

CARDIAC MULTIMODALITY IMAGING:

Informing better decisions - or just costly
pictures?

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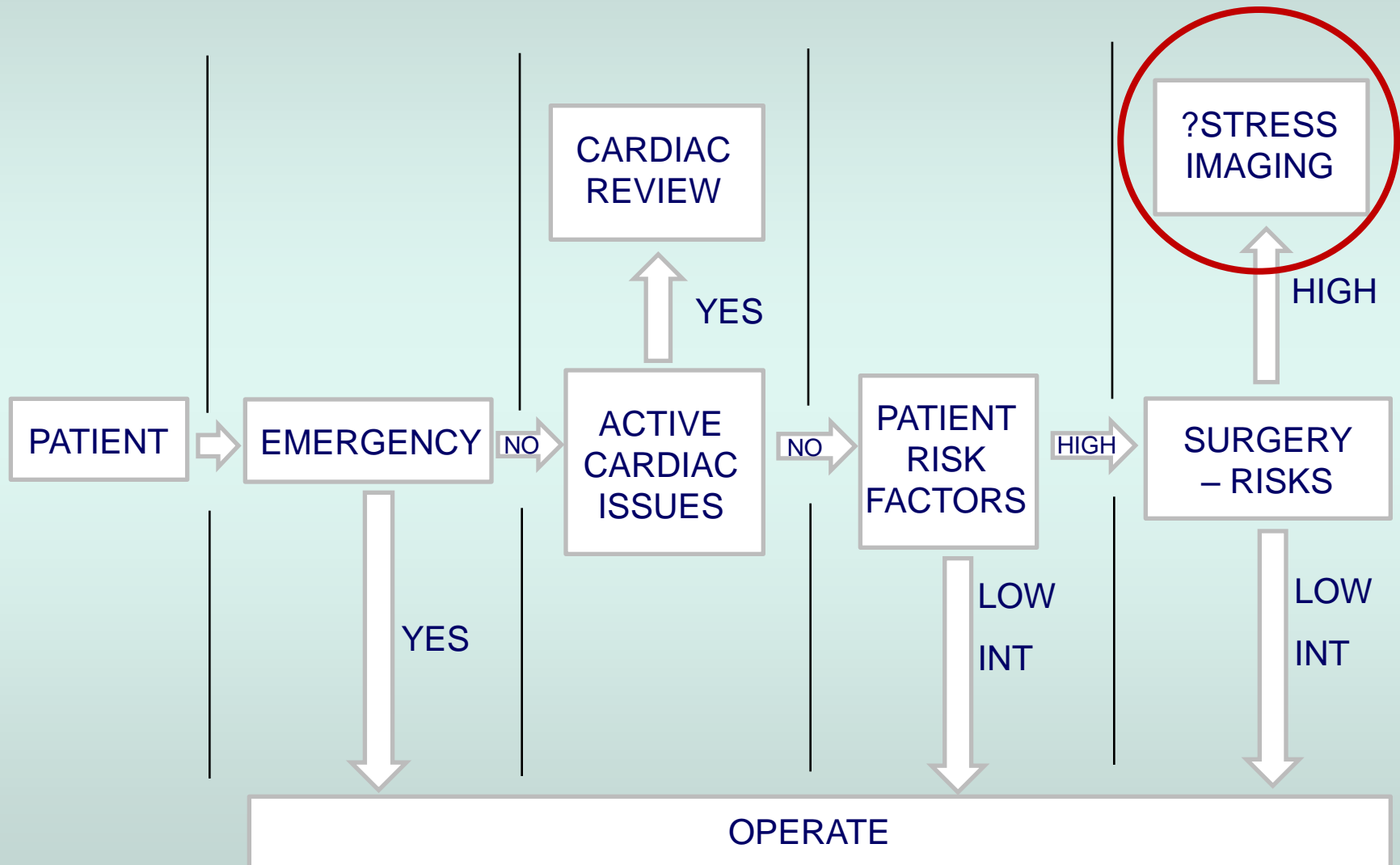
Overview



- Preoperative evaluation
 - Current evidence for imaging in preoperative risk assessment
- New modalities:
 - Cardiac MRI
 - CT coronary angiography
- Echocardiography
 - Portability and IV contrast

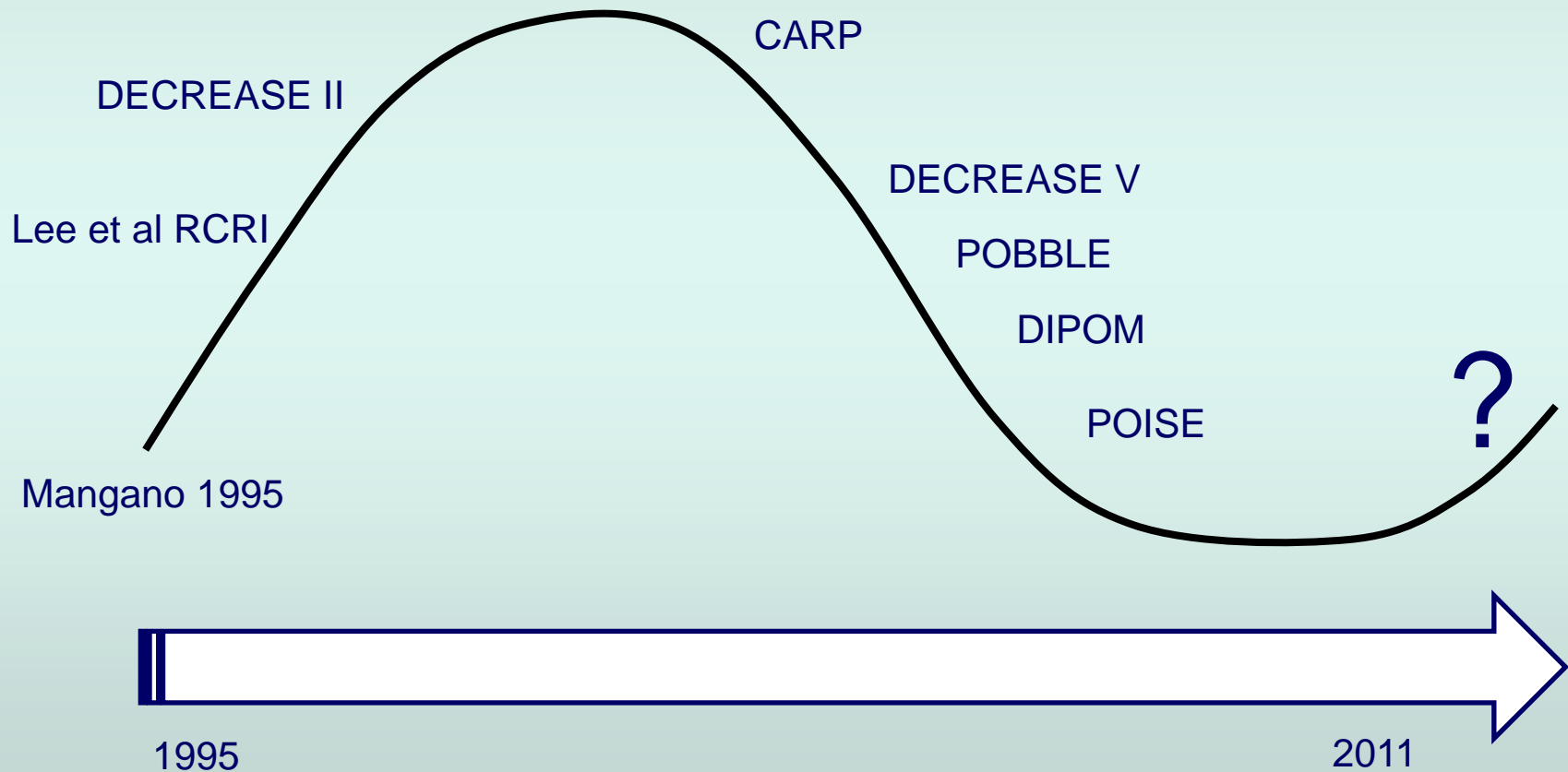


Preoperative evaluation



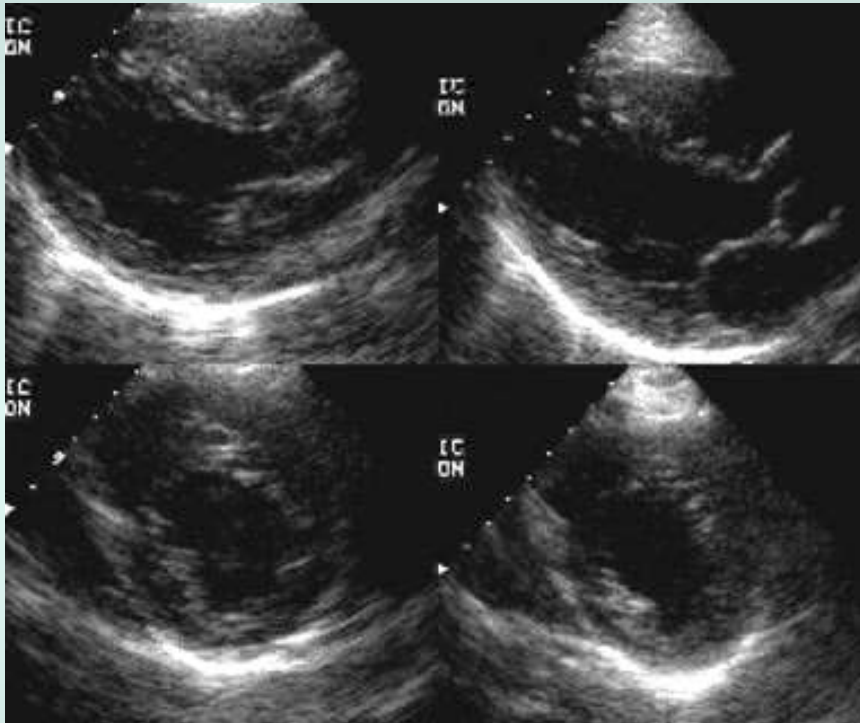


Imaging for risk – usage?





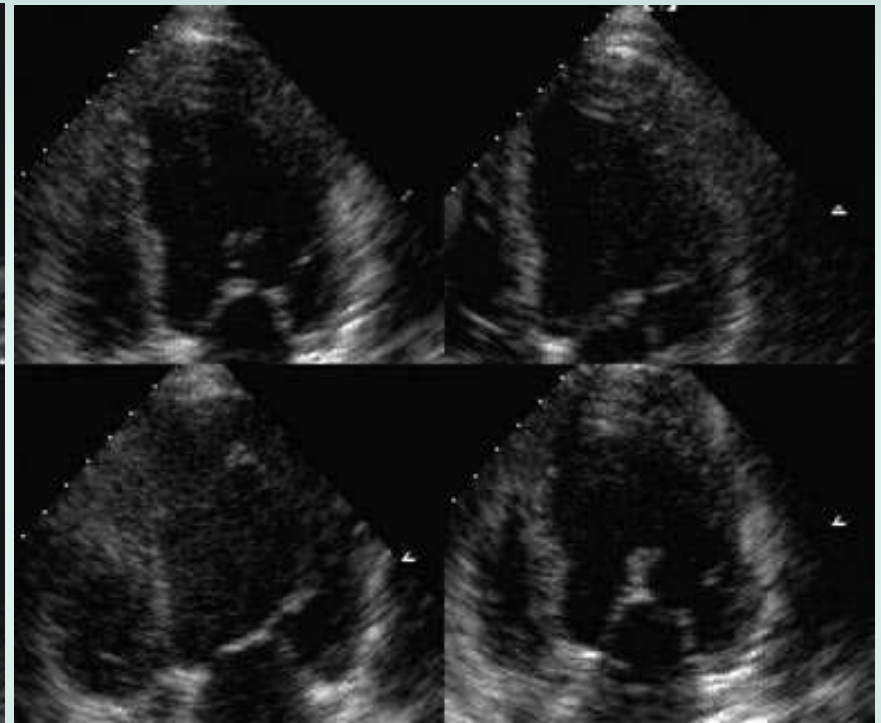
Stress Imaging - Echo



Rest

Stress

NORMAL



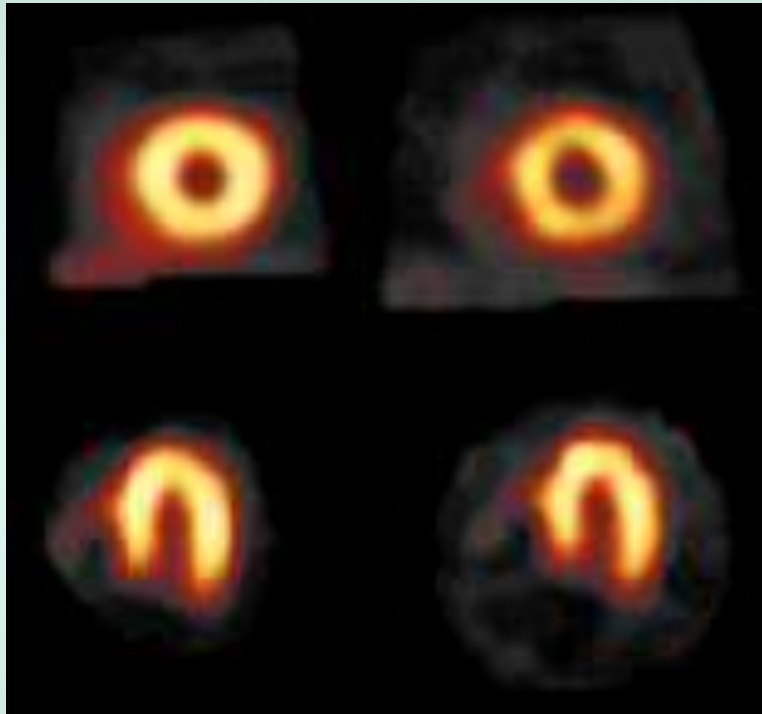
Rest

Stress

ISCHAEMIA



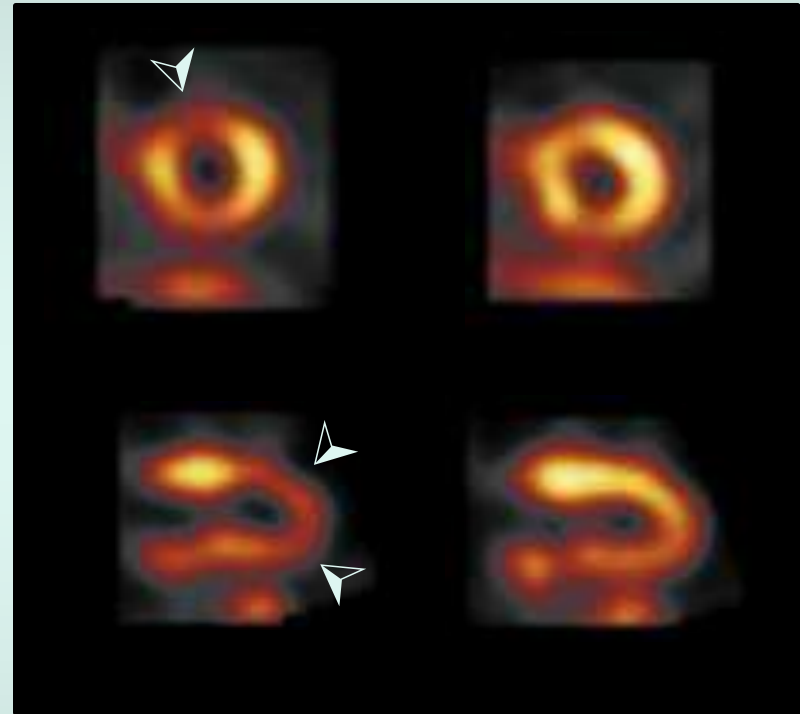
Stress perfusion - SPECT



Stress

Rest

NORMAL



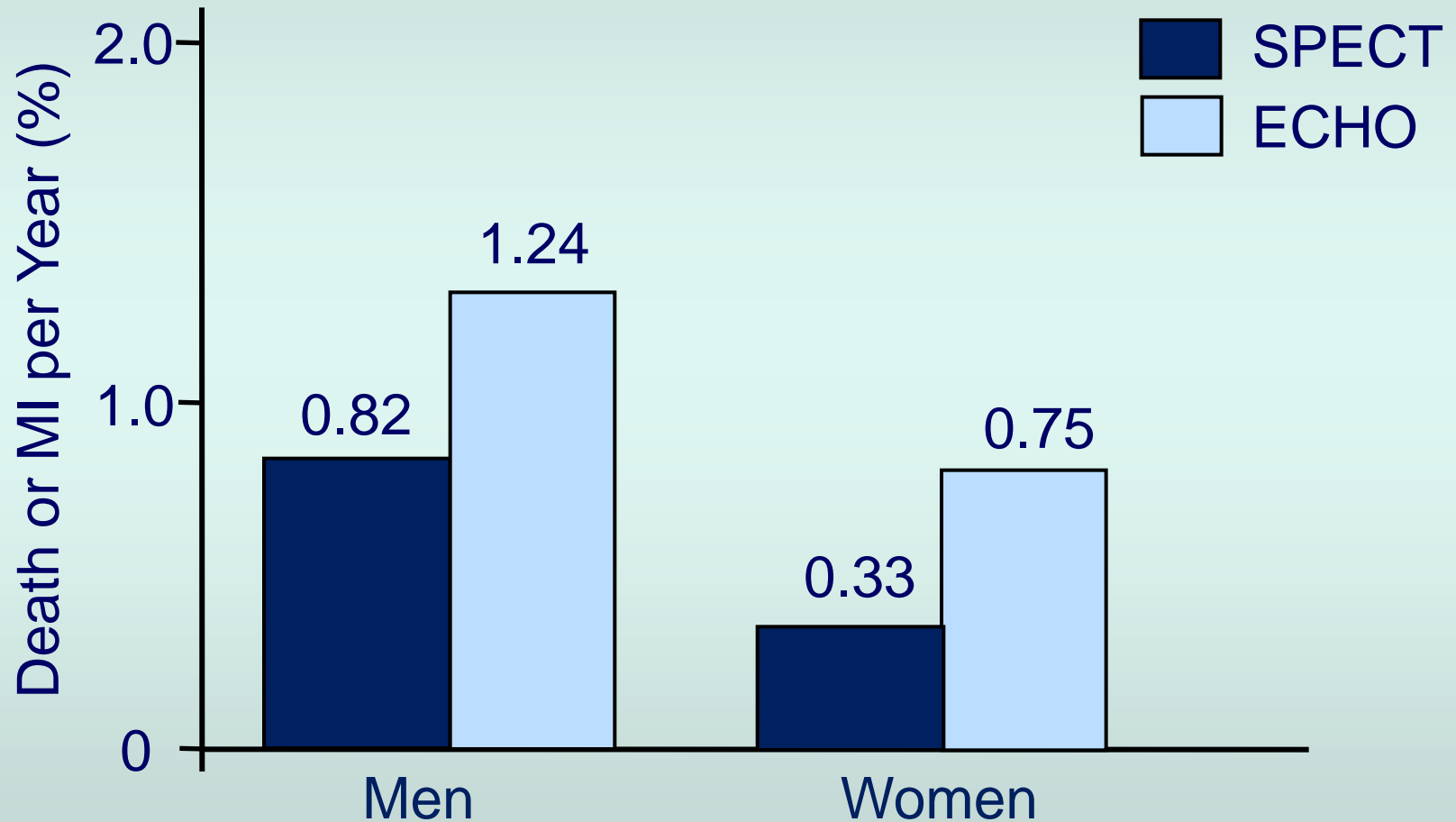
Stress

Rest

ISCHAEMIA

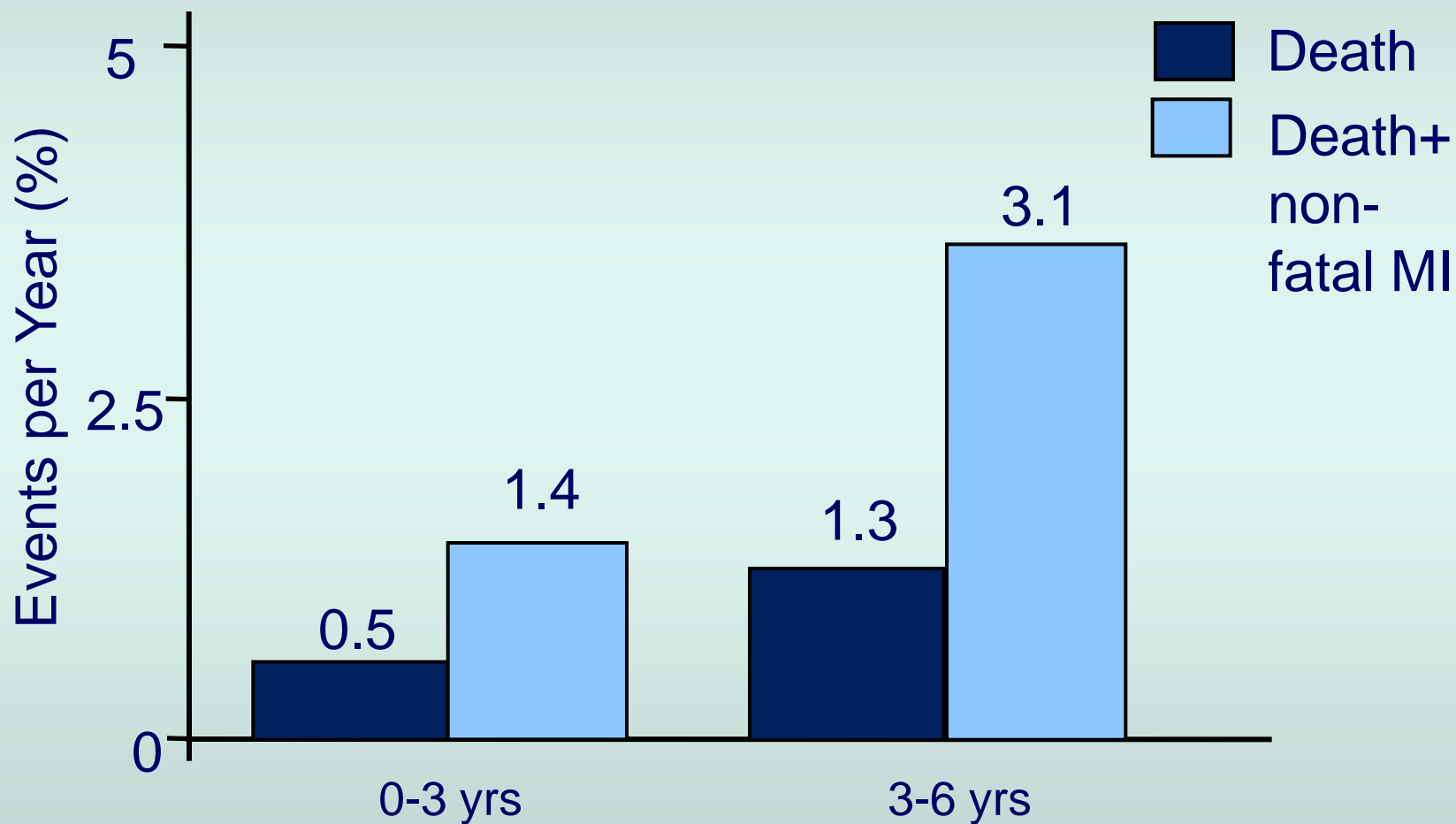


Event rates: SPECT and Echo



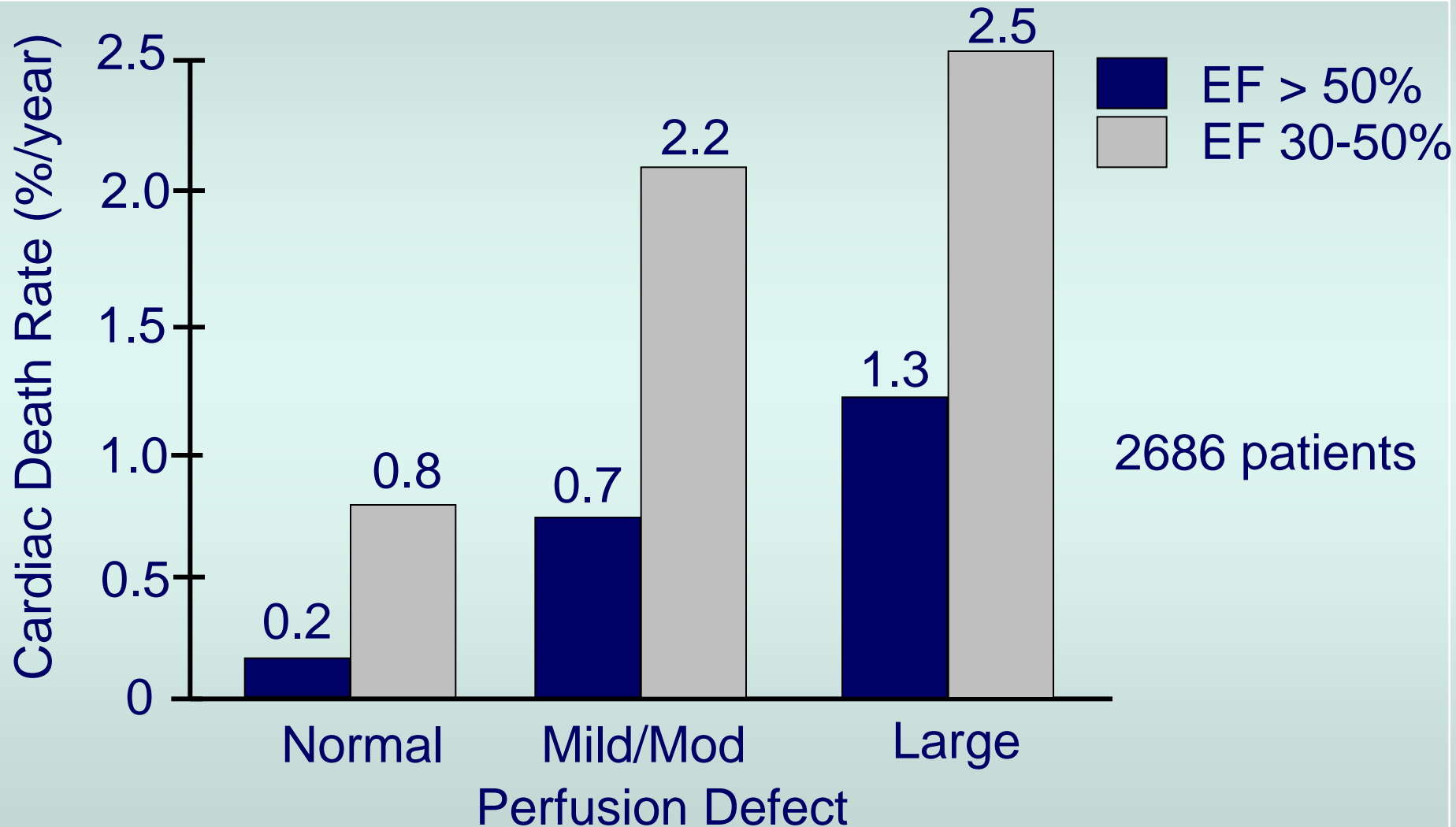


Event rates: known CAD



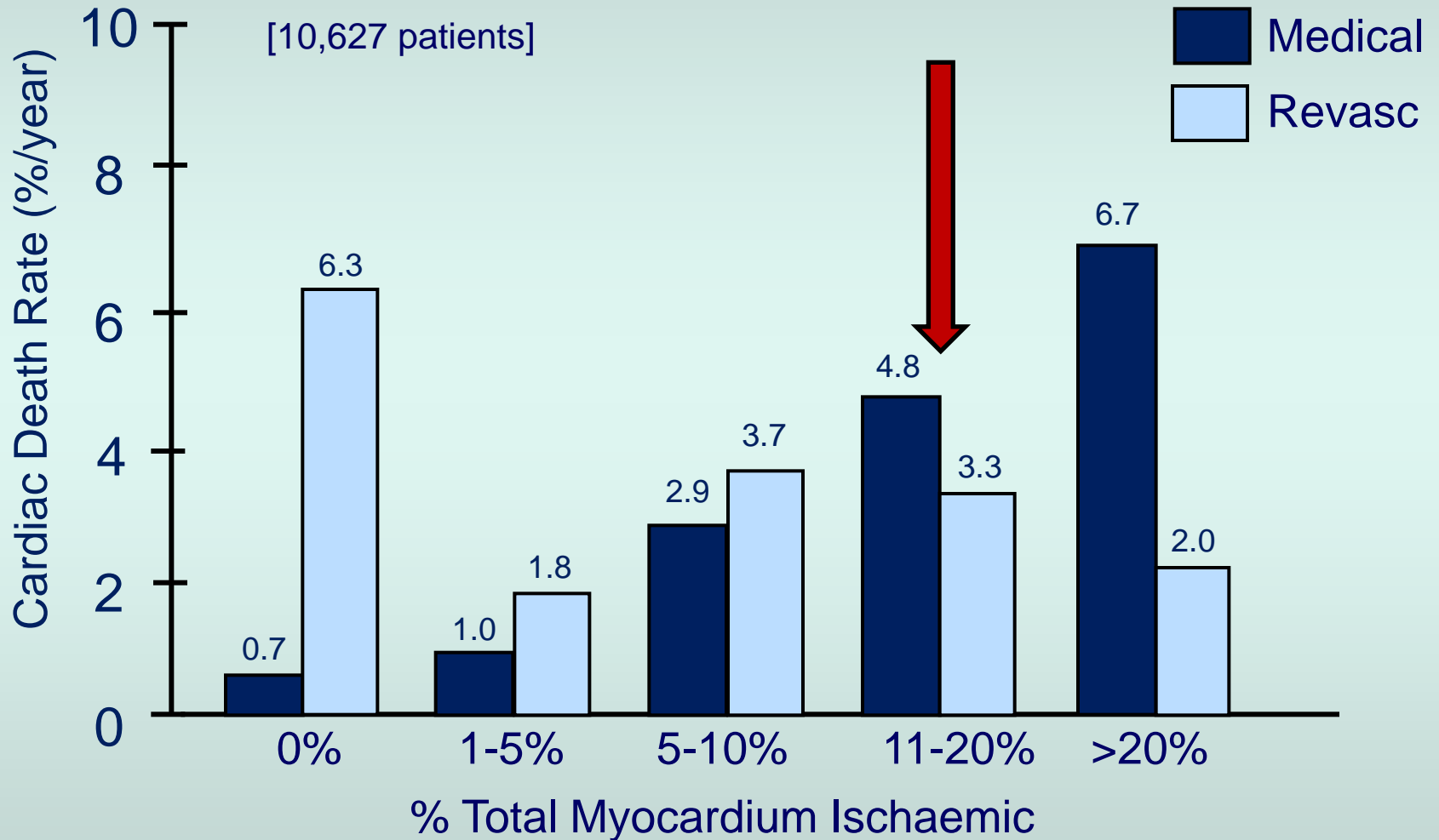


Adding LV function





Revascularisation - Ischaemic Burden



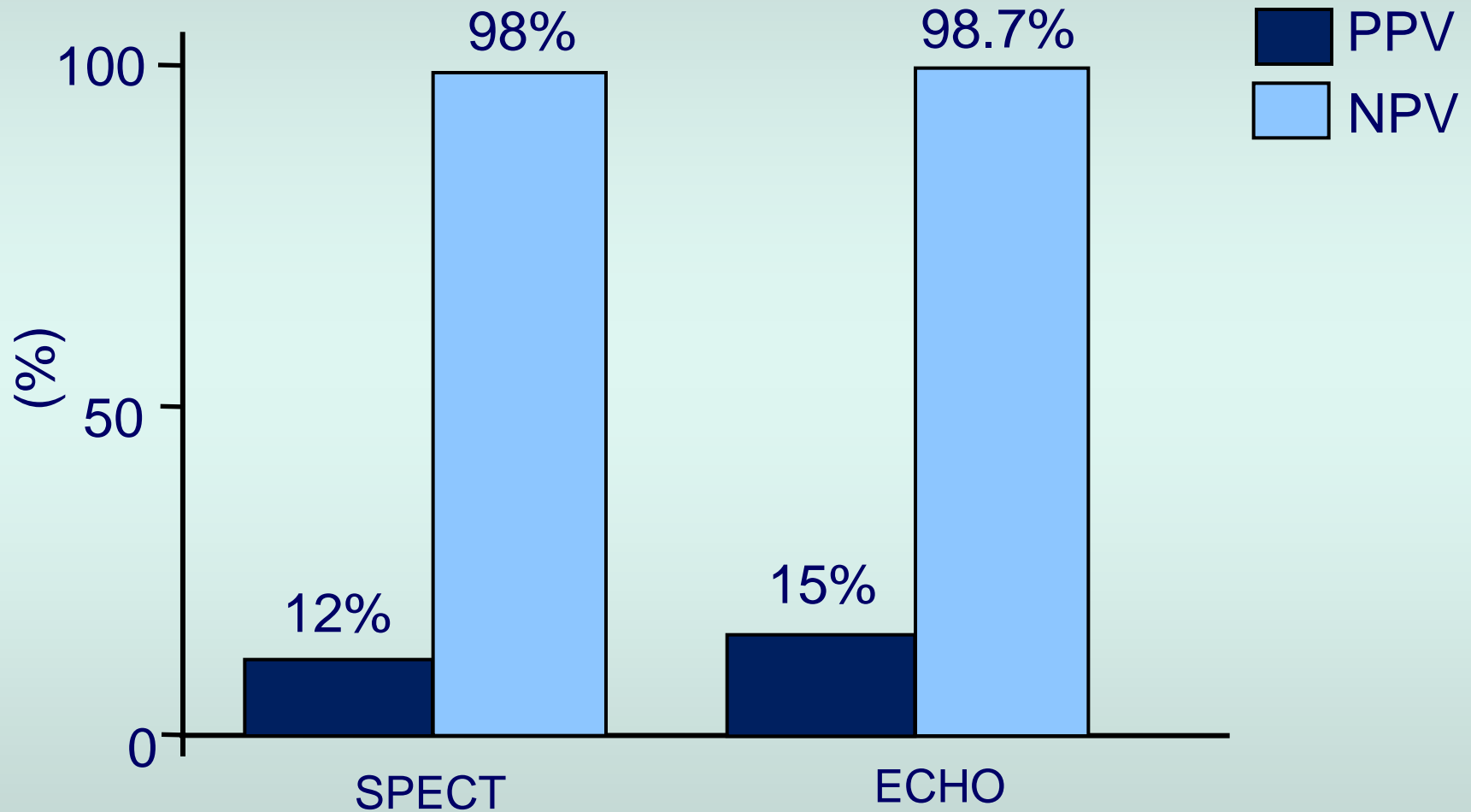


“Cardiac Imaging”





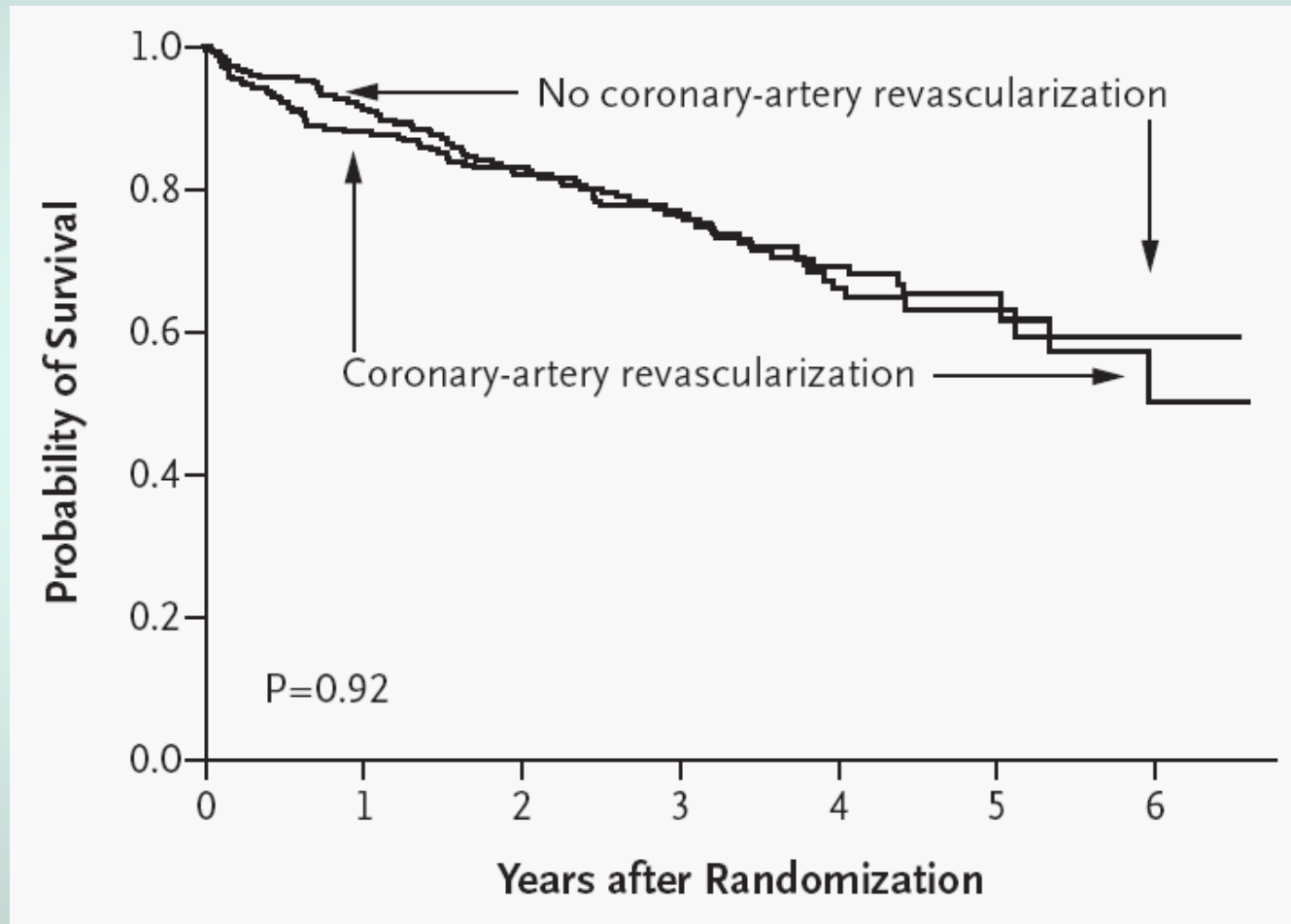
Does imaging predict events?



Summarised from: Fleisher et al. Circulation 2009;120:e169-276 (ACCF/AHA Update)

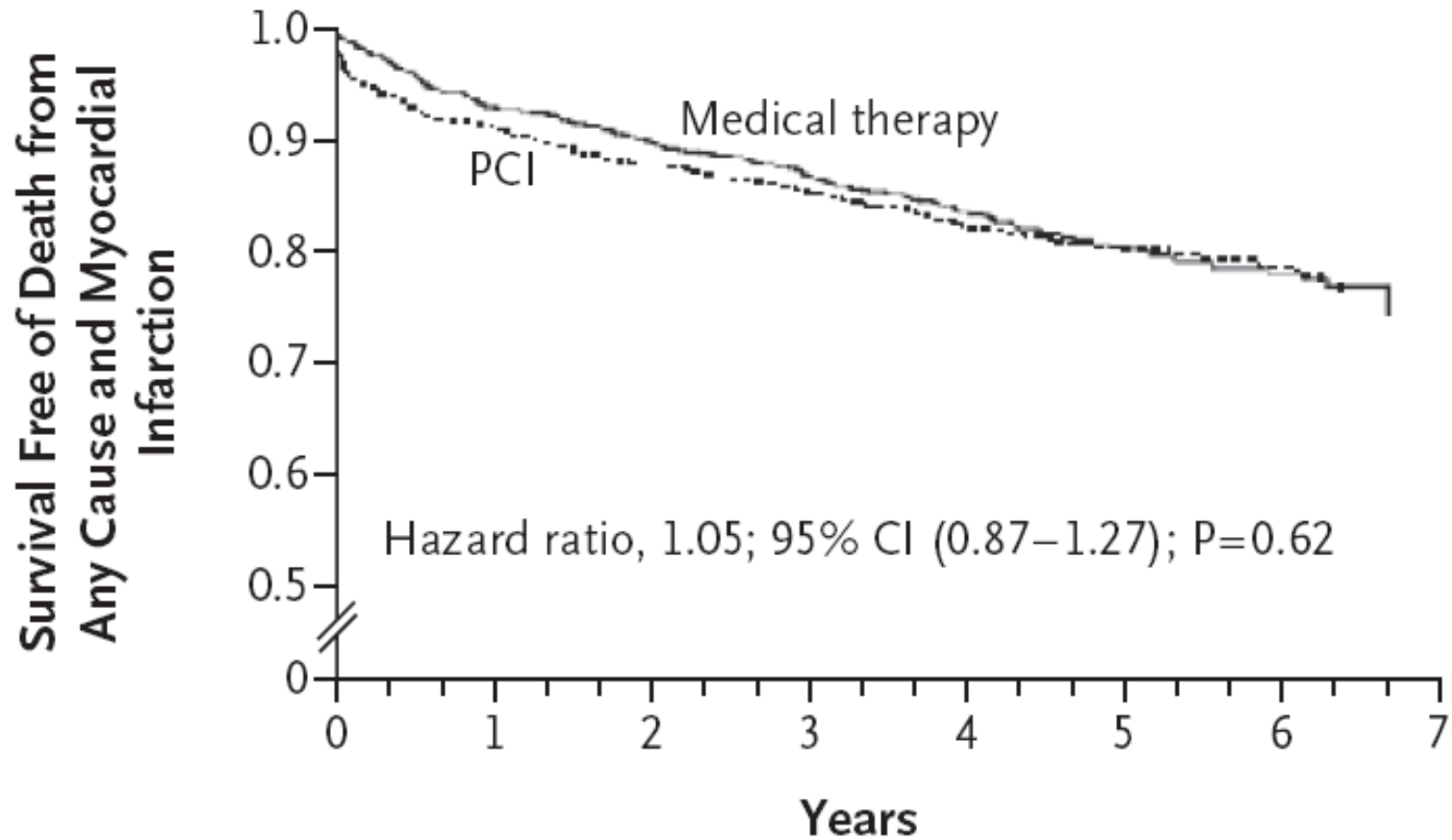


Can we change outcomes?



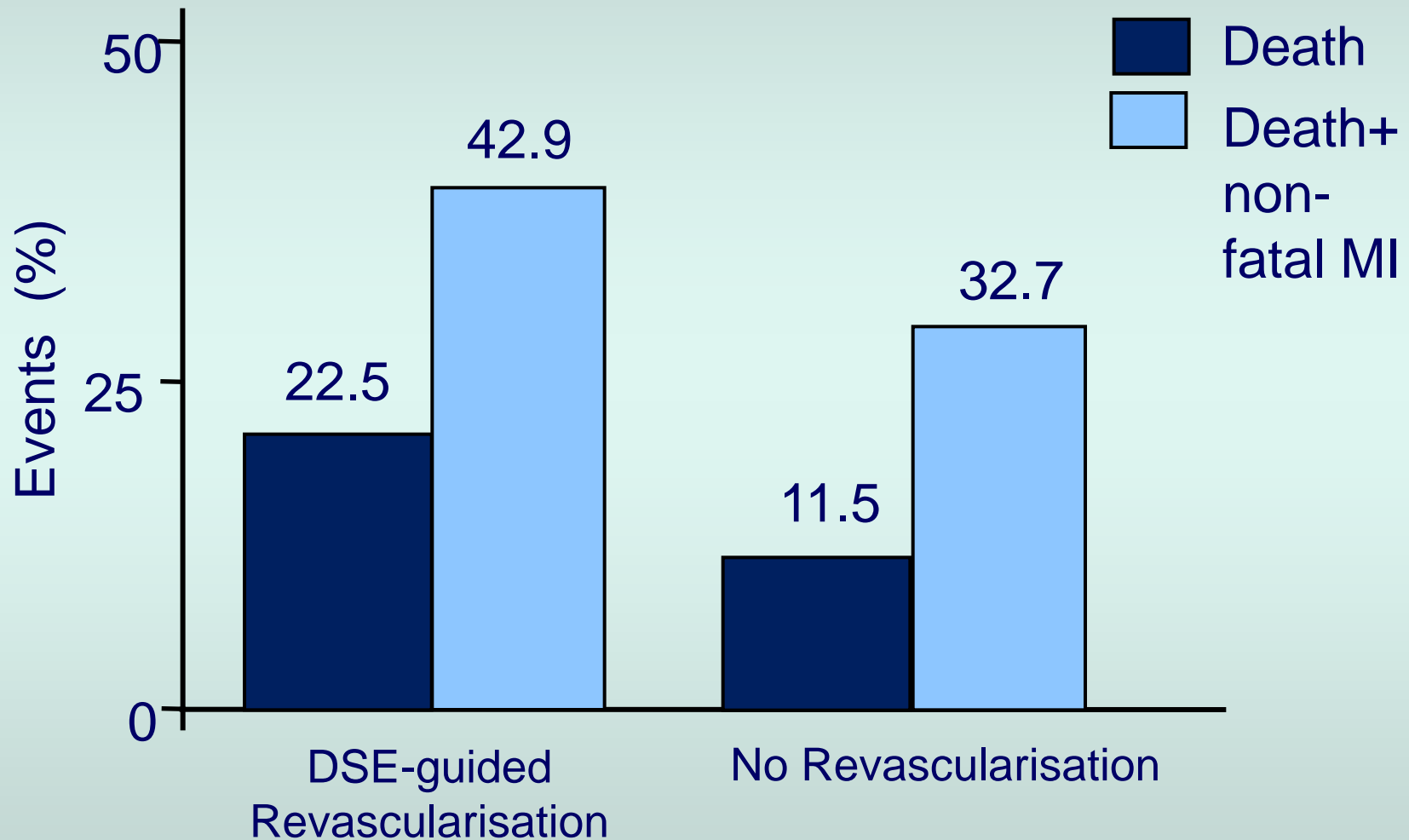


Courage!



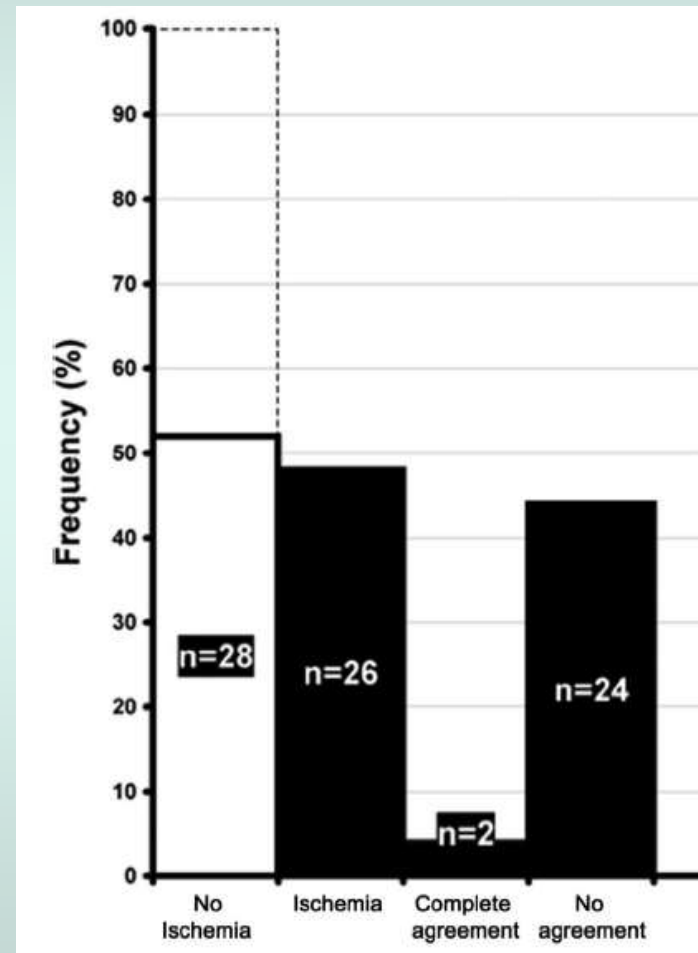
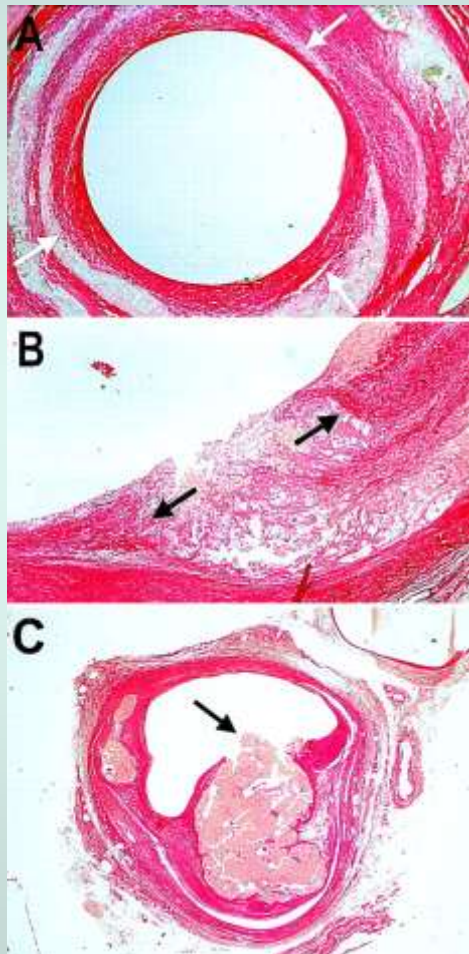


Imaging-guided revascularisation



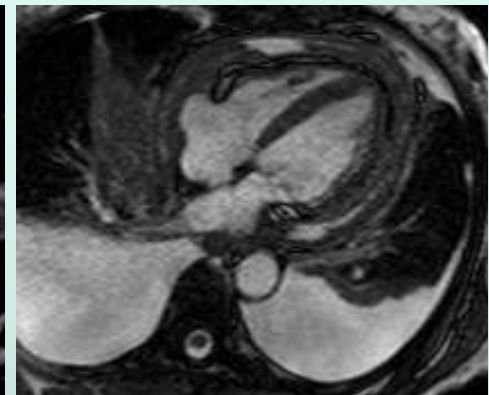
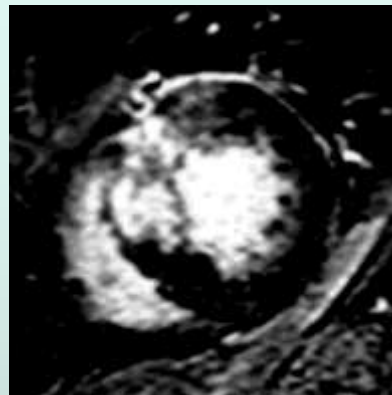
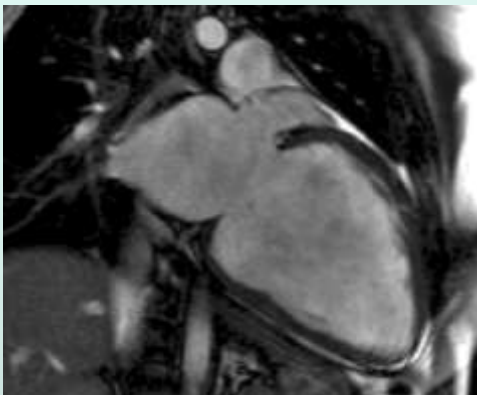
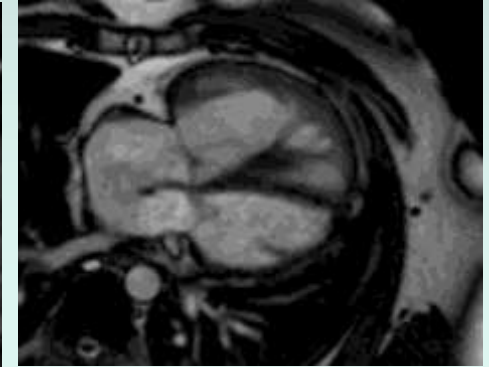
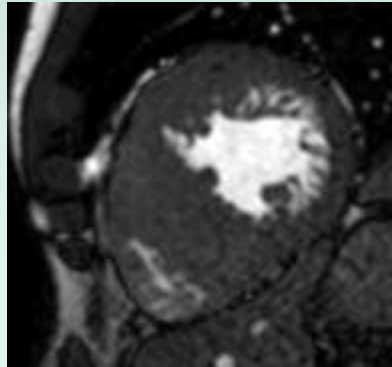
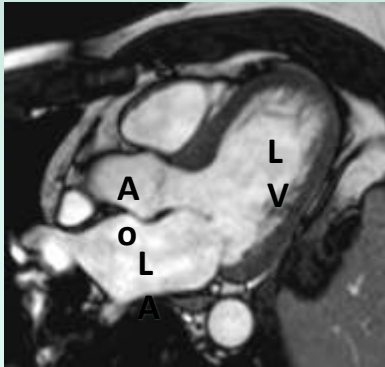


Ischaemia, obstruction & events





Cardiac MRI





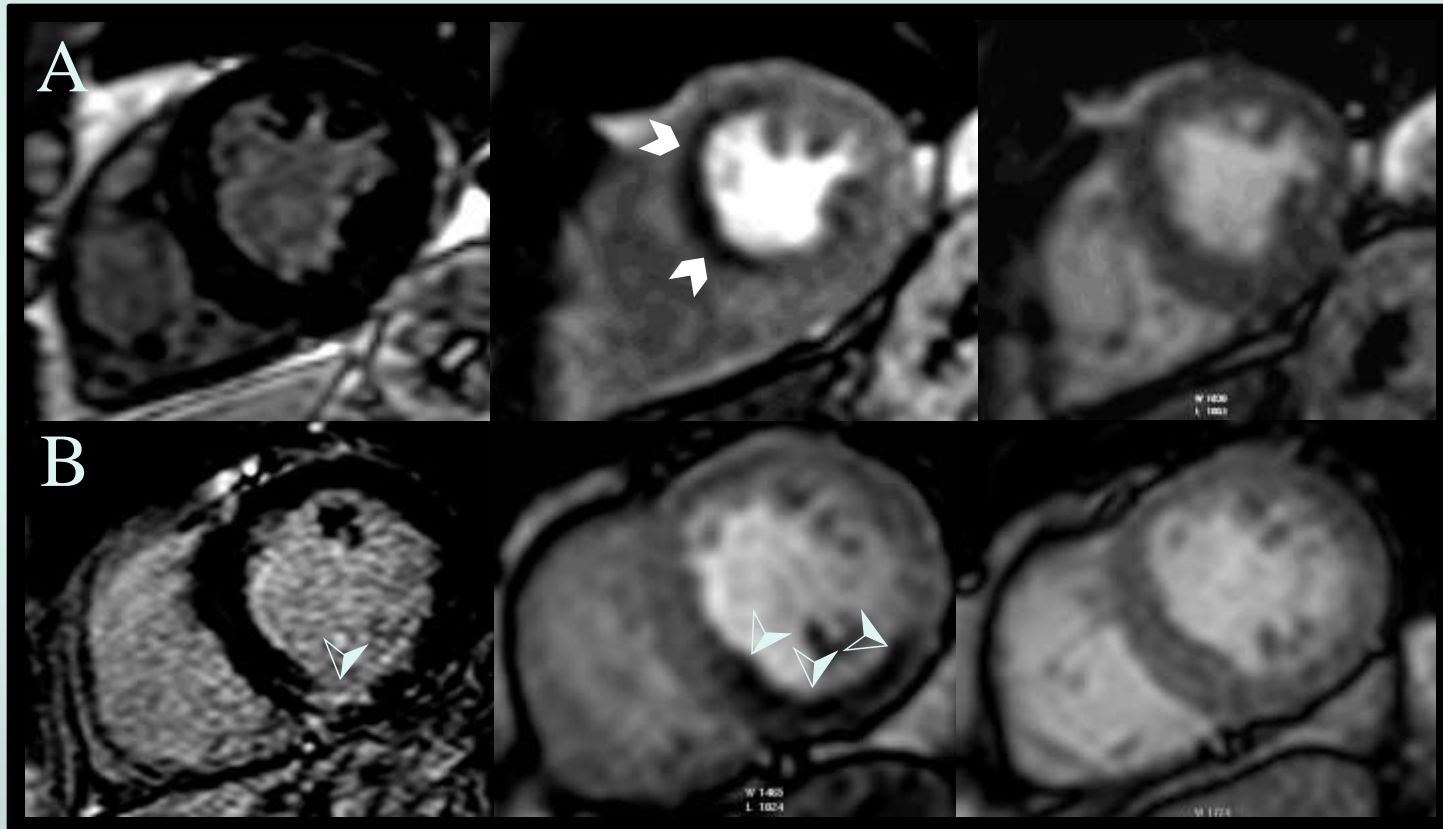
Stress Perfusion - CMR



DELAYED
ENHANCEMENT

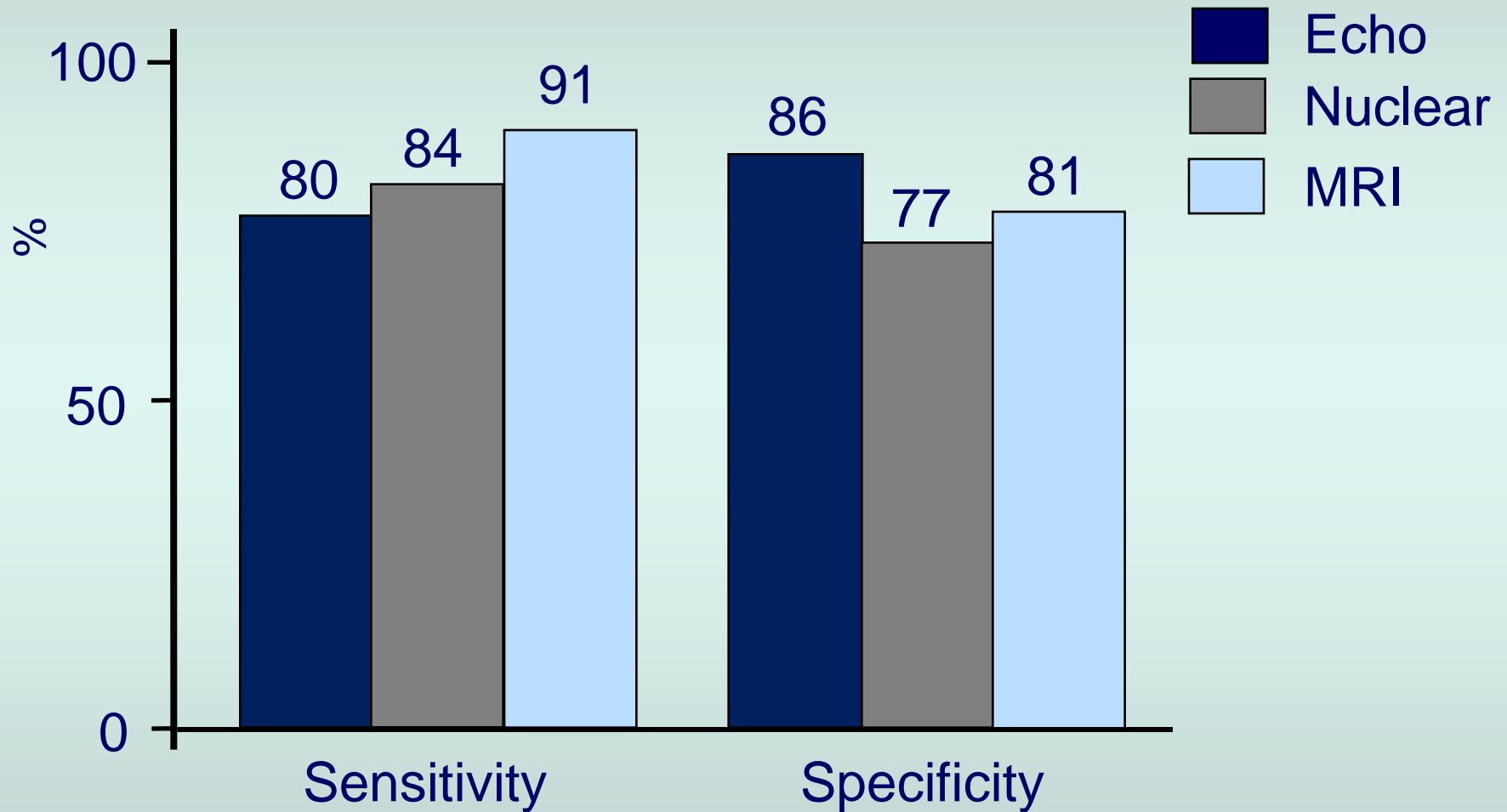
STRESS

REST





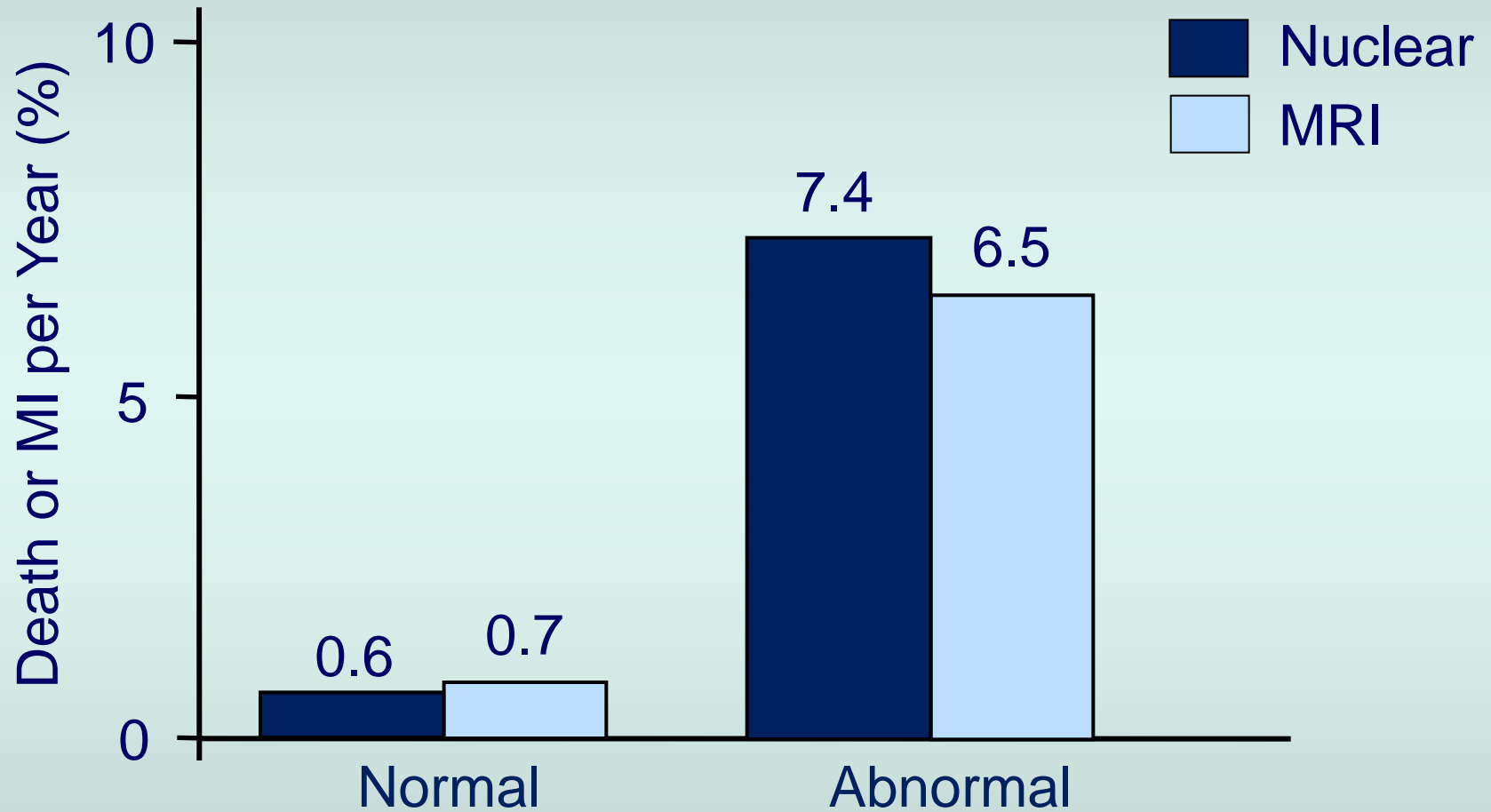
CMR vs SPECT and ECHO



Schinkel, A.F.L et al. Eur Heart J 2003;24:789-800
Nandalur KR et al. JACC 2007;50:1343-53



Event rates: SPECT and CMR

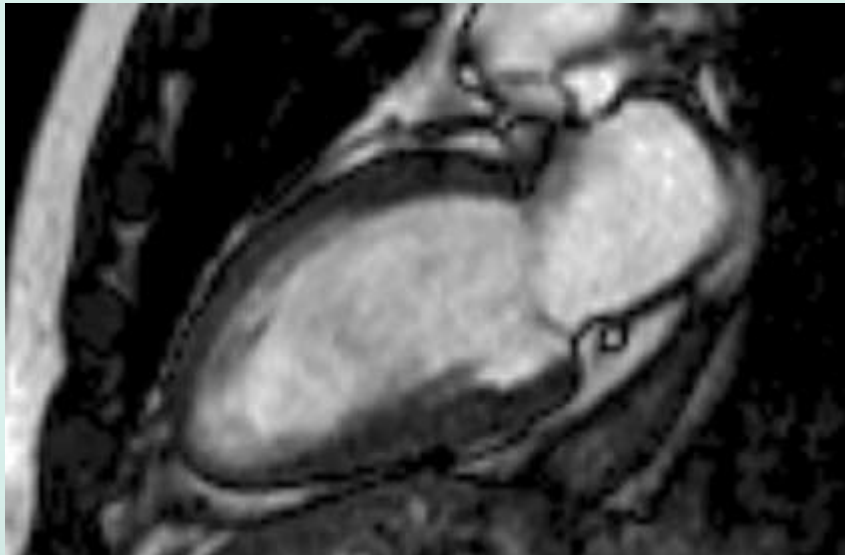


Iskander S, Iskandrian AE. J Am Coll Cardiol 1998;32:57-62

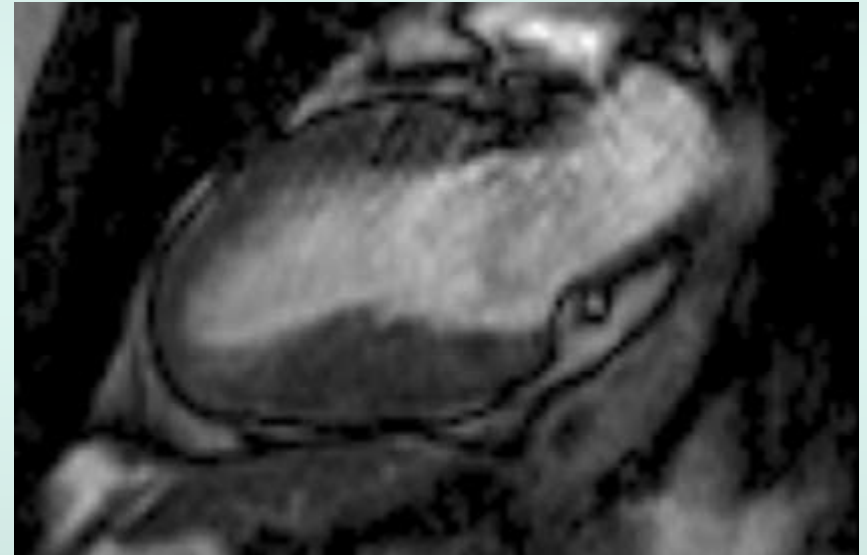
Hanke et al. Circulation 2007;115:1769



Dobutamine stress MRI



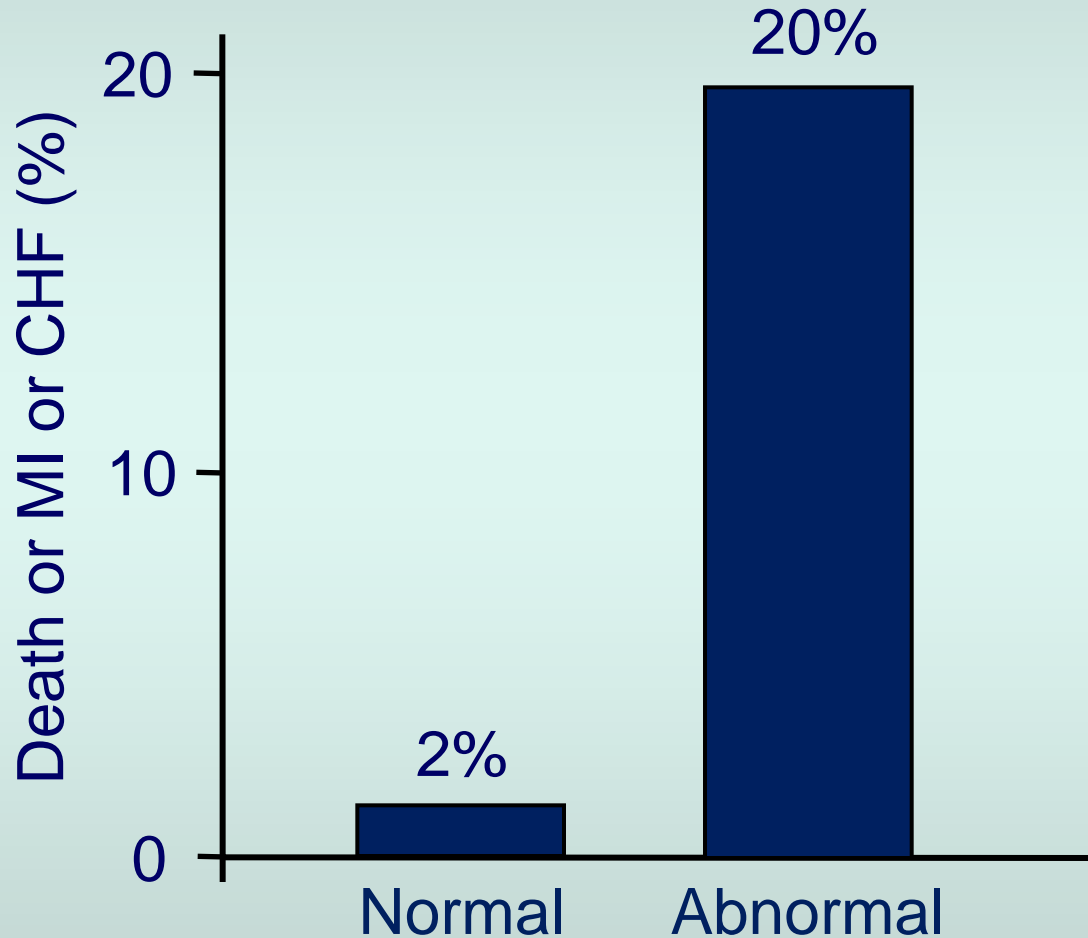
REST



STRESS



Preoperative use of DS-CMR





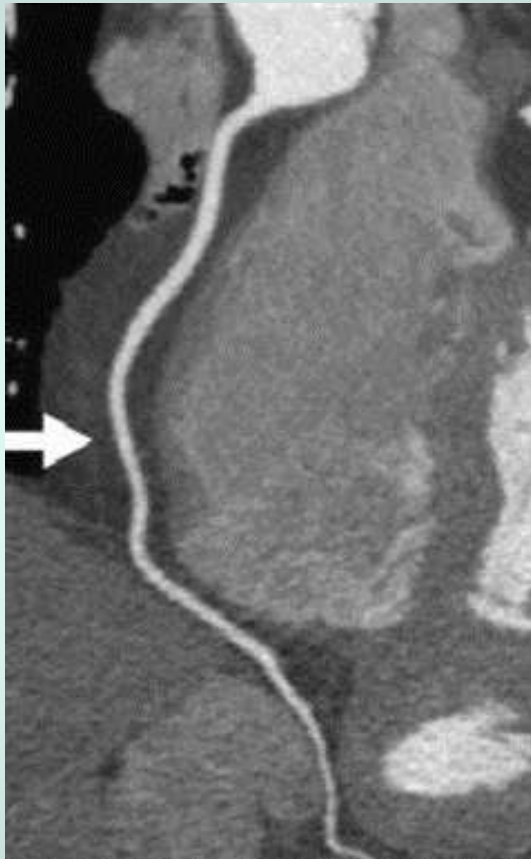
CMR - Summary



- No radiation
 - Comprehensive
 - Efficient
 - Accuracy/resolution
 - Prognostic
 - Quantitative (if required)
 - Viability assessed
- Minimal preoperative data
 - Pharmacologic stress only
 - CMR limitations
 - Claustrophobia
 - Devices – pacemakers etc
 - End stage renal disease
 - Expertise limited
 - Scanner availability



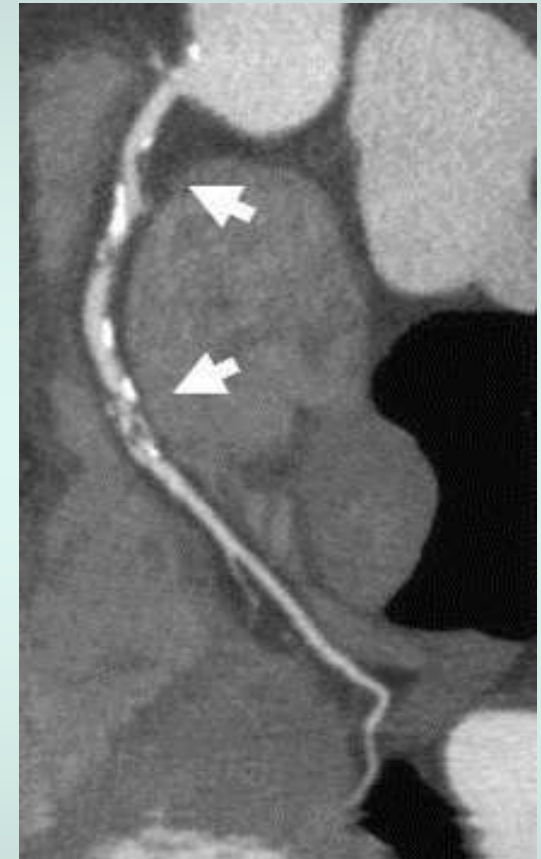
CT Coronary Angiography



NORMAL



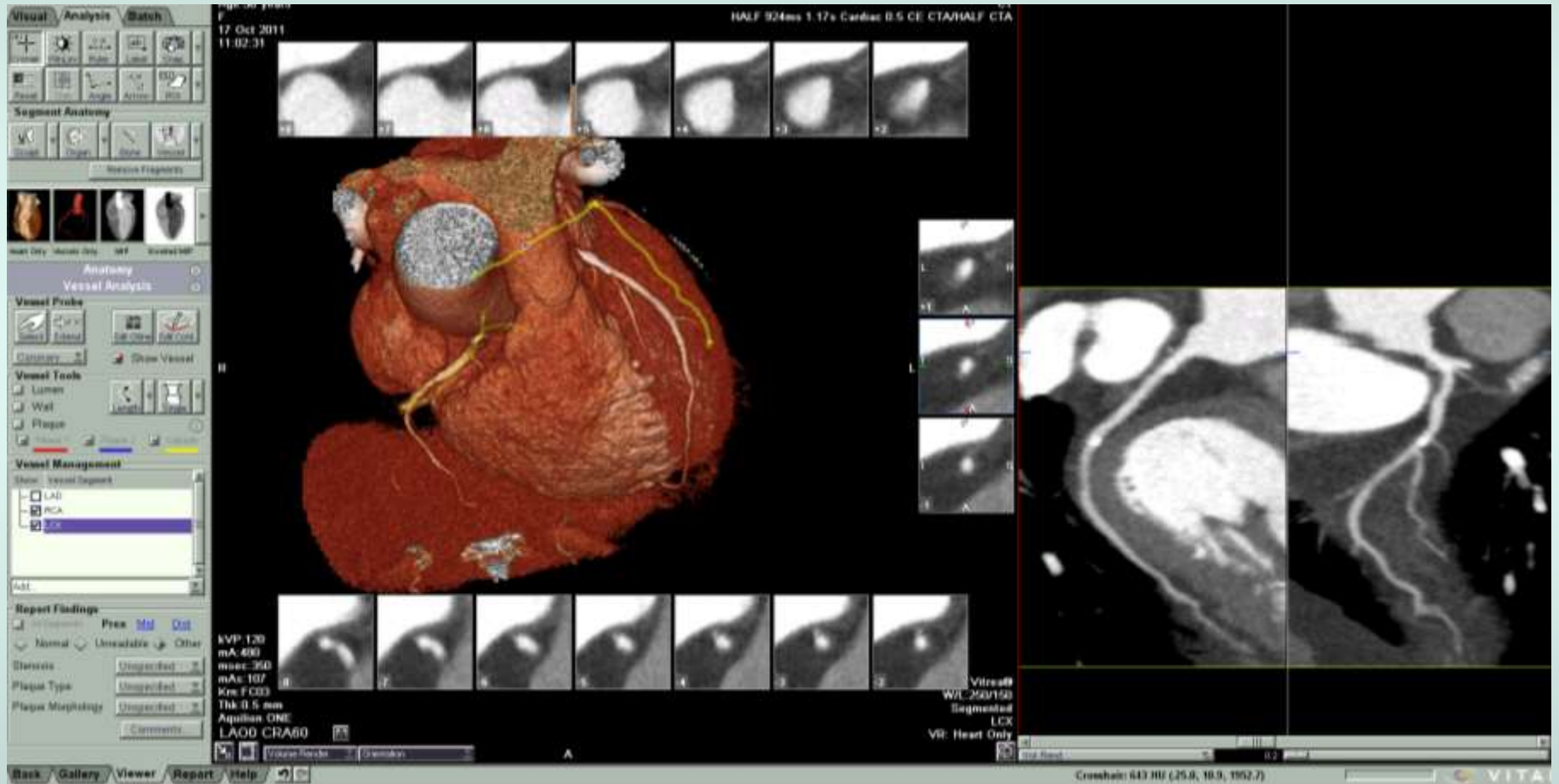
MILD



SEVERE

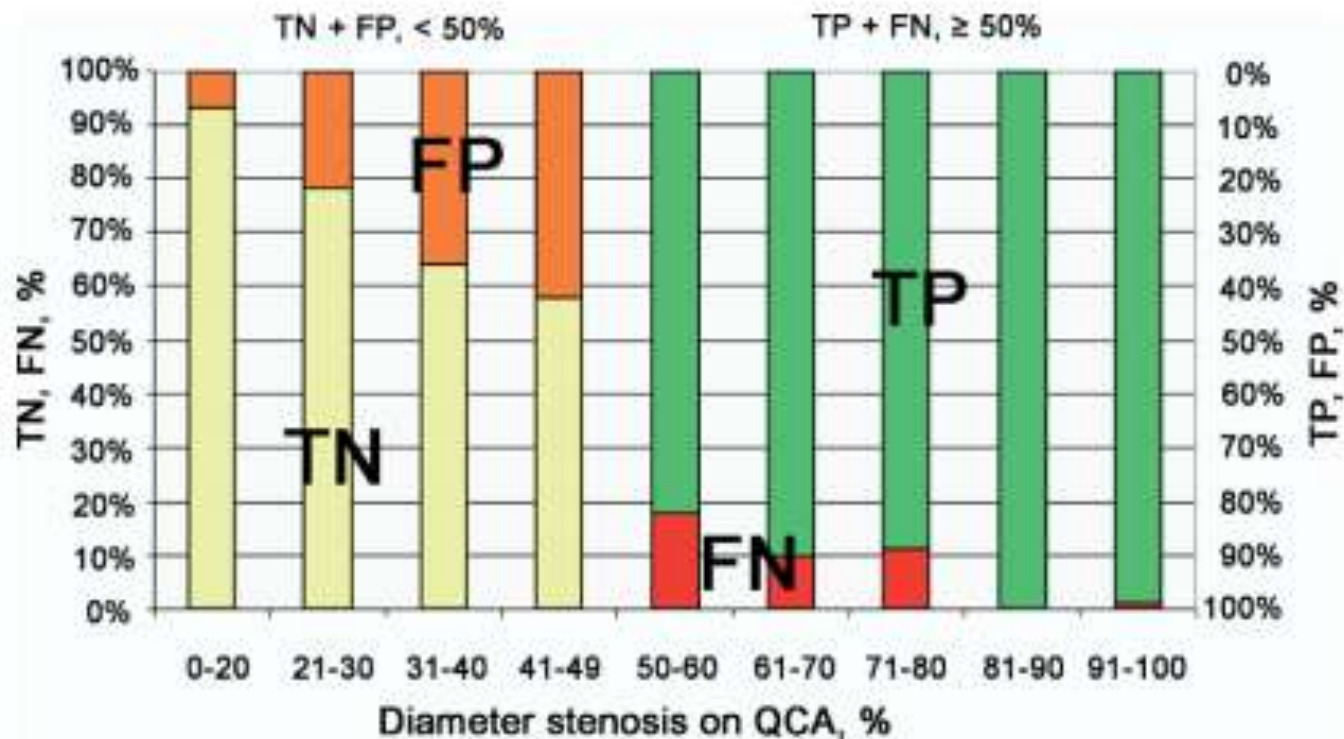


CTCA analysis





CTA – diagnostic performance



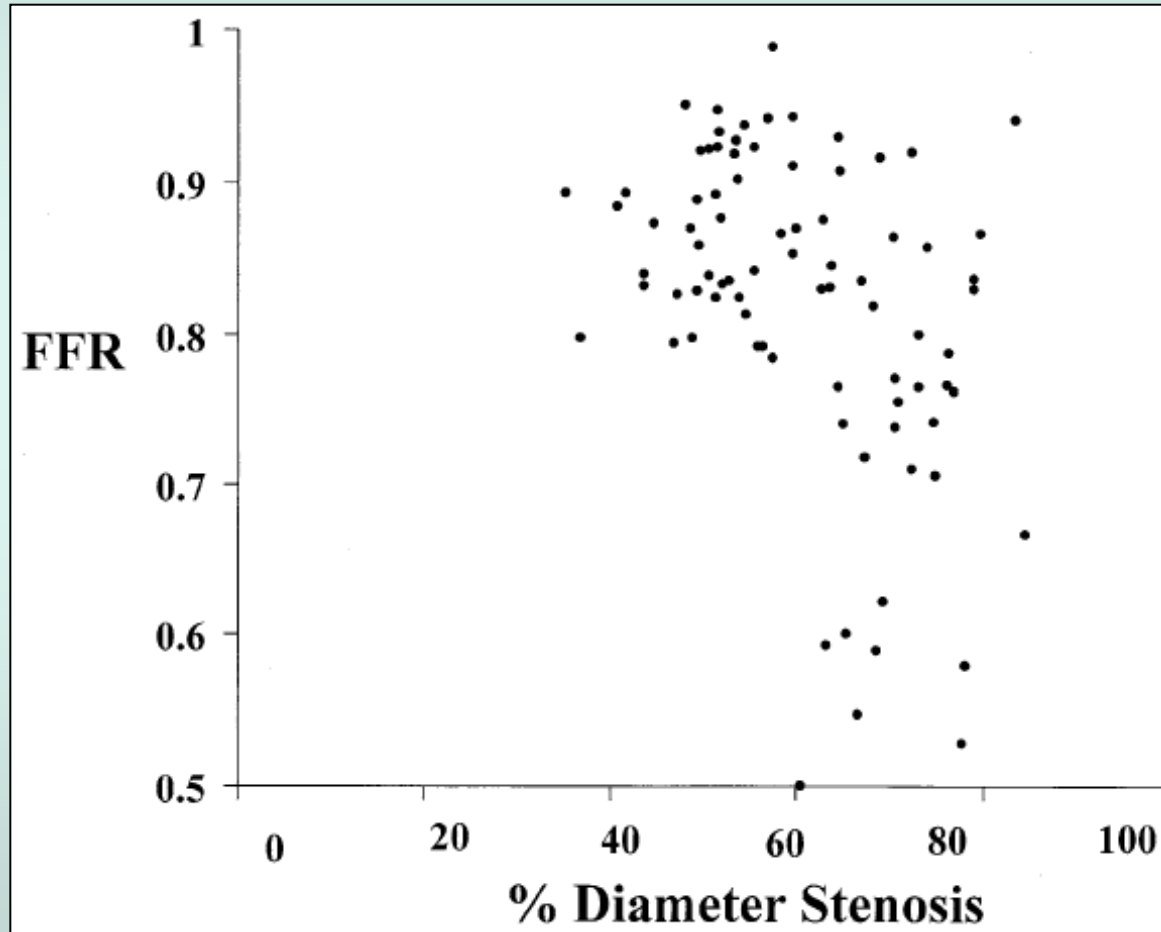
FP	286	34	77	74	180	102	50	10	80	TP
TN	3993	116	137	99	41	11	7	0	1	FN



Anatomy vs function?

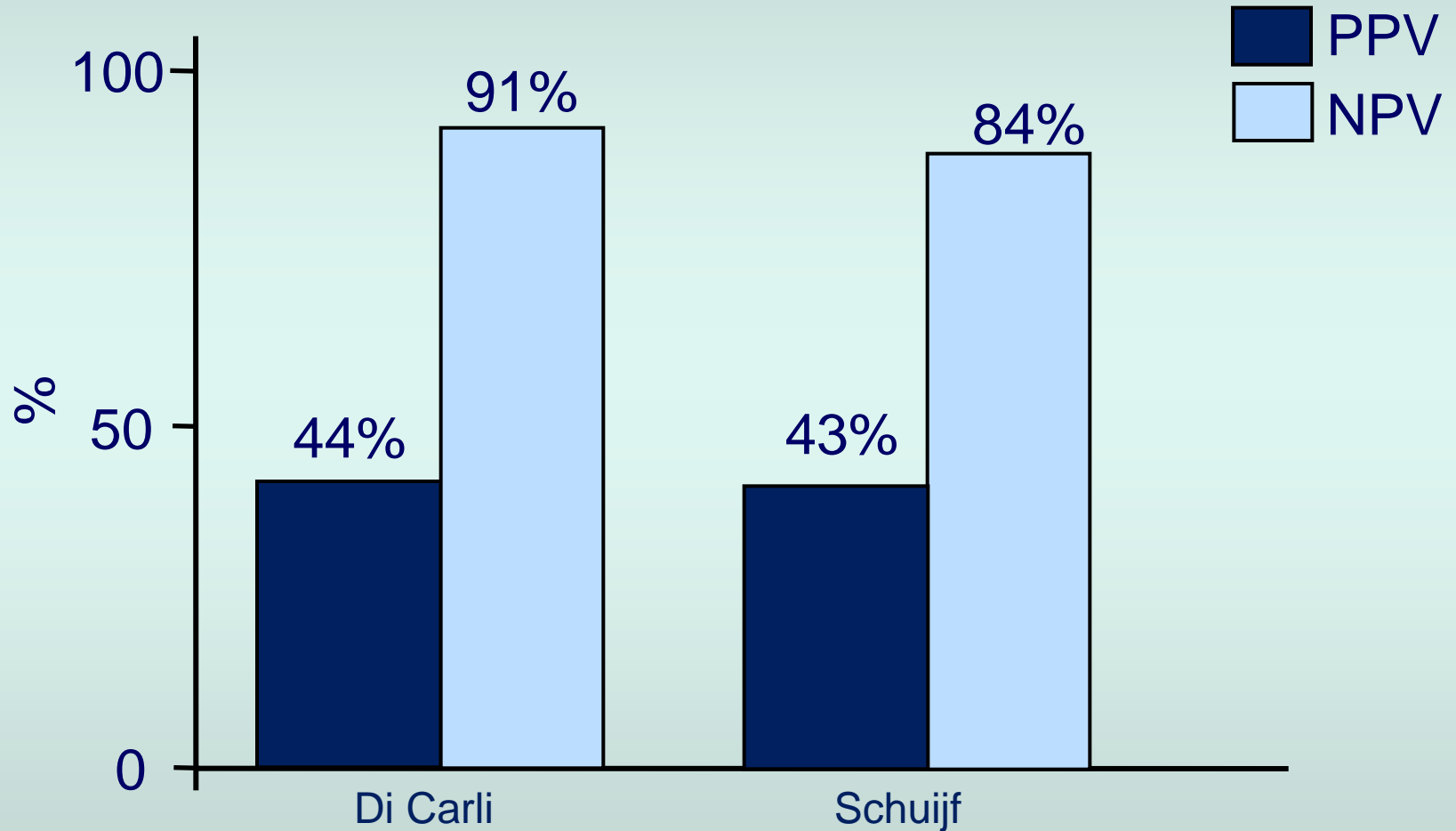


QCA vs FFR



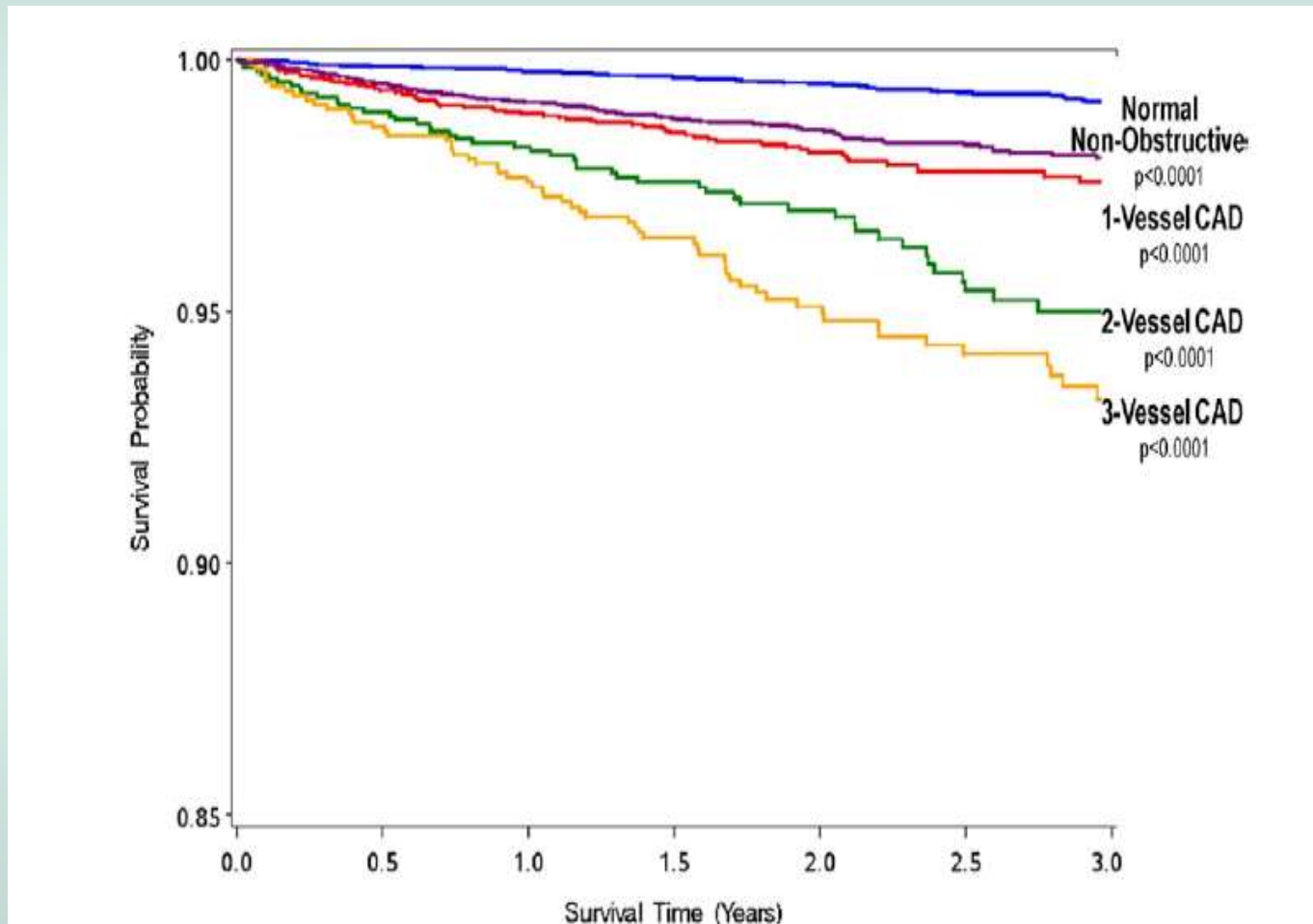


CCTA & SPECT: predicting ischaemia



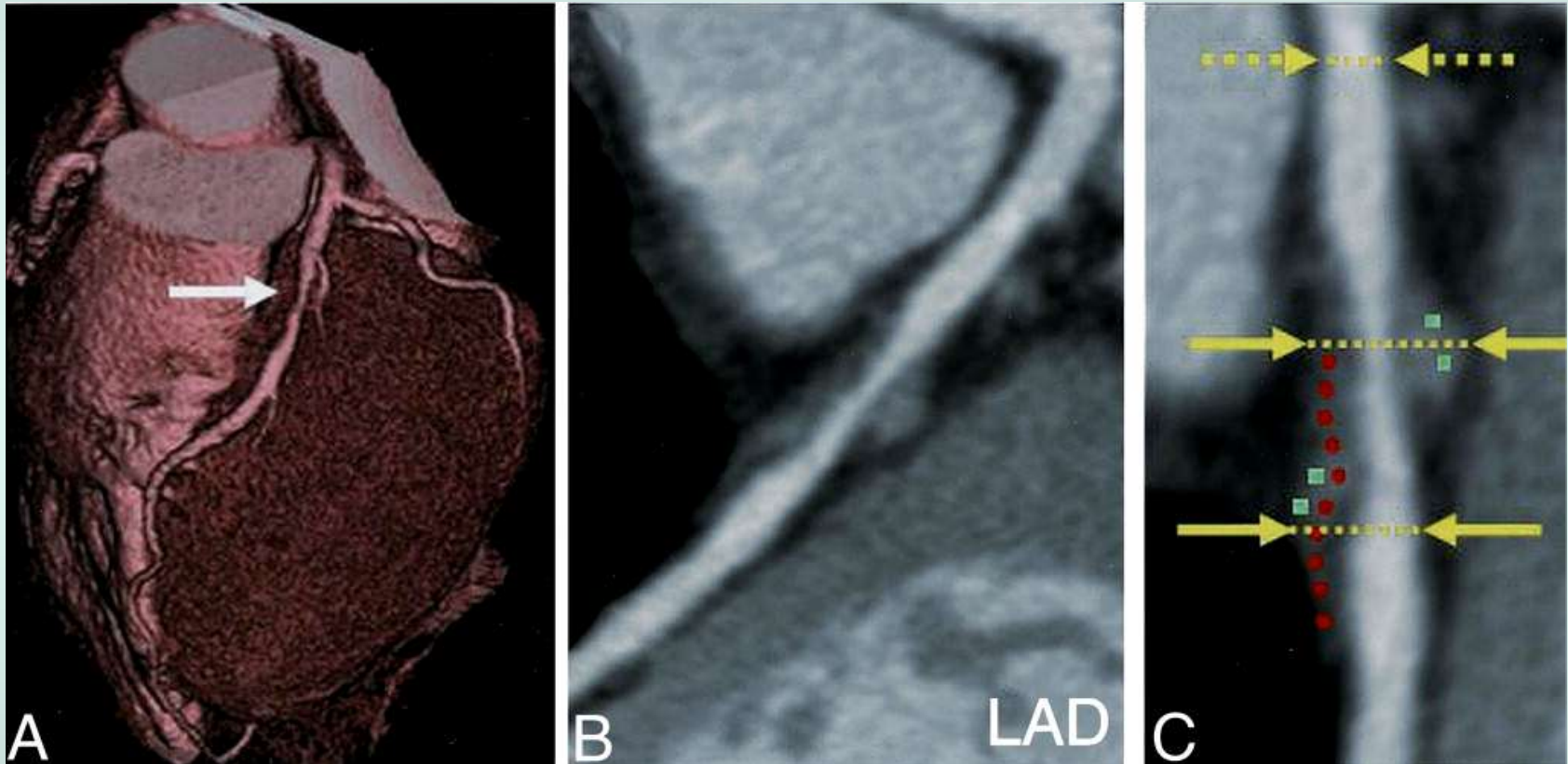


CTCA - Prognosis





Plaque Imaging





Preoperative CTCA



- Well established for assessment of CAD in non-coronary cardiac surgery
- Only two studies in non-cardiac surgery
 - Liver transplant
 - Observational

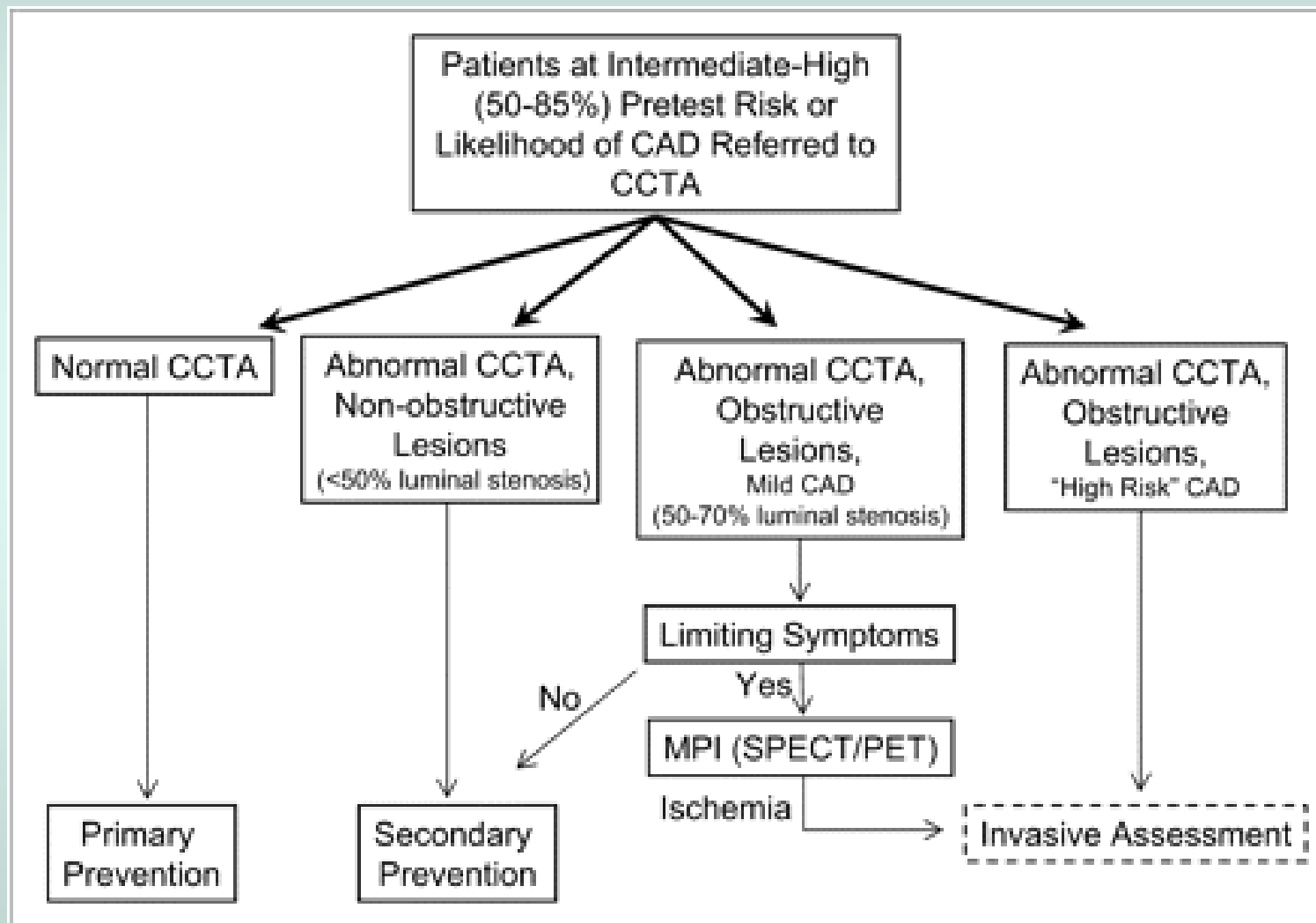
ESC Guidelines for pre-operative cardiac risk assessment. Eur Heart J 2009;30:2769-2812

Russo V, *et al* Heart 2007;93:1591–1598.

Jodocy et al. Eur J Radiol 2011;In press – on line 12th June



CTCA as gatekeeper?





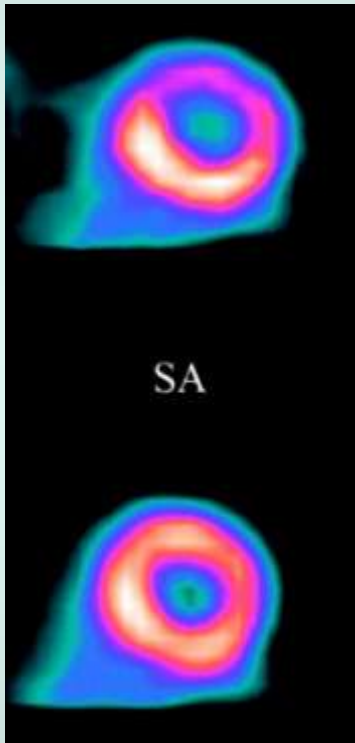
CTCA - Summary



- Outstanding negative predictive value
 - Accuracy
 - Prognostic
 - ?Plaque imaging
- Radiation dose – reducing now
 - Minimal preoperative data
 - No functional information on stenosis severity
 - CTCA limitations
 - Renal failure
 - Arrhythmia
 - Obesity
 - Expertise limited
 - Scanner availability



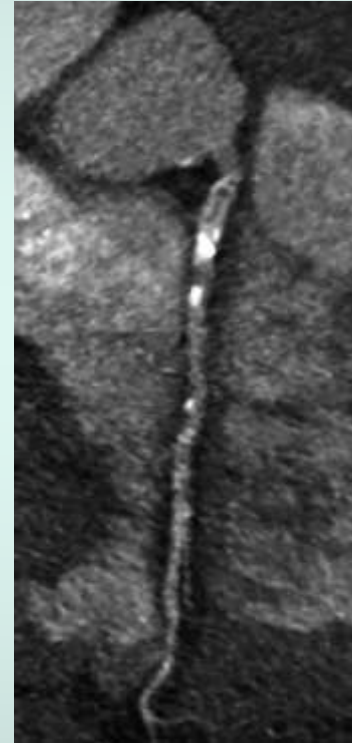
Obesity issues



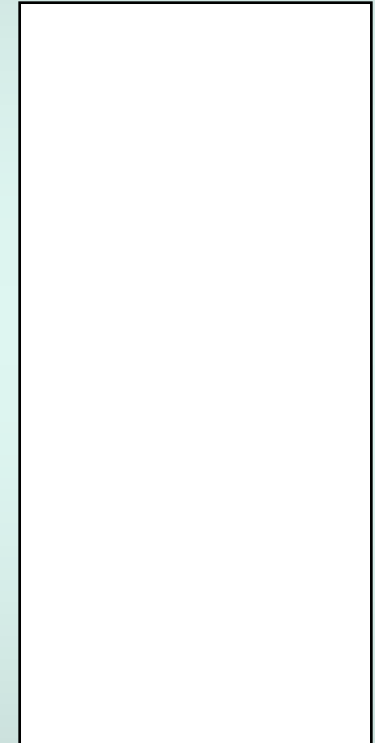
SPECT



ECHO



CTCA



CMR



Portability - not!



CMR



CTCA



Portable Echo



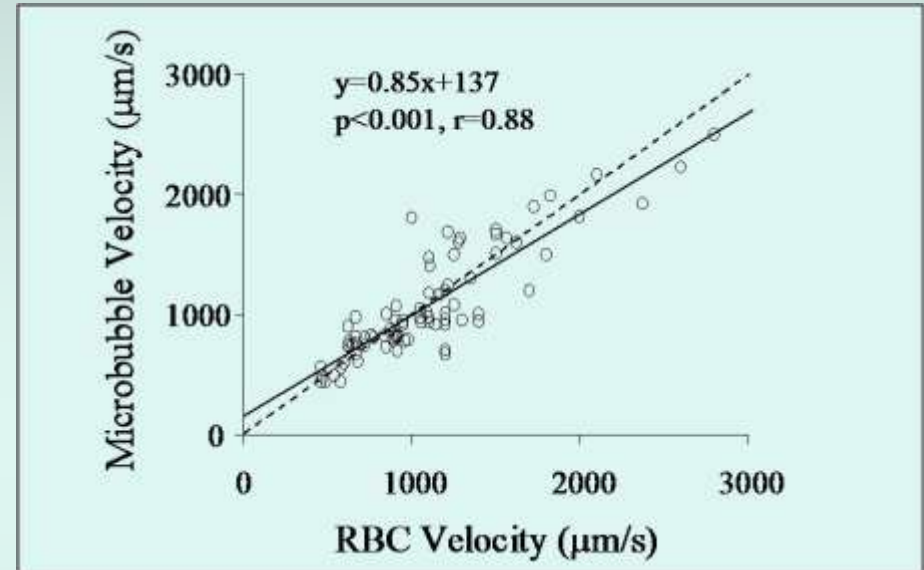
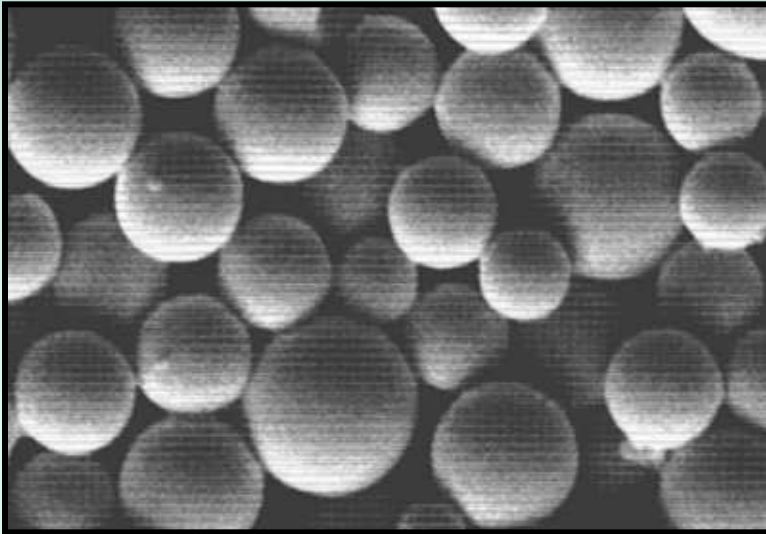
Institution Date Operator Exam ID Quality <input type="checkbox"/> good <input type="checkbox"/> technically difficult <input type="checkbox"/> Indication Demographics: H W Age Haemodynamics: BP HR CVP PCWP CO		Patient Details UR Name Address DOB Phone																																														
Ventricular Volume LV M-mode Hypovol. Normal Dilated <3 3-5.6 >5.6		Ventricular Systolic Function RV LV M-mode N Increased Normal Decreased N FS > 44% FS 28-44% FS < 28%																																														
Left Atrial Filling Pressure (Interatrial septum motion) Low Pressure Normal Pressure High Pressure Systolic buckling Systolic reversal Fixed curvature																																																
Haemodynamic State <table border="1"> <tr> <td></td> <td>Normal</td> <td>Empty</td> <td>Vasodilation</td> <td>Systolic Failure</td> <td>Primary Diastolic Failure</td> <td>Systolic & Diastolic Failure</td> <td>RV Failure</td> </tr> <tr> <td>Volume</td> <td>N</td> <td>▼</td> <td>N</td> <td>▲</td> <td>N / ▼</td> <td>▲</td> <td>RV ▲</td> </tr> <tr> <td>Systolic Function</td> <td>N</td> <td>N / ▲</td> <td>▲</td> <td>▼</td> <td>N</td> <td>▼</td> <td>RV ▼</td> </tr> <tr> <td>Filling Pressure</td> <td>N</td> <td>▼</td> <td>N</td> <td>▲</td> <td>▲</td> <td>▲</td> <td>▲</td> </tr> </table>					Normal	Empty	Vasodilation	Systolic Failure	Primary Diastolic Failure	Systolic & Diastolic Failure	RV Failure	Volume	N	▼	N	▲	N / ▼	▲	RV ▲	Systolic Function	N	N / ▲	▲	▼	N	▼	RV ▼	Filling Pressure	N	▼	N	▲	▲	▲	▲													
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Systolic Function	N	N / ▲	▲	▼	N	▼	RV ▼																																									
Filling Pressure	N	▼	N	▲	▲	▲	▲																																									
Measurements LVEDD LVESD FS LVEDA LVESA FAC LA size LA area TR RAP RVSP 3.0-5.6 >28% 8-14 50-65% <4 <20 Vmax 5-10 <25																																																
Valve Assessment <table border="1"> <tr> <td></td> <td>AV</td> <td>MV</td> <td>TV</td> <td>PV</td> <td>AV vel</td> <td>Peak</td> <td>Mean</td> <td>Pericardial Effusion</td> </tr> <tr> <td>Examined (Not significant)</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Abnormal</td> <td></td> <td></td> <td></td> <td></td> <td><1.5</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Stenosis</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Regurgitation</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>					AV	MV	TV	PV	AV vel	Peak	Mean	Pericardial Effusion	Examined (Not significant)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	Abnormal					<1.5				Stenosis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					Regurgitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
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Comments																																																

HEART scan





Microbubble Contrast Agents



Shell:

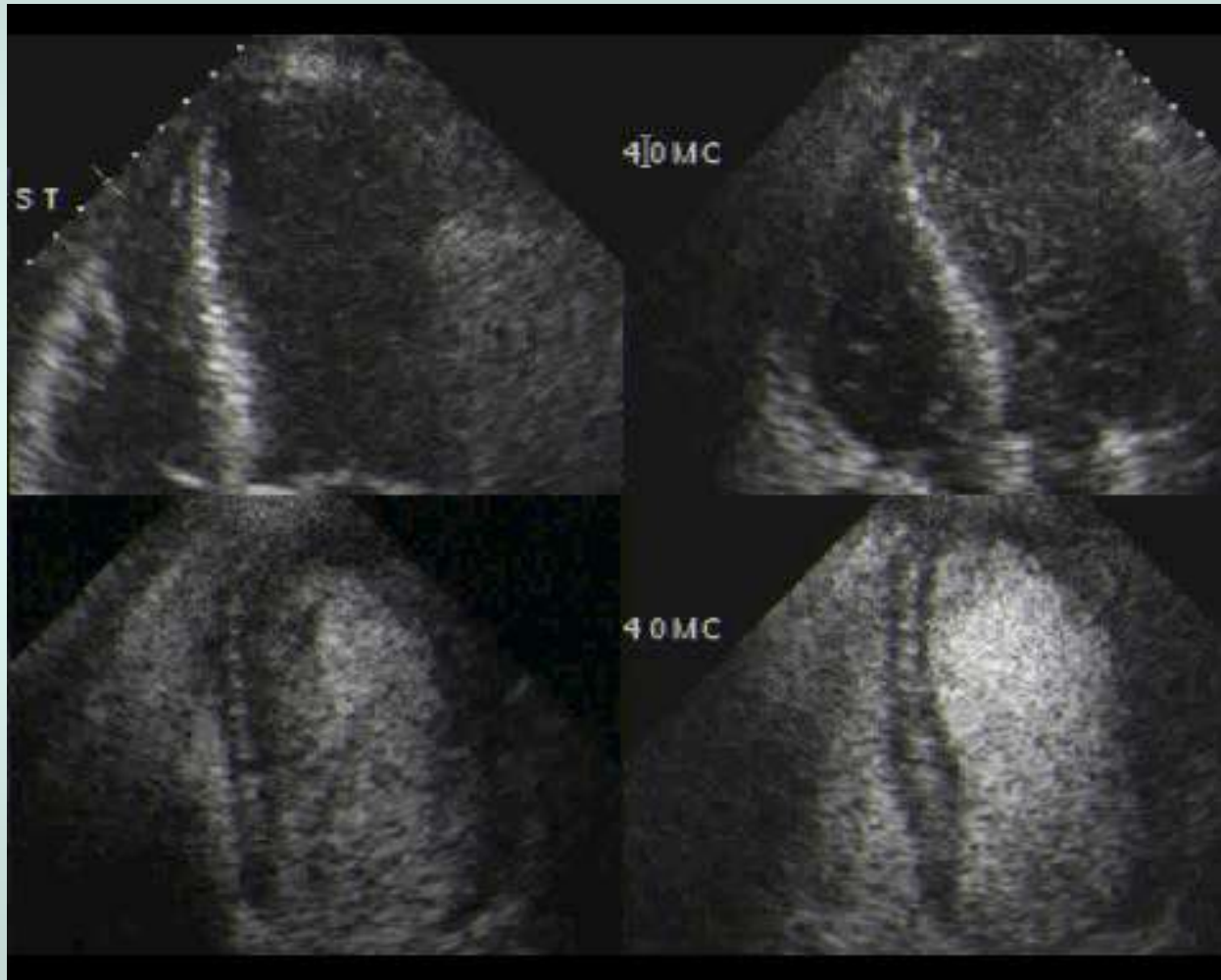
1. Albumin
2. Lipid
3. Polymer

Gas:

1. Perfluorocarbon
2. Air



Left ventricular opacification





Contrast - safety issues



2007 – FDA “Black Box” warning

Safety data – now extensive:

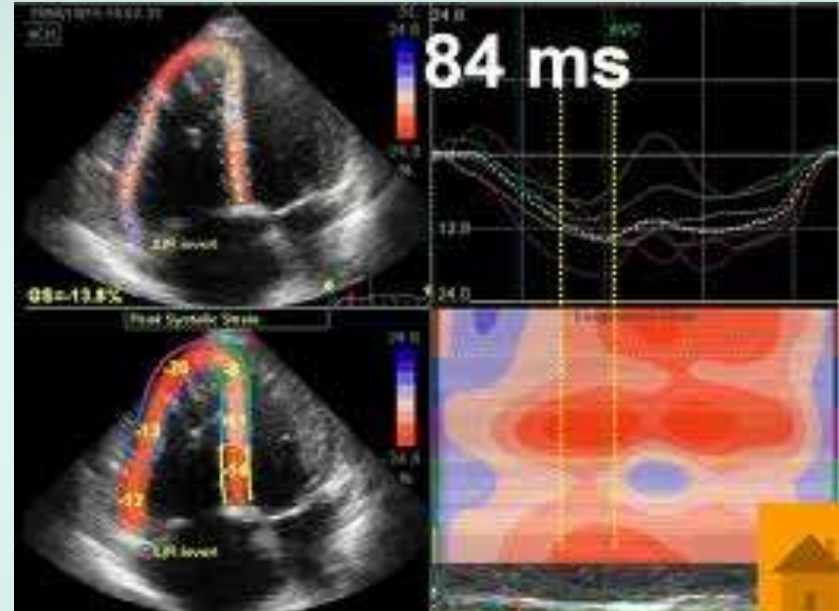
- iJACC (2009)
- 26,774 patients, stress echo
- Contrast = non contrast for adverse events
- 1:10,000 acute anaphylactoid reaction



Echo extras?



3D



Speckle and strain



Conclusions



- Echo remains the core imaging modality
- Cardiac CT has the greatest potential to be a 'disruptive technology'
- The majority of patients will not benefit from additional imaging for preoperative risk assessment