Diastolic heart failure

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Current European Diagnostic Criteria

- Signs or symptoms of CHF (effort dyspnea,pulmonary rales/edema, CPX-test VO_2 max < 25ml/kg/min)
- Normal or mildly reduced Lvsystolc function (EF > 45%, LVEDD <3,2 cm/m^2 , LVEDVI < 102 ml/ m^2)
- Abnormal LV relaxation, filling, diastolic stiffness by echo or catherization

Eur Heart J 1998,19:990-1003

The Strong Heart Study

- Population based
- N = 3184, CHF prævalence 3 %
- CHF: EF >54 % : **53%** (E/A ratio ↓,DT ↑, LVH↑)
- CHF associated with hypertension & LVH

Am J Cardiol
2000;86:1090-96

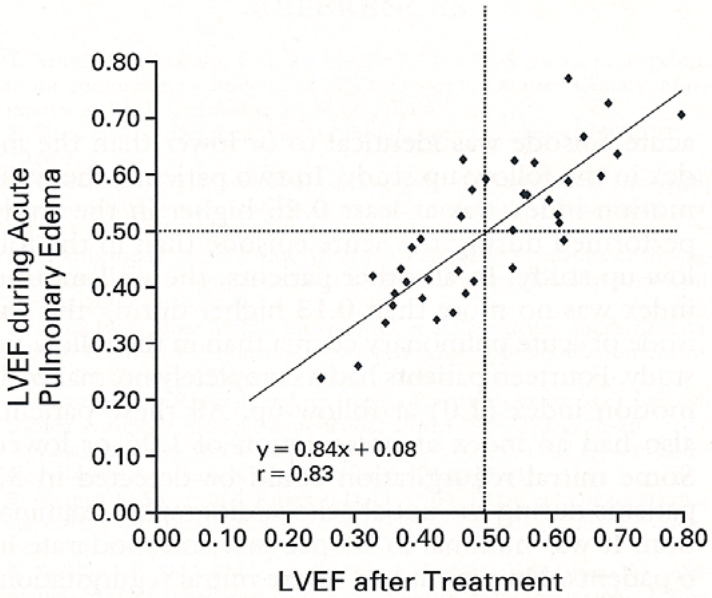
CHF with preserved LV systolic function

Characteristics & prognosis

- **Hospitalstudy**
- **N= 2498 pts, NYHA II-IV, EF > 40 %**
- **Catheterization: 1/3 no CAD, 2/3 CAD**
- *62 % hypertension, 32 % diabetes*
- **Mean EF = 58 %**
- **5 years overall mortality 28 %.**

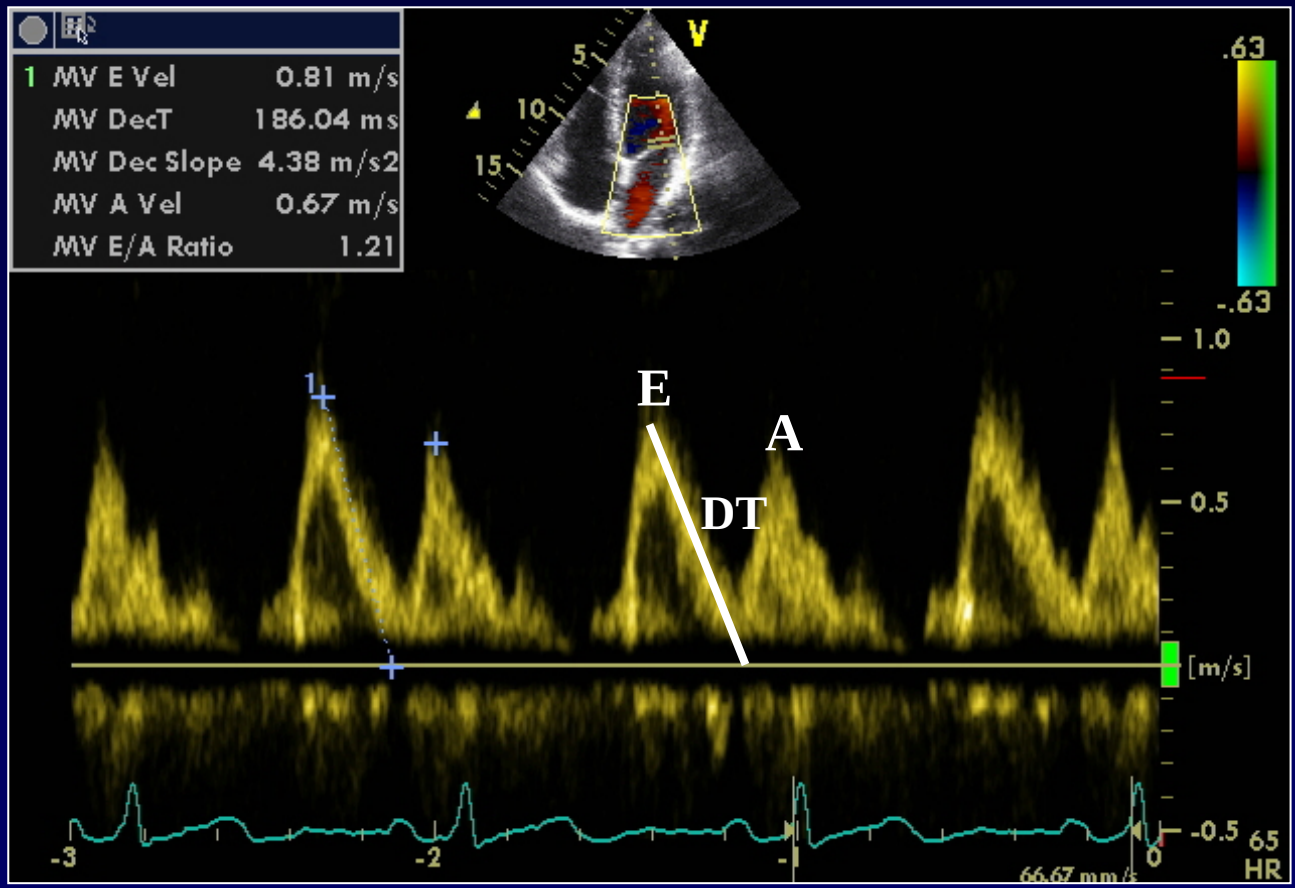
Am J Cardiol 2000;86:863-67
Duke University

LVEF before & after pulmonary oedema in hypertensive



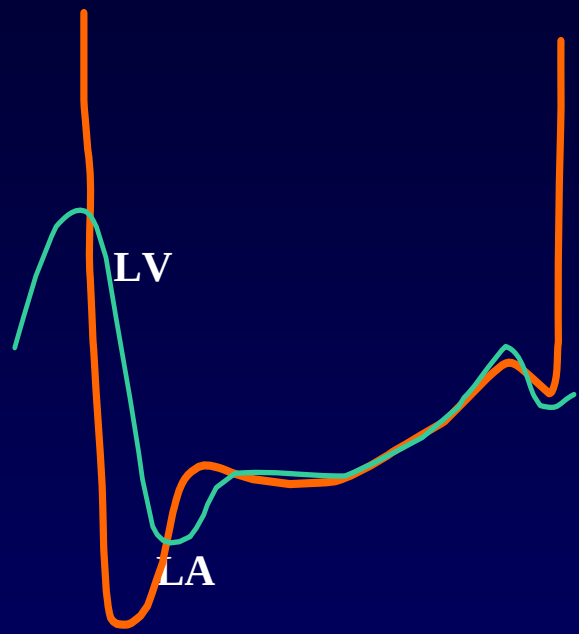
NEJM 2001,344:17-22

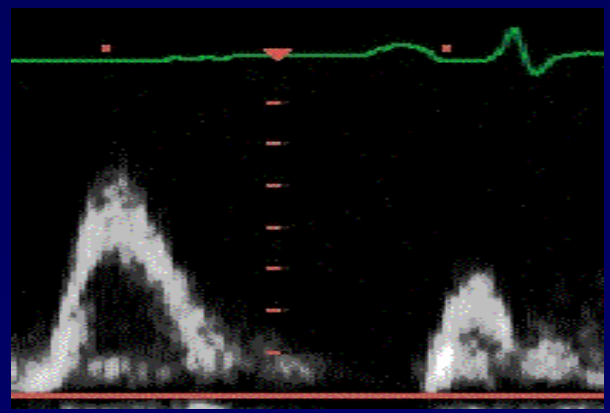
Mitral inflow



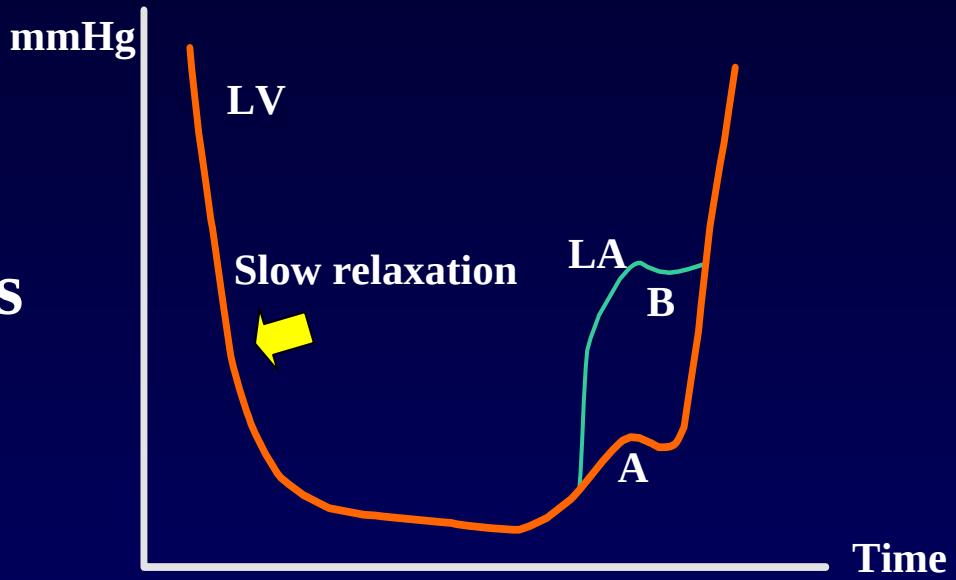
Normal LV Diastolic Function

Normal LV
mass, size, relaxation, and stiffness
LV filling - 2/3 early
1/3 atrial
Normal LA size and pressure





Mild LV Diastolic Dysfunction
Impaired LV relaxation



Normal LV

mass, size, stiffness

Impaired LV relaxation

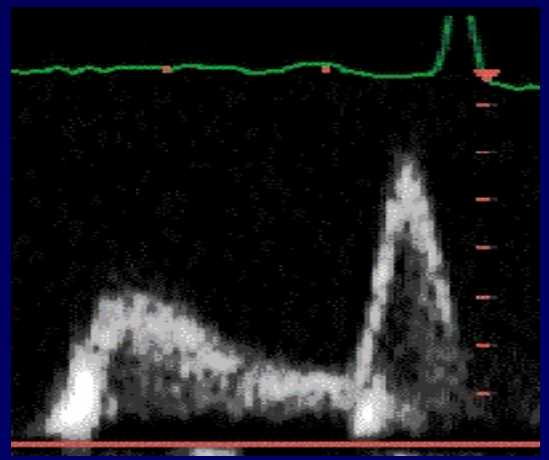
LV filling - ↓ early

↑ atrial

Normal LA size

LA pressure normal (A)

or mildly increased (B)



Moderat LV Diastolic Dysfunction
Pseudonormal LV filling

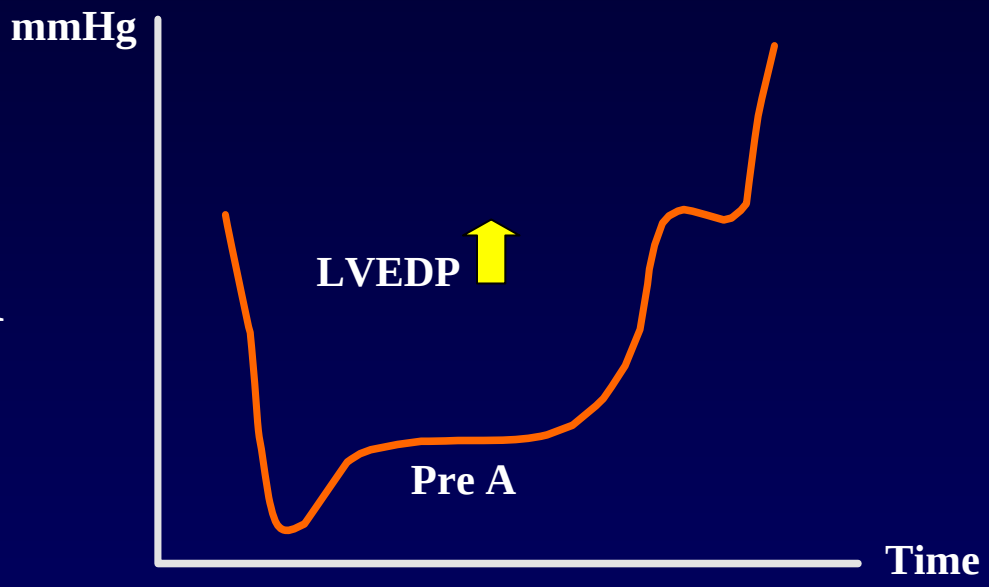
Normal LV
- **mass, size**

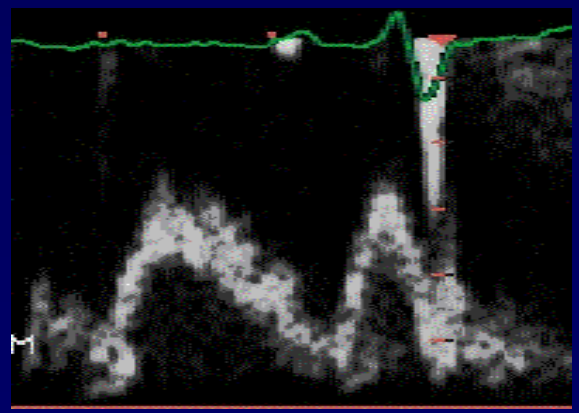
LV relaxation impaired

LV stiffness increase

LV filling -
- **pseudonormal**

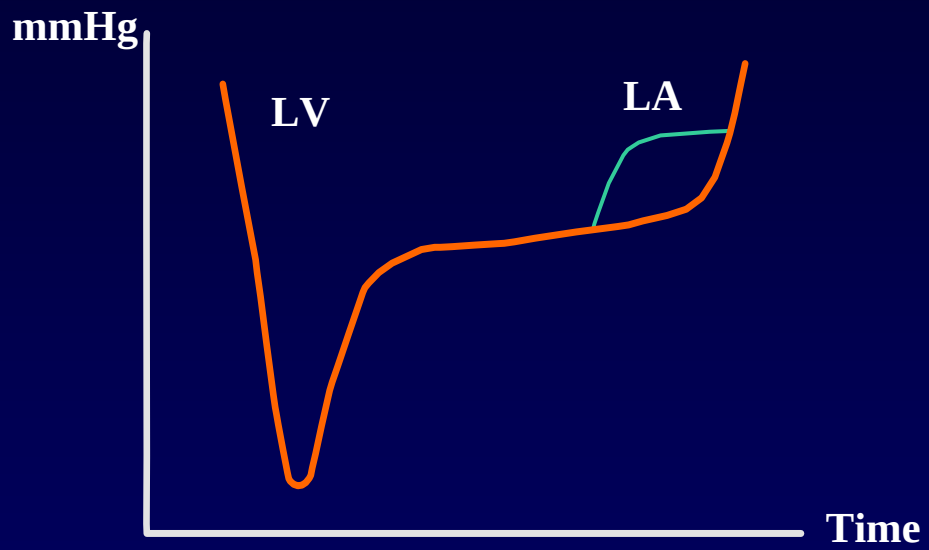
Increased LA size and
- **pressure**

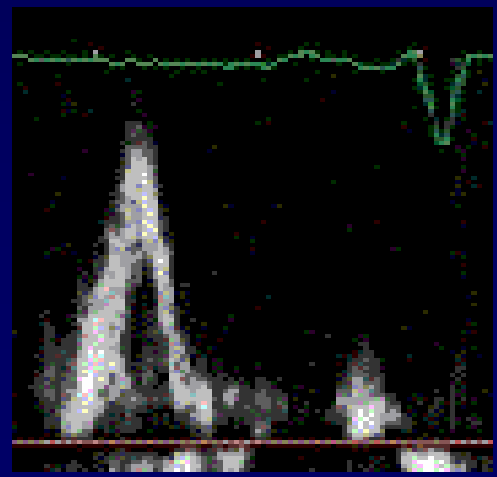




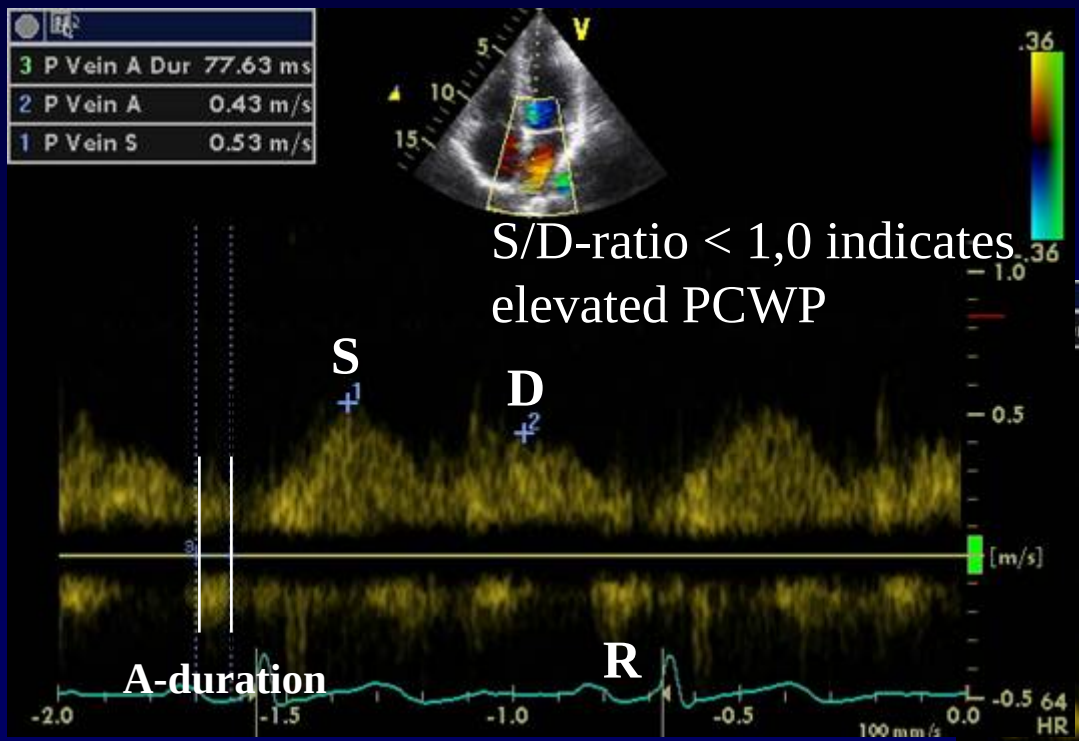
Severe LV Diastolic Dysfunction
Restrictive LV filling

- LV mass and size ⬆
- LV relaxation impaired
- LV stiffness increased
- LV filling - ⬆ early
  ⬇ atrial
- LA size and pressure greatly increased

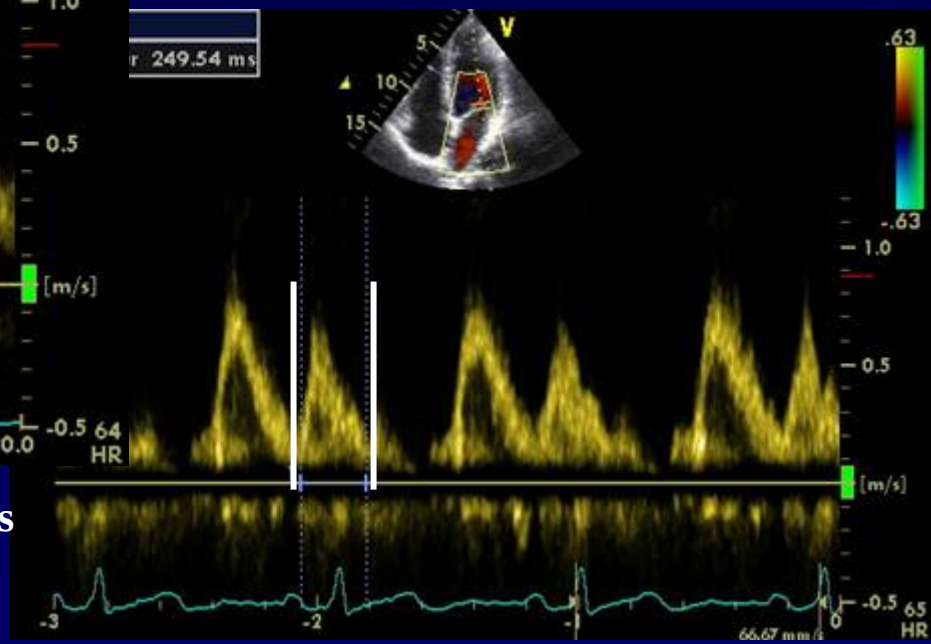




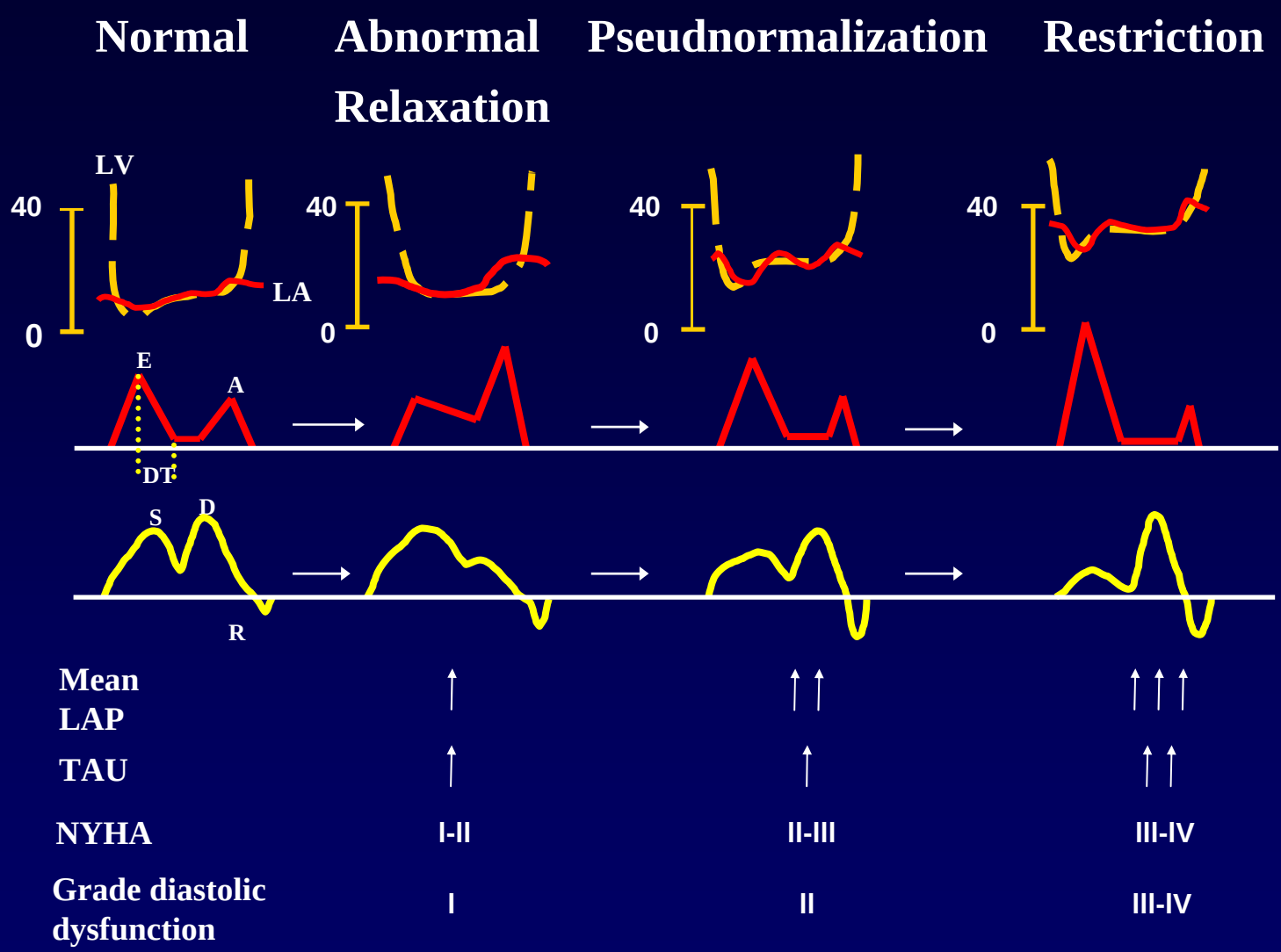
Pulmonary venous flow analysis



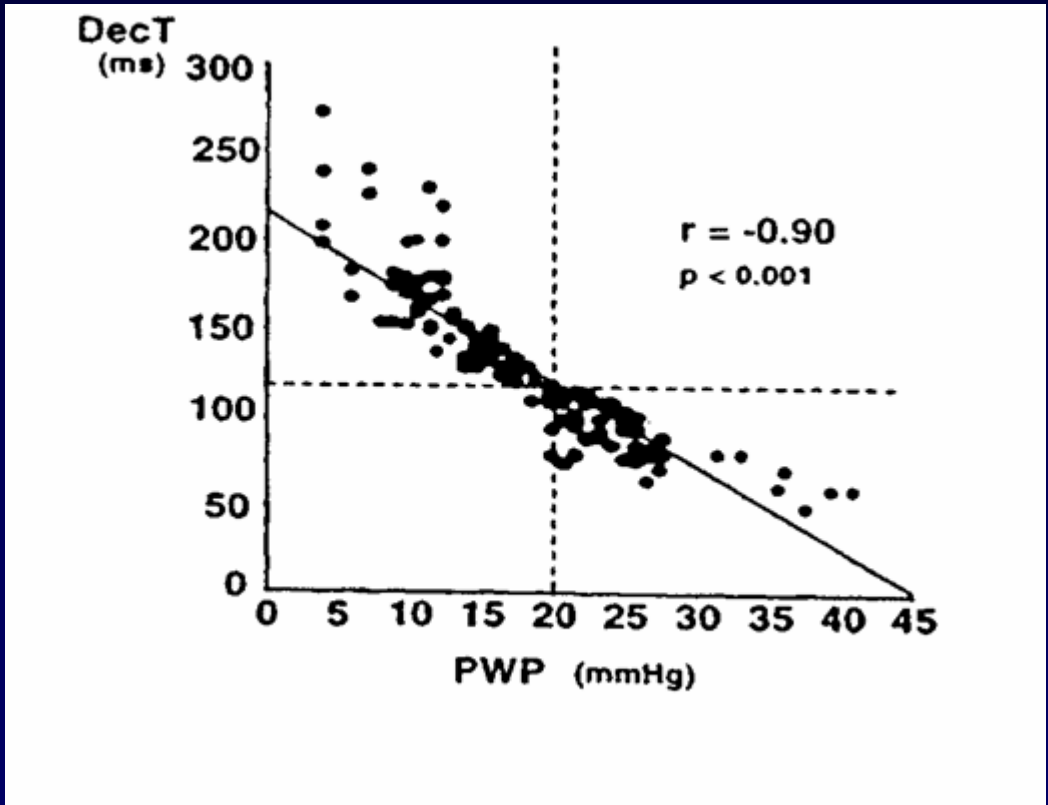
S/D-ratio < 1,0 indicates elevated PCWP



Mitral A duration – Pulmonary A duration < 0 ms indicates elevated PCWP

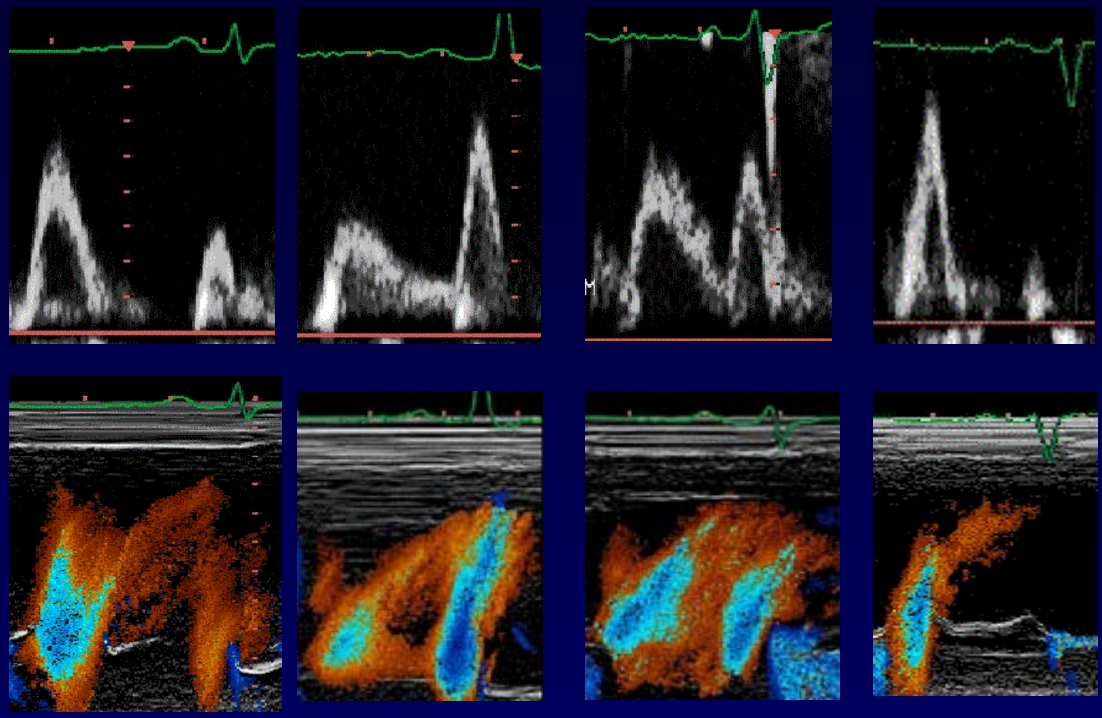

Normal
Abnormal Relaxation
Pseudnormalization
Restriction
LV
LA
40
0
E
A
DT
S
D
R
Mean LAP
TAU
NYHA
I-II
II-III
III-IV
Grade diastolic dysfunction
I
II
III-IV

Mitral E deceleration tid
Relation til PCWP



JACC 1994;23:1630-7

New indices
Color M-flow propagation



A. Normal

B. Impaired-relaxation

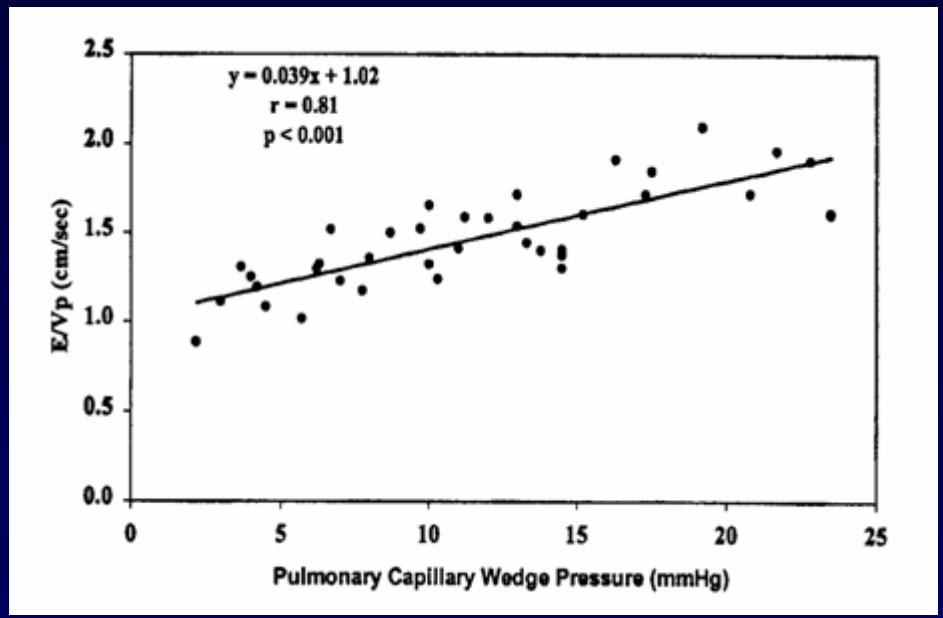
C. Pseudo-normal

D. Restrictive

Vp < 45 cm/s

JACC 2000;36:1841-6

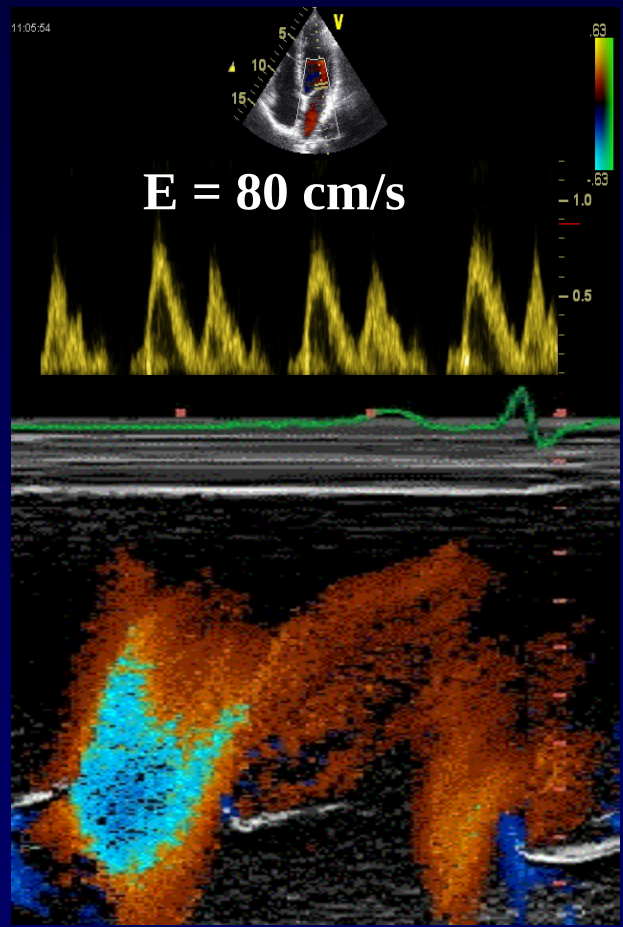
E/Vp ratio & PCWP



JACC 2000;36:1664-9

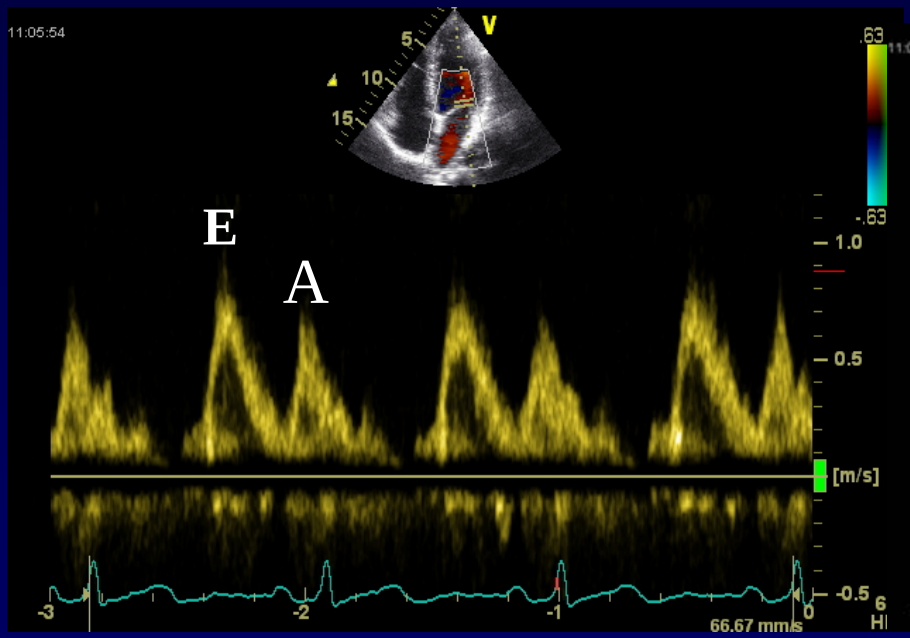
E/Vp ratio > 1,5

indicates elevated PCWP

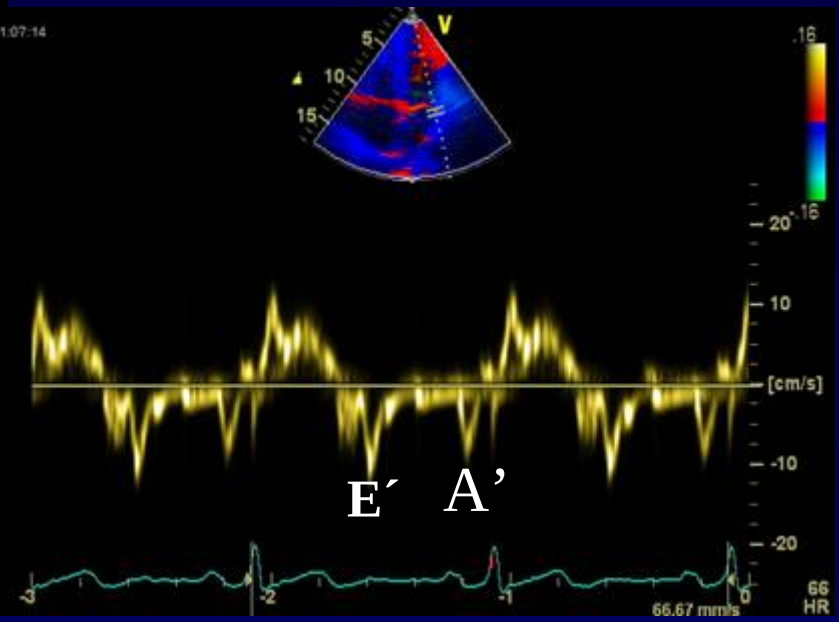


E/Vp = 1,2

Assessment of the E/E´ratio



Mitral E peak velocity



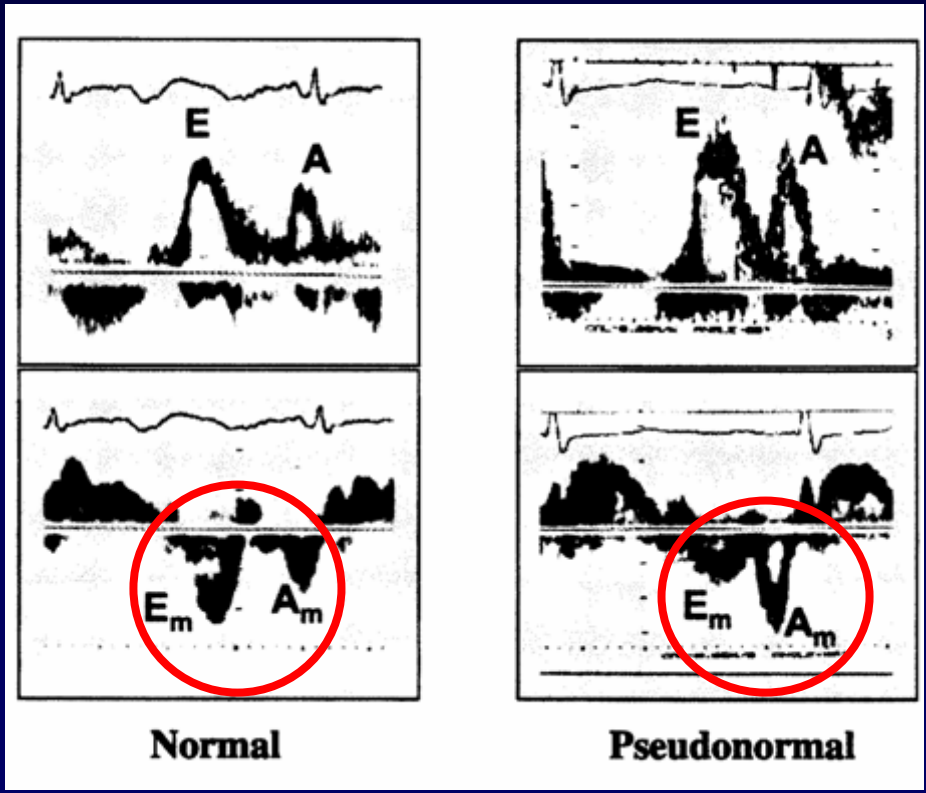
Pulsed TDI lateral mitral annulus

Pseudonormalization
Pulsed TDI

Mitral flow

Pulsed TDI

Lateral annulus

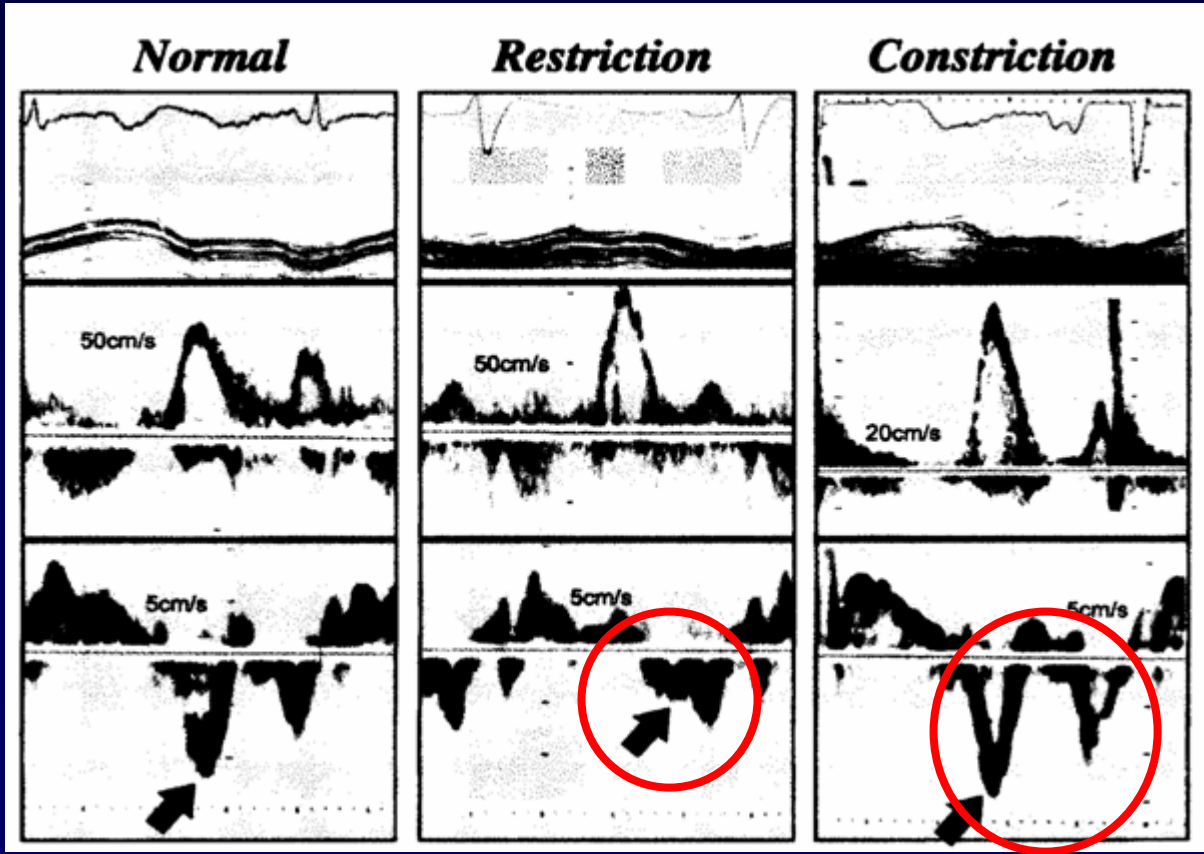


Constriction vs Restriction

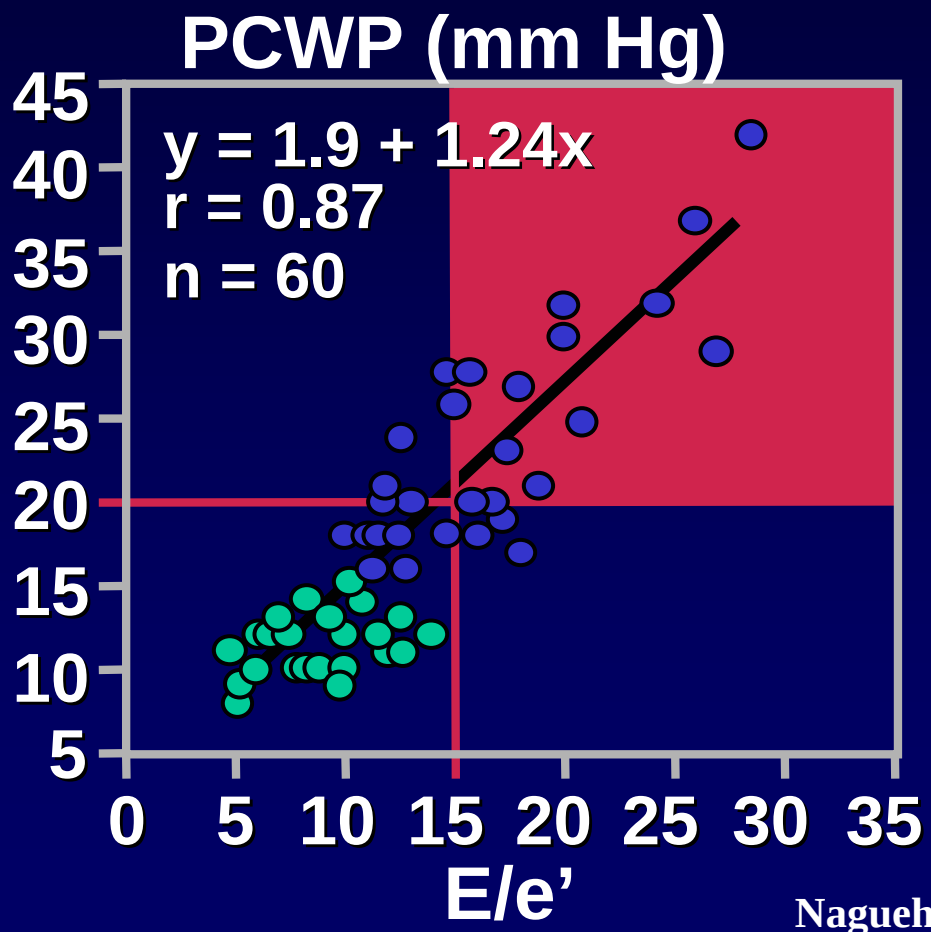
Mitral flow

Pulsed TDI

Lateral annulus



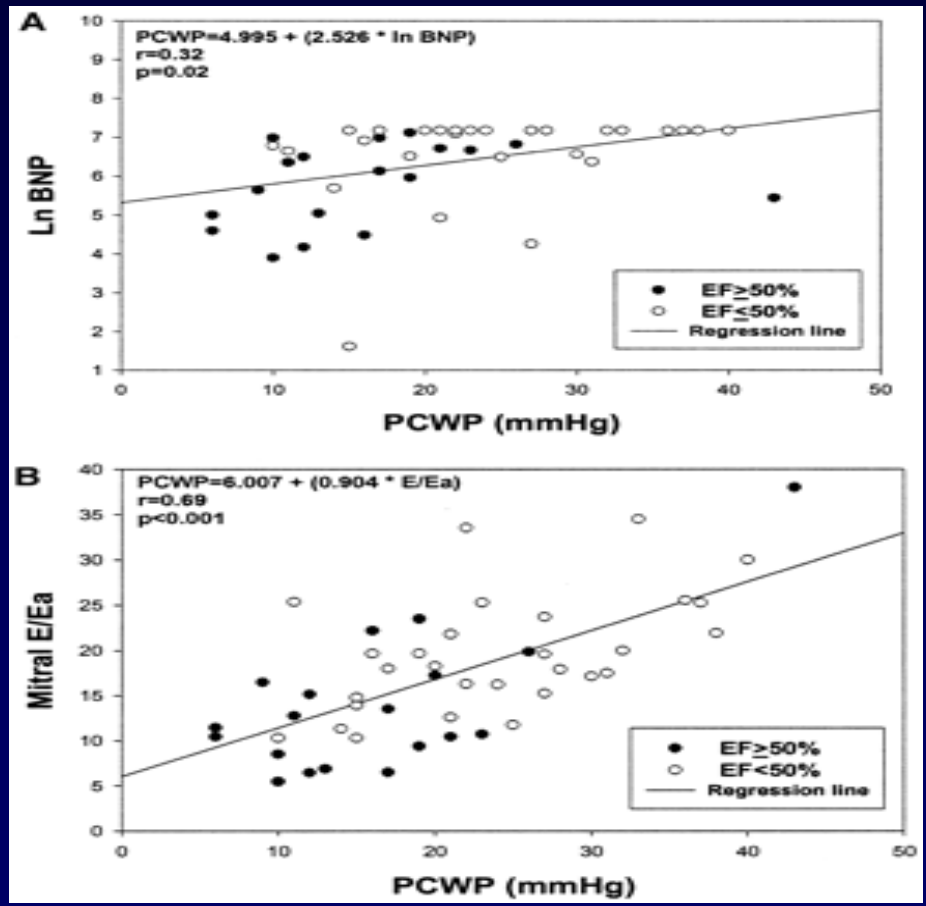
E/E' & PCWP



Nagueh et al,
J Am Coll Cardiol 1997;30:474-480

E/E´ & PCWP
LVEF

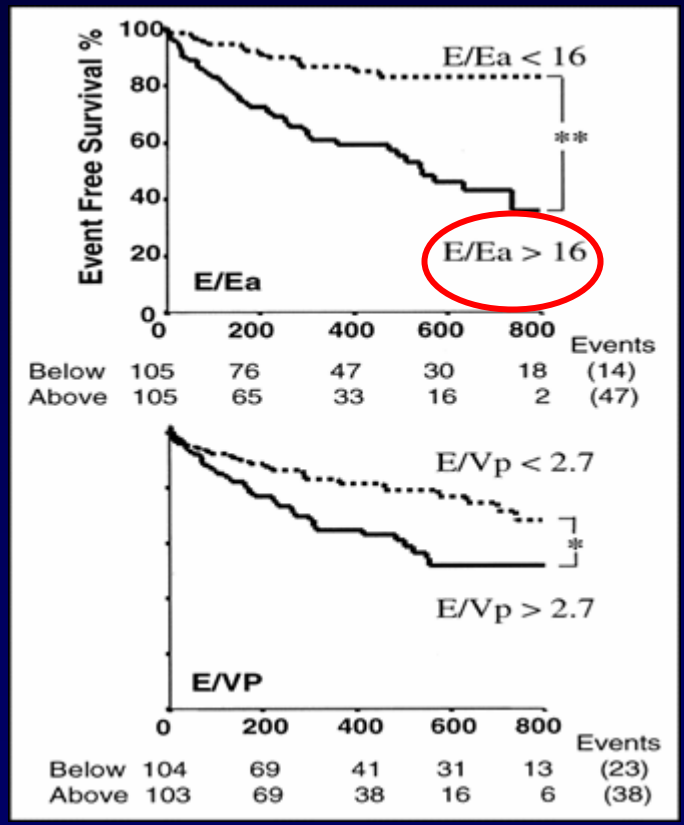
LVEF > & < 50 %



Circulation

2004,109:2432-2439

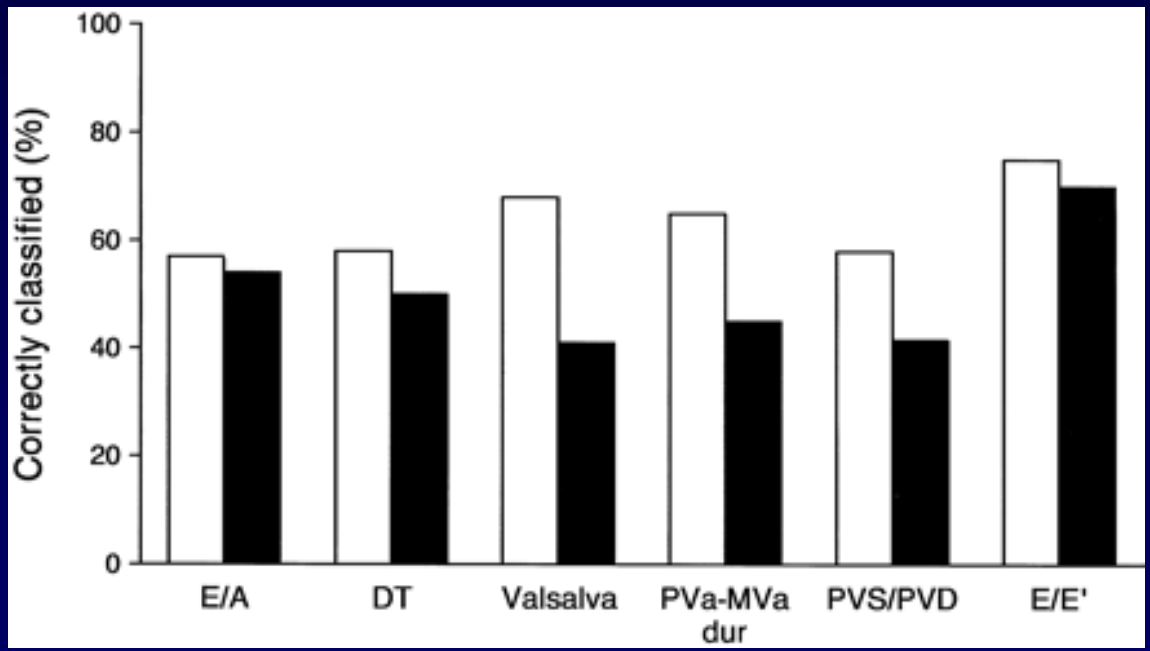
Prognostic implications of E/E´ CHF



Am J Cardiol

2005; 96:257-262

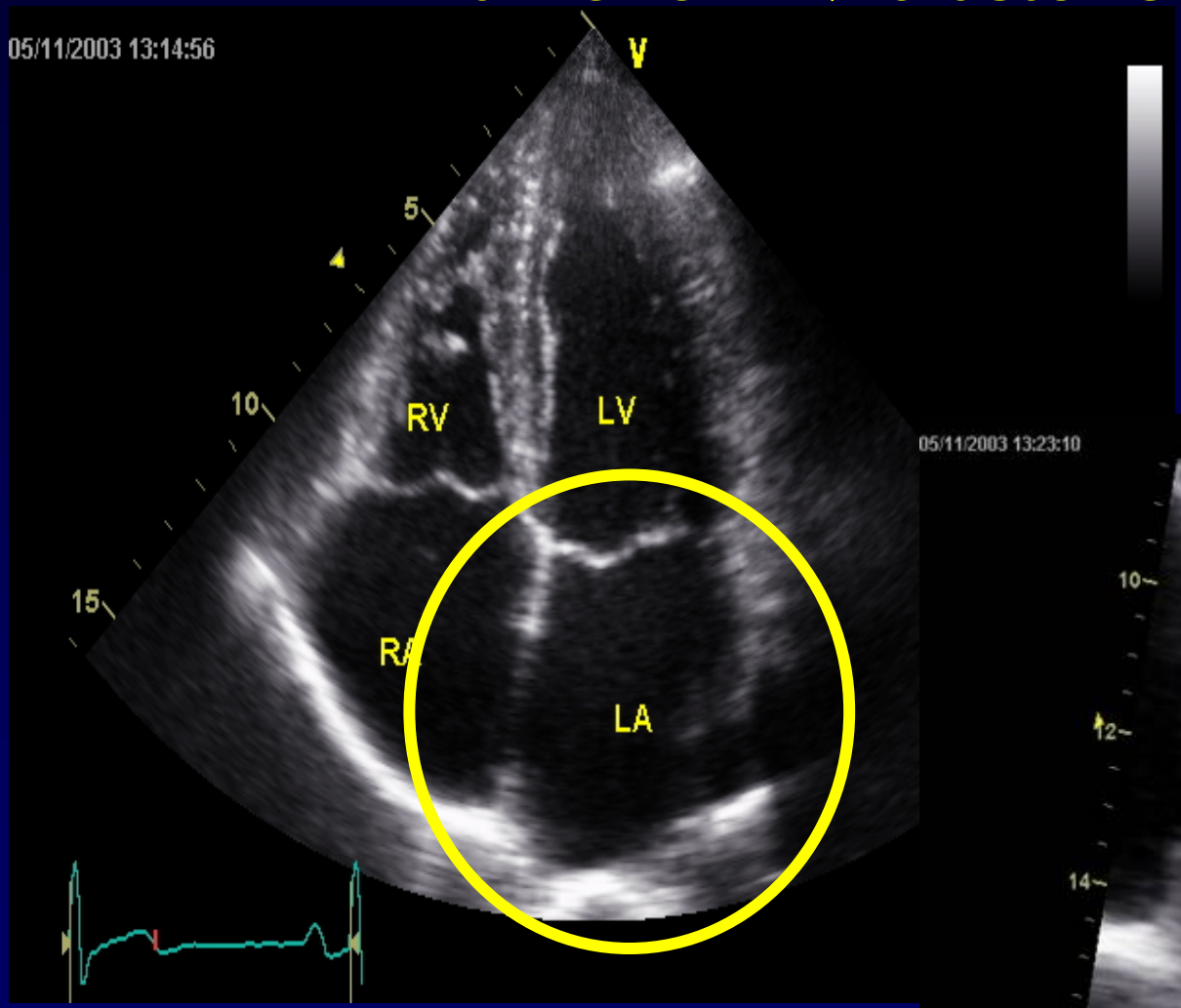
Value of diastolic filling parameters
PCWP

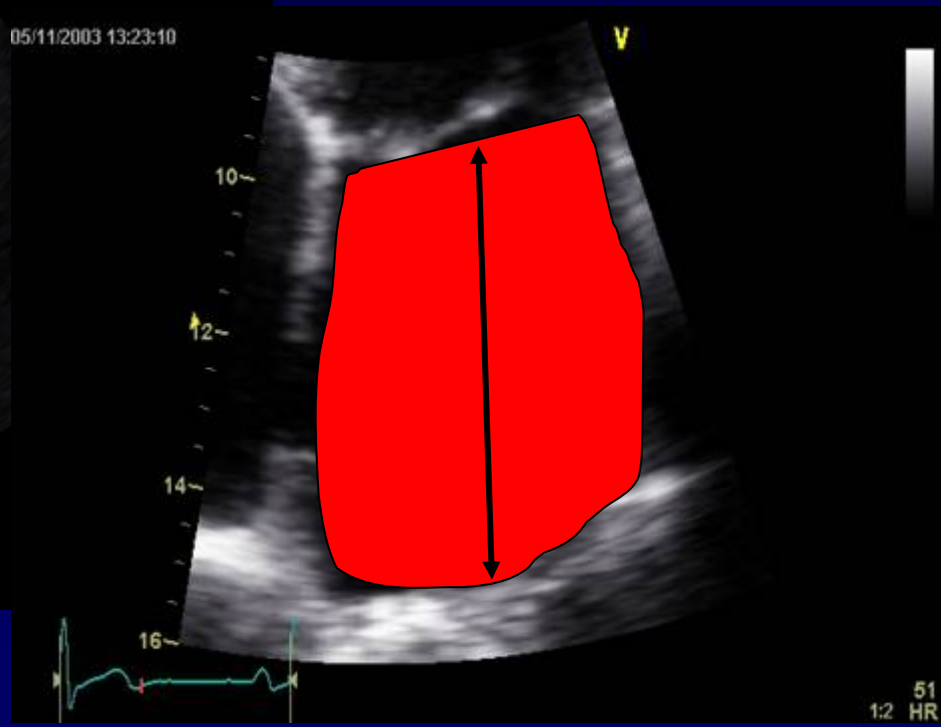


Circulation 2000

102:1788-1794

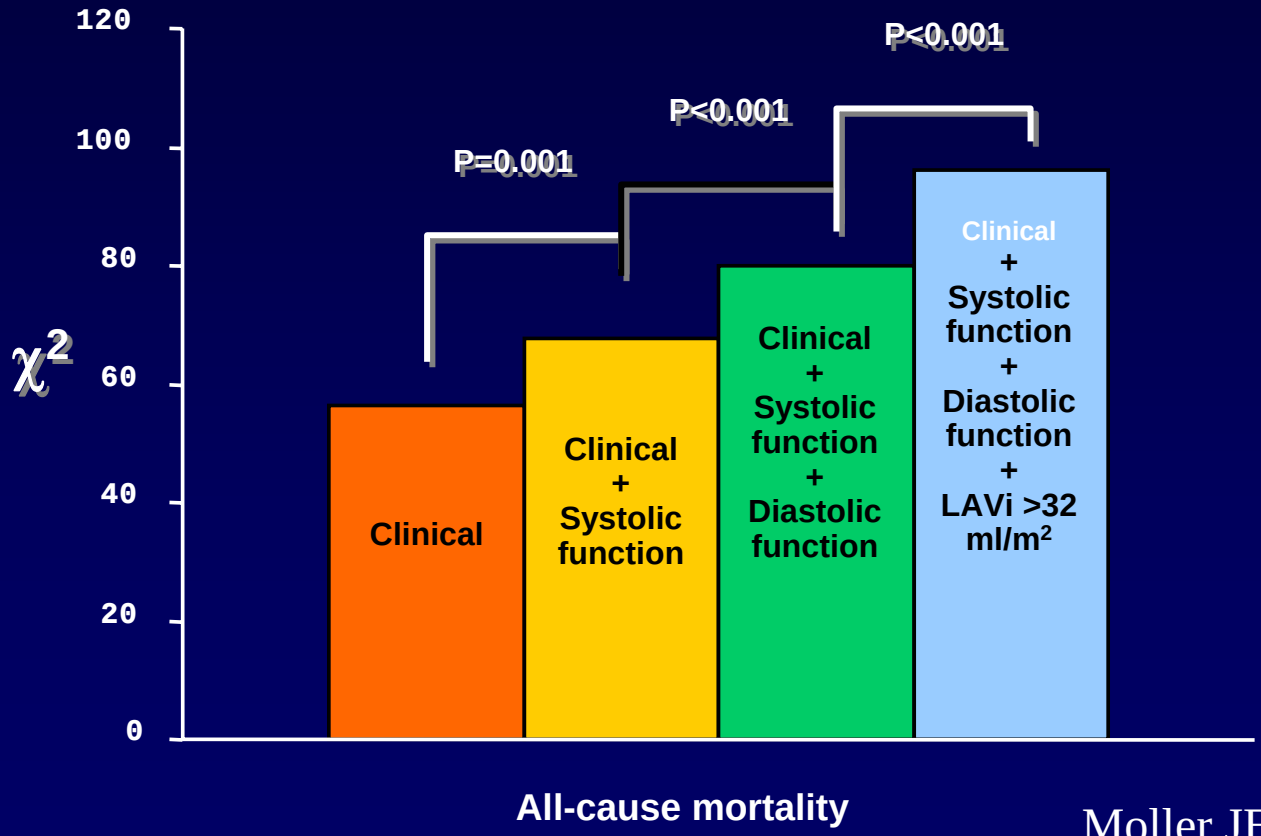
Left atria volume
Marker of LV diastolic filling





LA VOLUME INDEX AND SURVIVAL

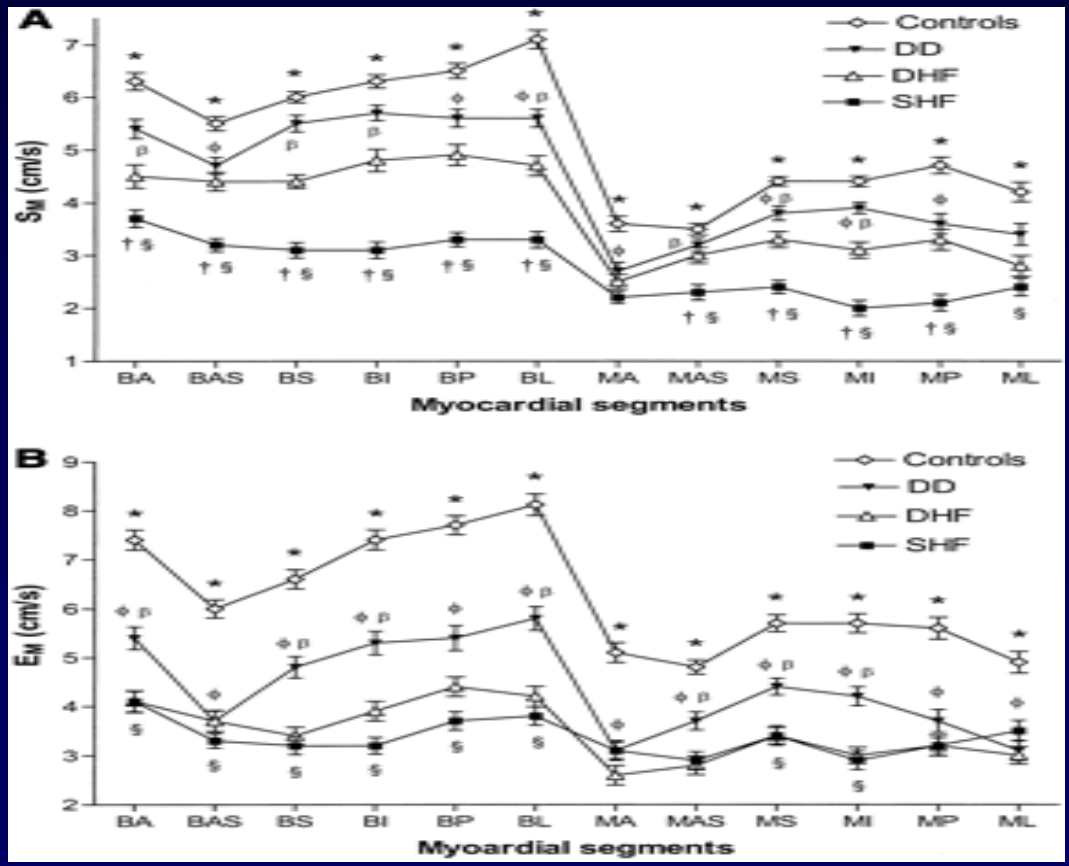
LA-volumen
AMI & prognosis



Moller JE et al

Circulation 2003

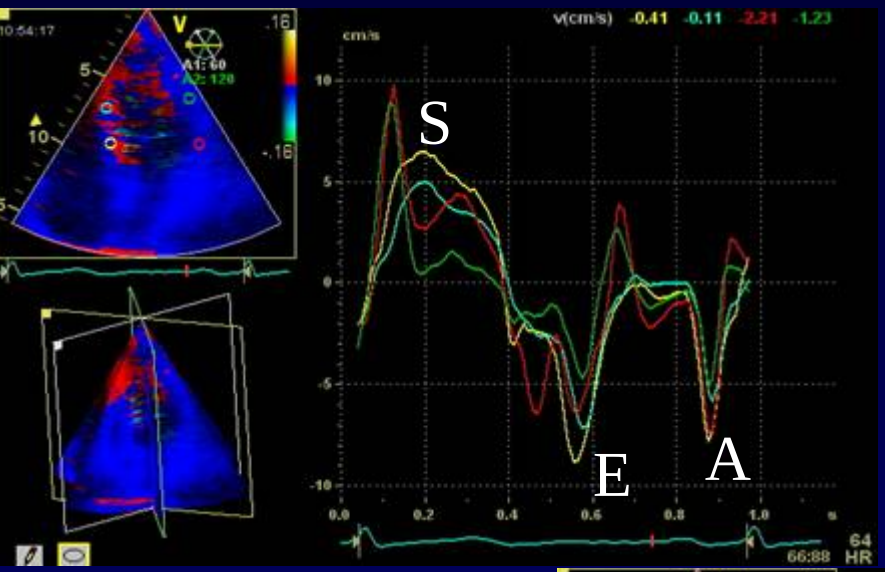
Systolic abnormalities in ”isolated” Diastolic Heart Failure



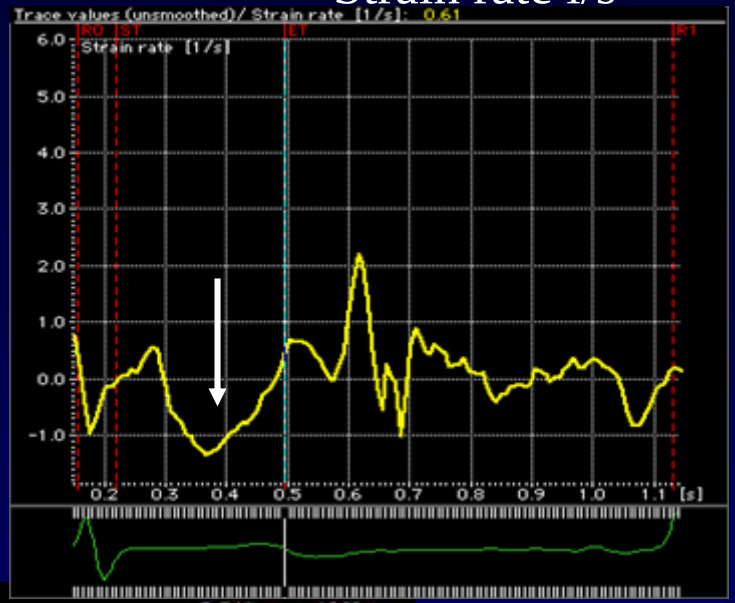
Circulation
2002;105:1195

LV longitudinal systolic analysis (TDI)

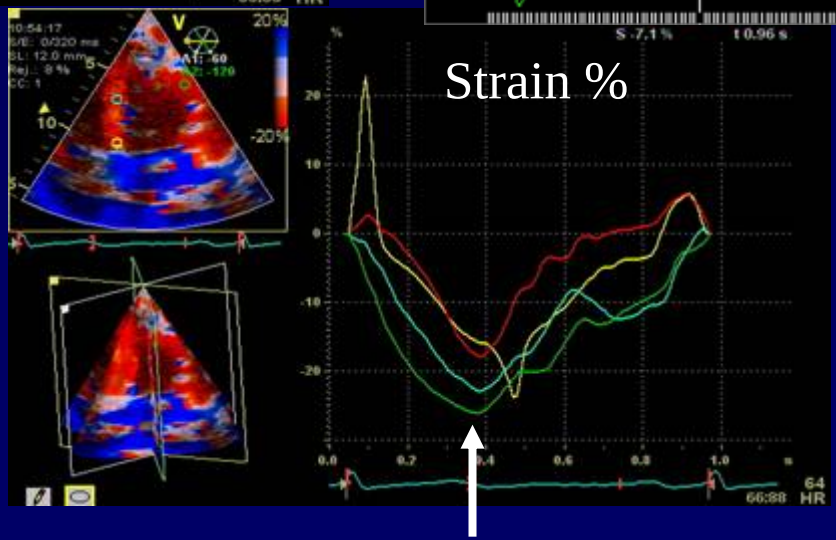
Systolic velocity cm/s



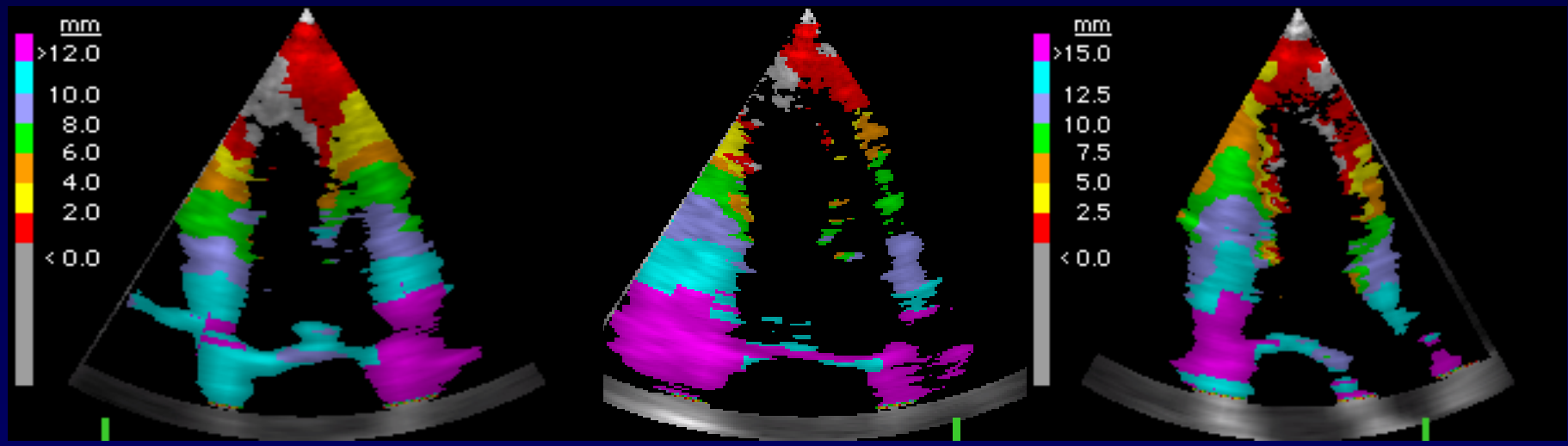
Strain rate l/s



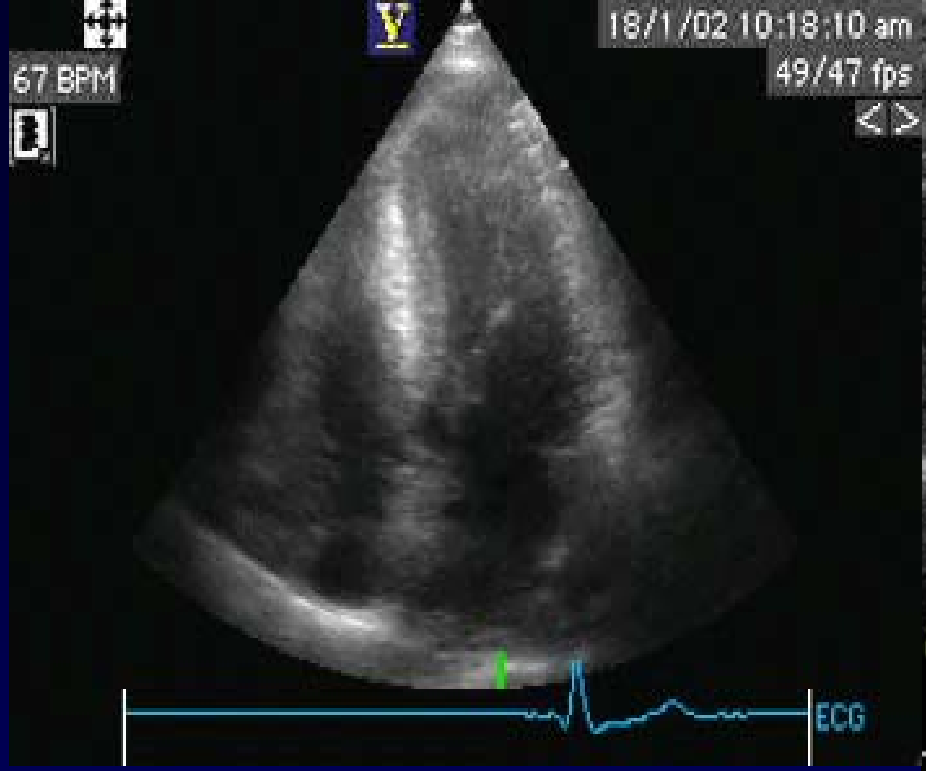
Strain %

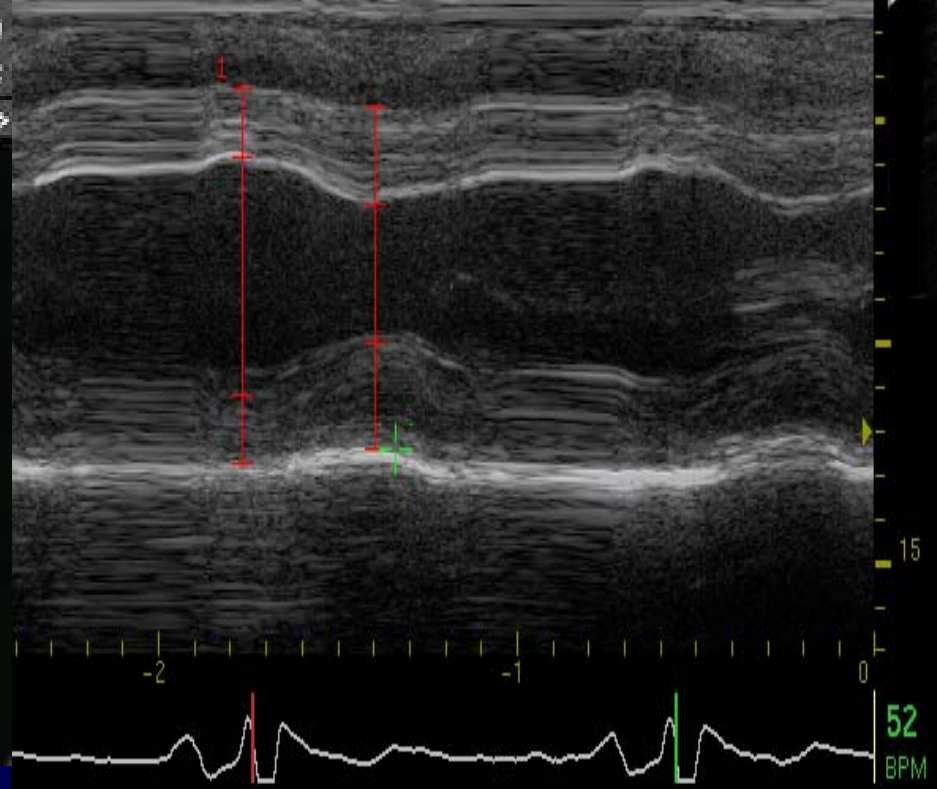


Longitudinal systolic function
Tissue tracking
(displacement)



Normal





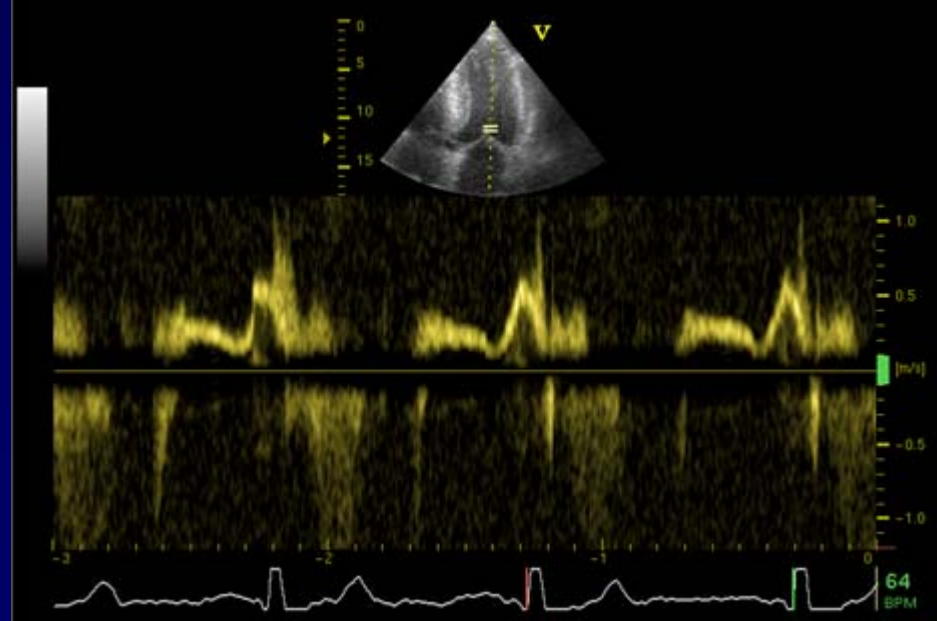
EDD = 5,2 cm

FS= 36 %

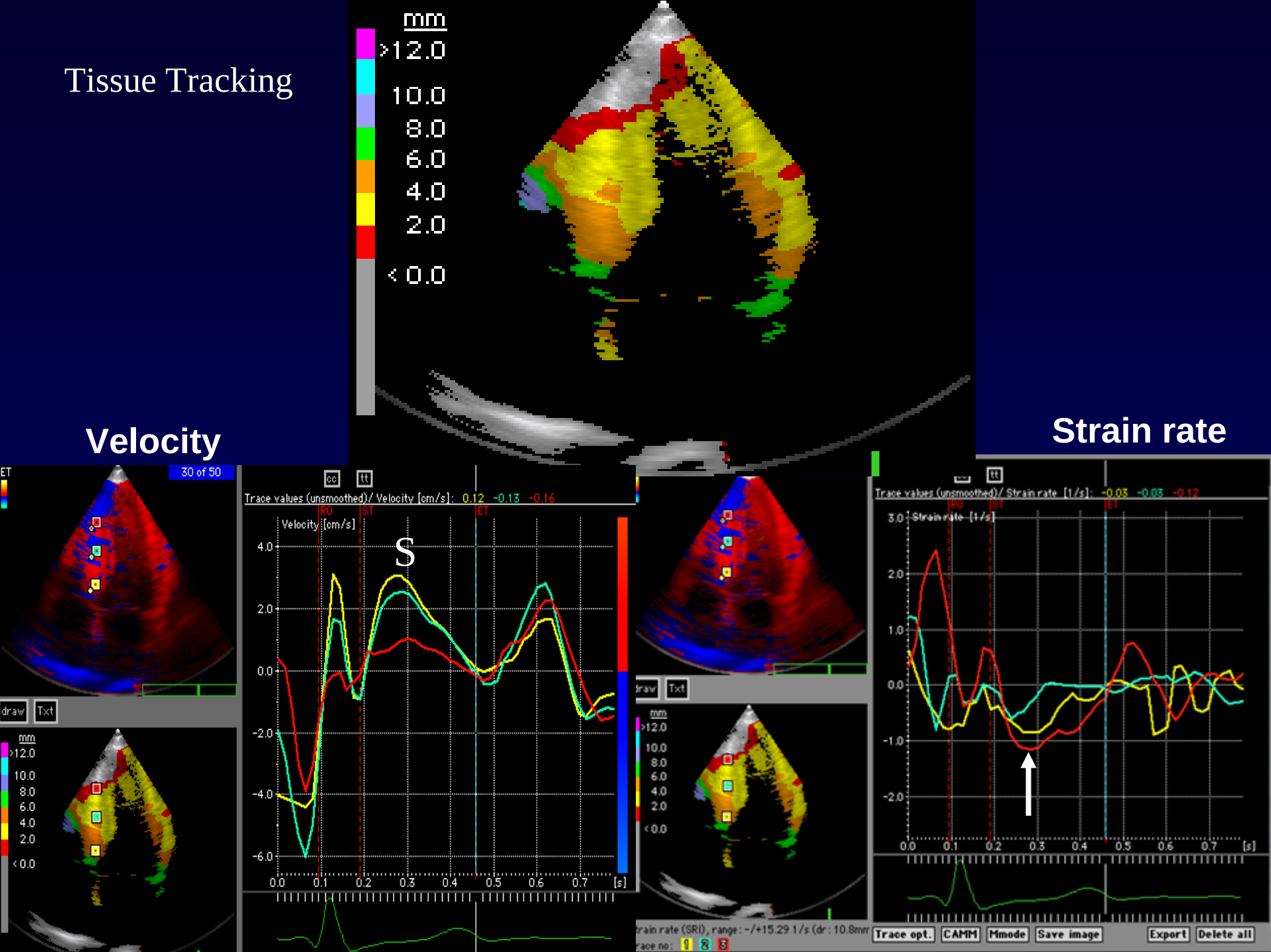
EF= 73 %

LVMI = 181 g/m2

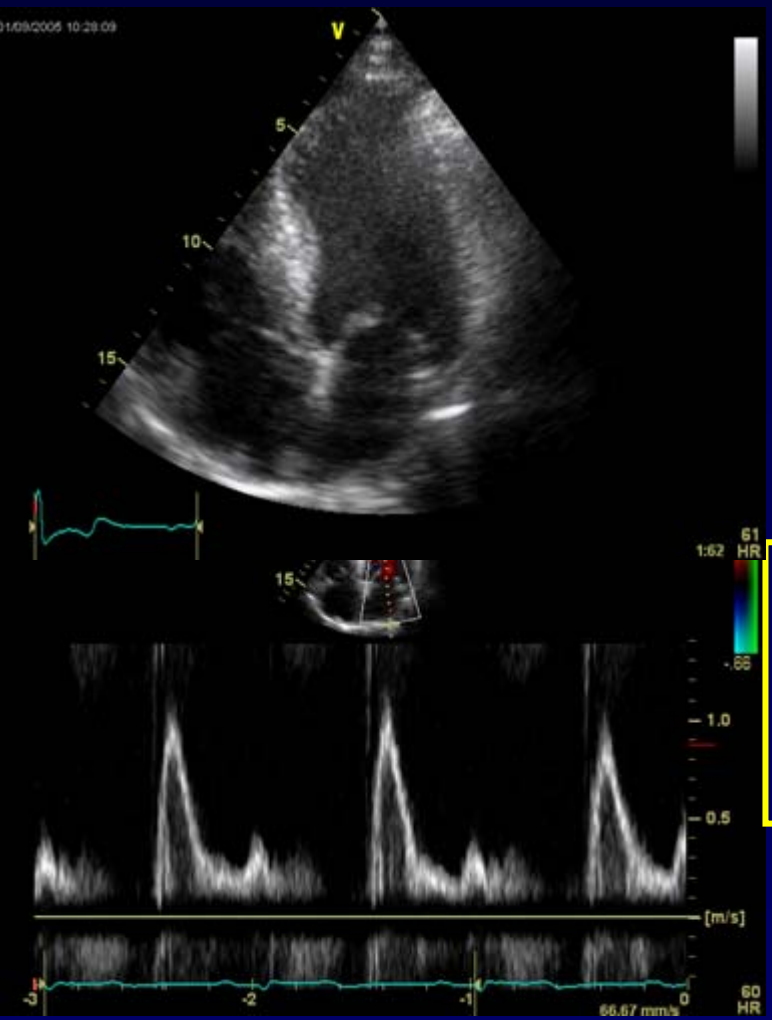
Impaired relaxation



Tissue Tracking



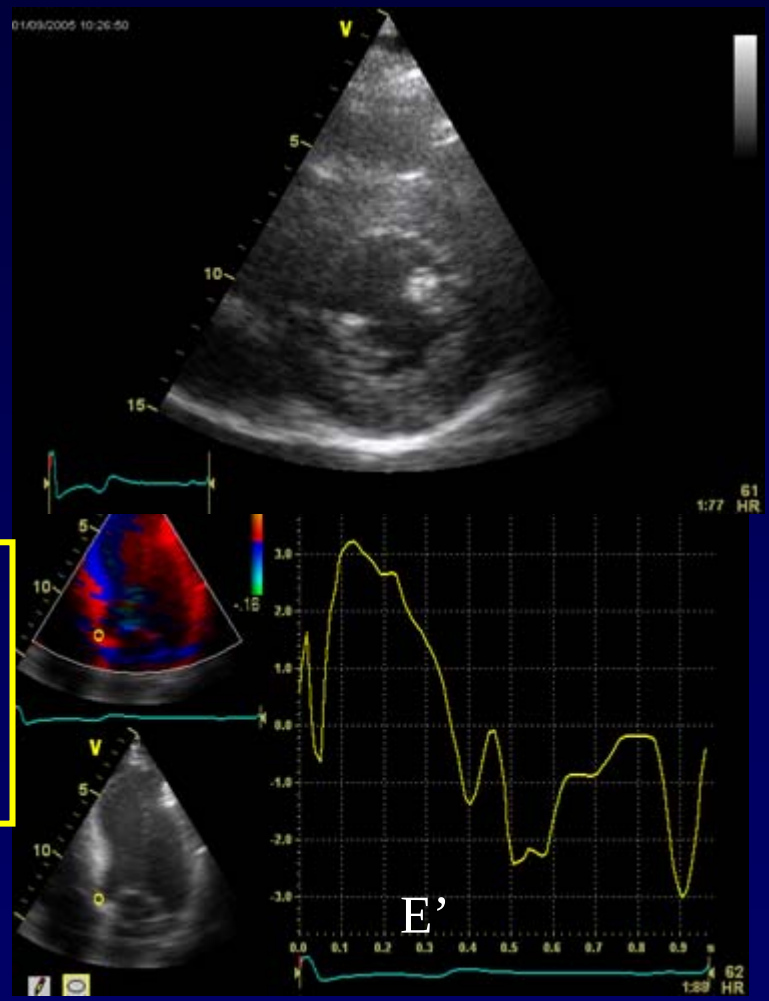
Diabetes mellitus & hypertension
NYHA II, LVEF > 60 %



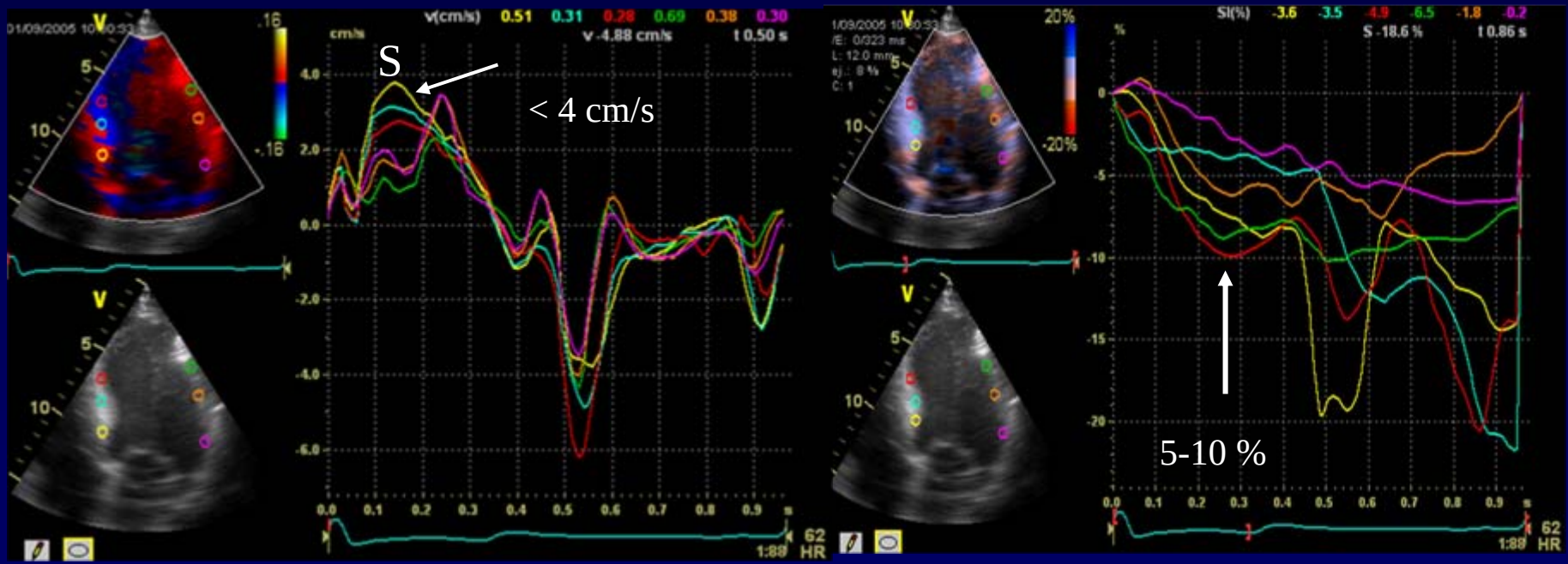
E/A = 3,0

DT =140 ms

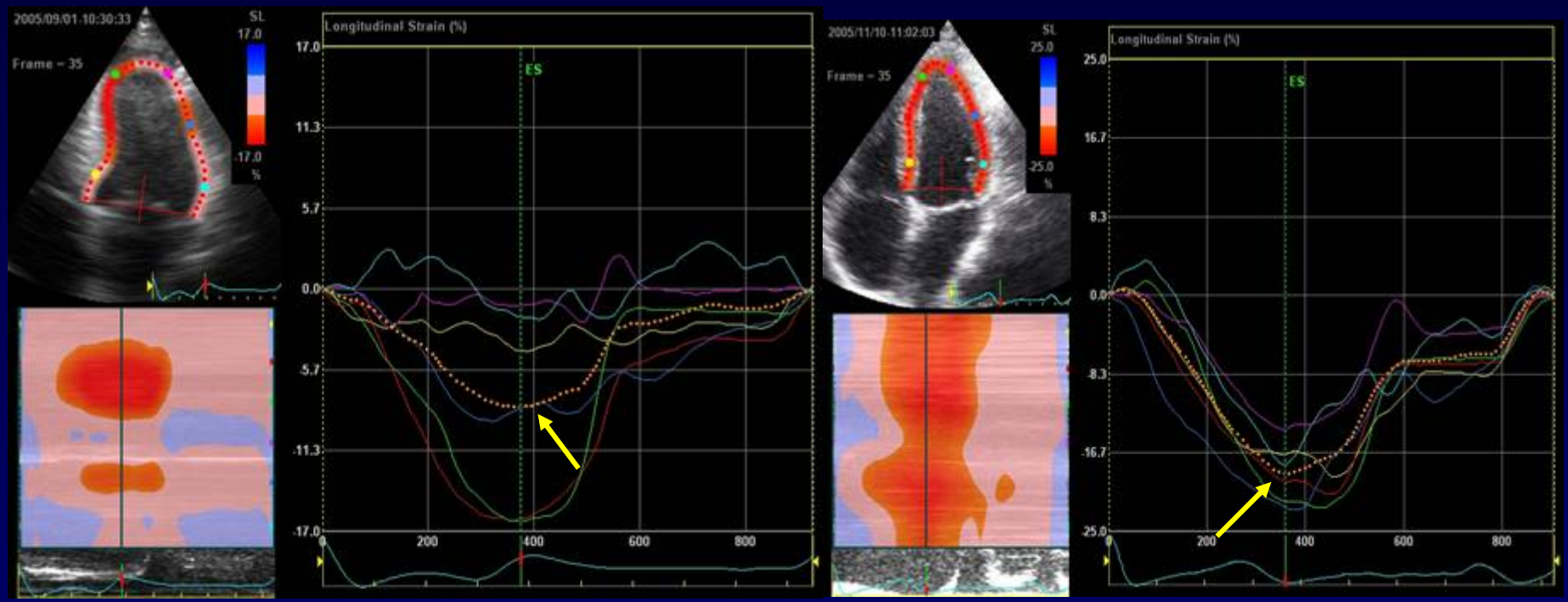
E/E’ = 34



LV longitudinal systolic function
Velocity & strain



2D LV longitudinal systolic strain



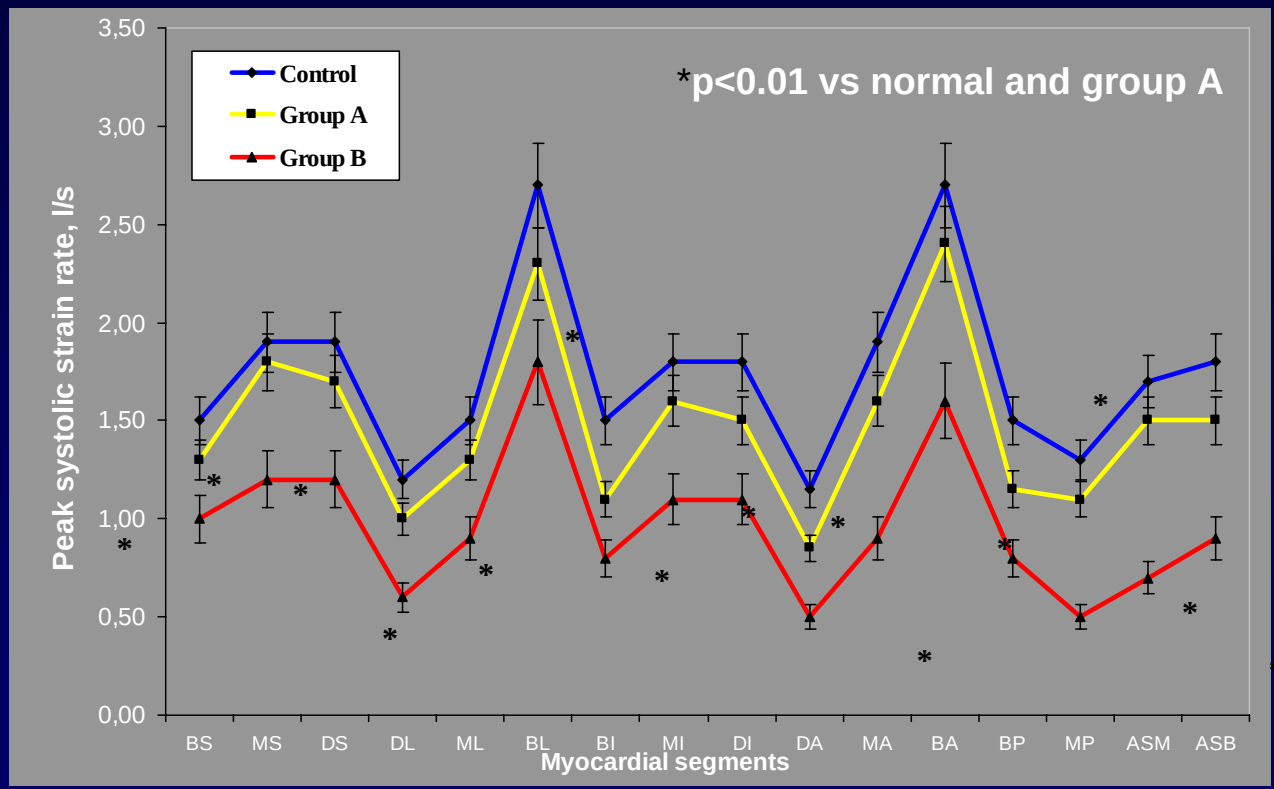
Patient

Mean 2D strain = 7 %

Normal subject

Mean 2D strain = 19 %

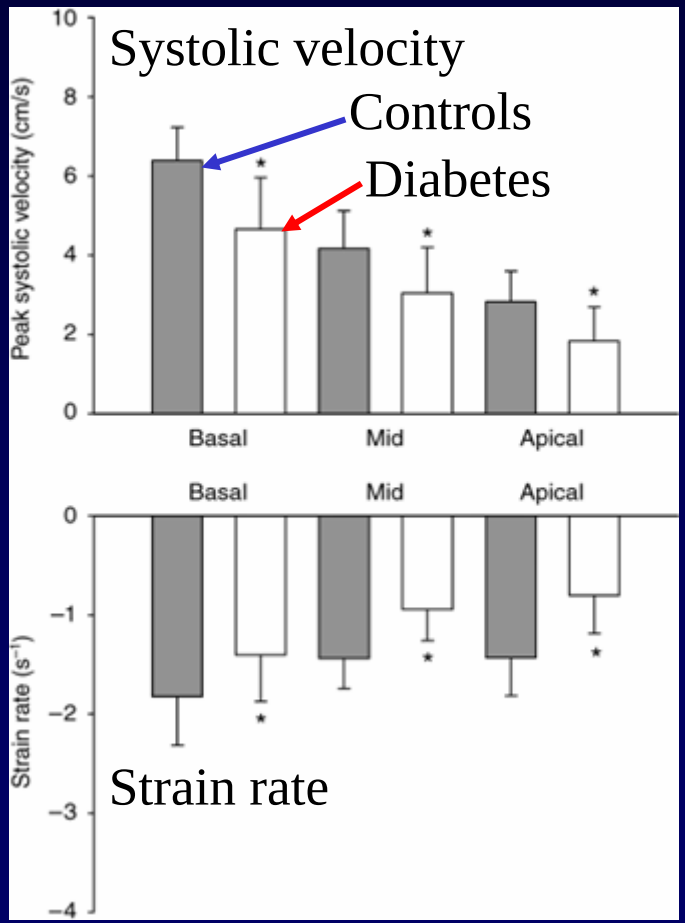
Hypertension
With or without abnormal diastolic LV filling
LV longitudinal deformation

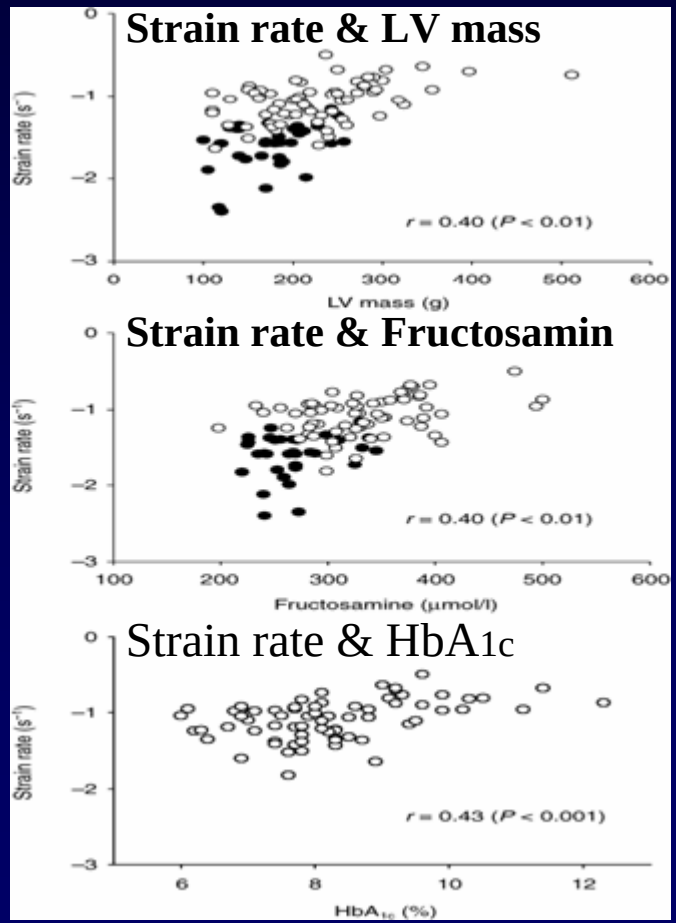


Poulsen et al

JASE 2000

LV longitudinal systolic function
Diabetes Mellitus Type 2





Diabetes medicine 2005

Andersen NH & Poulsen SH

Conclusions

- LV diastolic filling can be evaluated by measurements of peak E/A ratio, E deceleration time, E/E´, Vp & E/Vp.
- If possible pulmonary venous flow (S/D-ratio) analysis can be added.
- Evaluation of patients with suspected *”Diastolic Heart Failure”* should include LV longitudinal deformation analysis as abnormal LV longitudinal systolic dysfunction will often be present..