Stress Echo in Assessment of Diastolic Dysfunction

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Terminology

- Diastolic dysfunction
- Diastolic heart failure
- Heart failure with normal ejection fraction
- Heart failure with preserved ejection fraction

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Co-morbidities a/w HFNEF

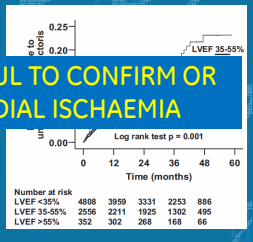
- Hypertension
- Diabetes
- Renal impairment
- Older age

Also a/w coronary artery disease

Diagnosis of Ischaemia

- Diastolic dysfunction and HFNEF frequently a/w coronary artery disease (40 – 50%)
- High risk of hospitalisation
- DIG trial

STRESS ECHO IS USEFUL TO CONFIRM OR EXCLUDE MYOCARDIAL ISCHAEMIA



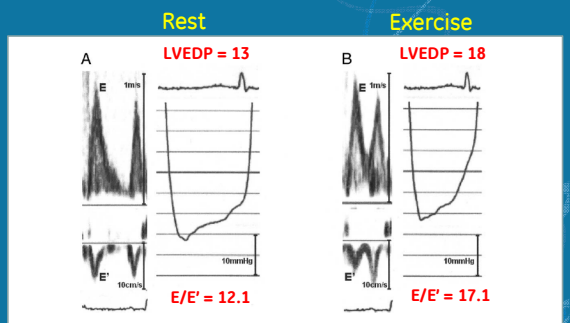
Ahmed et al. *AmJCard* 2007 99:460

Other Aims of Stress Echo

- To confirm whether abnormal diastolic filling is a cause of symptoms
  - Increased LA pressure
  - Absence of myocardial ischaemia
  - Absence of inducible valvular dysfunction

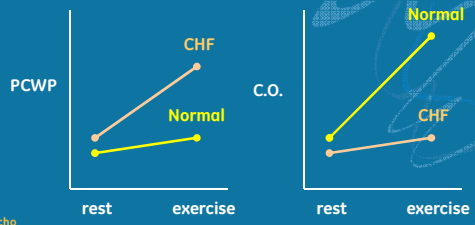
"THE DIASTOLIC STRESS TEST"

The Theory

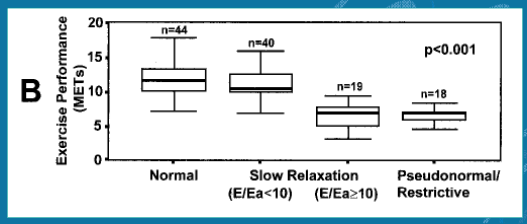


Burgess et al. *JACC* 2006 47:1891

Exercise Haemodynamics in Heart Failure



Exercise Capacity with Impaired LV Relaxation



Skaluba et al. *Circ* 2004 109:972

Exercise in Diastolic Dysfunction

- Reduced Peak Workload
- Peak Oxygen Consumption is reduced with HFNEF
- Reduced peak heart rate
- Reduced fall in systemic vascular resistance
- Greater rise in LVEDP

Maeder et al., *JACC* 2009 53:855

Recent Exercise Study

	HFNEF (n = 14)	Controls (n = 8)	p Value
LV end-diastolic volume index, ml/m^2	46 ± 8	58 ± 20	0.05
LV end-systolic volume index, ml/m^2	17 ± 3	22 ± 8	0.03
Relative wall thickness	0.41 ± 0.08	0.33 ± 0.06	0.03
LV ejection fraction, %	63 ± 6	62 ± 5	0.62
LV mass index, g/m^2	83 ± 16	95 ± 29	0.28
Left atrial volume index, ml/m^2	21.3 ± 7.0	18.9 ± 5.9	0.41
E/A ratio	0.95 ± 0.37	1.26 ± 0.55	0.13
Deceleration time, ms	224 ± 63	226 ± 80	0.94
s'_{septal}, cm/s	7.0 ± 1.2	7.8 ± 1.8	0.20
$s'_{lateral}$, cm/s	6.9 ± 1.7	8.8 ± 2.1	0.03
s'_{av}, cm/s	6.9 ± 1.2	8.3 ± 1.5	0.03
e'_{septal}, cm/s	6.1 ± 1.5	9.0 ± 3.1	0.007
$e'_{lateral}$, cm/s	7.7 ± 2.1	11.8 ± 4.5	0.008
e'_{av}, cm/s	6.9 ± 1.6	10.4 ± 3.7	0.005
E/e'_{septal}	13.2 ± 4.1	9.5 ± 3.4	0.04
$E/e'_{lateral}$	10.6 ± 3.4	7.2 ± 2.2	0.02
E/e'_{av}	11.6 ± 3.3	8.1 ± 2.5	0.02

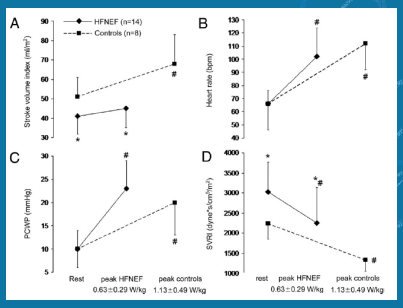
Maeder et al., *JACC* 2010:855

Haemodynamics in HFNEF

	HFNEF (n = 14)	Controls (n = 8)	p Value
Rest			
Heart rate, beats/min	66 ± 10	66 ± 20	0.97
Right atrial pressure, mm Hg	5 ± 3	5 ± 3	0.80
Mean arterial pressure, mm Hg	100 ± 7	101 ± 17	0.90
Mean pulmonary artery pressure, mm Hg	18 ± 5	16 ± 4	0.31
PCWP, mm Hg	10 ± 4	10 ± 4	0.94
Pulmonary vascular resistance index, dyne-s/cm^5/m^2	274 ± 176	155 ± 63	0.08
Systemic vascular resistance index, dyne-s/cm^5/m^2	3,029 ± 737	2,241 ± 388	0.01
Cardiac index, l/min/m^2	2.6 ± 0.5	3.5 ± 1.0	0.01
Stroke volume index, ml/m^2	41 ± 9	51 ± 10	0.02
Peak exercise			
Heart rate, beats/min	102 ± 22	112 ± 20	0.33
Percent predicted heart rate, %	67 ± 14	70 ± 14	0.63
Mean arterial pressure, mm Hg	120 ± 14	124 ± 11	0.41
Mean pulmonary artery pressure, mm Hg	37 ± 10	32 ± 8	0.22
PCWP, mm Hg	23 ± 6	20 ± 7	0.31
PCWP/work rate ratio, mm Hg/W/kg	46 ± 31	20 ± 9	0.03
Pulmonary vascular resistance index, dyne-s/cm^5/m^2	257 ± 135	119 ± 53	0.01
Systemic vascular resistance index, dyne-s/cm^5/m^2	2,251 ± 879	1,331 ± 272	0.01
Cardiac index, l/min/m^2	4.6 ± 1.6	7.4 ± 1.4	0.001
Stroke volume index, ml/m^2	45 ± 10	68 ± 15	0.001

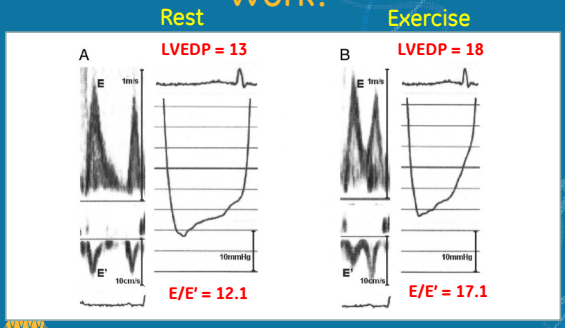
Maeder et al., *JACC* 2010:855

Haemodynamics in HFNEF



Maeder et al., *JACC* 2010:855

Does The Diastolic Stress test Work?



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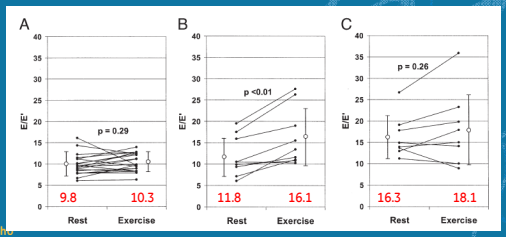
Exercise Echo & E/E'



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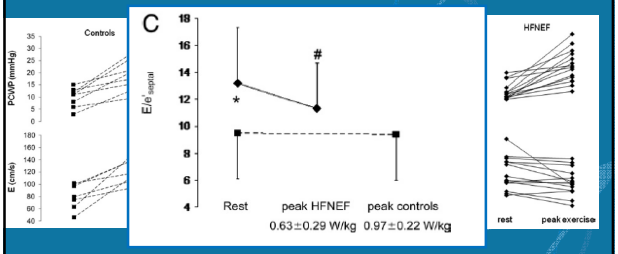
Perhaps Not So Simple



Maeder et al., *JACC* 2010:855

Perhaps We Need to Study Standardised Submaximal Exercise

- Advantage
  - Allows more direct comparison between individuals
- Disadvantage
  - Doesn't allow the association between echo findings and symptoms

How To Perform The Diastolic Stress Test

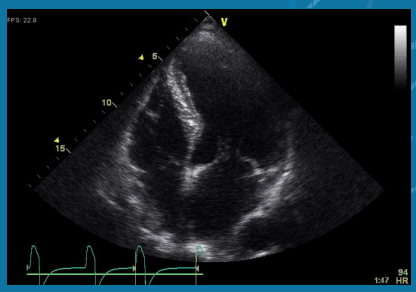
- Baseline imaging
  - Include MV inflow
  - Include mitral annular TDI
  - Include assessment of mitral regugitation
  - Include assessment of RVSP
- Exercise to symptoms
  - Assess ECG for arrhythmias or ischaemia

Diastolic Stress Test

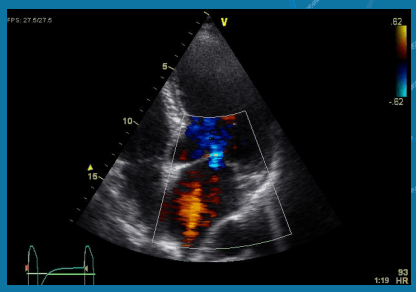
- Post Exercise
  - LV wall motion
  - Annular TDI – E'/A' usually separates first
  - Mitral inflow
  - Mitral regurgitation
  - TR velocity

Don't Forget Mitral Regurgitation

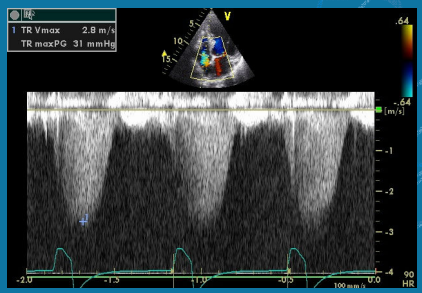
72 Y.O. with LBBB & severe SOBOE



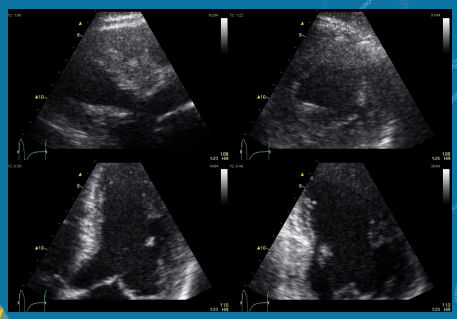
Resting Study



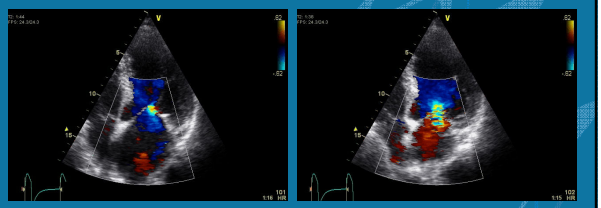
Baseline Study



Post Exercise – 3 mins

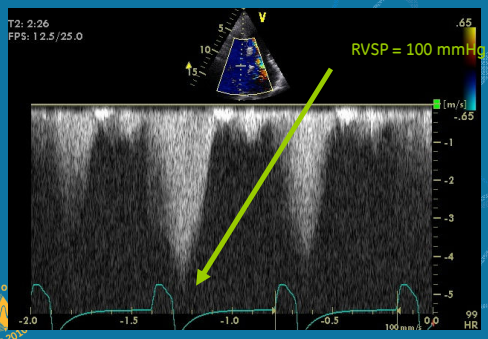


Post Exercise



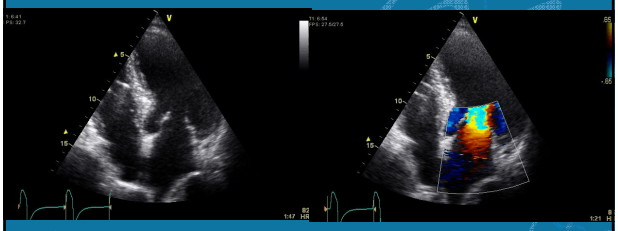
Echo Australia 2010

Post Exercise



Echo Australia 2010

Post CRT



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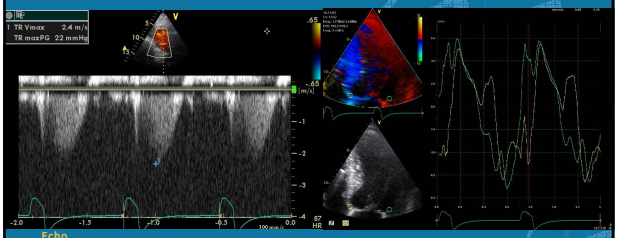
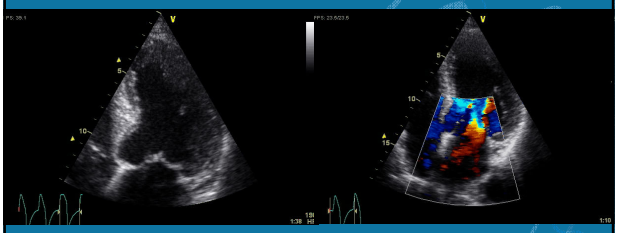
Post CRT



Echo Australia 2010

Post Exercise – 6 mins



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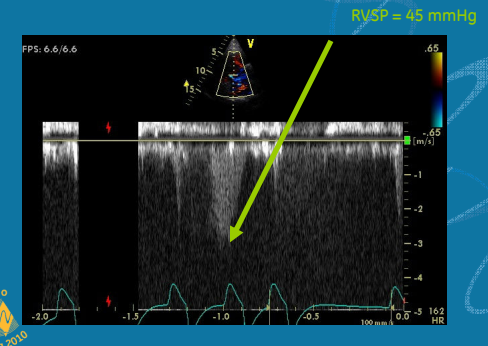
Post Exercise



Echo Australia 2010

Should We Be Using This Test?

However, the paucity of clinical data and the potential limitations in patients with regional LV dysfunction, mitral valve disease, and atrial fibrillation preclude recommendations for its routine clinical use at this time.

Nagueh et al., *JASE* 2009

Heart Foundation Conference 2011
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www.heartfoundation2011.org

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