# The recovery of LV diastolic function after AMI can be predicted with diastolic reserve during exercise echocardiography

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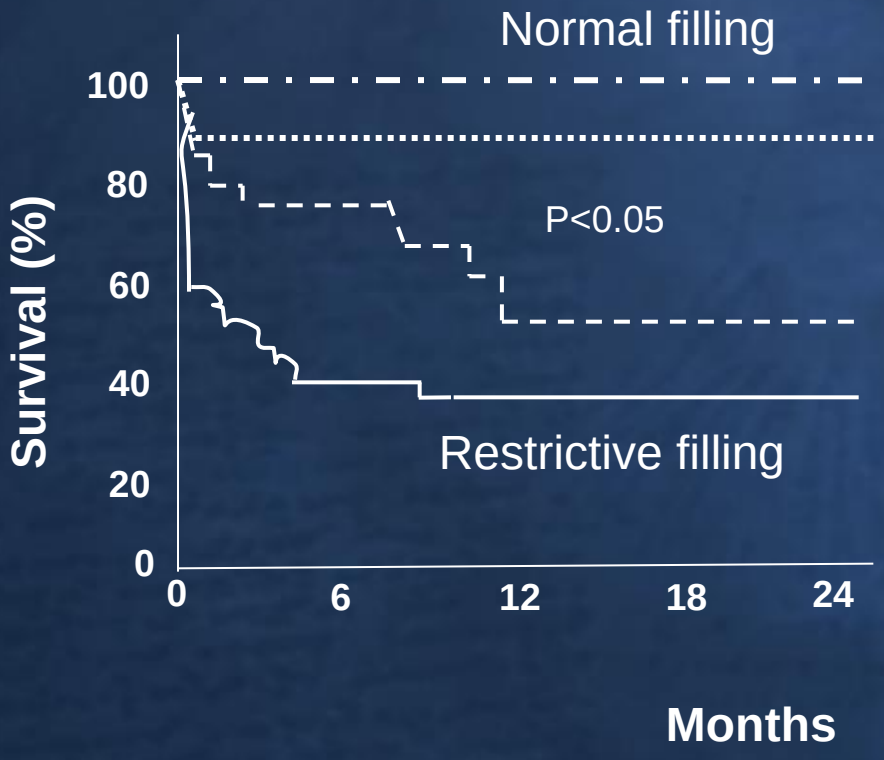
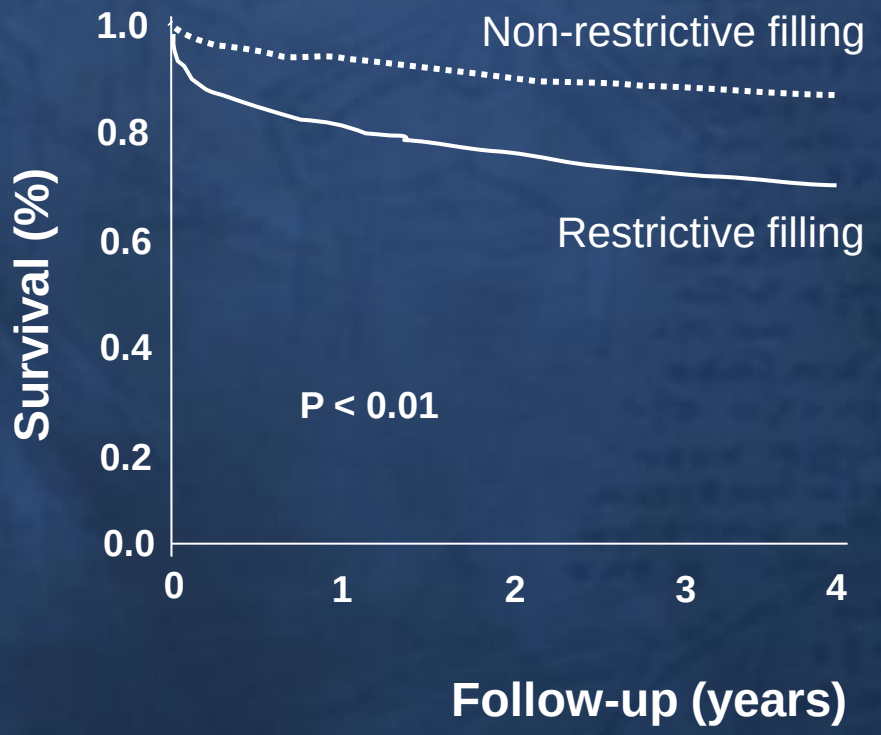
# Stress echocardiography after AMI

- **Stress (exercise or pharmacological) echocardiography can be used to assess ischemia and viability using WMSI, LVEF**
- **Residual ischemia : poor outcome**
- **Viability (contractile reserve) : spontaneous recovery of function and good outcome**

*Picano E et al. JACC 1995;26:908–13*
*Sicari R et al. JACC 1997;29:254–60.*
*Pierard LA et al. JACC 1990;15:1021–31*
*Picano E et al. Circulation 1998;98:1078–84*

# Prognostic importance of a LV filling pattern after AMI




*Moller JE et al. JACC 2000;36(6):1841-6*

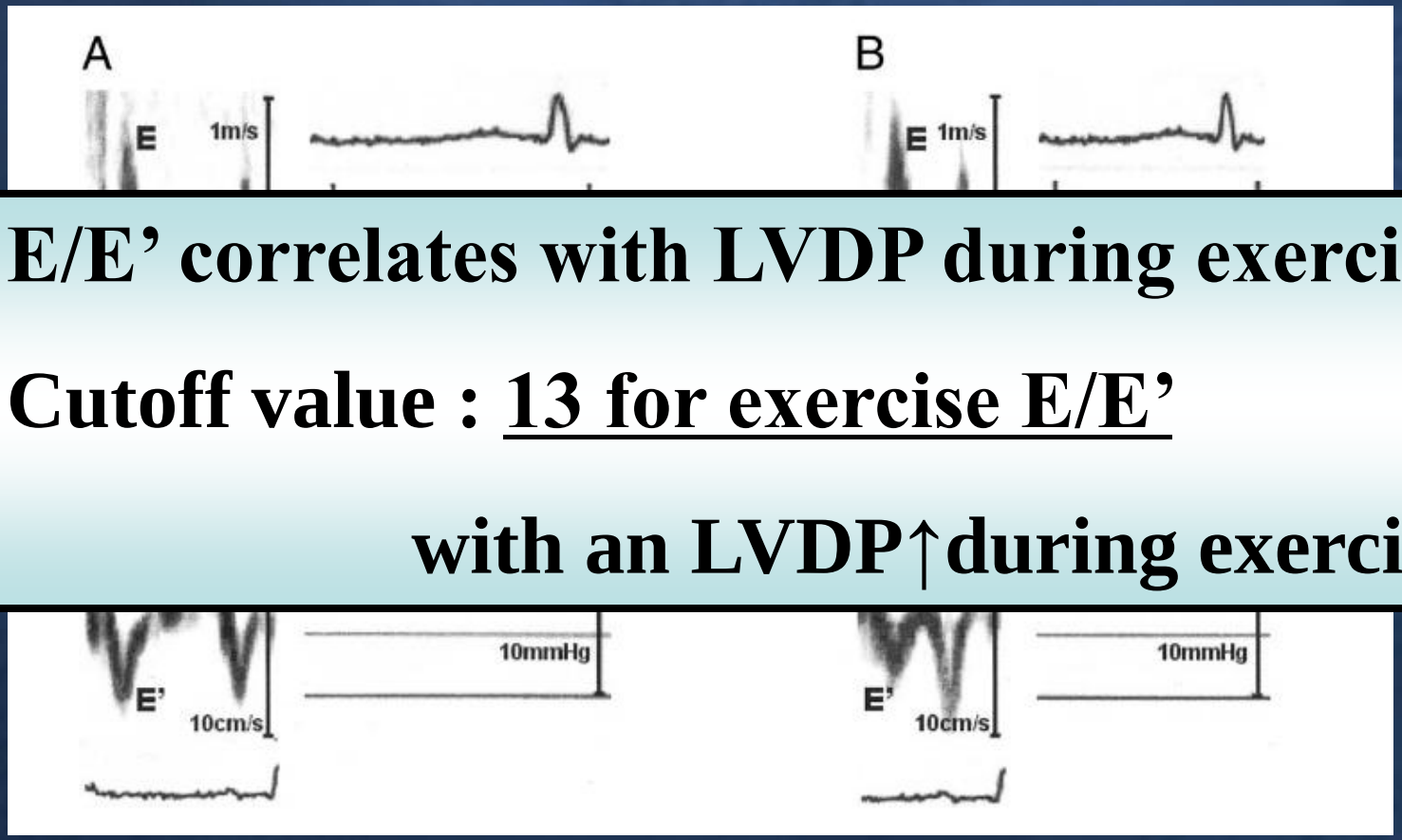
*MeRGE AMI collaborators. Circulation 2008;117(20):2591-8*

# Diastolic vs. systolic function as a predictor of outcome after primary PCI

| f/u LVEF (%) | Univariate | | Multiple regression | |
|---|---|---|---|---|
| | r | p value | $R^2$ | p value |
| Baseline DT | 0.61 | 0.002 | 0.39 | 0.002 |
| WMSI | -0.52 | 0.01 | | |
| LVEF | 0.50 | 0.01 | 0.54 | <0.02 |
| S’ | 0.36 | 0.1 | | |
| E | 0.36 | 0.1 | | |
| E / E’ | | | 0.66 | 0.02 |

*Naqvi TZ et al. AJC 2006;97:160-6*

# Diastolic function during exercise




**1. E/E' correlates with LVDP during exercise**

**2. Cutoff value : <u>13 for exercise E/E'</u>**

**with an LVDP↑during exercise**

*Burgess MI et al. JACC 2006;47:1891-900*

# Background

- Exercise is more physiological and therefore a preferred method for stress testing
- Reduced ventricular compliance and inappropriately elevated filling pressure

  after AMI are important causes of DOE and early termination of exercise
- Few studies about the changes of LV diastolic function during exercise in pts with AMI

# Objectives

- **We sought to assess *dynamic changes of diastolic function*, including LV filling pressure using Doppler imaging *during exercise* and *its impact on recovery of diastolic function* in patients with coronary revascularization after AMI**

# Methods (1)

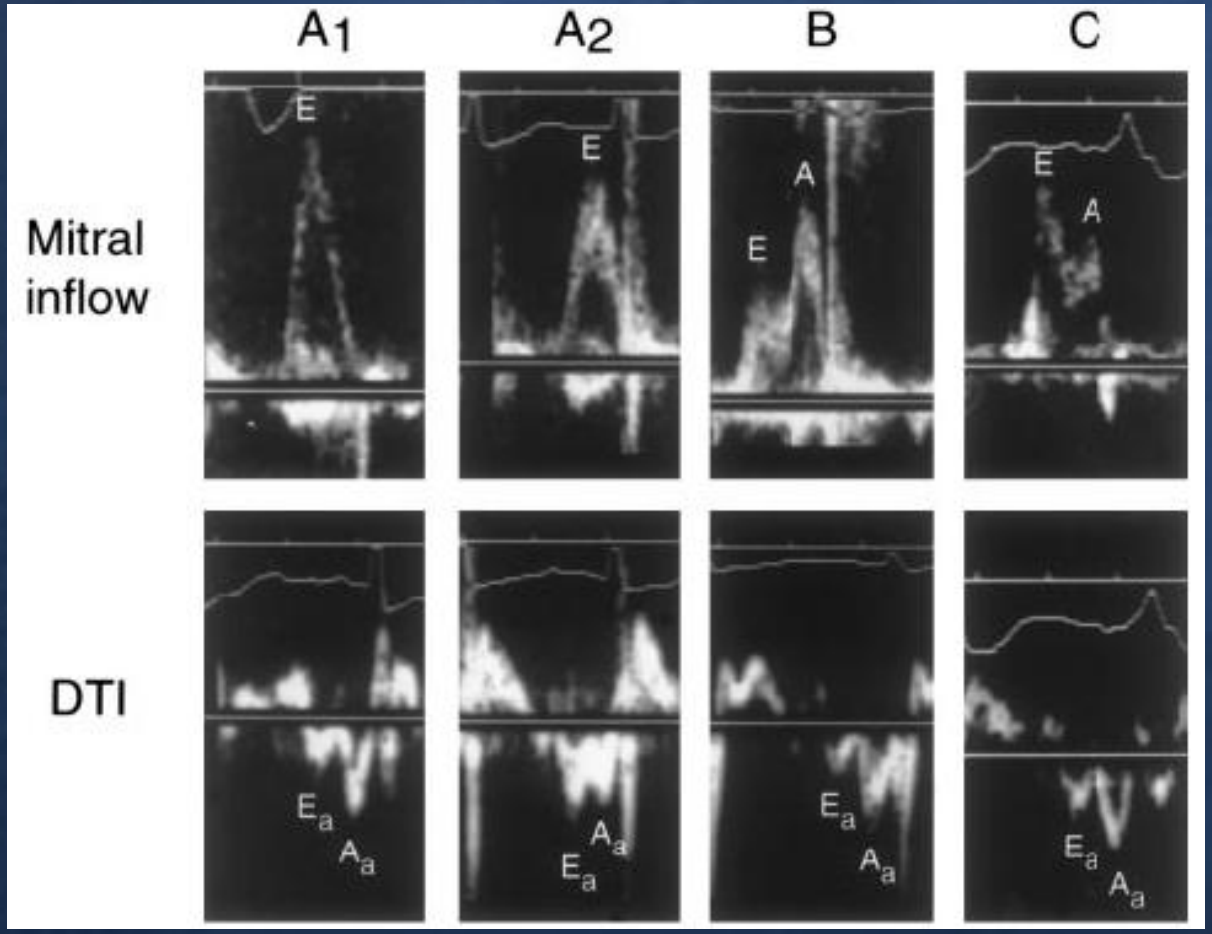
- 51 male patients with first ST-elevation AMI
- After within 7 days after revascularization
- Vivid 7, GE Medical Systems, EchoPac PC
- Exclusion criteria :

  significant VHD, CHF, RCA MI (involve basal septal wall)
- Conventional & tissue Doppler parameters were measured at baseline and peak exercise during semisupine stress echocardiography

  (25W, 3-minute increments)
- Echo follow up after 6-8months with optimal medical treatment

# Methods (2)

- E/E' can be used to estimate PCWP with reasonable accuracy in tachycardia, even with complete merging of E & A velocities




*Nagueh SF et al. Circulation 1998;98:1644-50*

# Baseline clinical characteristics

- 51 male patients presenting with AMI

| | Mean |
|---|---|
| Age (years) | 52.3 ± 9.0 |
| Duration of chest pain (min) | 206 ± 213 |
| BMI (kg/m$^2$) | 25.2 ± 2.43 |
| DM / HTN / Smoking (%) | 22 / 41 / 76 |
| SBP / DBP (mmHg) | 123 ± 17.1 / 76 ± 11.5 |
| AMI lesion | |
| LAD / LCx | 39 / 12 |
| Beta blockers (%) | 49 (96%) |
| TIMI 2/3 flow after PCI | 3 / 48 (94%) |

# Laboratory findings

| | Mean (n=51) |
|---|---|
| T.Chol (mg/dl) | 189.3 ± 51.8 |
| TG (mg/dl) | 141.8 ± 105.0 |
| HDL (mg/dl) | 37.0 ± 8.0 |
| LDL (mg/dl) | 118.6 ± 38.4 |
| Hs-CRP (mg/dl) | 0.66 ± 1.25 |
| BNP (pg/ml) | 172.5 ± 183.6 |
| Glucose (mg/dl) | 168.8 ± 74.9 |
| CK-MB | 38.3 ± 70.4 |
| Peak TnT level (ug/L) | 2.63 ± 3.89 |
| Creatine (mg/dl) | 1.22 ± 0.75 |

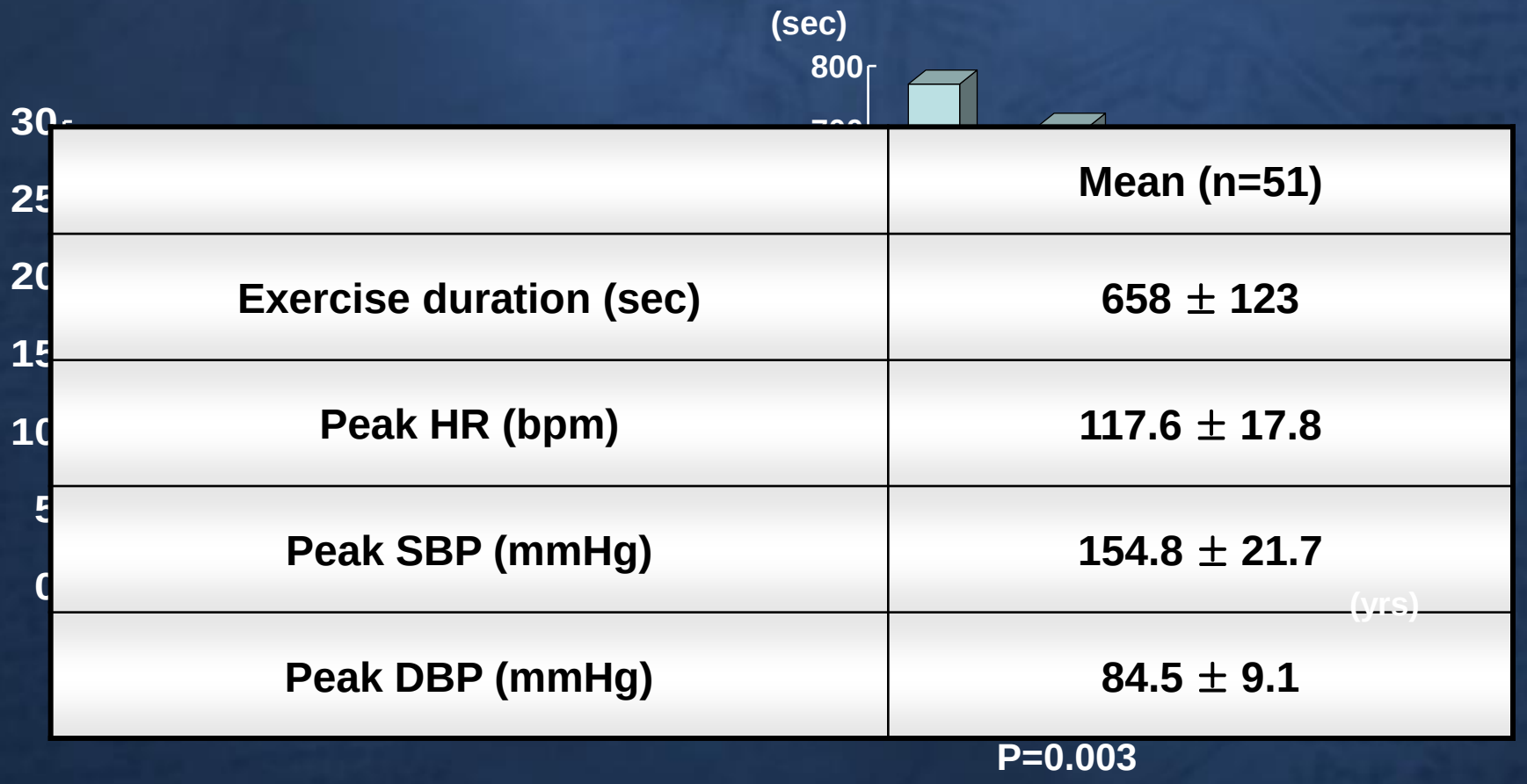
# Baseline echocardiographic characteristics

| | Mean |
|---|---|
| LVIDd (mm) | 48.4 ± 3.4 |
| IVSd / PWd (mm) | 10.6 ± 1.35 / 10.0 ± 1.25 |
| EF (%) | 45.4 ± 19.9 |
| LVMI (g/m$^2$) | 118.3 ± 24.4 |
| LAVI (ml/m$^2$) | 24.7 ± 6.4 |
| E / A (cm/sec) | 65.3 ± 14.8 / 66.0 ± 15.2 = 1.12 ± 0.33 |
| DT (sec) | 212.7 ± 37.7 |
| E’ / A’ (cm/sec) | 5.93 ± 1.35 / 7.83 ± 1.61 |
| E / E’ | 11.2 ± 2.41 |
| S’ (cm/sec) | 7.14 ± 1.53 |
| RVSP (mmHg) | 25.7 ± 4.40 |

# Exercise capacity

- Peak exercise (watts)

- Duration of exercise (sec) by ages




| | Mean (n=51) |
|---|---|
| Exercise duration (sec) | 658 ± 123 |
| Peak HR (bpm) | 117.6 ± 17.8 |
| Peak SBP (mmHg) | 154.8 ± 21.7 |
| Peak DBP (mmHg) | 84.5 ± 9.1 |

P=0.003

# The changes in Doppler parameters during peak exercise

| | Baseline | Peak exercise |
|---|---|---|
| E (cm/sec) | 65.3 ± 14.8 | 113.8 ± 11.8 |
| A (cm/sec) | 66.0 ± 15.2 | 83.9 ± 18.7 |
| DT (sec) | 212.7 ± 37.7 | 160.1 ± 28.1 |
| E’ (cm/sec) | 5.83 ± 1.46 | 8.14 ± 1.57 |
| A’ (cm/sec) | 7.83 ± 1.61 | 9.62 ± 2.13 |
| E / E’ | 11.2 ± 2.14 | 14.5 ± 3.47 |
| S’ (cm/sec) | 7.14 ± 1.53 | 8.96 ± 2.29 |
| RVSP (mmHg) | 25.7 ± 4.40 | 52.3 ± 16.7 |

# The changes in Doppler parameters after 6 months

| | baseline | 6M later | P value |
|---|---|---|---|
| E (cm/sec) | 65.3 ± 14.8 | 62.7 ± 13.2 | 0.014 |
| A (cm/sec) | 66.0 ± 15.2 | 64.7 ± 16.4 | < 0.001 |
| DT (sec) | 213 ± 37.7 | 221 ± 41.2 | 0.758 |
| E’ (cm/sec) | 5.93 ± 1.35 | 6.20 ± 1.03 | <0.001 |
| A’ (cm/sec) | 7.83 ± 1.61 | 8.11 ± 1.46 | 0.002 |
| E / E’ | 11.2 ± 2.41 | 10.3 ± 2.32 | 0.001 |
| S’ (cm/sec) | 7.14 ± 1.53 | 7.27 ± 1.65 | 0.016 |
| RVSP (mmHg) | 25.7 ± 4.40 | 25.5 ± 2.85 | 0.381 |

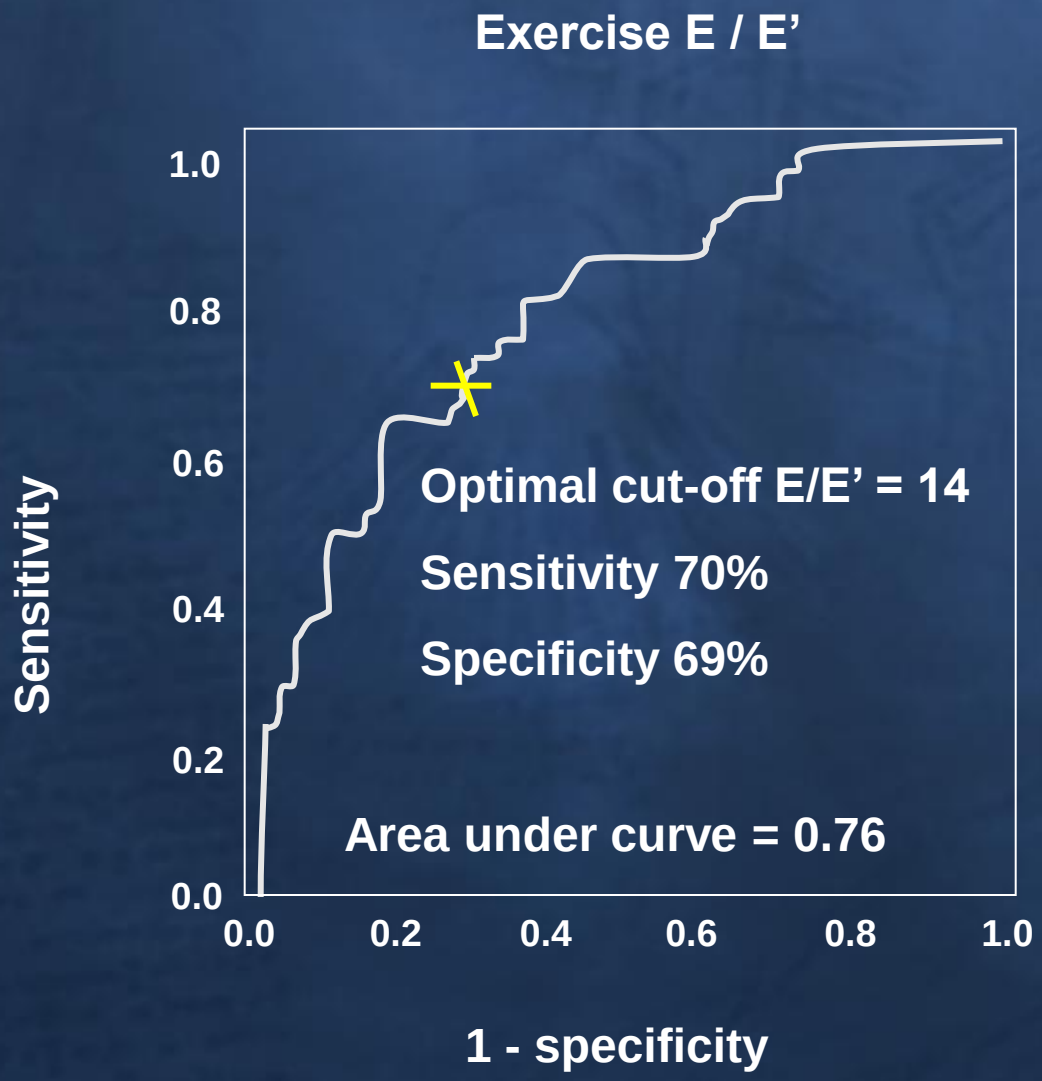
# Correlation between exercise capacity and echo variables

| | Correlation analysis | | Regression analysis (Multi) | |
|---|---|---|---|---|
| | r | p | ß | p |
| Age | -0.482 | <0.001 | -0.468 | 0.033 |
| SBP | -0.257 | 0.071 | | |
| LVMI | 0.050 | 0.730 | | |
| LAVI | -0.050 | 0.738 | -0.206 | 0.291 |
| S' rest | 0.035 | 0.807 | | |
| E' rest | 0.330 | 0.021 | | |
| E / E' rest | -0.344 | 0.014 | | |
| E' stress | 0.712 | 0.002 | 0.649 | 0.007 |
| E/E' stress | -0.572 | 0.026 | | |

# Univariate & multivariate predictors of recovery of diastolic function

| | Univariate | | Multivariate | |
|---|---|---|---|---|
| | ß | p | ß | p |
| Age | 0.287 | 0.299 | 0.210 | 0.349 |
| SBP | 0.319 | 0.247 | | |
| LVMI | -0.002 | 0.996 | | |
| LAVI | 0.029 | 0.926 | -0.208 | 0.371 |
| S' rest | -0.372 | 0.172 | -0.372 | 0.130 |
| E' rest | -0.178 | 0.526 | | |
| E / E' rest | 0.592 | 0.020 | 0.598 | 0.045 |
| E' stress | -0.755 | 0.001 | | |
| E/E' stress | 0.895 | <0.001 | 0.735 | 0.030 |

# ROC curve to predict diastolic function



# limitations

- Impaired exercise tolerance is associated with peripheral factors

  (skeletal muscle, metabolism, endothelial function, ergoreflex activation etc..)

- In merging of E & A waves, the accuracy in E/E' during exercise is not confirmed

➔ Most patients have merging after 50 watts d/t relatively slow HR with ß-blockers

# Conclusion

- **The best correlation with *exercise capacity* was *E' at peak exercise***

- **The evaluation of hemodynamic response of *diastolic function during exercise is feasible during stress echocardiography* and provides valuable information in *predicting recovery of diastolic function* in patients after AMI**

# Thank you for your attention !