

Investigating Stable Chest Pain – The Return of Stress ECHO?

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A Common Problem

- Multiple causes, most non-cardiac
- The Health Survey for England¹ (2006) found that about 8% of men and 3% of women aged between 55 and 64 years have, or have had angina
- 14% and 8% respectively for people aged between 65 and 74 years. It is estimated that almost 2 million people in the UK have or have had angina.

1. Health Survey for England 2006: CVD and risk factors adults, obesity and risk factors children

Publication date: January 31, 2008

But How Do We Know It's Angina?

- NICE Guidance 2010
- History
- History
- History
- Or History and further investigation

Issue date: March 2010

Chest pain of recent onset

Assessment and diagnosis of recent onset chest pain or discomfort of suspected cardiac origin

Presentation with stable chest pain

Diagnose stable angina based on one of the following:

- clinical assessment alone **or**
- clinical assessment plus diagnostic testing (that is, anatomical testing for obstructive coronary artery disease [CAD] and/or functional testing for myocardial ischaemia). **[1.3.1.1]**

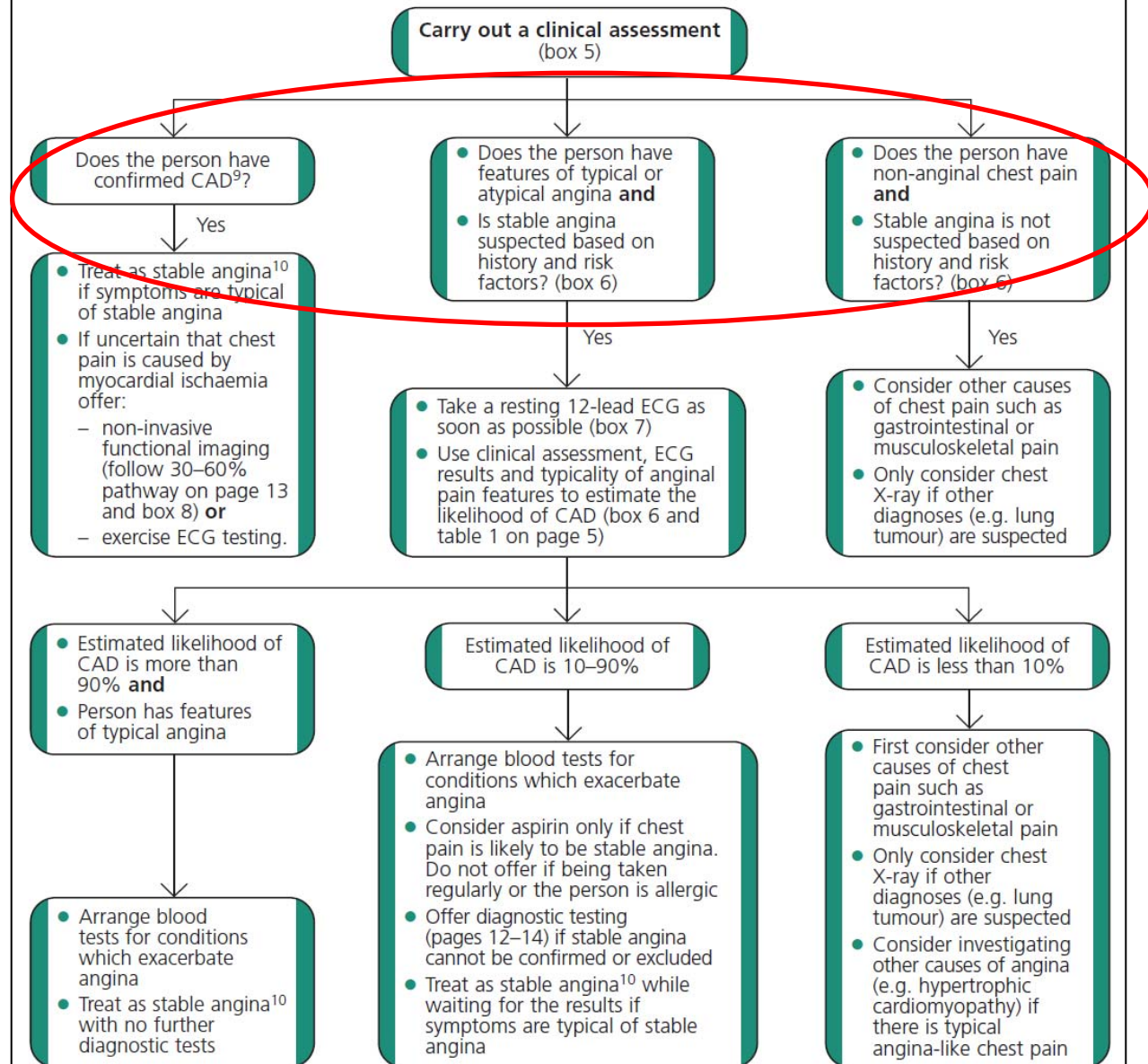
“Clinical assessment alone may be sufficient to confirm or exclude a diagnosis of stable angina, but when there is uncertainty, additional diagnostic testing (functional or anatomical testing) guided by the estimates of likelihood of coronary artery disease in table 1 is required”

Clinical Assessment

- Detailed history and categorisation of pain
- Record risk factors including age and previous known coronary disease or intervention
- Physical examination – ? signs of cardiovascular disease or risk factors.

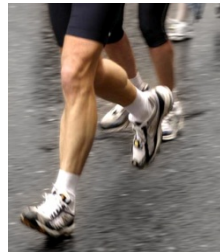
People presenting with stable chest pain

- Angina can be diagnosed based on clinical assessment alone or clinical assessment plus diagnostic testing.
- Manage risk factors for cardiovascular disease⁸ if chest pain is not stable angina.



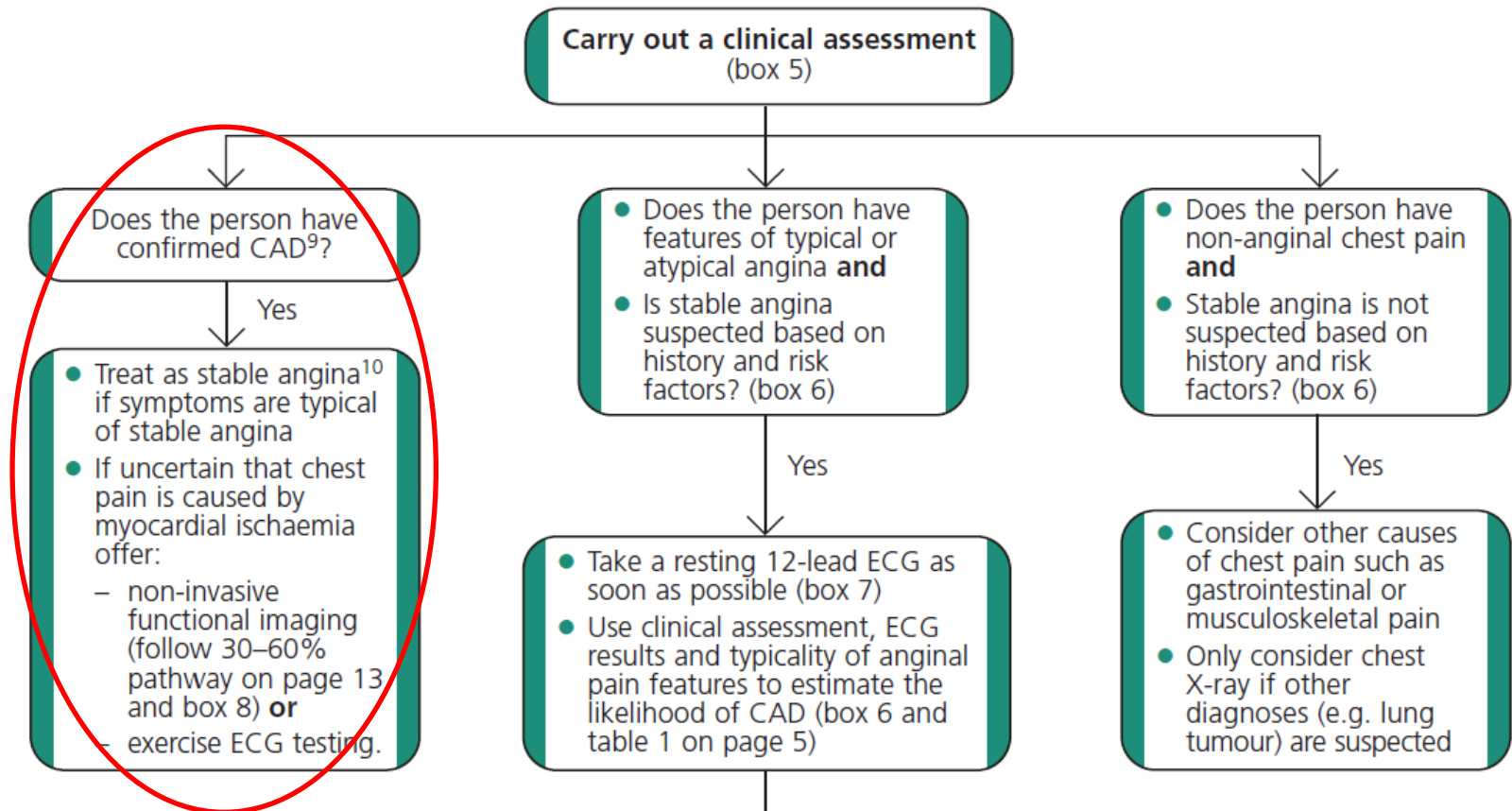
'Typical Angina'

- Anginal pain is:
 - **constricting discomfort in the front of the chest, neck, shoulders, jaw or arms**
 - **precipitated by physical exertion**
 - **relieved by rest or GTN in about 5 minutes.**
- Typical angina = **all** the above features, people with
- Atypical angina = **two** features
- Non-anginal chest pain = **one** or none of the features
- NB. Definitions should not differ between sex or ethnic groups



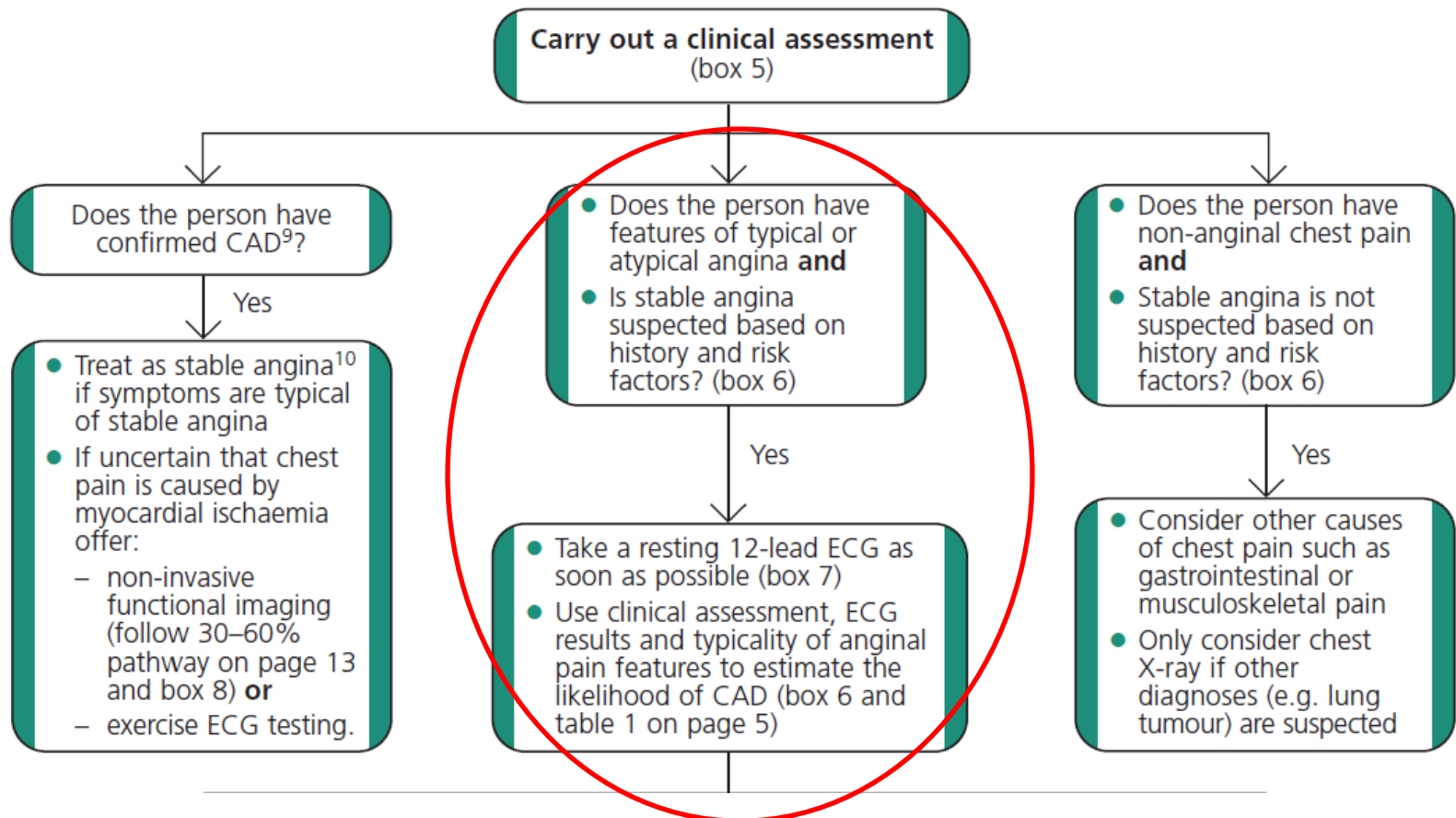
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Estimating Likelihood

Table 1 Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors²

Age (years)	Non-anginal chest pain				Atypical angina				Typical angina			
	Men		Women		Men		Women		Men		Women	
	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi
35	3	35	1	19	8	59	2	39	30	88	10	78
45	9	47	2	22	21	70	5	43	51	92	20	79
55	23	59	4	25	45	79	10	47	80	95	38	82
65	49	69	9	29	71	86	20	51	93	97	56	84

For men older than 70 with atypical or typical symptoms, assume an estimate > 90%.
 For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

Values are per cent of people at each mid-decade age with significant coronary artery disease (CAD).

Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).

Lo = Low risk = none of these three.

The shaded area represents people with symptoms of non-anginal chest pain, who would not be investigated for stable angina routinely.

Note: These results are likely to overestimate CAD in primary care populations.

If there are resting ECG ST-T changes or Q waves, the likelihood of CAD is higher in each cell of the table.

High Risk: Diabetes, Smoking, Hyperlipidaemia

Low Risk: None of the above.

myocardial ischaemia offer:

- non-invasive functional imaging (follow 30–60% pathway on page 13 and box 8) **or**
- exercise ECG testing.

- Take a resting 12-lead ECG as soon as possible (box 7)
- Use clinical assessment, ECG results and typicality of anginal pain features to estimate the likelihood of CAD (box 6 and table 1 on page 5)

- Consider other causes of chest pain such as gastrointestinal or musculoskeletal pain
- Only consider chest X-ray if other diagnoses (e.g. lung tumour) are suspected

- Estimated likelihood of CAD is more than 90% **and**
- Person has features of typical angina

- Arrange blood tests for conditions which exacerbate angina
- Treat as stable angina¹⁰ with no further diagnostic tests

Estimated likelihood of CAD is 10–90%

- Arrange blood tests for conditions which exacerbate angina
- Consider aspirin only if chest pain is likely to be stable angina. Do not offer if being taken regularly or the person is allergic
- Offer diagnostic testing (pages 12–14) if stable angina cannot be confirmed or excluded
- Treat as stable angina¹⁰ while waiting for the results if symptoms are typical of stable angina

Estimated likelihood of CAD is less than 10%

- First consider other causes of chest pain such as gastrointestinal or musculoskeletal pain
- Only consider chest X-ray if other diagnoses (e.g. lung tumour) are suspected
- Consider investigating other causes of angina (e.g. hypertrophic cardiomyopathy) if there is typical angina-like chest pain

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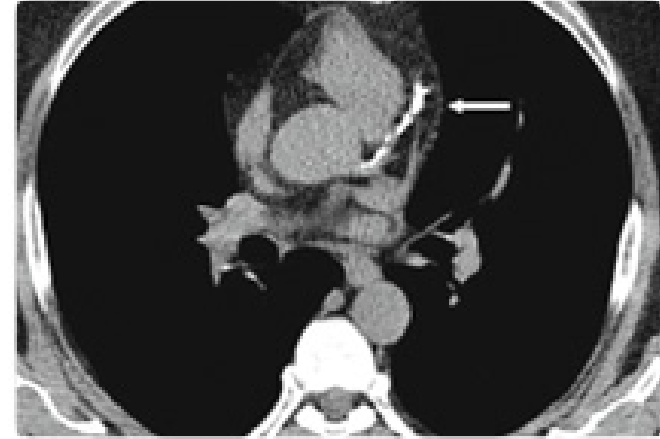
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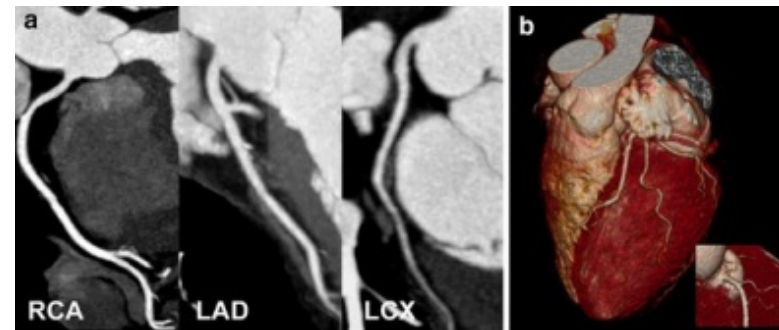
Likelihood 10-29%

- 'Lower Risk' group
- Offer CT calcium scoring



Score

- 0 – consider alternative diagnosis
- 1-400 – offer CTCA
- >400 – follow 61-90% risk pathway



Likelihood 30-60%

- 'Intermediate Risk' Group
- Offer 'non-invasive functional imaging'- i.e. myocardial perfusion SPECT, stress echocardiography, stress/contrast CMR

Reversible ischaemia?

- Yes: Treat as stable angina
- No: Consider alternative diagnosis
- Inconclusive: Consider angiography

Likelihood 61-90%

- 'Higher Risk' group

Angiography/Revascularisation appropriate?

- Yes: Offer angiography. Treat as stable angina if 'significant' CAD
- No: Consider non-invasive functional imaging.

'Treat as Stable Angina'??

- NICE Guidelines for the management of stable angina expected July 2011.
- These guidelines focus on investigation only.

NICE Guidelines 2010 – Limitations?

- Guidelines only
- Dependence on classical, typical features.
- Are these features ‘typical’ of all patient groups?
- On what are these clinical predictors based?

15 January 1993

Volume 118

Number 2

Annals of Internal Medicine

Value of the History and Physical in Identifying Patients at Increased Risk for Coronary Artery Disease

David B. Pryor, MD; Linda Shaw, AB; Charles B. McCants, BS; Kerry L. Lee, PhD;
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- **1030 consecutive outpatients referred for non-invasive testing for suspected coronary artery disease**
- **168 patients underwent angiography within 30 days**
- **Endpoints: Survival at 3 years, Presence of 'significant' CAD, Presence of severe CAD, Presence of LMS disease.**
- **Initial assessment was found to be a better predictor of significant CAD compared with exercise treadmill testing and equivalent at predicting death and severe CAD.**

Table 1. Characteristics Used To Estimate Outcomes*

Characteristics	Any Disease	Severe Disease	Left Main Disease	Survival
History				
Age	X	X	X	X
Gender	X	X	X	X
Chest pain				
Type	X	X	X	
Frequency		X		X
Course		X		X
Nocturnal		X		X
Length of time present		X	X	
Diabetes mellitus	X	X		
Smoking	X	X		
Hyperlipidemia	X	X		
Hypertension		X		
Previous history of myocardial infarction	X	X		X
Peripheral or cerebral vascular disease		X	X	X
Congestive heart failure severity				X
Physical examination				
Carotid bruit		X	X	X
Ventricular gallop				X
Electrocardiogram				
Significant Q waves	X	X		X
ST-T wave changes	X	X		X
Conduction abnormalities†				X
Premature ventricular contractions				X
Chest radiograph				
Cardiomegaly				X

* X indicates that the variable is a significant predictor in the multivariable regression model.

† Conduction abnormalities included left bundle-branch block, right bundle-branch block, intraventricular conduction delay, and left axis deviation.

Characteristics

Age
Sex (0 = male, 1 = female)
Age * Sex (interaction)
Typical angina (1 if present)
Atypical angina (1 if present)
History of MI (1 if present)
ECG Q waves (1 if present)
History of MI * Q waves (interaction)
Smoking (1 if present)
Hyperlipidemia (1 if present)
Diabetes (1 if present)
ECG ST-T wave changes (1 if present)
Age * Smoking (interaction)
Age * Hyperlipidemia (interaction)
Sex * Smoking (interaction)

Coefficient

0.1126
-0.328
-0.0301
2.581
0.976
1.093
1.213
0.741
2.596
1.845
0.694
0.637
-0.0404
-0.0251
0.550

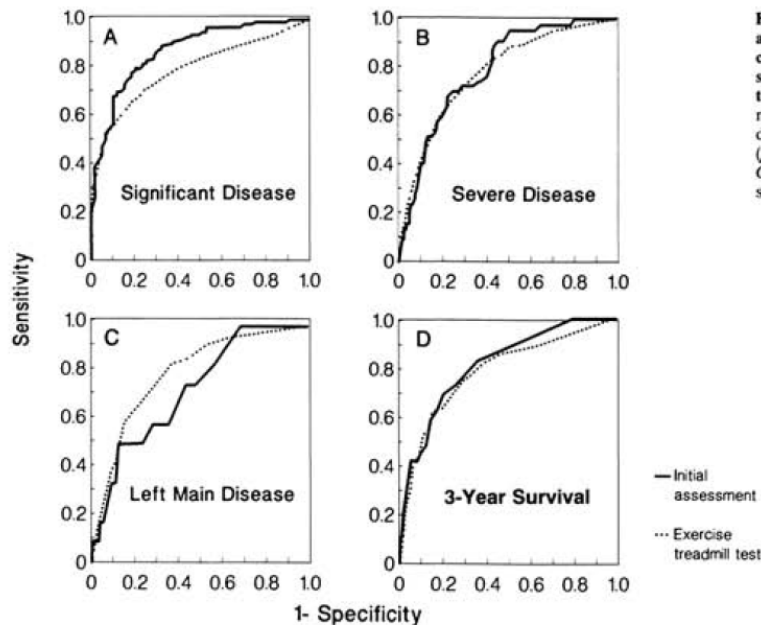


Figure 6. Receiver operating characteristic curves comparing the discriminatory ability of the initial assessment with that of the exercise treadmill test. Results for any significant disease (panel A); severe disease (left main or three-vessel) (panel B); left main disease (panel C); and survival (panel D) are shown.

Ethnic Variations?

- Anecdotal experience

ACUTE CORONARY SYNDROMES







Acute coronary syndromes and their presentation in Asian and Caucasian patients in Britain

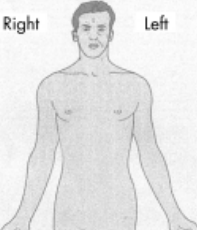
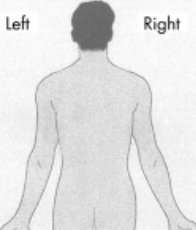
Molly Teoh, Susan Lalondrelle, Michael Roughton, Richard Grocott-Mason, Simon W Dubrey



Heart 2007;93:183-188. doi: 10.1136/hrt.2006.091900

Teoh et al 2006

Chest pain survey	
Name	
Age	
Sex	
Race	
Diabetes ?	
Diagnosis	

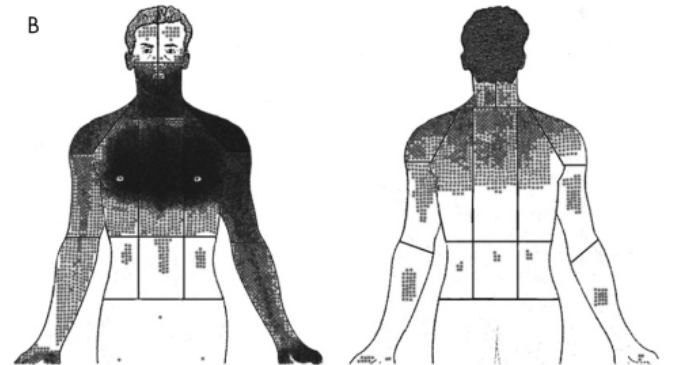
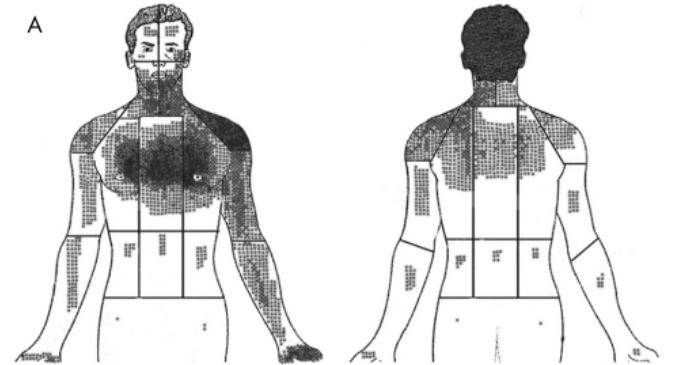
 Stabbing	 Shooting pain	 Dull ache
 Heavy weight on chest	 Burning pain	 Squeezing pain

Right		Left	
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Pain scale:	
	1 2 3 4 5 6 7 8 9 10 

Instructions:

1. Circle the icon which best demonstrates the NATURE of your pain.
2. Shade on the image opposite the SITE of your pain.
3. Circle the number on the pain scale according to the INTENSITY of your pain.



A=Asian

B=Caucasian

Limitations Continued

- Is it over-protocolised?
 - Individual anomalies: e.g. 45 year old Asian male with central constricting pain brought on by exercise and relieved by rest. Hypertensive with a strong family history.
 - Likelihood score: 51% - offer non-invasive imaging.
-but.. Would anyone NOT refer him immediately for angiography?!

What about the ETT?

- NICE 2010:
‘1.3.6.5 Do not use exercise ECG to diagnose or exclude stable angina for people without known CAD’
- So is there a role for ETT?

.....yes probably

European Guidelines



European Heart Journal (2010) 31, 2501–2555
doi:10.1093/eurheartj/ehq277

ESC/EACTS GUIDELINES



Guidelines on myocardial revascularization

The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

- *‘Because of high availability and low costs, an exercise electrocardiogram (ECG) is the most commonly used test to confirm the anginal nature of the symptoms and to provide objective evidence of inducible ischaemia....’*
- *‘...Many of the patients with an intermediate likelihood of CAD post-exercise ECG are reclassified into higher or lower likelihood groups after non-invasive functional imaging’*

Stress ECHO

- 1935: Observation that coronary occlusion resulted in instantaneous abnormality of wall motion²
- Stressors include exercise, dipyridamole and dobutamine.
- Relatively inexpensive.
- Does not involve ionising radiation. The 'ALARA' principle
- Good safety profile. Rate of death approx. 1:5000³

2: Tennant R, Wiggers CJ. The effect of coronary occlusion on myocardial contraction. Am J Physiol. 1935, 112; 351-361.

3. Source: Stress echocardiography expert consensus statement. European Journal of Echocardiography. 2008. 9; 415-437

DSE Performance

- A negative test equates to a 1 year cardiac event rate of 0.4-0.9% (equivalent to MPS)⁴
- Sensitivity approx 84%
- Specificity approx 86%⁵
- Similar to MPS
- ETT: sens 68%, spec 77%

- 4: [Metz LD](#), [Beattie M](#), [Hom R](#), [Redberg RF](#), [Grady D](#), [Fleischmann KE](#).. **The prognostic value of normal exercise myocardial perfusion imaging and exercise echocardiography: a meta-analysis.** J Am Coll Cardiol. 2007 Jan 16;49(2):227-37. Epub 2006 Dec 29
5. [Picano E](#), [Molinaro S](#), [Pasanisi E](#). **The diagnostic accuracy of pharmacological stress echocardiography for the assessment of coronary artery disease: a meta-analysis.** Cardiovasc Ultrasound. 2008 Jun 19;6:30.

DSE

- Recommended for intermediate risk patients without known CAD
- Also appropriate after coronary angiography in asymptomatic patients with significant disease, or symptomatic patients with moderate disease
- Other indications: assessment of myocardial viability, contractile reserve and severity of aortic stenosis.

Table 7 Indications of different imaging tests for the diagnosis of obstructive coronary artery disease and for the assessment of prognosis in subjects without known coronary artery disease^a

	Asymptomatic (screening)	Symptomatic			Prognostic value of positive result ^a	Prognostic value of negative result ^a	References
		Pretest likelihood ^b of obstructive disease					
		Low	Intermediate	High			
Anatomical test							
Invasive angiography	III A	III A	IIb A	I A	I A	I A	12
MDCT angiography	III B ^c	IIb B	IIa B	III B	IIb B	IIa B	17–20
MRI angiography	III B	III B	III B	III B	III C	III C	22
Functional test							
Stress echo	III A	III A	I A	III A ^d	I A	I A	12
Nuclear imaging	III A	III A	I A	III A ^d	I A	I A	12
Stress MRI	III B	III C	IIa B	III B ^d	IIa B	IIa B	12, 23–25
PET perfusion	III B	III C	IIa B	III B ^d	IIa B	IIa B	26

^aFor the prognostic assessment of known coronary stenosis, functional imaging is similarly indicated.

^bThe pretest likelihood of disease is calculated based on symptoms, sex, and risk factors.

^cThis refers to MDCT angiography, not calcium scoring.

^dIn patients with obstructive CAD documented by angiography, functional testing may be useful in guiding the revascularization strategy based on the extent, severity, and localisation of ischaemia.

CAD = coronary artery disease; MDCT = multidetector computed tomography; MRI = magnetic resonance imaging; PET = positron emission tomography.

Contraindications

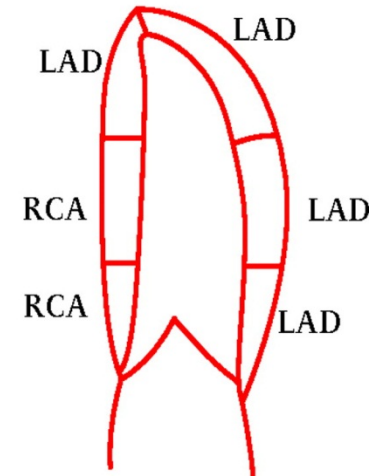
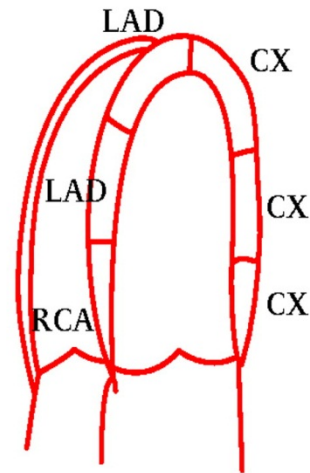
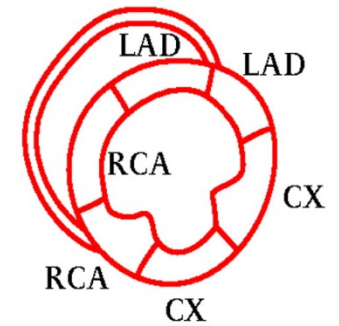
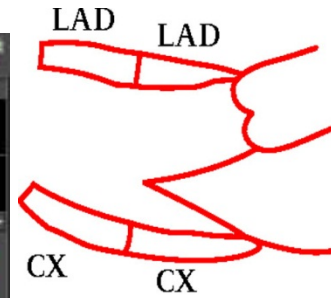
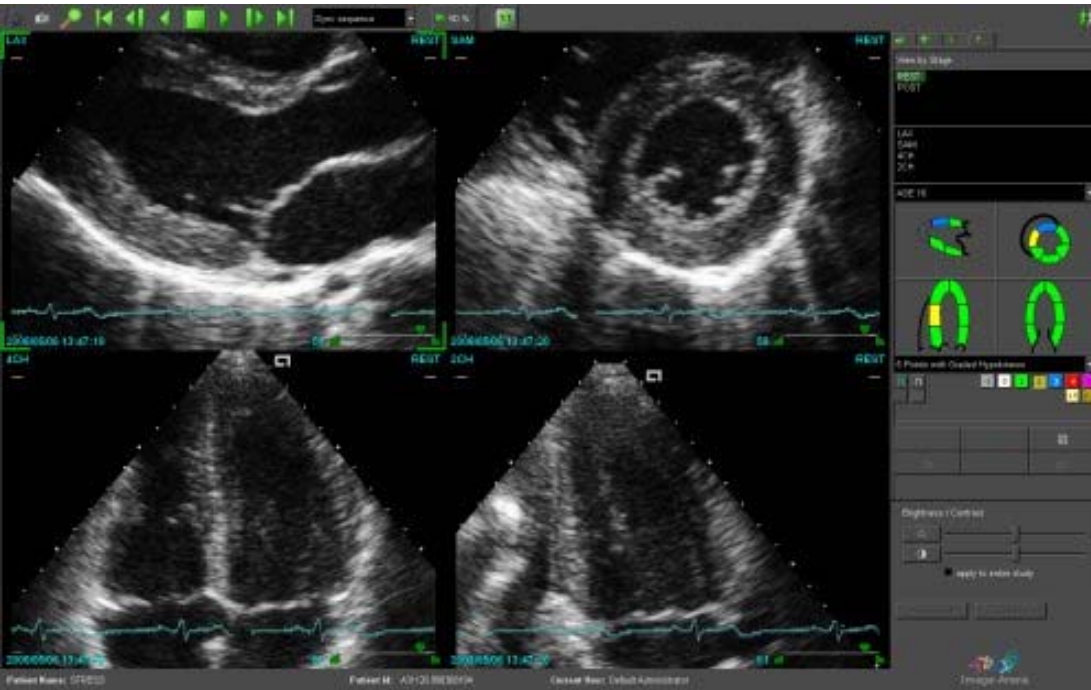
Absolute Contraindications:

- Resting chest pain within 24 hrs
- Myocardial infarction within the last four weeks
- Systemic resting BP > 200/110
- History of confirmed VT (unrelated to acute MI)
- Known LV thrombus
- Recent PE

Procedure

- Patients are fasted. B-blockers withheld for 48hrs
- Resting ECHO study, five specific views recorded
- Dobutamine commenced at increasing doses:
 - Low dose: 10 μ g/kg/min (3 minutes) - five imaging views repeated.
 - High dose: Increase initially to 20 μ g/kg/min for 3 minutes. Then 30 μ g/kg/min +/- atropine to achieve THR – five imaging views repeated
 - Recovery: After infusions have ceased. Full series of images.

17-Segment Model



Reporting

- Baseline, low dose, high dose and recovery images are compared in each view
- A normal response is demonstrated by progressive improvement in wall motion from baseline through to the high dose images
- Ischaemia is indicated by a 'biphasic' response in a given territory (i.e. an initial improvement, followed by reduction in contractile function at high dose)
- Myocardial viability is indicated by any improvement in contractility either at low or high dose.

Summary

- Current NICE Guidelines for the investigation of chest pain rely heavily on history and risk factors. Further investigation should be justified by diagnostic uncertainty.
- Angiography has prognostic as well as diagnostic implications
- The ETT for investigation of patients without known CAD has been side-lined by the guidelines but still has a role to play
- DSE offers a safe and accurate method for confirming the presence or absence of CAD and (more importantly) cardiac ischaemia. A negative or positive result has very clear prognostic implications

Thank You

Any Questions?