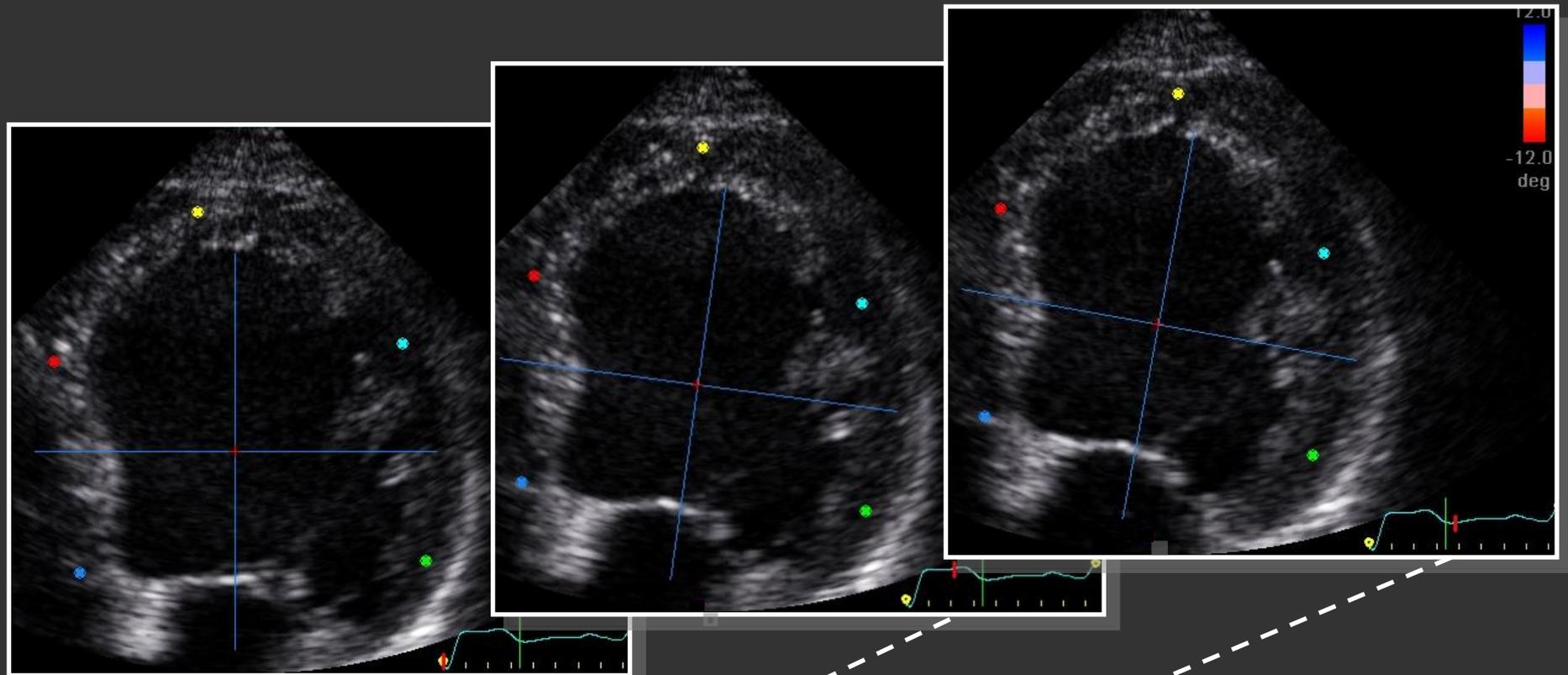


- Lateral E/E' better than septal

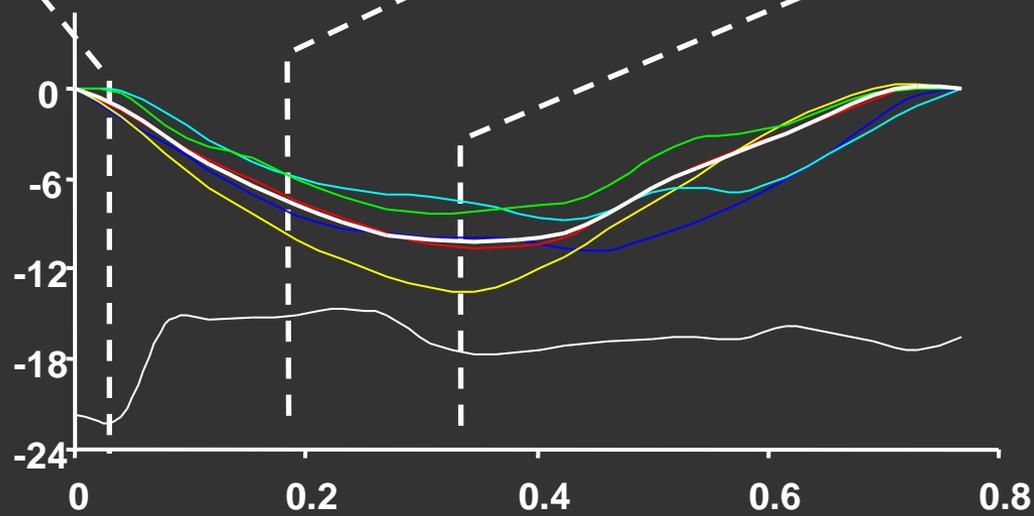
(the only independent predictor in multivariable analysis)

- Septal E/E' limited in ischemic HF (septal MIs)

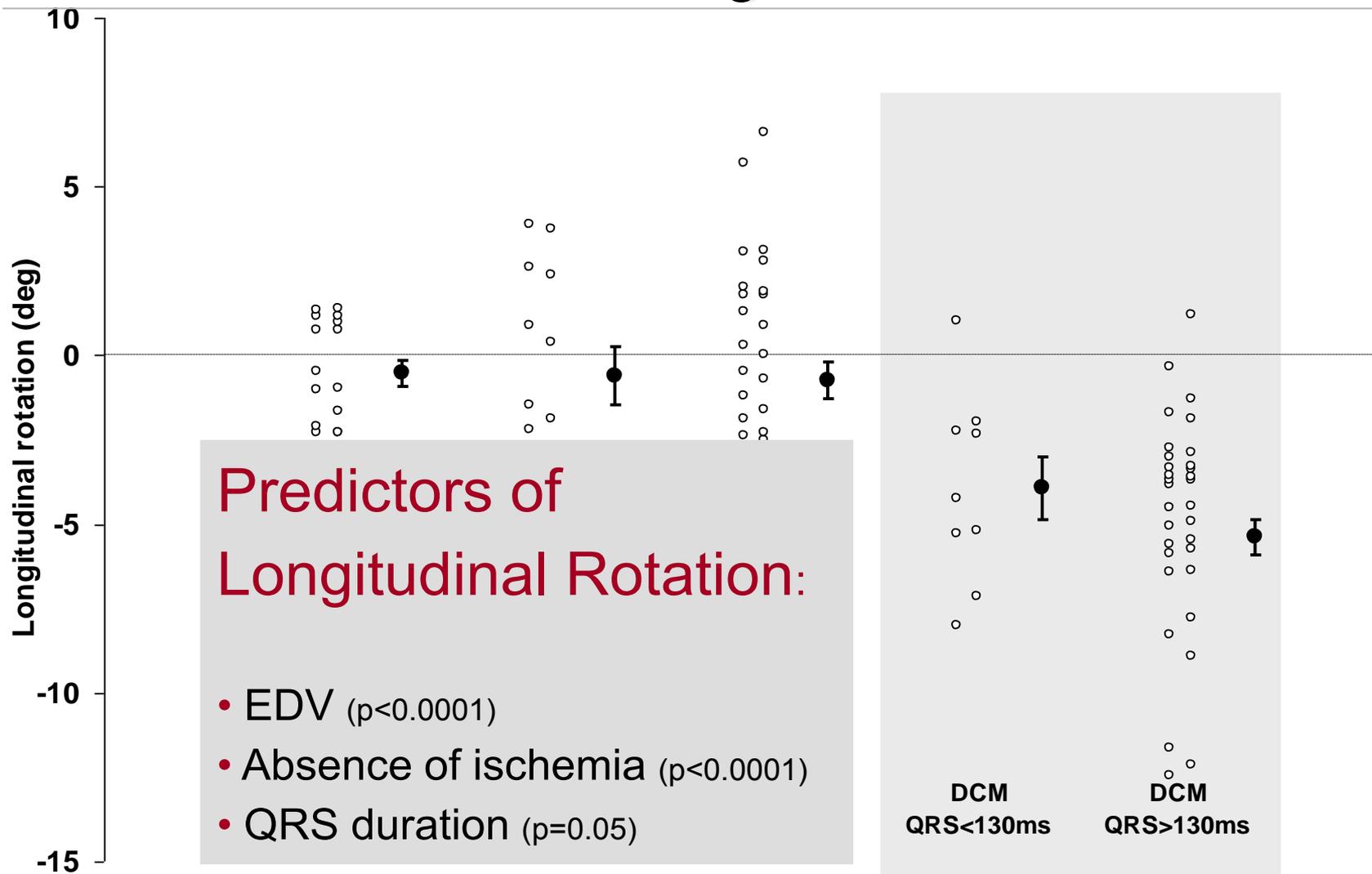
Longitudinal Rotation



Longitudinal
Rotation (°)



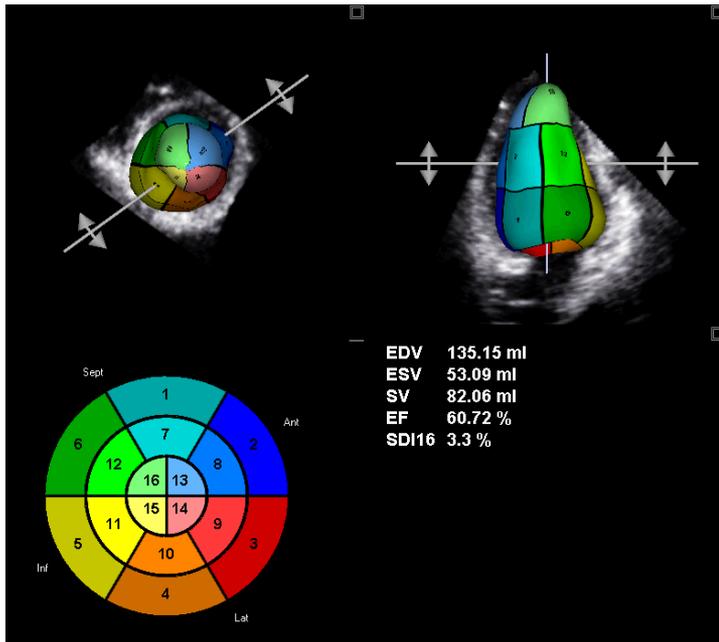
Longitudinal Rotation: Unrecognized Motion Pattern in Pts with Enlarged Hearts due to DCM



3D Echo

4D Quantitation of LV Function

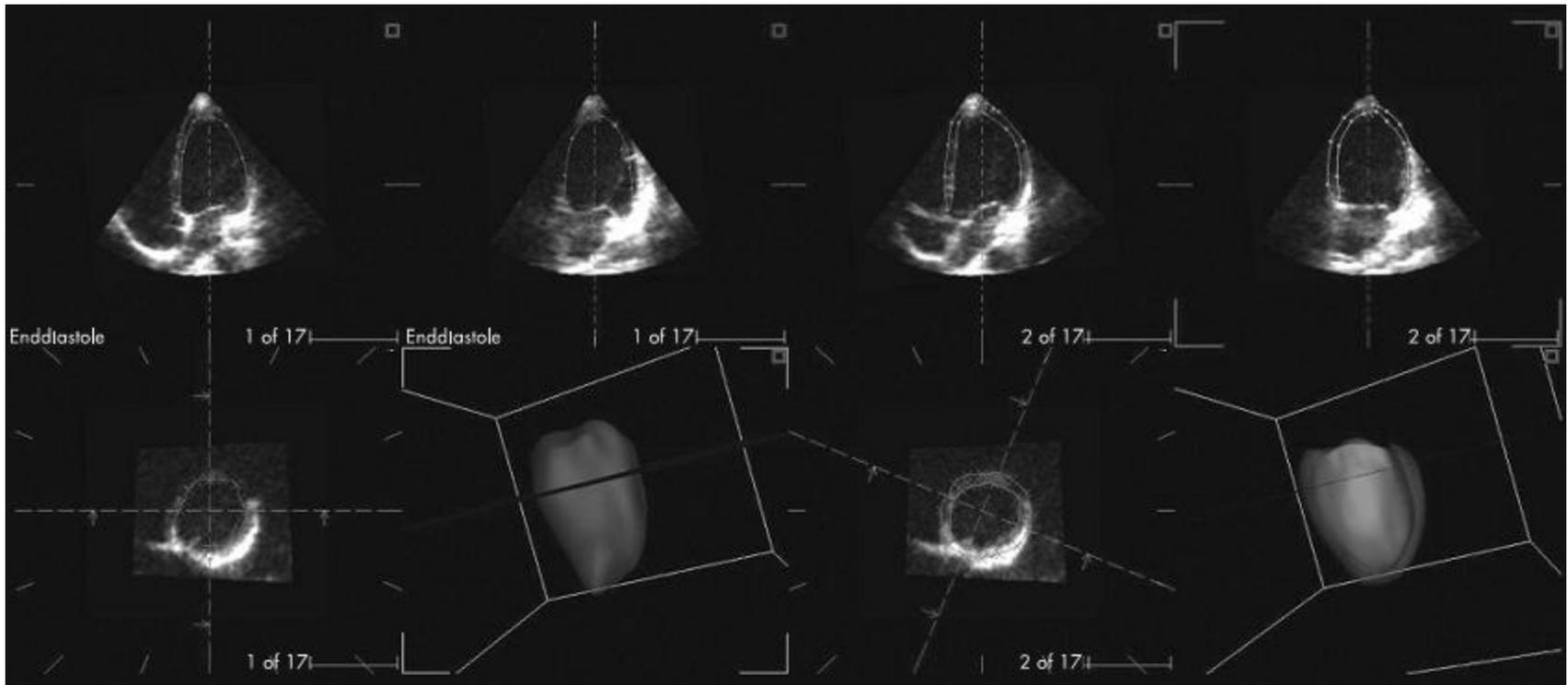
Reliable Measurements of LV Geometry and Function



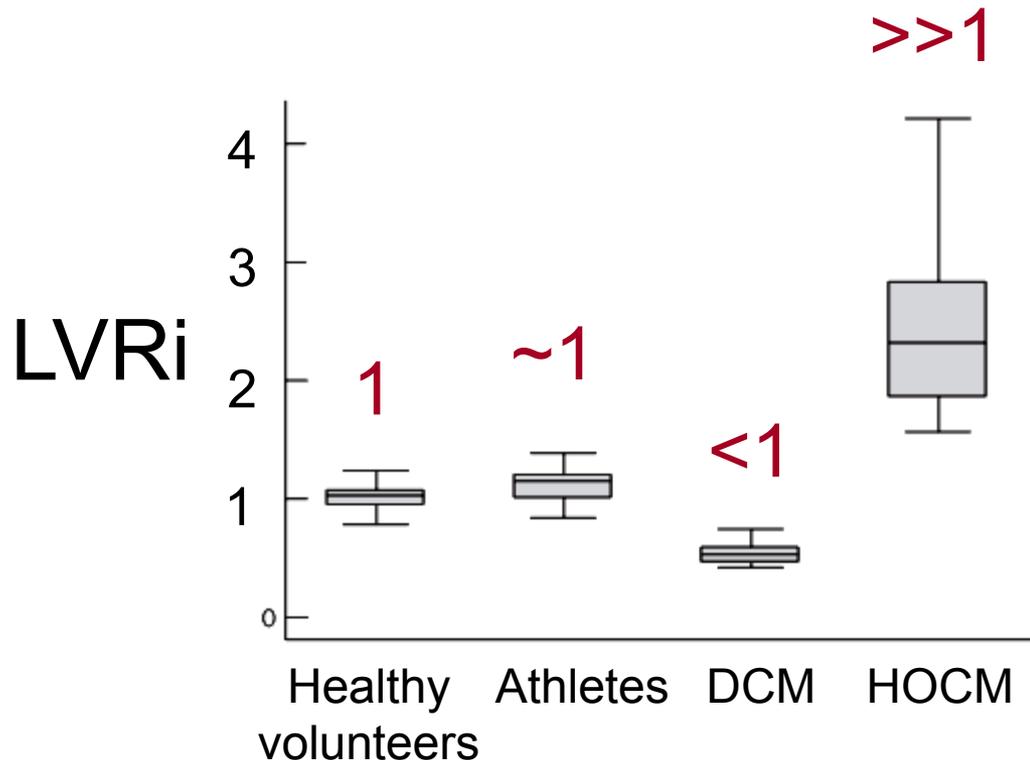
		<i>Mean difference ± SD vs MRI</i>	
		RT3DE	2DE
Jenkins 2004	EDV (ml)	-4±9	-54±33
	ESV (ml)	-3±18	-28±28
	EF (%)	0±7	-1±13
Caiani 2005	EDV (ml)	-4±29	-23±86
	ESV (ml)	-4±33	-19±60
	EF (%)	-8±14	+4±16
Jacobs 2006	EDV (ml)	-14±17	-23±29
	ESV (ml)	-7±16	-15±24
	EF (%)	-1±6	1±9

LV Remodelling Index (LVRi) in Various Conditions by RT-3D Echo

- 220 subjects: normals, athletes, DCM, HOCM
- 3D: off-line endocardial and epicardial border tracing in 8 different cutting planes



RT-3D Echo-Derived LVRI in Various Pathophysiologic Conditions



LV Remodelling Index

$$\text{LVRI} = \frac{\text{LV mass}}{\text{LVEDV}}$$

Clinical Decision Making by 3D Echo

- 220 pts, 3 hospitals
- 3D: 83% feasible; add time 5.4±2 min

Clinically-relevant measurement thresholds:

- LVEDV >50ml/m²
(surgery for regurgitant valve lesions)
- LVEDV >30ml/m²
(prognosis after MI)
- LVEF <35%
(indication for ICD)
- LVEF <40%
(indication for HF treatment)

Reallocation by 3D

8.5%, (5/59)

12.4%, (13/105)

17.5%, (11/63)

16.1%, (13/81)

Assessment of Prognosis in DCM

Instead of Conclusion:

- Introducing **novel** parameters *does not imply* to discard well established “conventional” ones
- New: **complementary** instead of competitive!
- **Complex puzzle** of clinical and diagnostic modalities to identify pts at high risk of death, in whom more aggressive approach is needed.