Université de Liège

CHU de Liège

Acute chest pain:
Game changer or waste of resources ?

Stress Imaging to rule out myocardial ischaemia

Luc A. Pierard, MD, PhD, FACC, FESC
Professor of Medicine
Head, Department of Cardiology
University Hospital, Liège, Belgium

Université de Liège

CHU de Liège

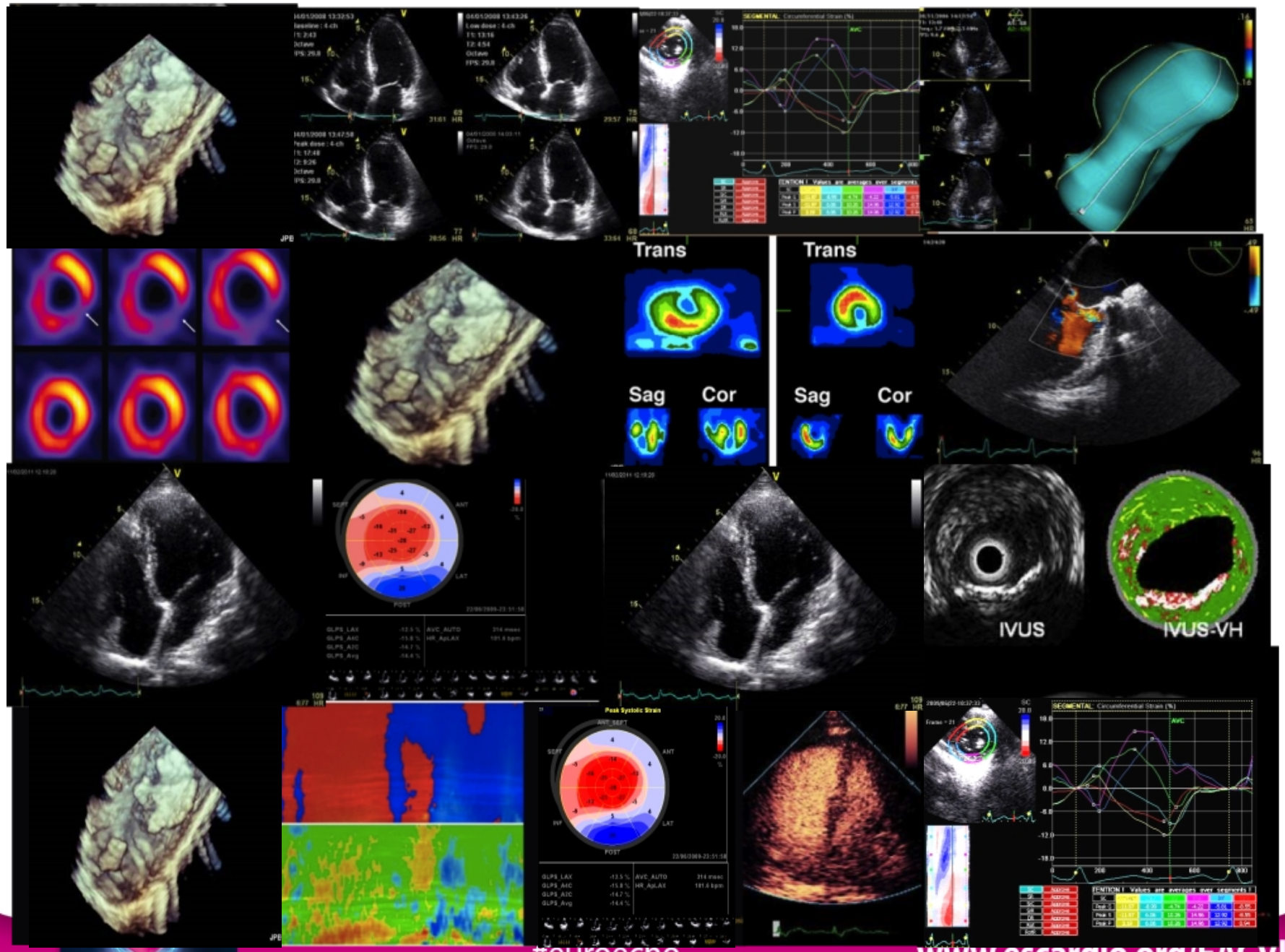
Acute chest pain

No conlict of interest

Luc A. Piérard, MD, PhD, FACC, FESC
Professor of Medicine
Head, Department of Cardiology
University Hospital, Liège, Belgium

Acute chest pain evaluation

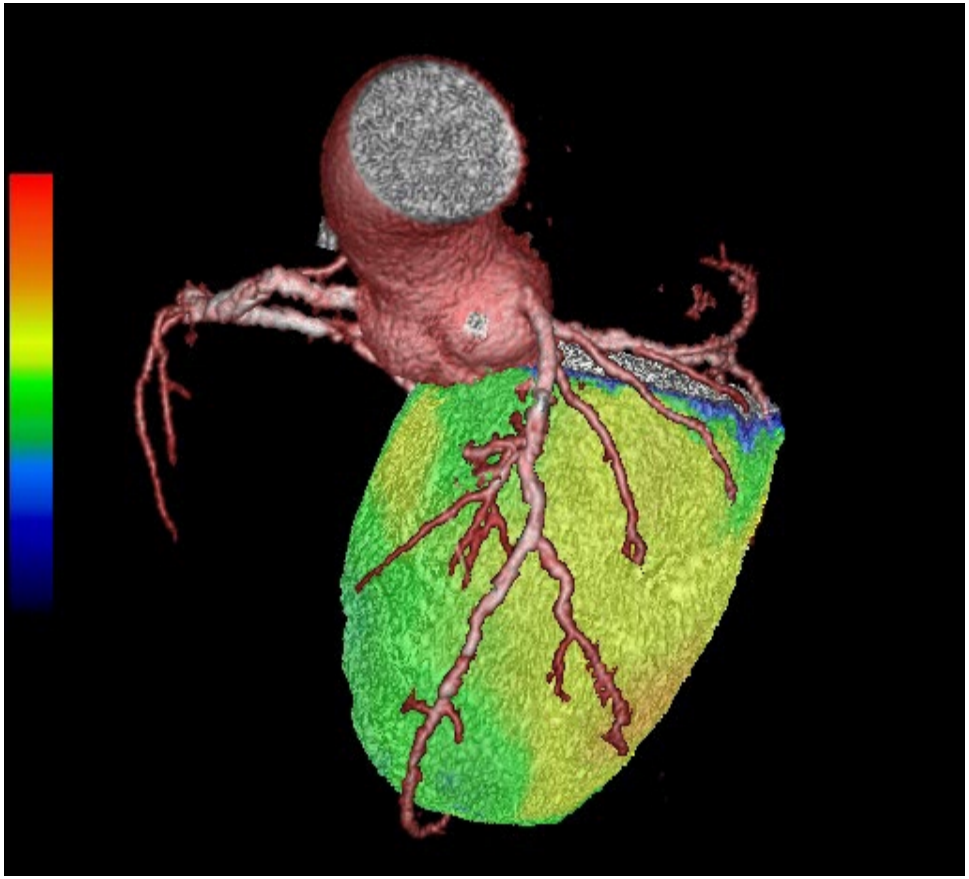
- 8 million visits/yr in ED for chest pain
- Majority of low risk population
- Missed ACS rate: 3%-5%; erroneously discharged
- Annual cost related to chest pain: $10 to $12 billion
- ECG, troponin and secondary testing
- Variety of strategies (provocative testing or imaging to identify significant CAD)


Trans
Sag
Cor
Trans
Sag
Cor
IVUS
IVUS-VH

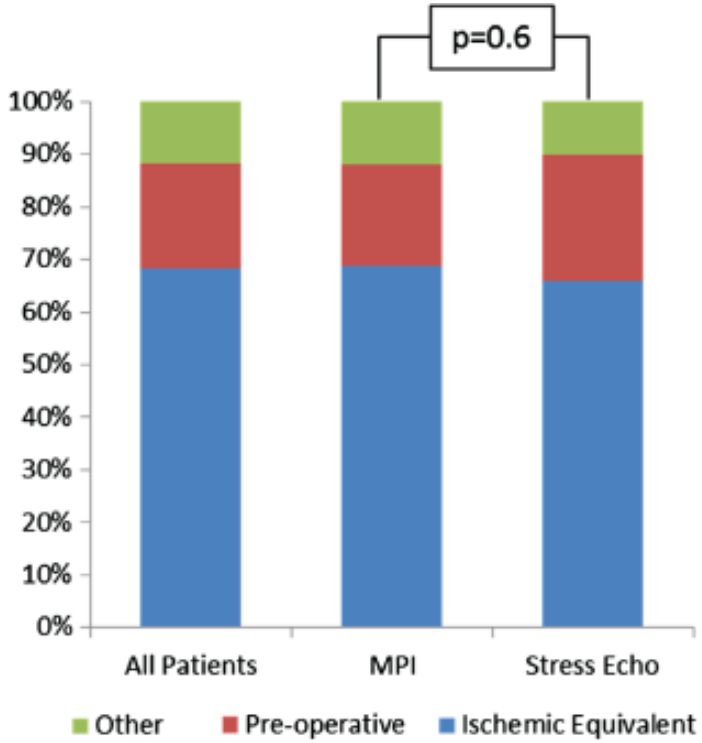
Medical imaging

- US Medicare on CV imaging: $ 4.7 billions
- Cost increase annually: 17% to 26%
- Availability, feasability, accuracy, prognostic value, radiation exposure, cost-effectiveness
- Inappropriate use ?

Availability



Application of appropriate use criteria to cardiac stress testing in the hospital setting



Chest pain or possible ACS: very low rate of inappropriate testing (2%)
Preoperative exam in low-risk patients: 77% of inappropriate tests

Gertz et al
Clin Cardiol. 2014 21. doi: 10.1002/clc.22340. [Epub ahead of print]
.

Case

- 57-year old woman
- Negative estrogen status
- Atypical chest pain
- Diabetes treated by metformin
- LDL-C = 131 mg/dL
- Normal ECG
- Normal hs troponin (twice)

Case: pre-test probability

• 57-year old woman	3
• Negative estrogen status	3
• Atypical chest pain	3
• Diabetes treated by metformin	2
• LDL-C = 131 mg/dL	1
• Normal ECG	
• Normal troponin	
• Pre-test probability	12

Morise JACC 2003;42:42-50

Pre-test probability

- Low: < 8
- Intermediate: 8 – 15
- High: > 15
- The patient: score of 12
- Pre-test intermediate probability
- Indication of stress imaging (ESC Guidelines: I A)

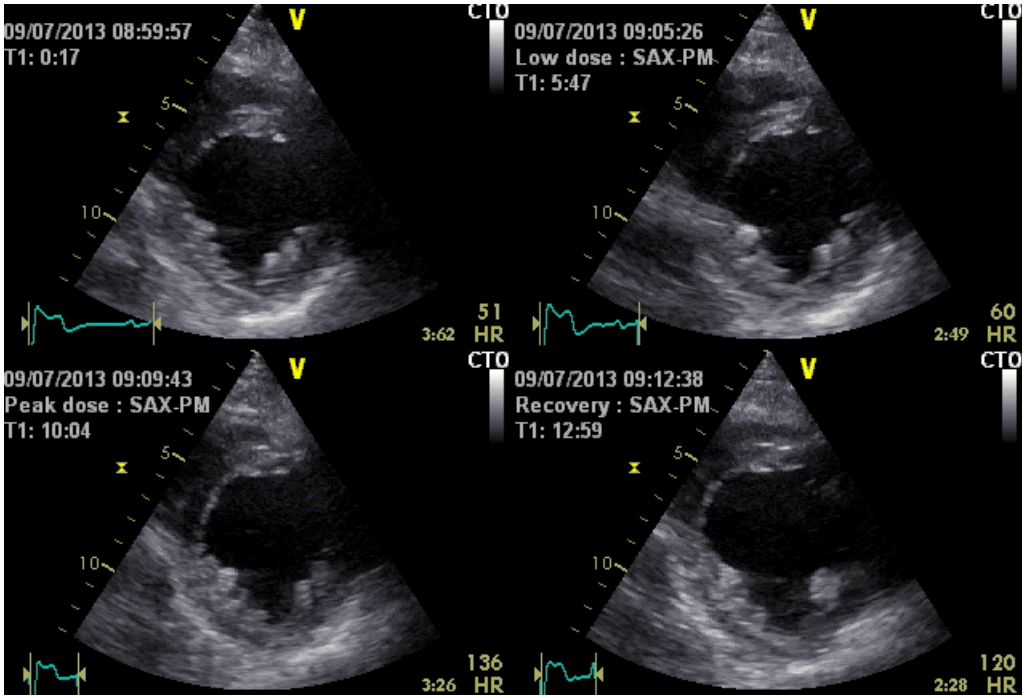
ESC Guidelines

- Diagnostic tools:
  - Echo is the most important modality
    - LV function
    - Transient dyssynergy during ischaemia
    - DD: dissection, AS, HCM, pulmonary embolism, pericardial effusion
  - **Stress imaging in patients with non-diagnostic ECG and normal cardiac biomarkers**
  - CMR: function, perfusion, viability and scar in 1 session
  - CT: useful to exclude ACS or other causes of chest pain

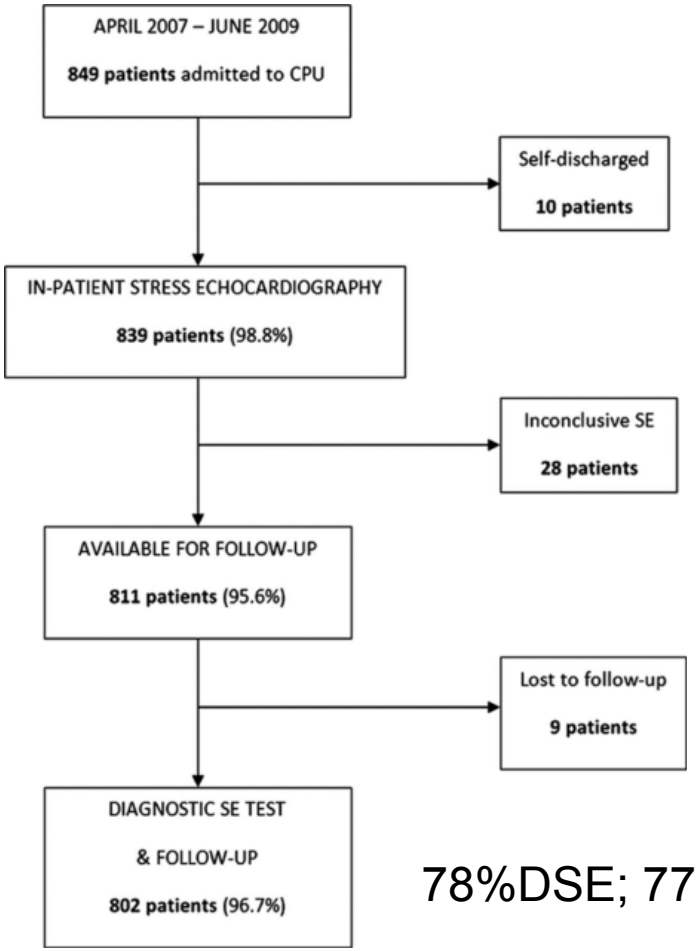
She was submitted to stress echo 8h after admission

Semi-supine exercise echo

Induced posterior ischaemia; PCI of LCx



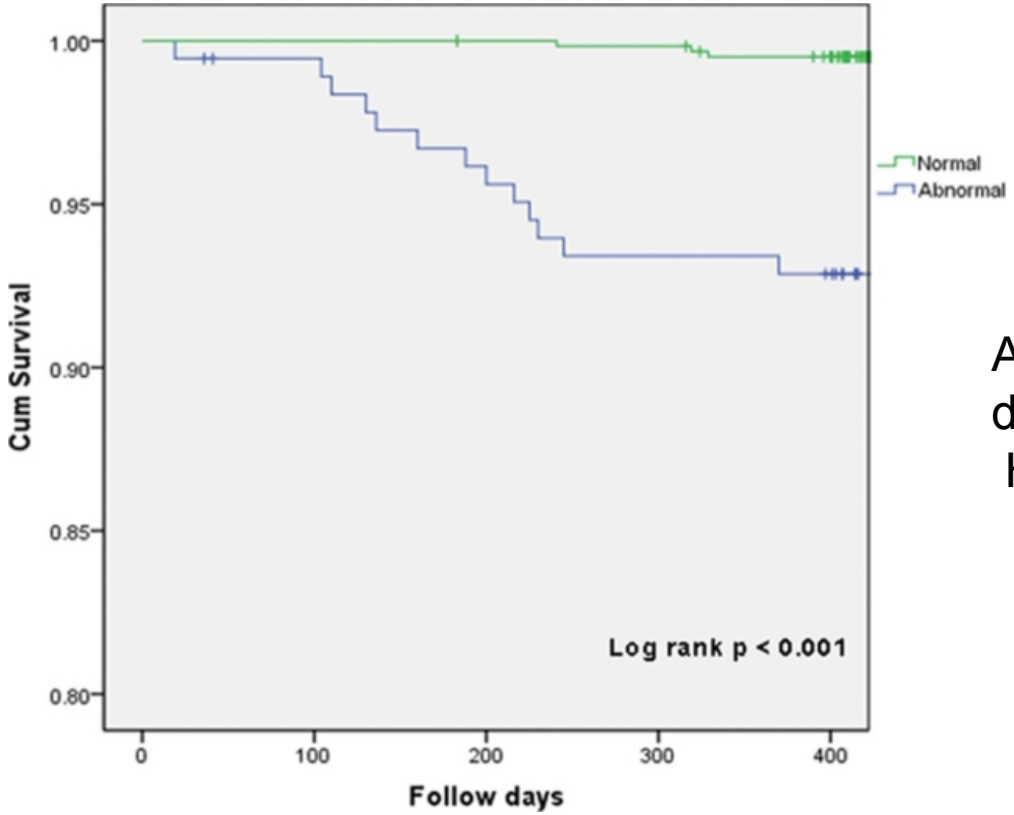
Incremental diagnostic and prognostic value of stress echo in a chest pain unit



78%DSE; 77%(618 of 802)normal SE

Shah B N et al. Circ Cardiovasc Imaging. 2013;6:202-209

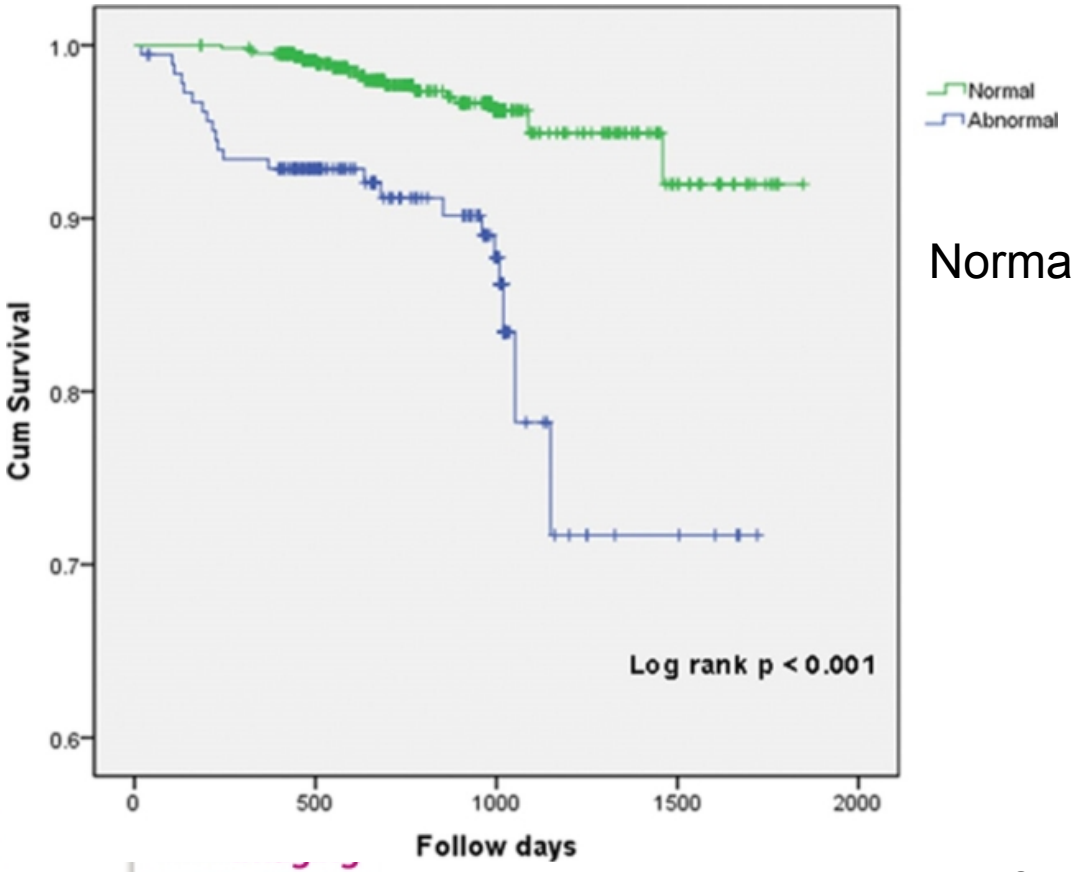
Time to any hard event in the first year for patients with normal and abnormal stress echo



Abnormal SE: strongest predictor of death or MI
HR=3.97(95%CI,1.87-8.4)

Shah B N et al. Circ Cardiovasc Imaging. 2013;6:202-209

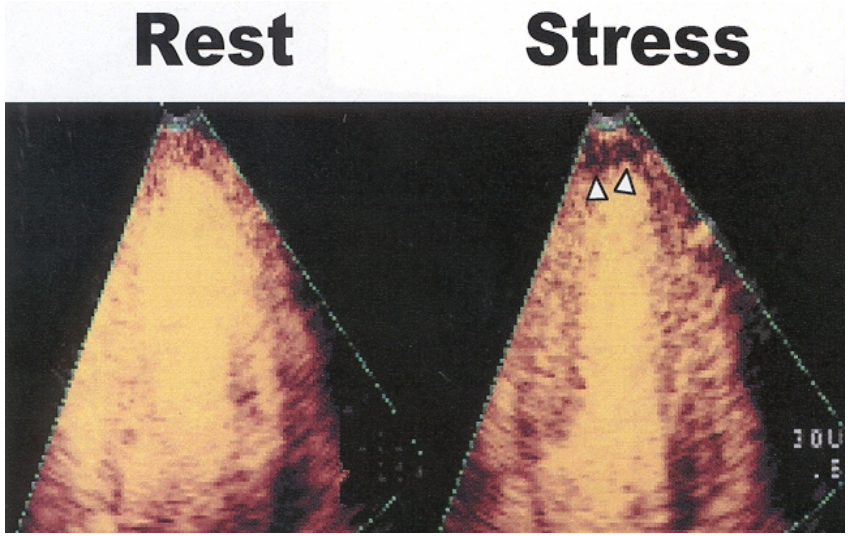
Time to any hard event for patients with normal and abnormal stress echo results over a 27±11-month period

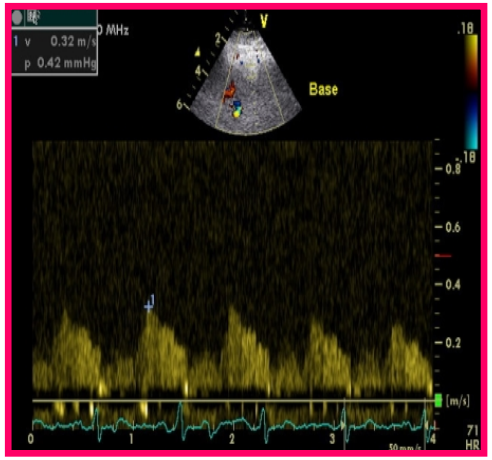


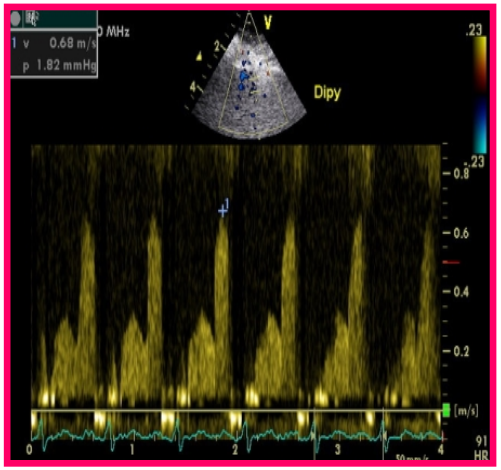
Normal SE: annual mortality rate 1.02%
annual hard event rate 1.24%

Shah B N et al. Circ Cardiovasc Imaging. 2013;6:202-209

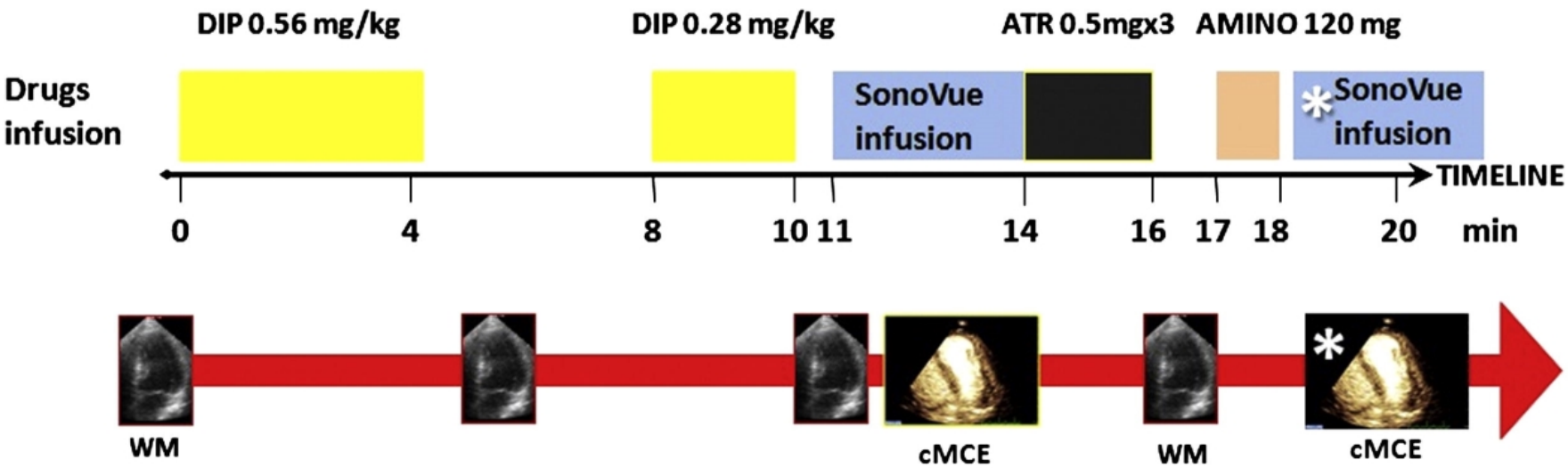
Myocardial perfusion and CFR-LAD during stress echo







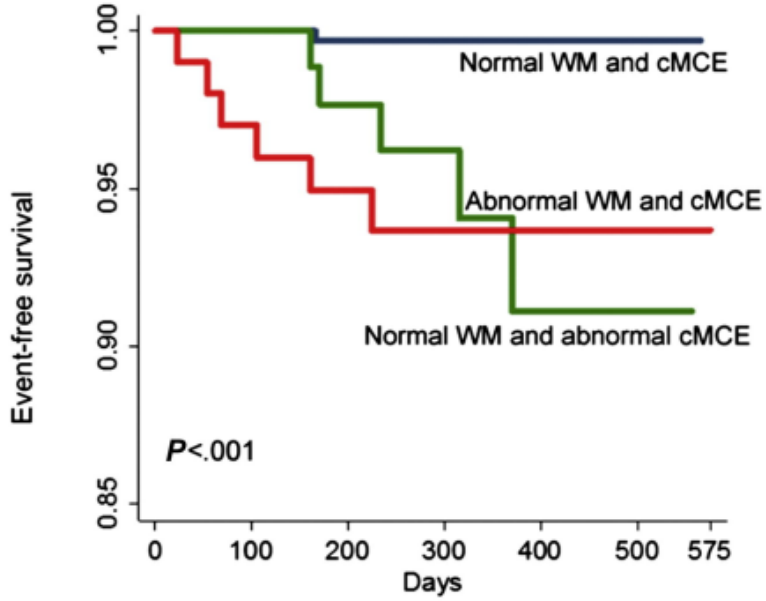
SE protocol (High dose dipyridamole-atropine)

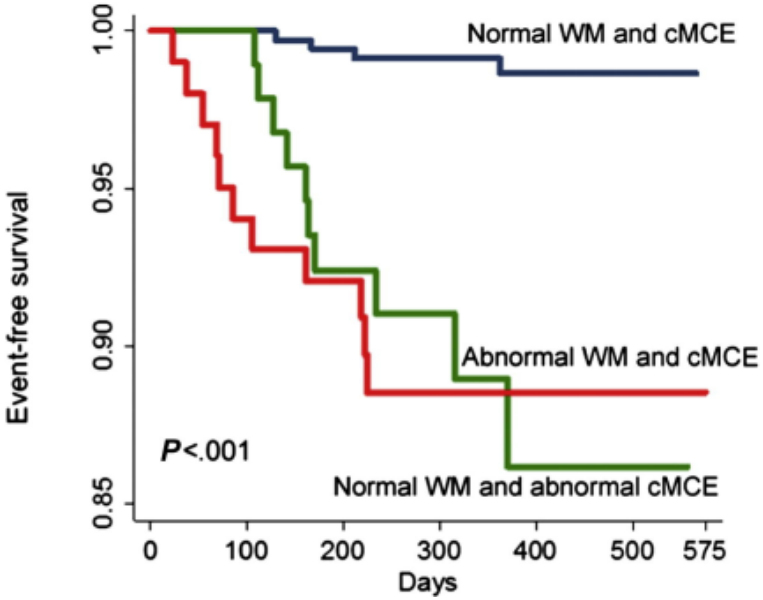


* Recovery contrast echocardiography was performed only when abnormal perfusion and/or function at stress was detected

J Am Soc Echocardiogr. 2011 Dec;24(12):1333-41.
Gaibazzi N[1], Squeri A, Reverberi C, Molinaro S, Lorenzoni V, Sartorio D, Senior R

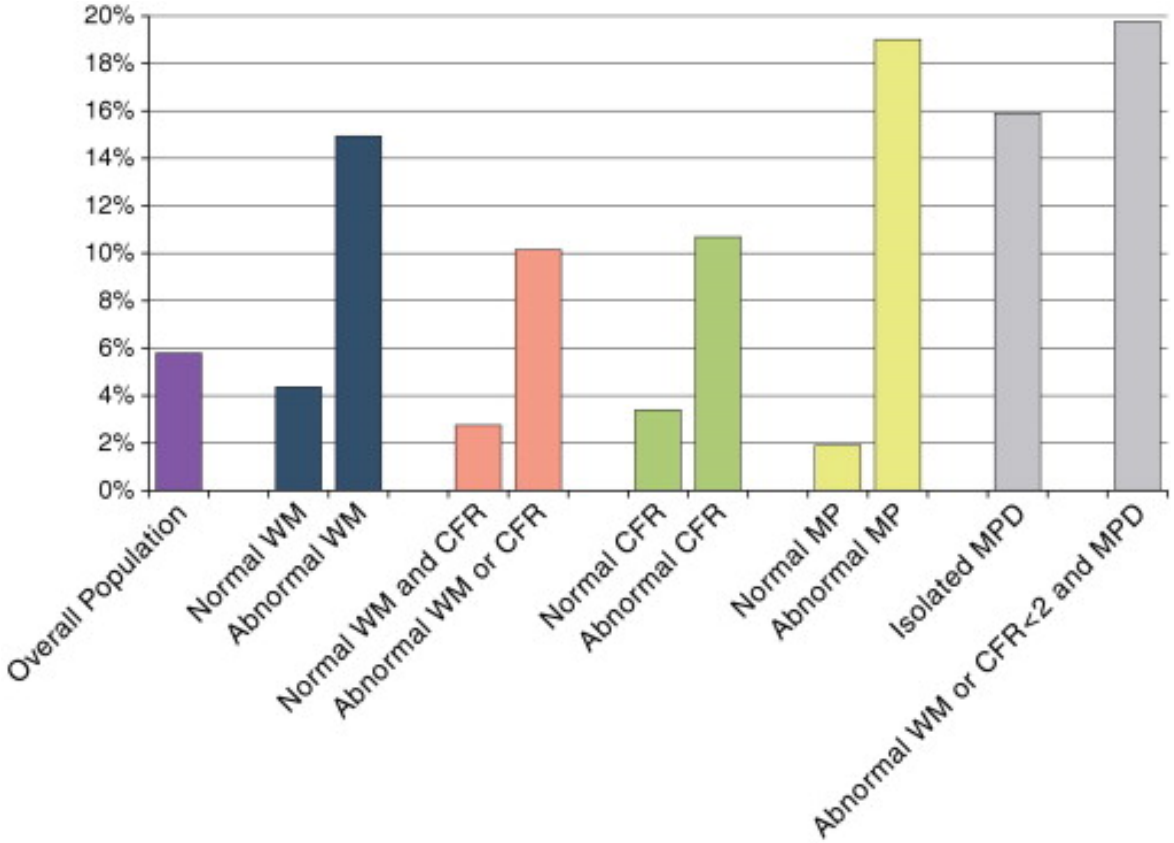
Contrast SE predicts hard and combined cardiac events





Gaibazzi N et al,
J Am Soc Echocardiogr. 2011;24:1333-41..

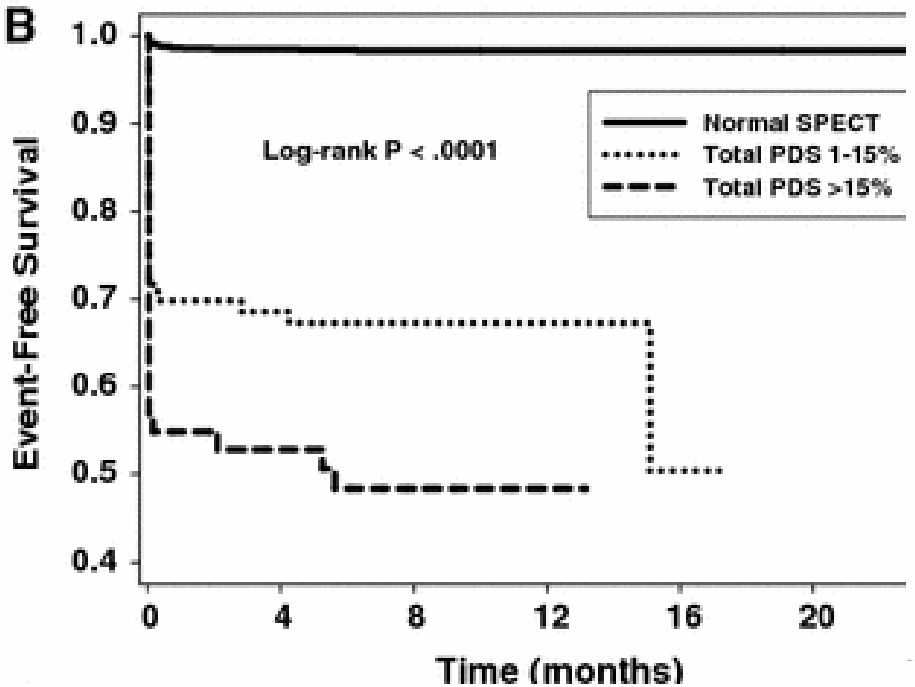
Comparative Prediction of Cardiac Events by Wall Motion, Wall Motion Plus Coronary Flow Reserve, or Myocardial Perfusion Analysis : A Multicenter Study of Contrast Stress Echocardiography

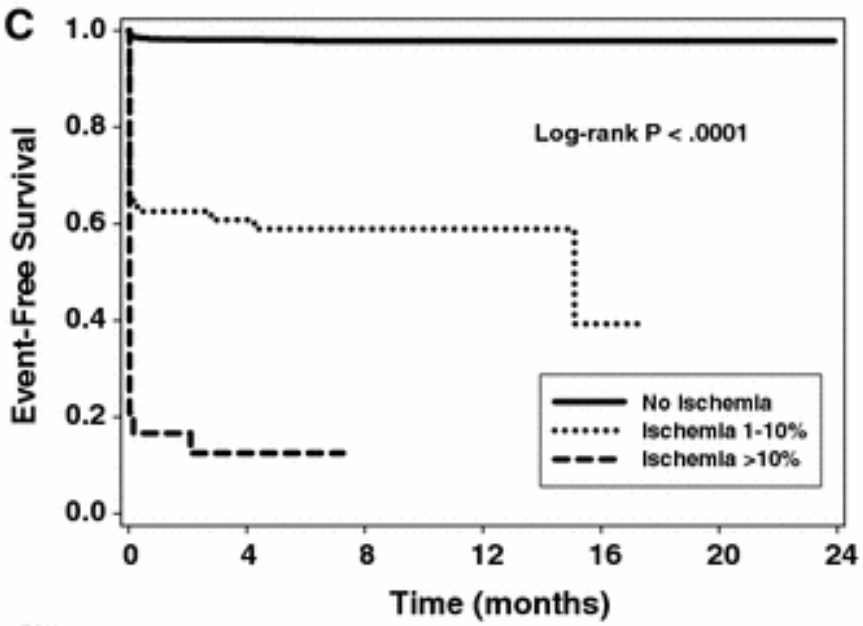


Gaibazzi et al JACC: Cardiovascular Imaging, 2013, 1 - 12

Acute chest pain: value of stress MPI

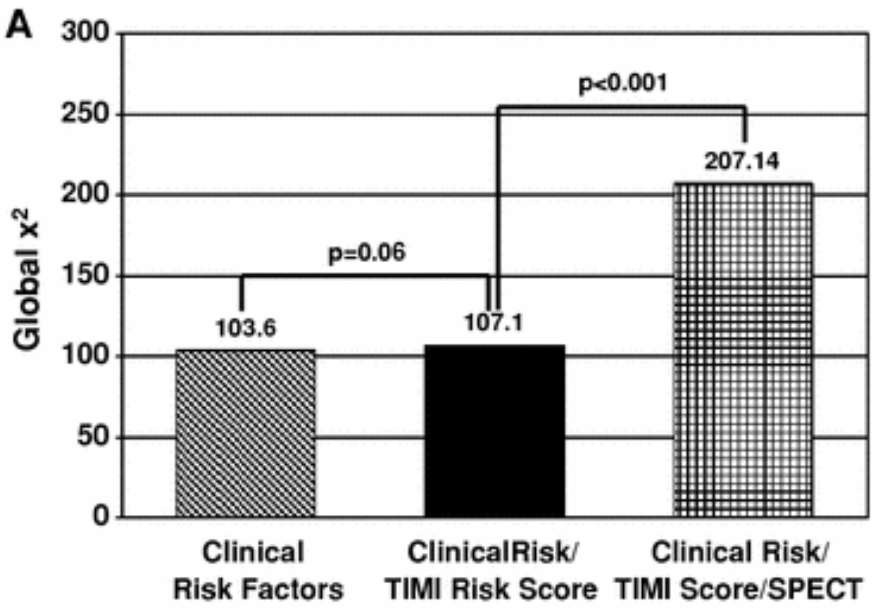
1,576 consecutive pts; stress SPECT within 24h
Normal SPECT in 91%: event rate 1.6%; hard event rate 0.5%

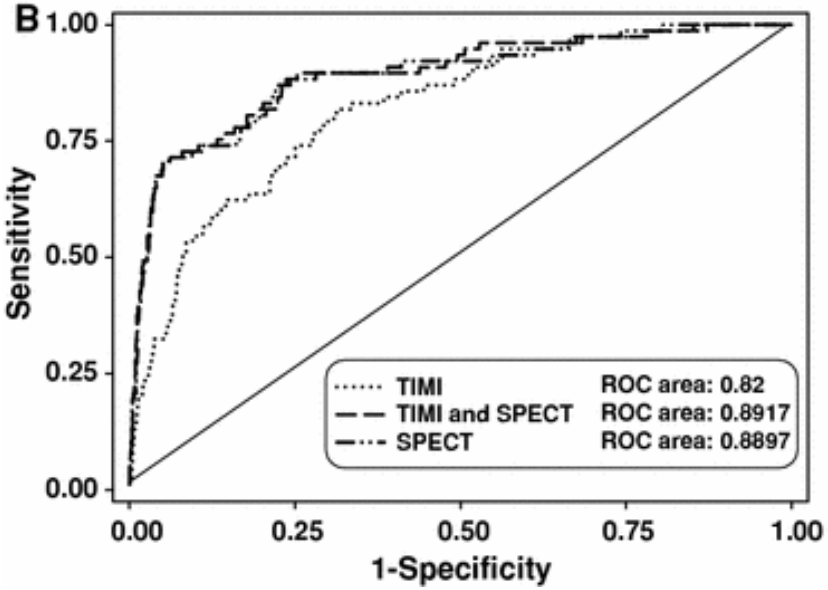




Nabi F et al J Nucl Cardiol. 2012 ;19: 233-4

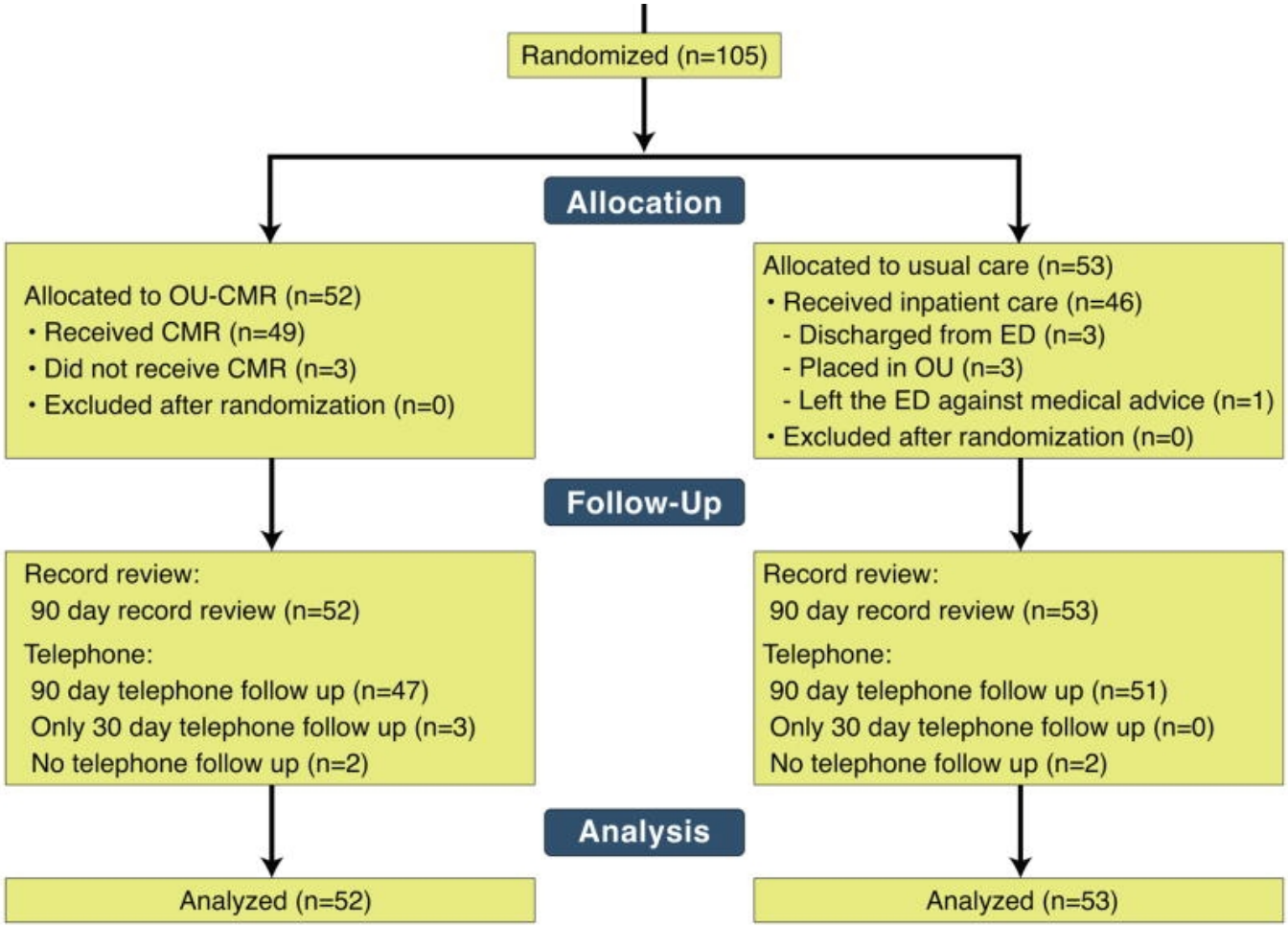
Incremental benefit of SPECT as compared to clinical variables and TIMI score in predicting cardiac events





Nabi F et al J Nucl Cardiol. 2012;19:233-4

Stress CMR reduces revascularization, hospital readmission, and recurrent cardiac testing in intermediate-risk patients with acute chest pain



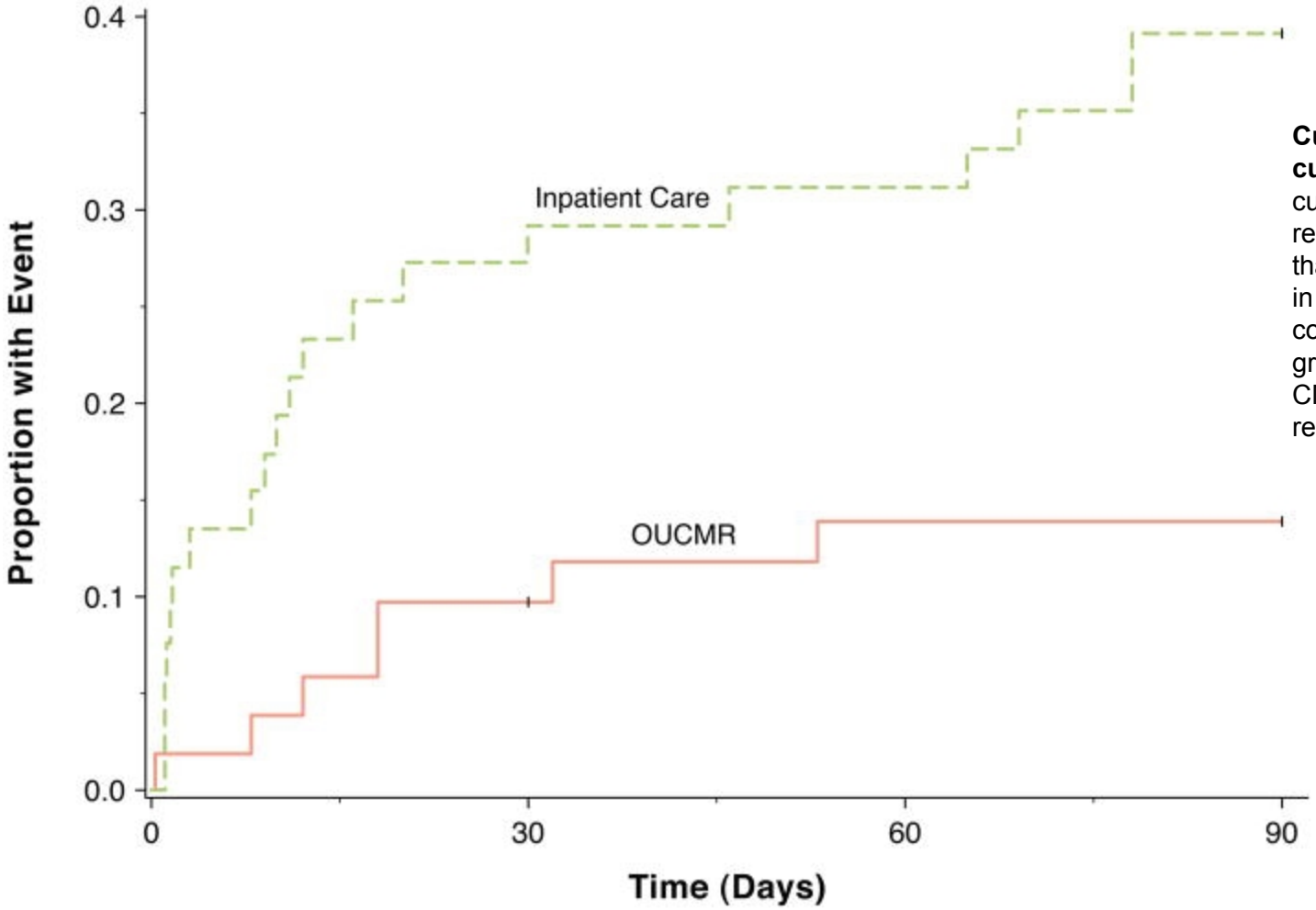
Miller CD, et al
JACC Cardiovasc Imaging. 2013 ;6:785-94.

Outcomes and events through 90 days

	Usual care(n=53)	CMR(n=52)	p-value
Hospital admission	**47 (89)**	**8 (15)**	
Composite primary outcome	20 (38)	7 (13)	0.004
Revascularization	8 (15)	1 (2)	0.31
Hospital readmission	12 (23)	1 (2)	0.33
Recurrent cardiac testing	9 (17)	2 (4)	0.028
ACS after discharge	3 (6)	0 (0)	0.24

Miller et al JACC Cardiovasc Imaging 2013;6:785-94

Stress CMR reduces revascularization, hospital readmission, and recurrent cardiac testing in intermediate-risk patients with acute chest pain



Cumulative incidence curves Cumulative incidence curves demonstrate an early reduction in composite events that continued through 90 days in the OU-CMR group compared to the usual care group. OU, observation unit; CMR, cardiac magnetic resonance.

Miller et al JACC Cardiovasc Imaging 2013;6:785-94

Stress cardiac MR imaging vs stress echo in pts with intermediate risk chest pain

Interpretation and Modality	Sensitivity (%)	Specificity (%)	Accuracy (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
Clinical interpretation					
Stress cardiac MR imaging	100 (8/8) [63, 100]	92 (48/52) [82, 98]	93 (56/60) [84, 98]	67 (8/12) [35, 90]	100 (48/48) [93, 100]
Stress echocardiography	38 (3/8) [9, 76]	96 (50/52) [87, 100]	88 (53/60) [77, 95]	60 (3/5) [15, 95]	91 (50/55) [80, 97]
P value	.025	.41	.37	.79	NA*
Blinded interpretation					
Stress cardiac MR imaging	88 (7/8) [47, 100]	90 (47/52) [79, 97]	90 (54/60) [79, 96]	58 (7/12) [28, 85]	98 (47/48) [89, 100]
Stress echocardiography	63 (5/8) [24, 91]	92 (48/52) [81, 98]	88 (53/60) [77, 95]	56 (5/9) [21, 86]	94 (48/51) [84, 99]
P value	.31	.71	.76	.90	.36

Adenosine stress cardiac MR: improved performance compared with stress echo

Heitner JF et al
Radiology. 2014 ;271:56-64.

Logistic regression models utilizing blinded stress-imaging

Model and Variable	Model χ^2	Model *P* Value	Odds Ratio	Variable *P* Value
Model A: Clinical with stress cardiac MR imaging	21.2	<.001	…	…
Total no. of cardiac risk factors	…	…	1.17	.11
Stress cardiac MR imaging	…	…	63.4	<.001
Model B: Clinical with stress echocardiography	12.1	.002	…	…
Total no. of cardiac risk factors	…	…	1.18	.69
Stress echocardiography	…	…	19.0	.001
Model C: Clinical with both stress tests	26.3	<.001	…	…
Total no. of cardiac risk factors	…	…	0.87	.81
Stress cardiac MR imaging	…	…	56.6	.002
Stress echocardiography	…	…	15.7	.04

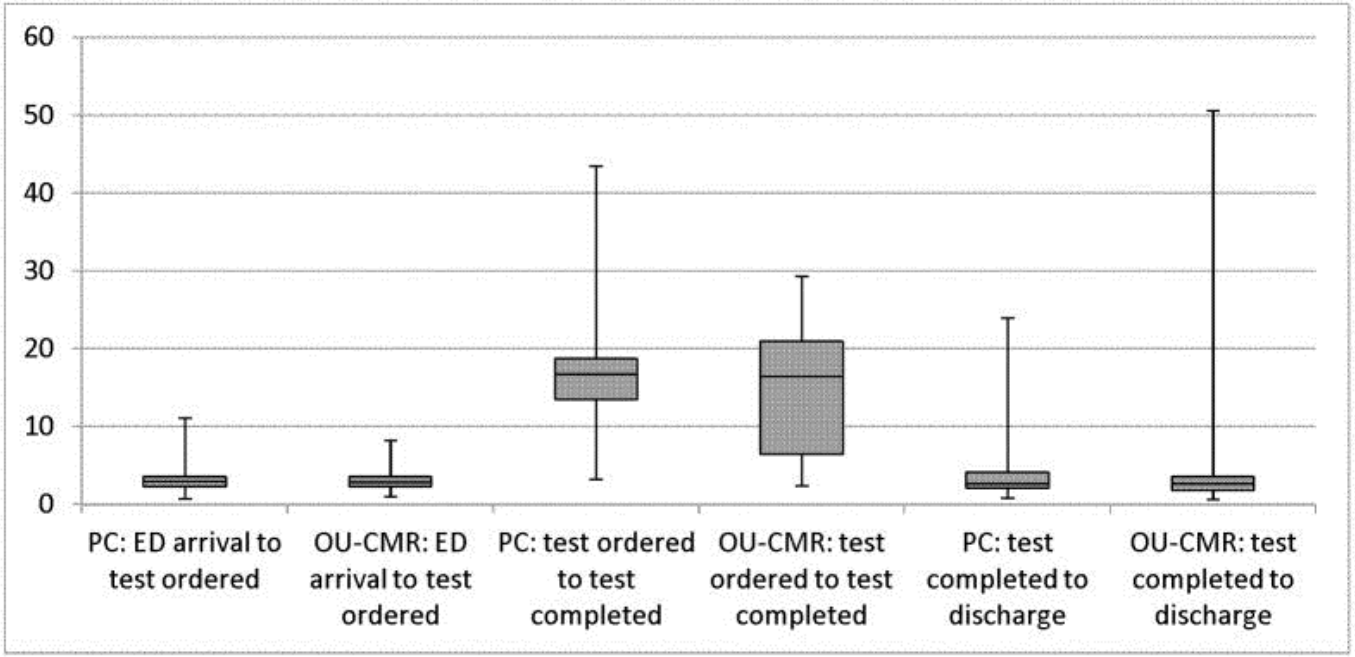
Multivariate analysis: stress cardiac MR imaging was the strongest independent predictor of significant CAD (P=0.002)

Heifner et al Radiology. ***2014 ;271:56-64..***

Lower risk patients: CMR stress vs provider selected stress test

- 120 pts randomized
- PC: stress echo(62%), CMR(32%), Cath(3%), nuclear(2%), coronary CT(2%)
- No difference:
  - in length of stay: 24.2h vs 23.8h
  - cath without revascularization
  - 30-day ACS (both 3%)

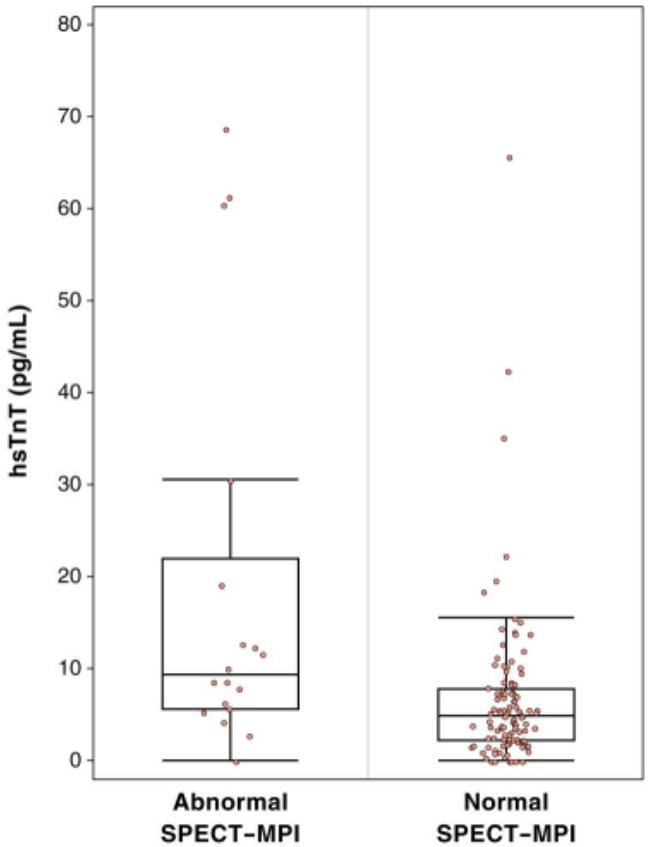
Provider-directed imaging stress testing reduces health care expenditures in lower-risk chest pain patients presenting to the ED.



Mean costs: $2586 for CMR and $2050 for PC group

Miller et al
Circ Cardiovasc Imaging. 2012 :111-8.

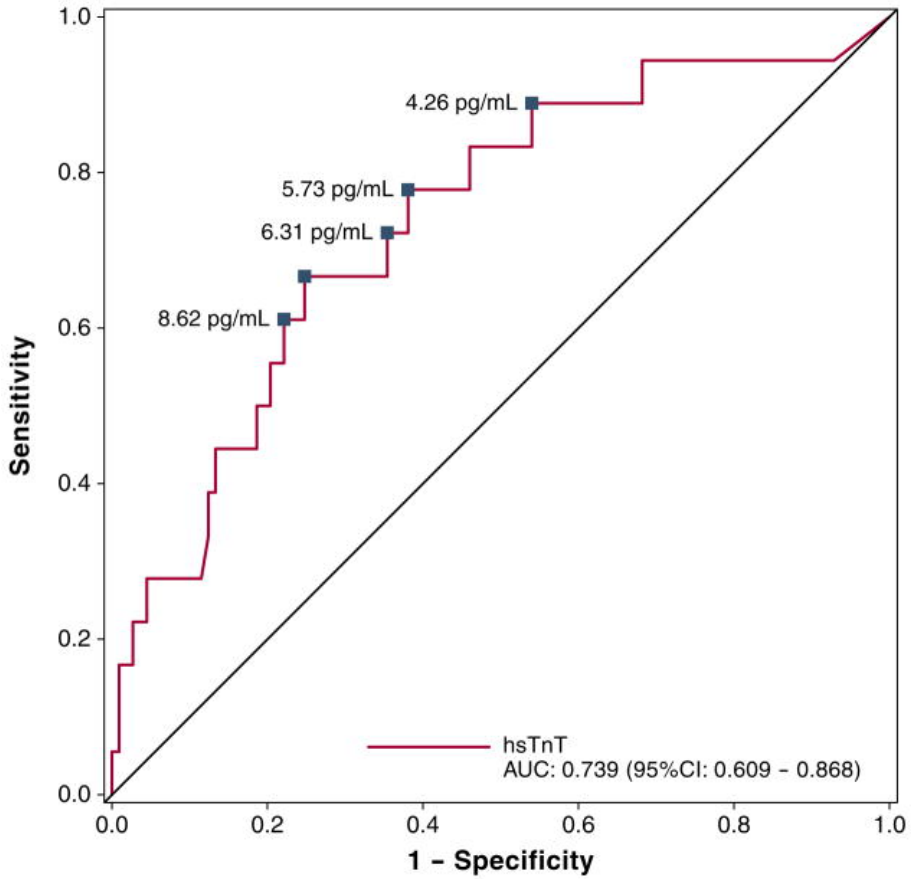
hs TnT level predicts abnormal stress test



Patients from ROMICATE1 hsTnT Levels Between Patients With Normal and Abnormal SPECT-MPI Median high-sensitivity troponin T (hsTnT) levels were significantly higher in patients with abnormal single-photon emission computed tomography–myocardial perfusion imaging (SPECT-MPI) compared with those with normal SPECT-MPI (9.41 pg/ml [interquartile range (IQR): 5.73 to 19.20 pg/ml] vs. 4.89 pg/ml [IQR: 2.34 to 7.68 pg/ml], p = 0.001).

Ahmed W et al, JACC Cardiovasc Imaging. 2013; 6:72-82

hs TnT level predicts abnormal stress test



hs TnT: powerful triage tool in chest pain patients ?

Ahmed W et al, JACC Cardiovasc Imaging. 2013; 6:72-82

Conclusions 1

- There are few high-risk patients presenting with ACP
- Standard of care: serial biomarkers and subsequent stress testing
- Stress imaging increases sensitivity

Conclusions 2

- Optimal test remains unclear

- Future role of hs troponin?
  - Will + hs Tn negate the need for subsequent stress imaging?
  - Negative hs troponin: direct discharge; low level hs Tn : additional testing?

- Cost analysis is critical to define an optimal protocol