Imaging and Physiology Summit
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FFR-Guided PCI

William F. Fearon, M.D.
Assistant Professor
Division of Cardiovascular Medicine
Stanford University Medical Center

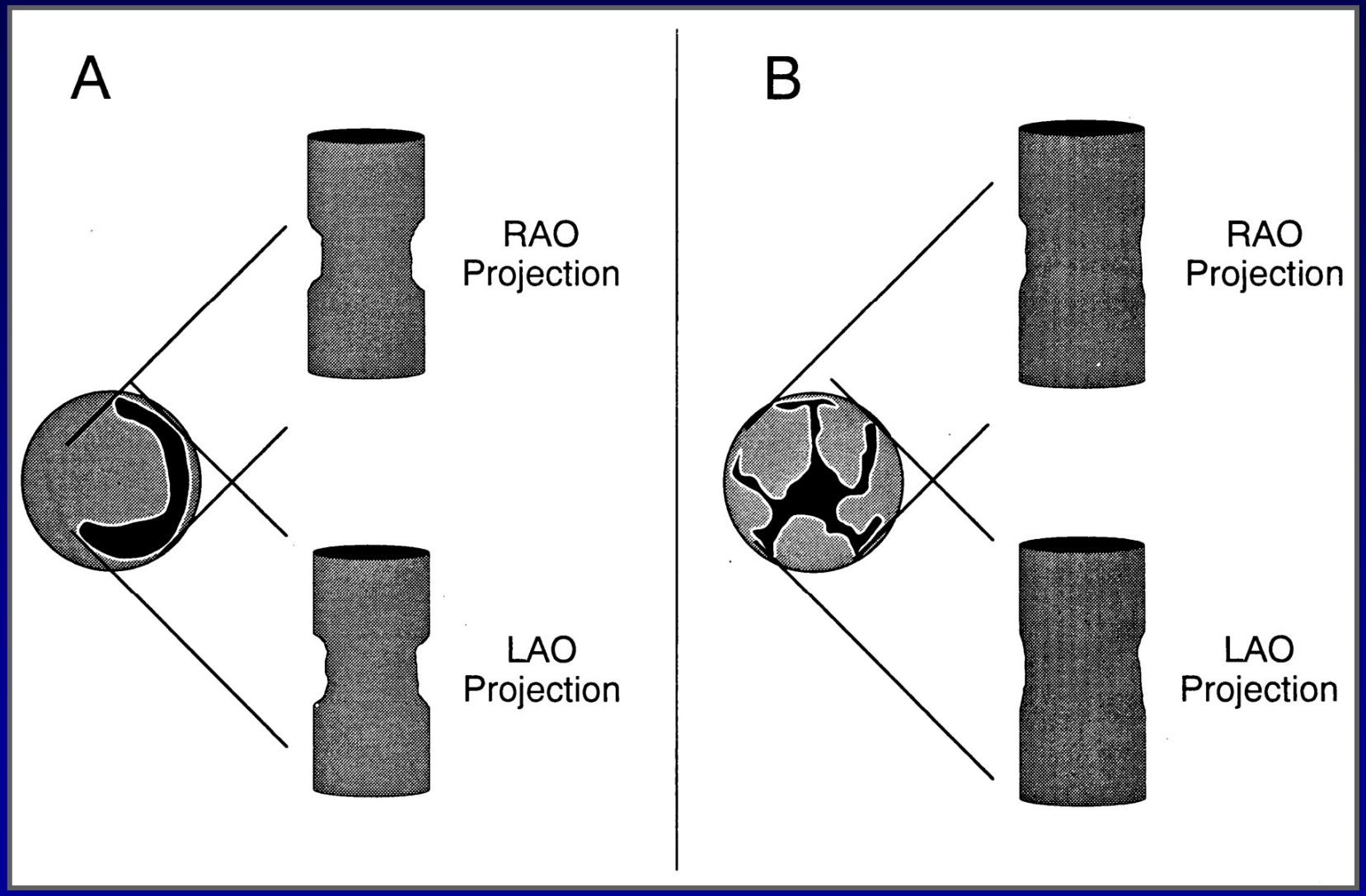
Why do we need FFR-guided PCI?

- Limitations of coronary angiography
- Limitations of noninvasive techniques
- Downside to indiscriminate stenting
- Identifying and treating ischemia is critical
- It may increase number of PCI-eligible patients

Why do we need FFR-guided PCI?

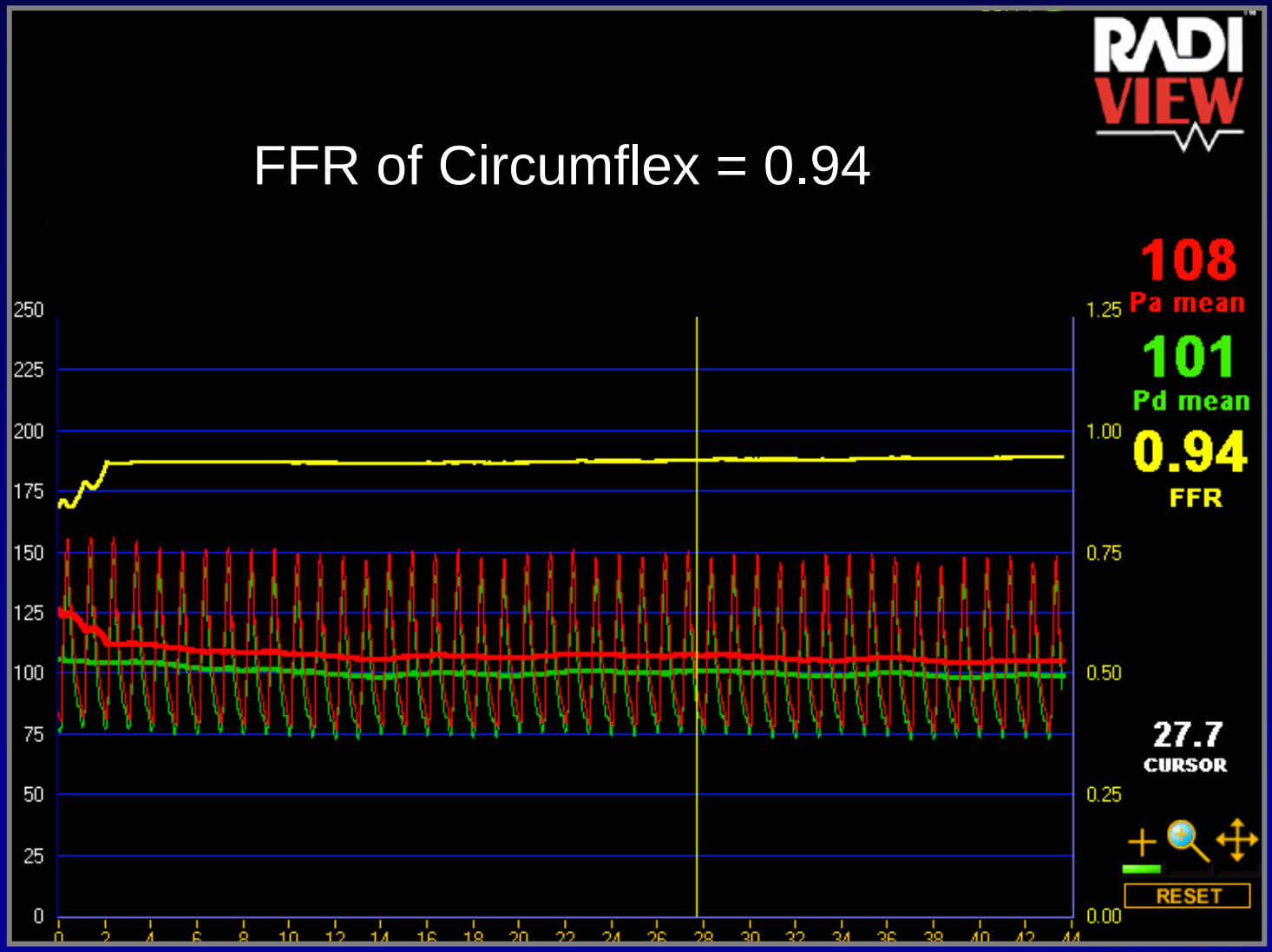
- Limitations of coronary angiography
  - "Lumenogram"
  - Disconnect between angiography and physiology

Limitations of Angiography:



Topol and Nissen Circulation 1995;92:2333-42

Disconnect between Angiography and Physiology



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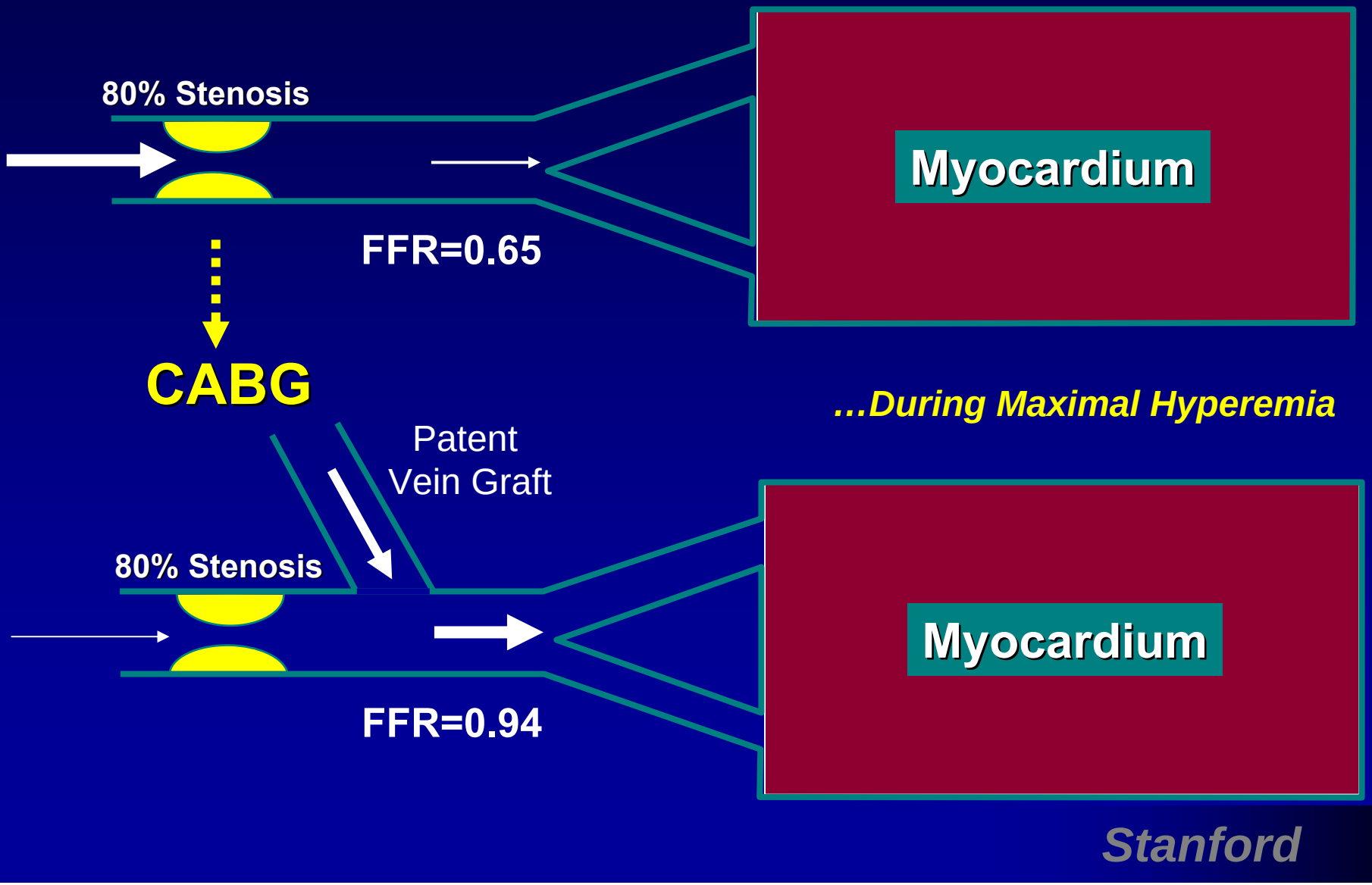

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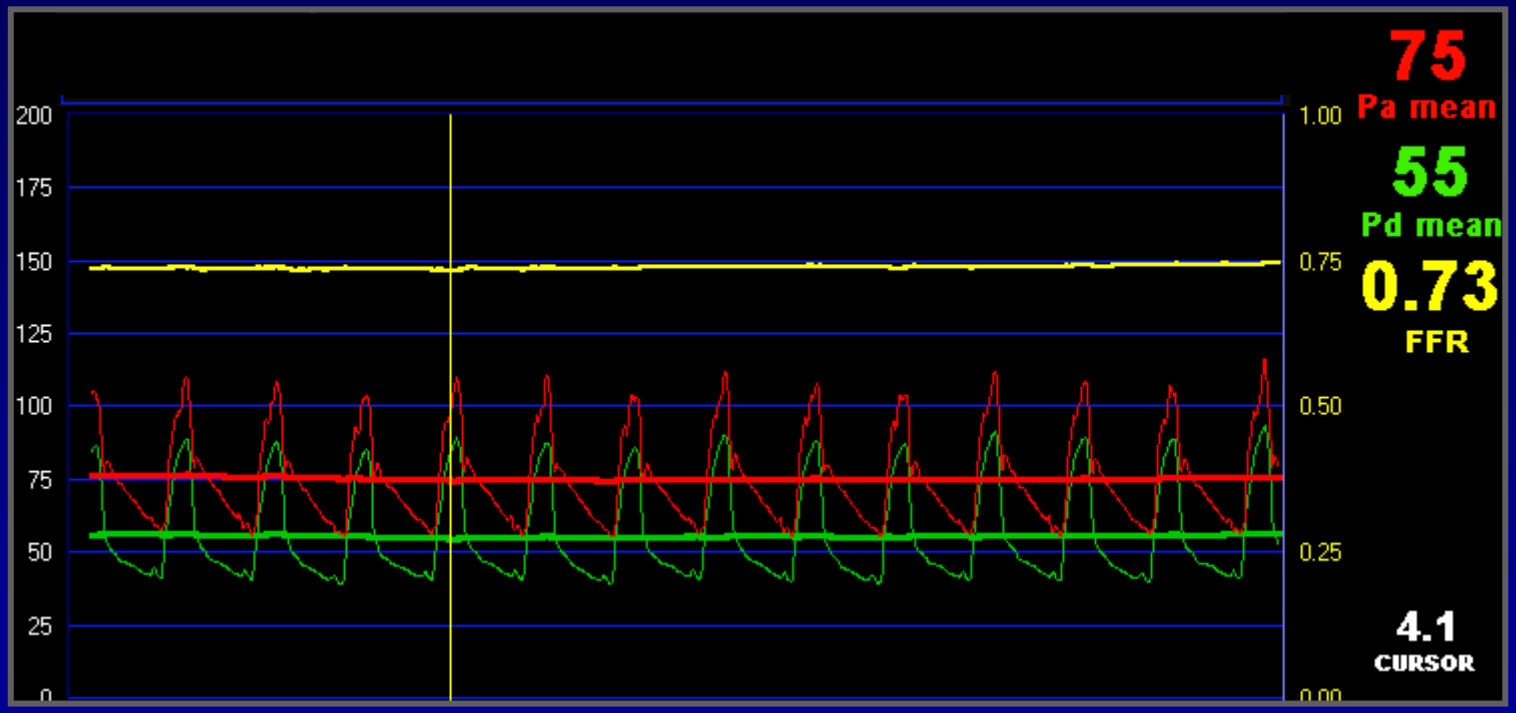

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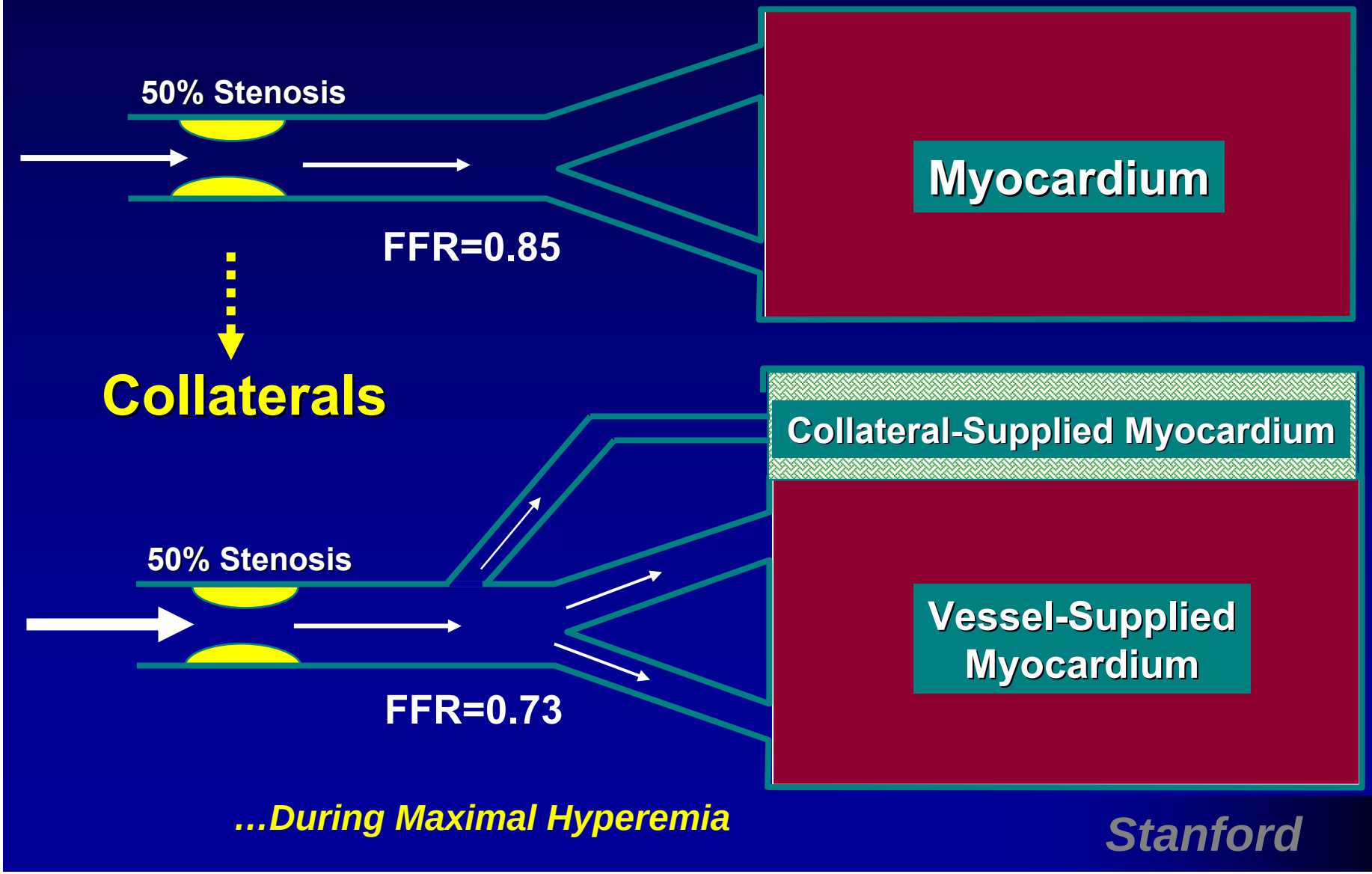

…During Maximal Hyperemia

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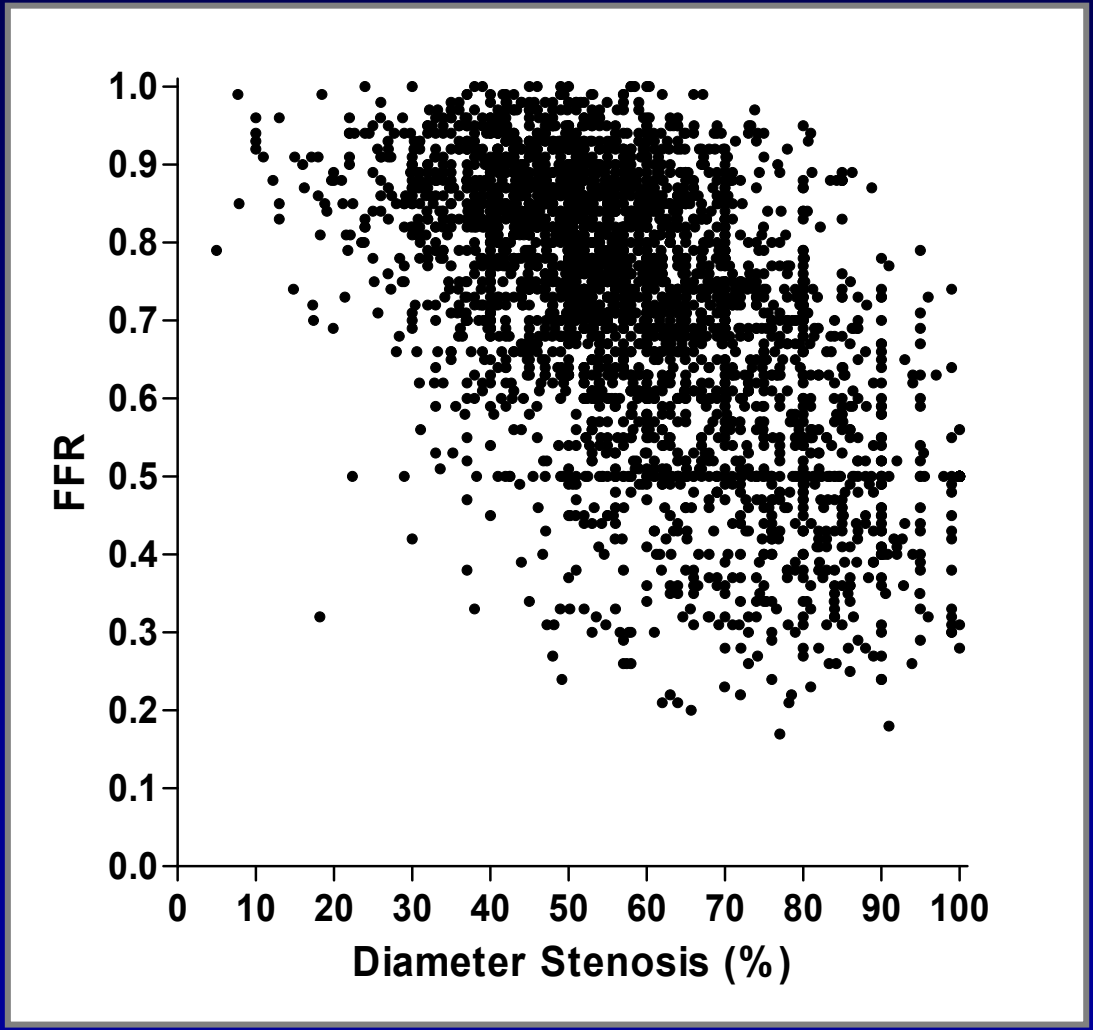
Limitation of Angiography

Comparison of QCA to FFR in over 3,000 lesions



Courtesy of Bernard De Bruyne, MD, PhD

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Why do we need FFR-guided PCI?

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Limitations of Noninvasive Imaging:

143 Patients with angiographically significant 3 vessel disease (> 70% diameter stenosis)

Thallium Scan Finding	% Patients
No Defect	18%
Single Vessel Pattern	36%
Two Vessel Pattern	36%
Three Vessel Pattern	10%

Lima et al. J Am Coll Cardiol 2003;42:63-70

Limitations of Noninvasive Imaging:

58 patients with MVD (>50% angiographic stenosis)

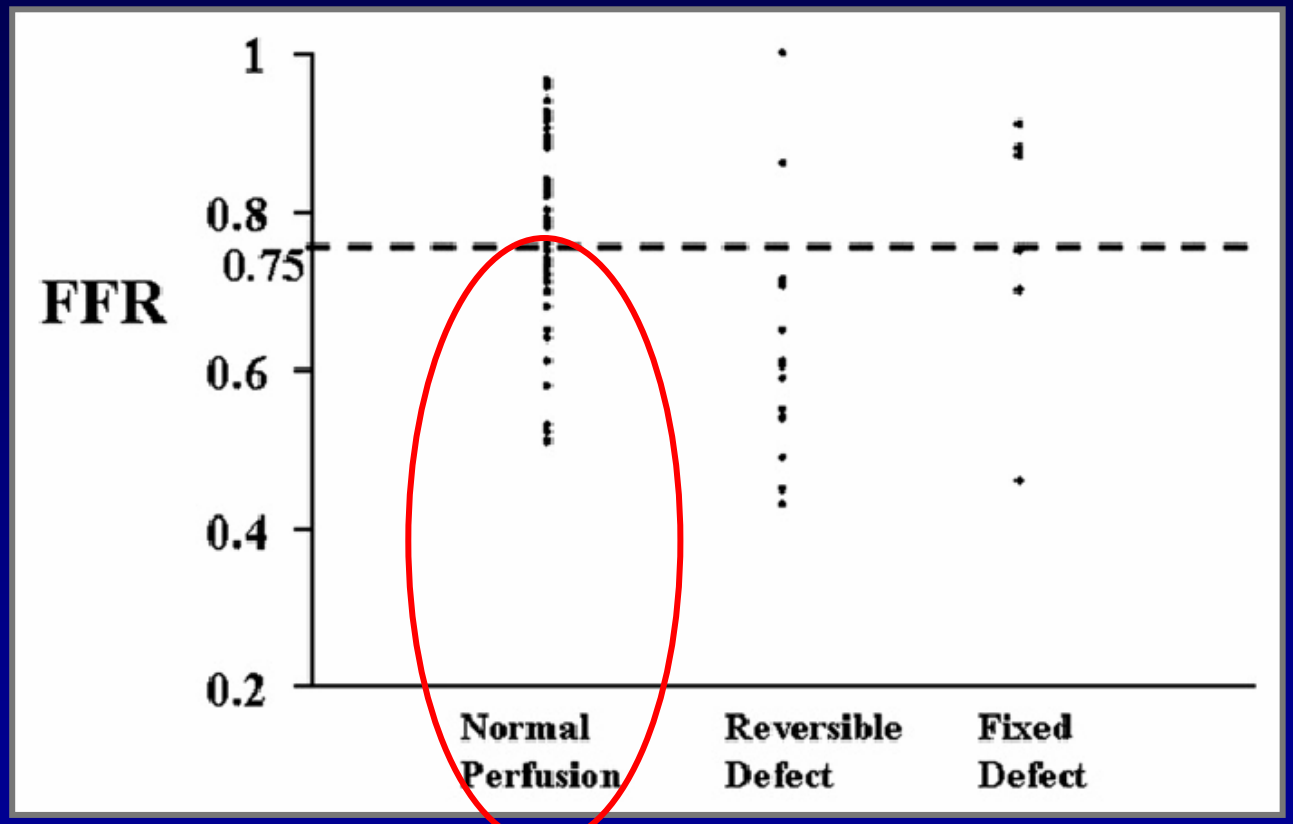
Extent of CAD	DASE		DMIBI	
	Sensitivity % (n)	Specificity % (n)	Sensitivity % (n)	Specificity % (n)
Multivessel disease by abnormalities in multiple vascular territories				
All Patients	72 (42/58)	95 (119/125)*	66 (38/58)	76 (95/125)
No CAD		100 (64/64)*		88 (56/64)
Single-vessel CAD		90 (55/61)*		64 (39/61)
Single-vessel RCA		83 (25/30)		60 (18/30)
Single-vessel LAD		94 (17/18)*		61 (11/18)
Single-vessel LCX		100 (13/13)		77 (10/13)
Multivessel CAD	72 (42/58)		66 (38/58)	
Two-vessel CAD	68 (27/40)		58 (23/40)	
LCX & RCA	71 (12/17)		65 (11/17)	
LAD & RCA	75 (12/16)		50 (8/16)	
LAD & LCX	43 (3/7)		57 (4/7)	
Three-vessel CAD	83 (15/18)		83 (15/18)	

- Stress echo had a 72% sensitivity (as low as 43% for LAD and L Cx disease)

Smart et al. J Am Coll Cardiol 2000;36:1265-1273

FFR vs. Nuclear Perfusion Scan in MVD

36 patients with multivessel CAD



Discordance occurred in 31% of vessels / territories, predominantly because of a low FFR and normal nuclear result

Ragosta et al. Am J Cardiol 2007;99:896-902

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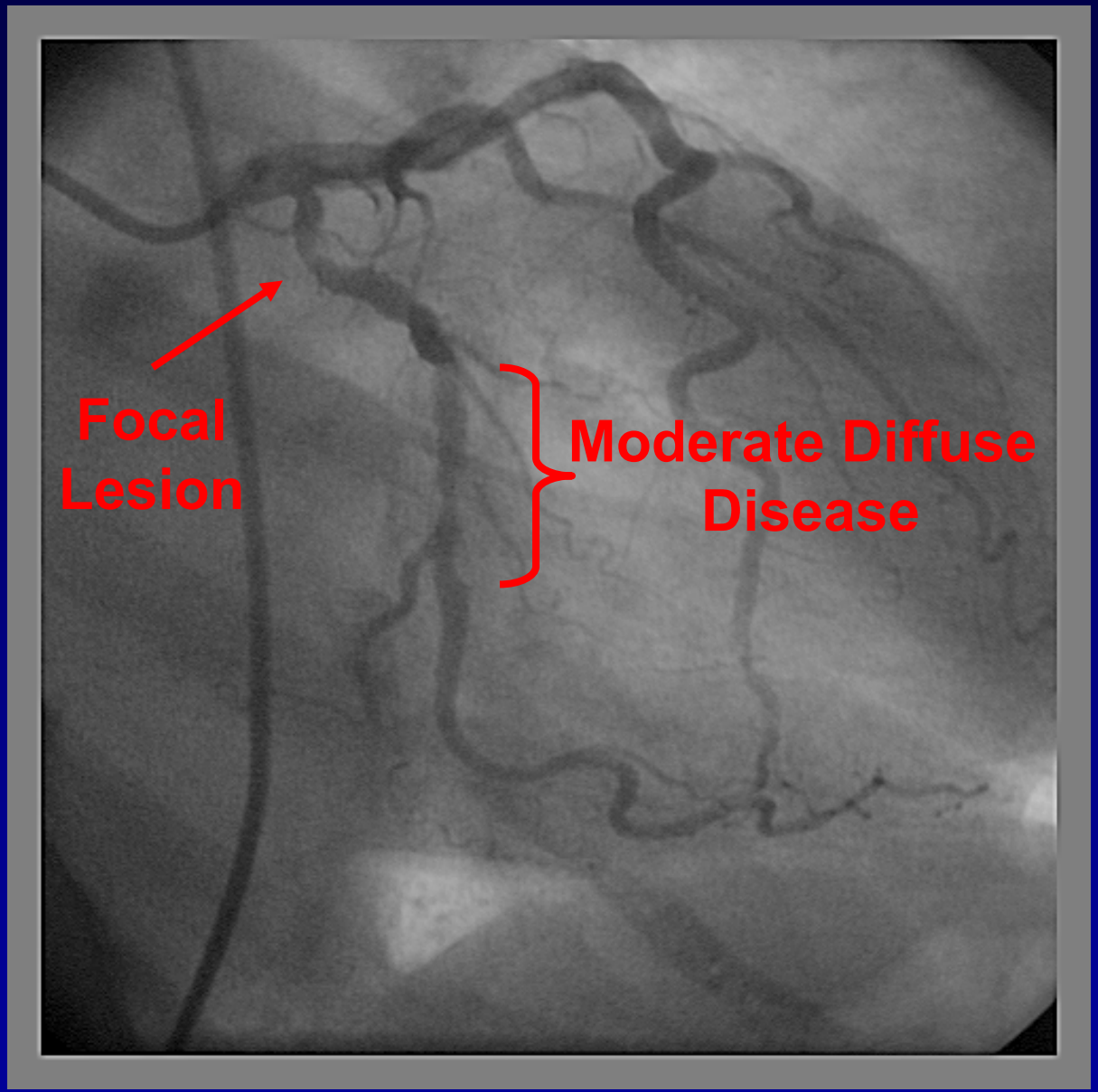

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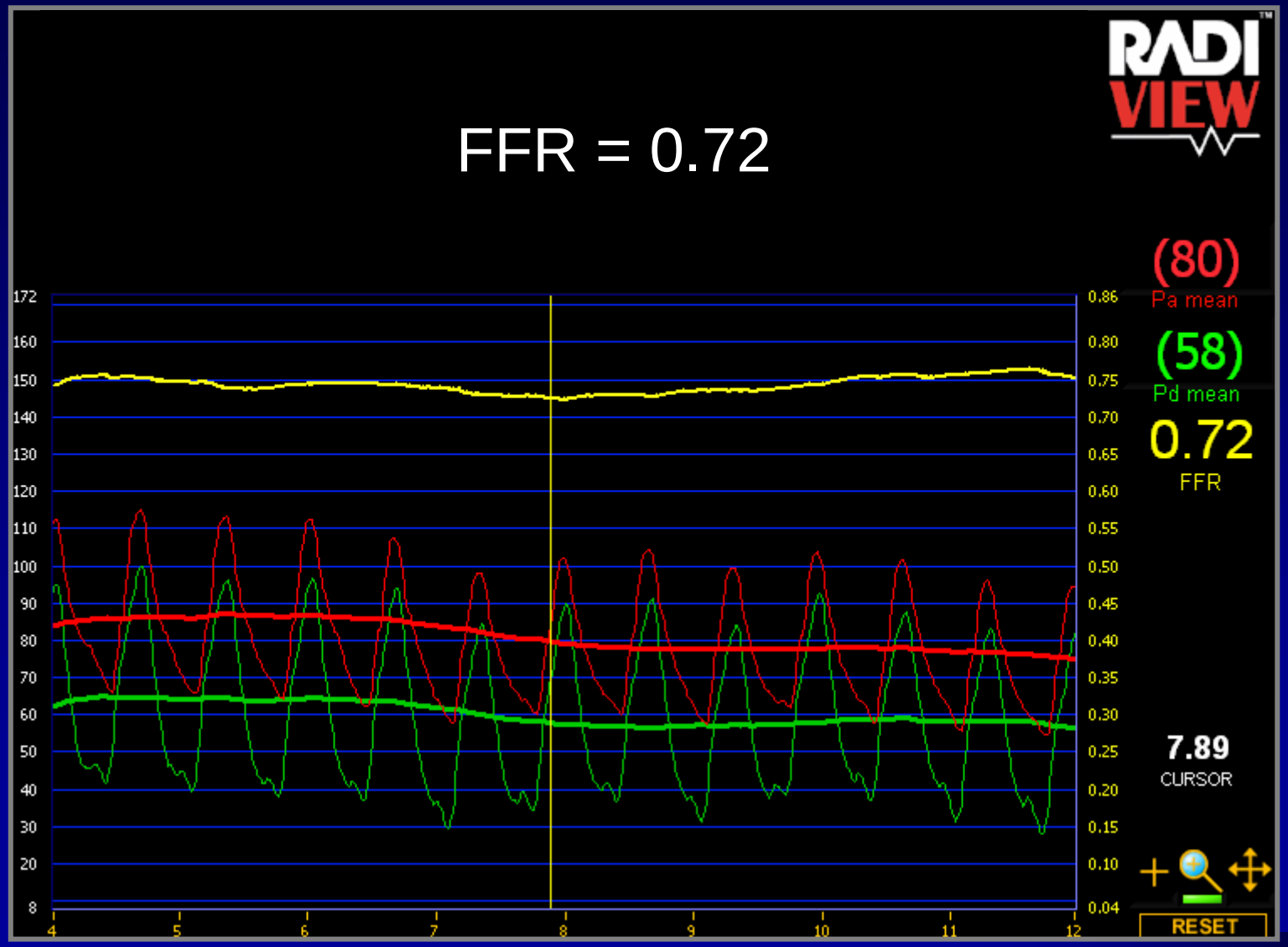
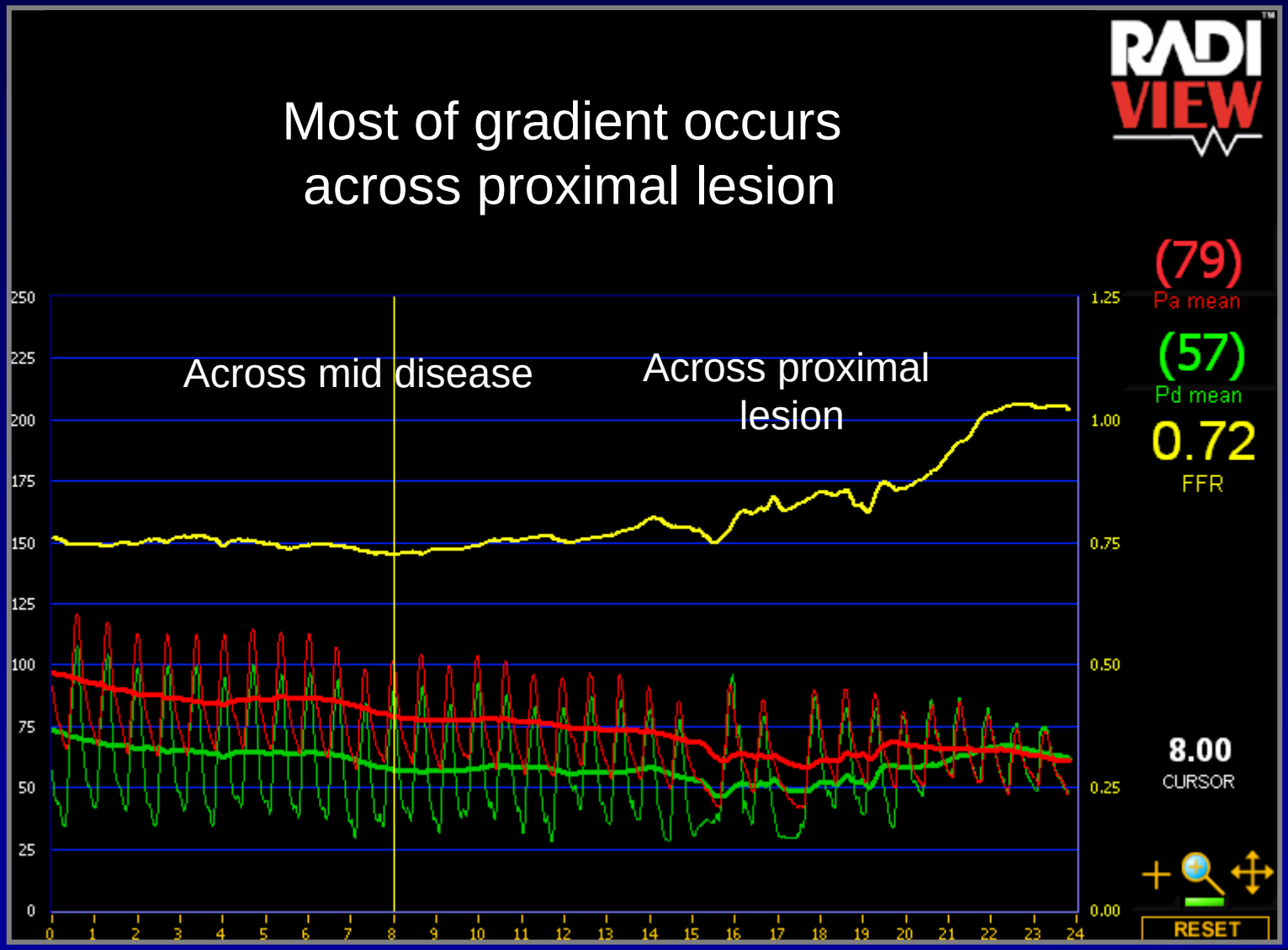
FFR Left Circumflex



Pullback in Circumflex



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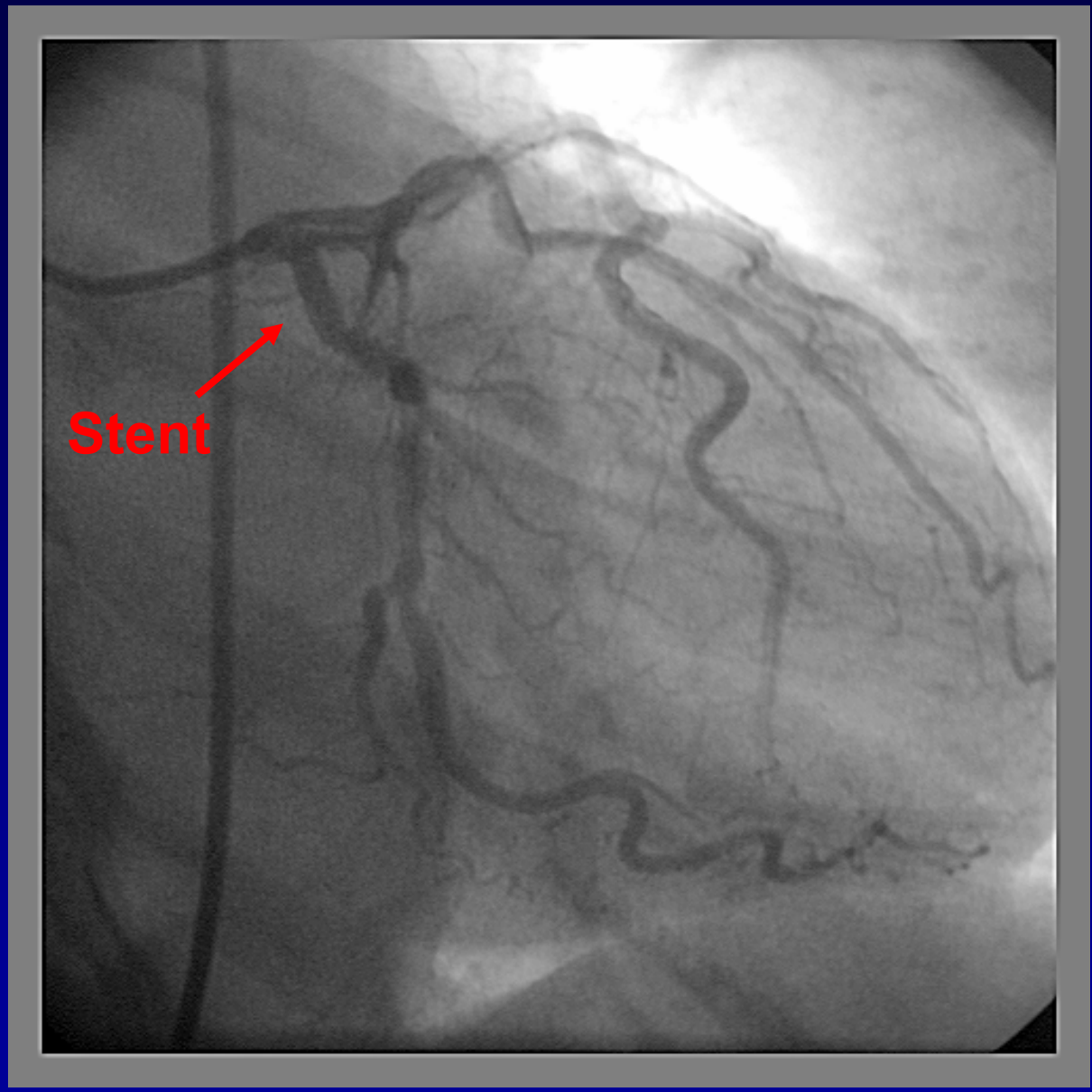

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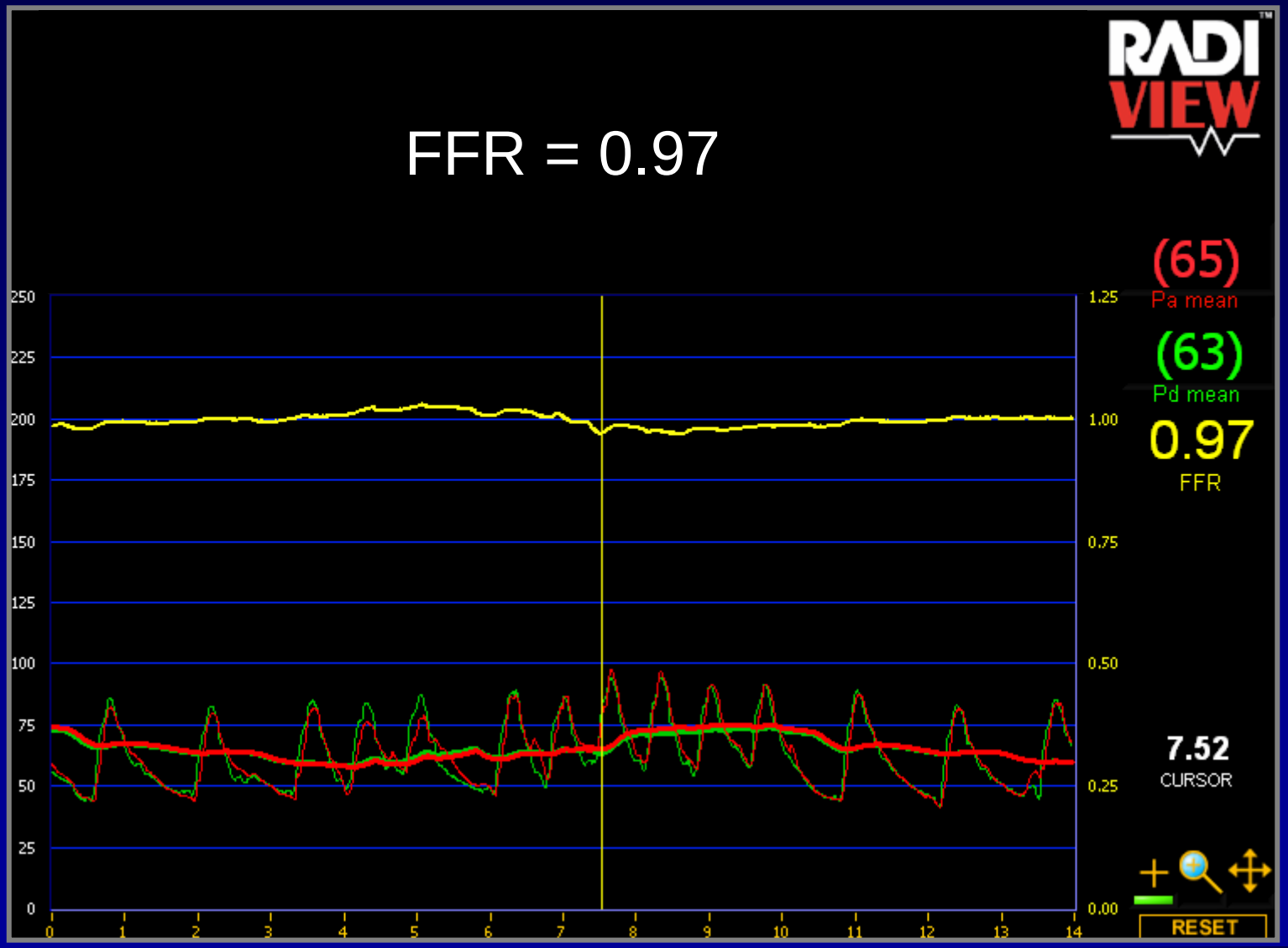
After "spot-stenting" proximal circumflex



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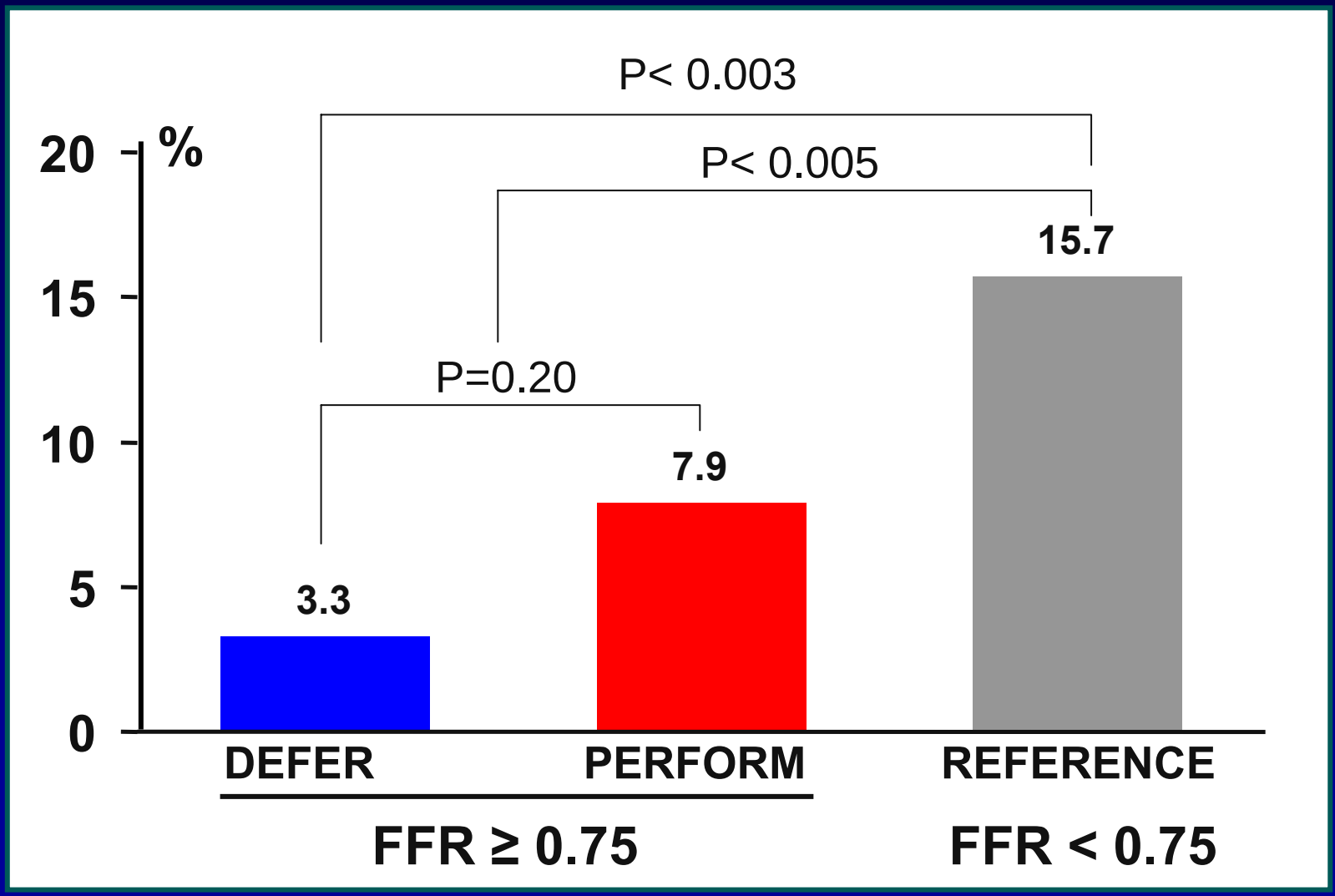
Cardiac Death and MI After 5 Years



Pijls et al. J Am Coll Cardiol 2007;49:2105-11

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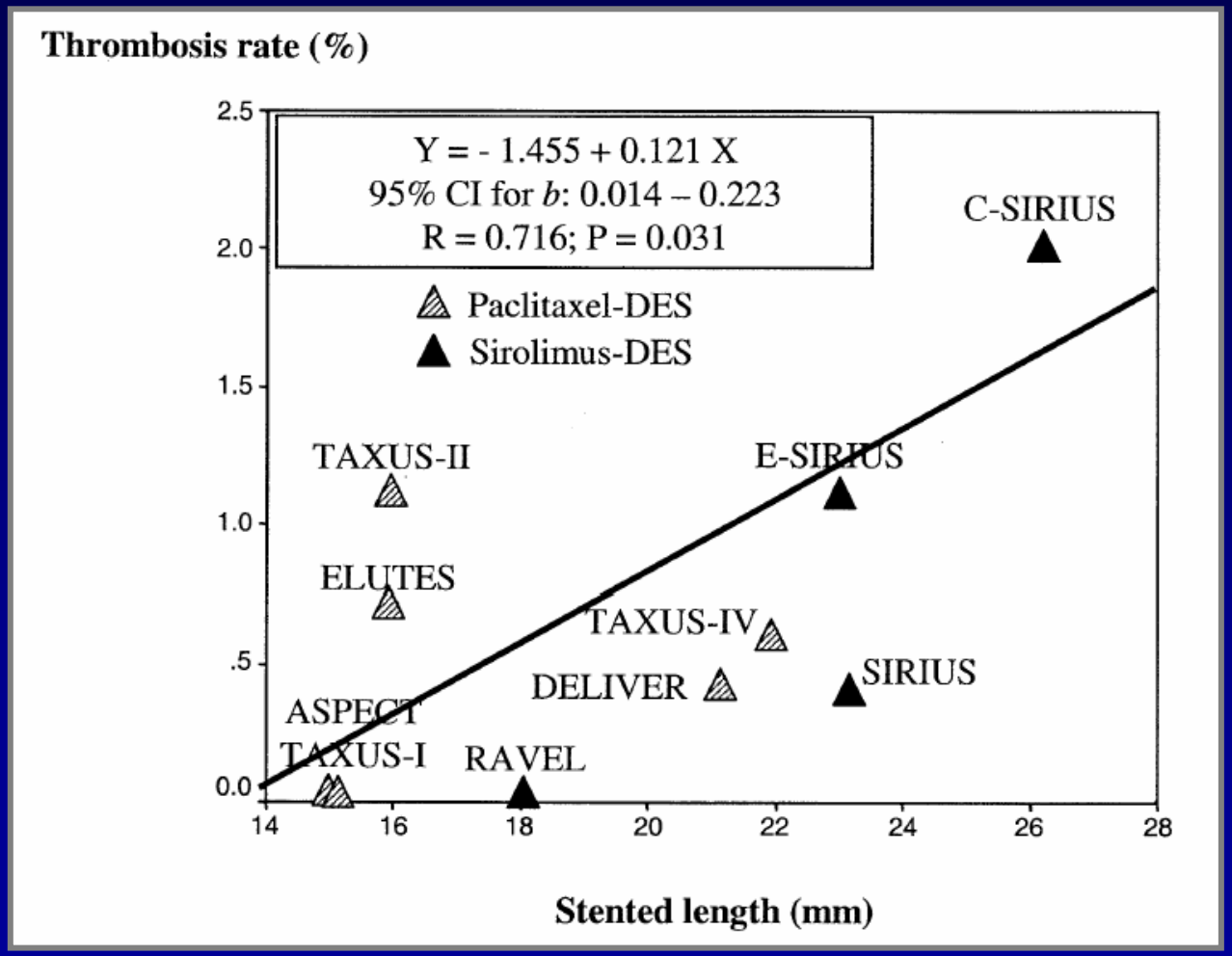
Relationship between DES **Length** and Thrombosis Rate



Moreno et al. J Am Coll Cardiol 2005;45:954-9

Relationship between DES **Number** and Thrombosis Rate

Variable	Regression Equation	R	p Value
% of patients with diabetes	Y = 0.694 + 0.0004 X	0.098	0.994
Use of glycoprotein IIb/IIIa	Y = 0.483 + 0.022 X	0.663	0.101
% of IVUS guidance	Y = 0.556 − 0.002 X	0.269	0.751
Lesion length	Y = −1.681 + 0.208 X	0.632	0.070
Stented length	Y = −1.455 + 0.121 X	0.716	0.031
Stented/lesion length	Y = −1.432 + 1.348 X	0.380	0.329
Number of stents per patient	Y = −1.765 + 2.080 X	0.752	0.020
RVD	Y = 6.924 − 2.238 X	0.526	0.152
MLD post-procedure	Y = 3.196 − 0.916 X	0.344	0.384
% stenosis post-procedure	Y = 0.777 − 0.009 X	0.123	0.848
Duration of clopidogrel therapy	Y = 0.702 − 0.0002 X	0.098	0.999

Number of stents per patient: R = 0.75, p = 0.02

Moreno et al. J Am Coll Cardiol 2005;45:954-9

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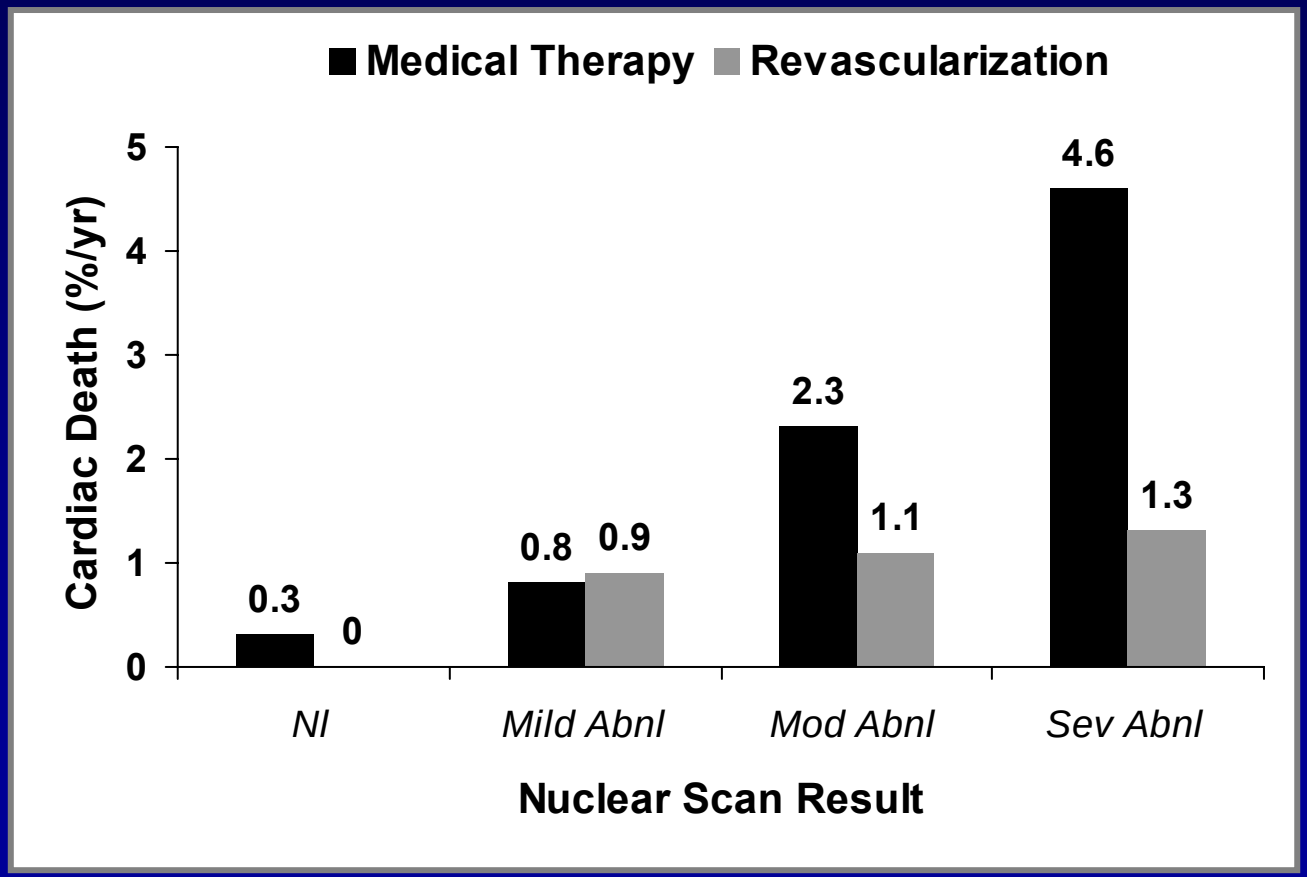
Importance of Revascularization when Ischemia is Present

Nuclear perfusion scans performed in > 5000 patients



Hachamovitch et al. Circulation 1998;97:535-543

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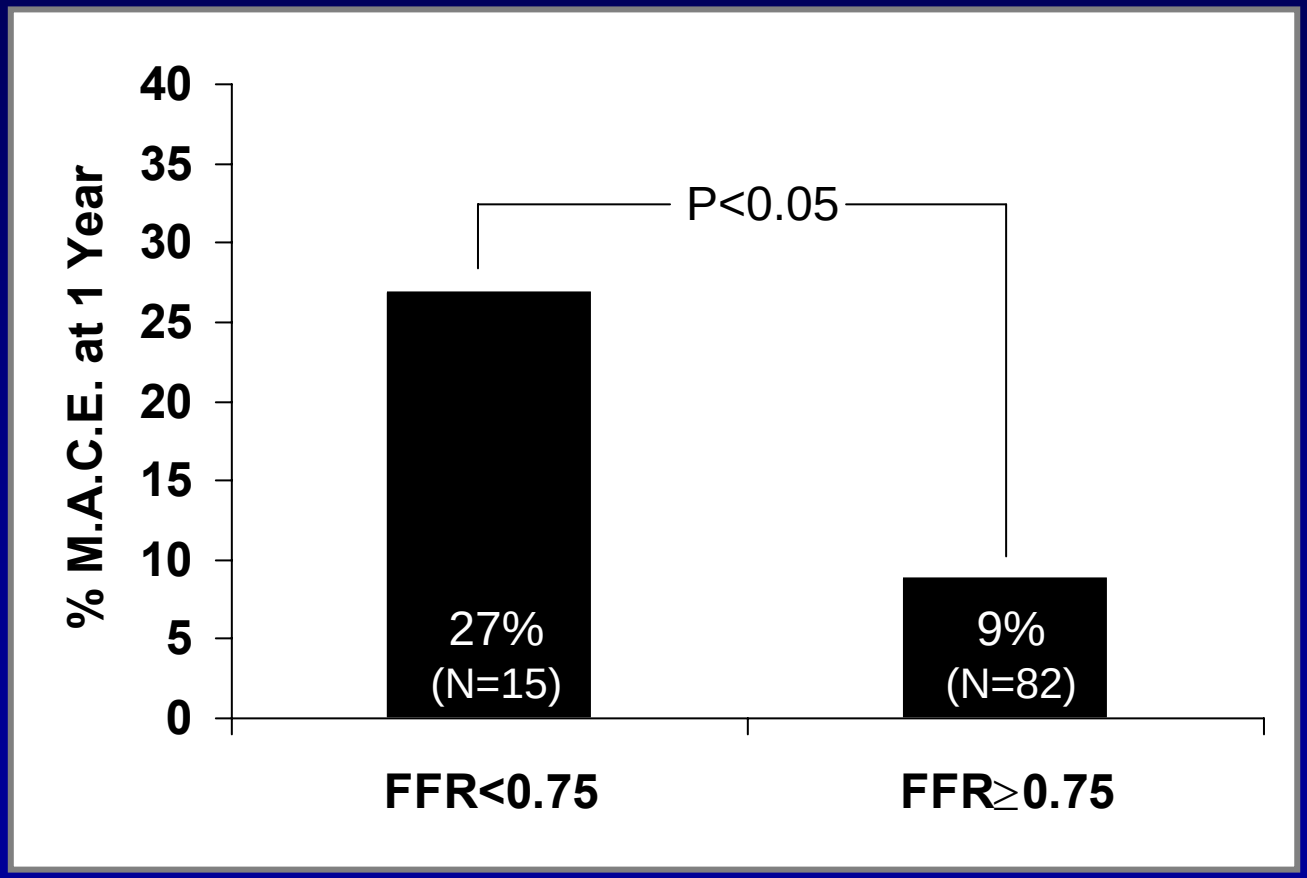
Danger of Deferring PCI if FFR < 0.75

97 patients with intermediate lesions and normal NPS all treated medically



Chamuleau et al. Am J Cardiol 2002;89:377-380

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Danger of not Heeding FFR Result

71 patients in whom FFR was ignored:

34 deferred despite FFR < 0.80

37 stented despite FFR > 0.80

	Non-compliance group ($n = 71$)		Compliance group ($n = 336$)	
	No revasc ($n = 34$)	Revasc ($n = 37$)	No revasc ($n = 237$)	Revasc ($n = 99$)
Clinical events	7/34 (21%)	4/37 (11%)	14/237 (7%)	6/99 (6%)
Death	2/34 (6%)	1/37 (3%)	3/237 (1%)	0/99
Acute coronary syndromes	2/34 (6%)	1/31 (3%)	2/237 (1%)	0/99
Vessel revascularization	3/34 (9%)	2/37 (5)	9/237 (4%)	6/99 (6%)

P=0.01

Legalery et al. Eur Heart J 2005;26:2623-2629

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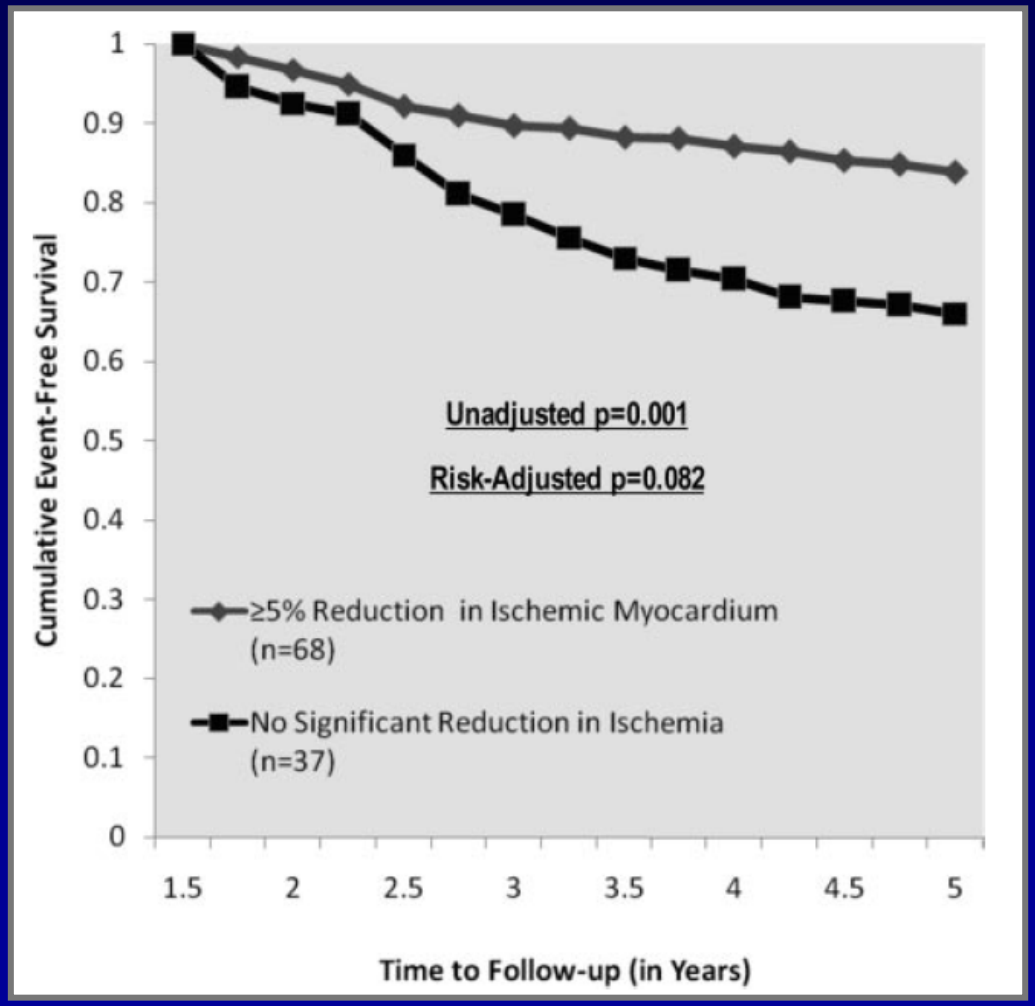
COURAGE Nuclear Substudy

Comparison of death/MI in patients with mod-severe pre-treatment ischemia based on whether or not ischemia was relieved



Shaw et al. Circulation 2008;117:1283

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FFR-guided PCI in MVD

- 150 patients with MVD referred for CABG
- If FFR < 0.75 in all 3 vessels or 2 including the proximal LAD then CABG (87 patients)
- Otherwise PCI performed (63 patients)

TABLE II. Angiographic Characteristics of the Culprit (FFR ≤ 0.75) and Nonculprit Stenoses (FFR > 0.75)

	FFR ≤ 0.75	FFR > 0.75	*P*
n	259	101	
RD	2.78 ± 0.51	2.85 ± 0.54	0.23
% stenosis	54 ± 12	53 ± 10	0.77
MLD	1.27 ± 0.45	1.35 ± 0.42	0.09

Botman et al. Cathet Cardiovasc Intervent 2004;63:184-191

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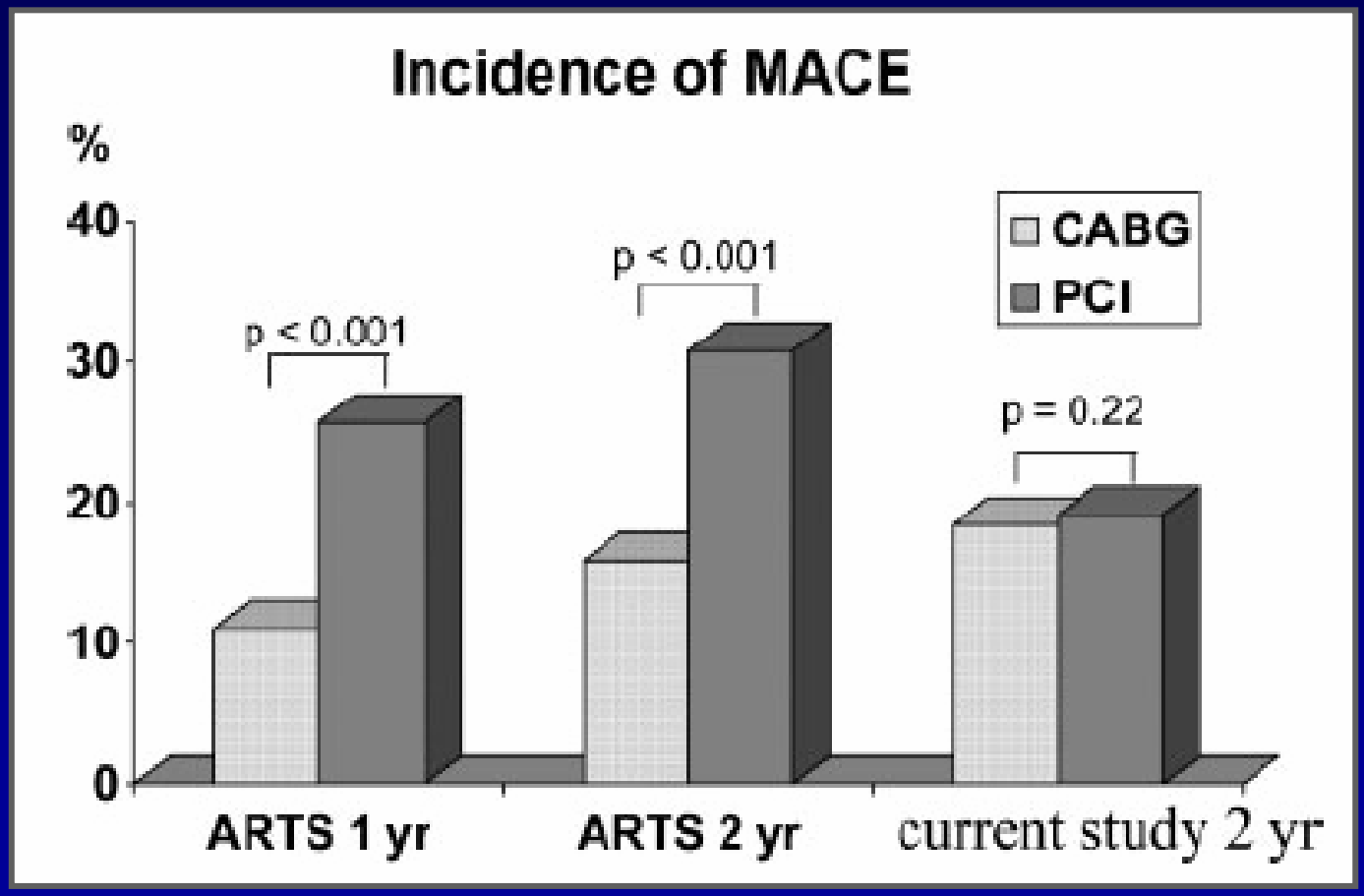
FFR-guided PCI in MVD

Similar event rate between FFR-guided PCI and CABG



Botman et al. Cathet Cardiovasc Intervent 2004;63:184-191

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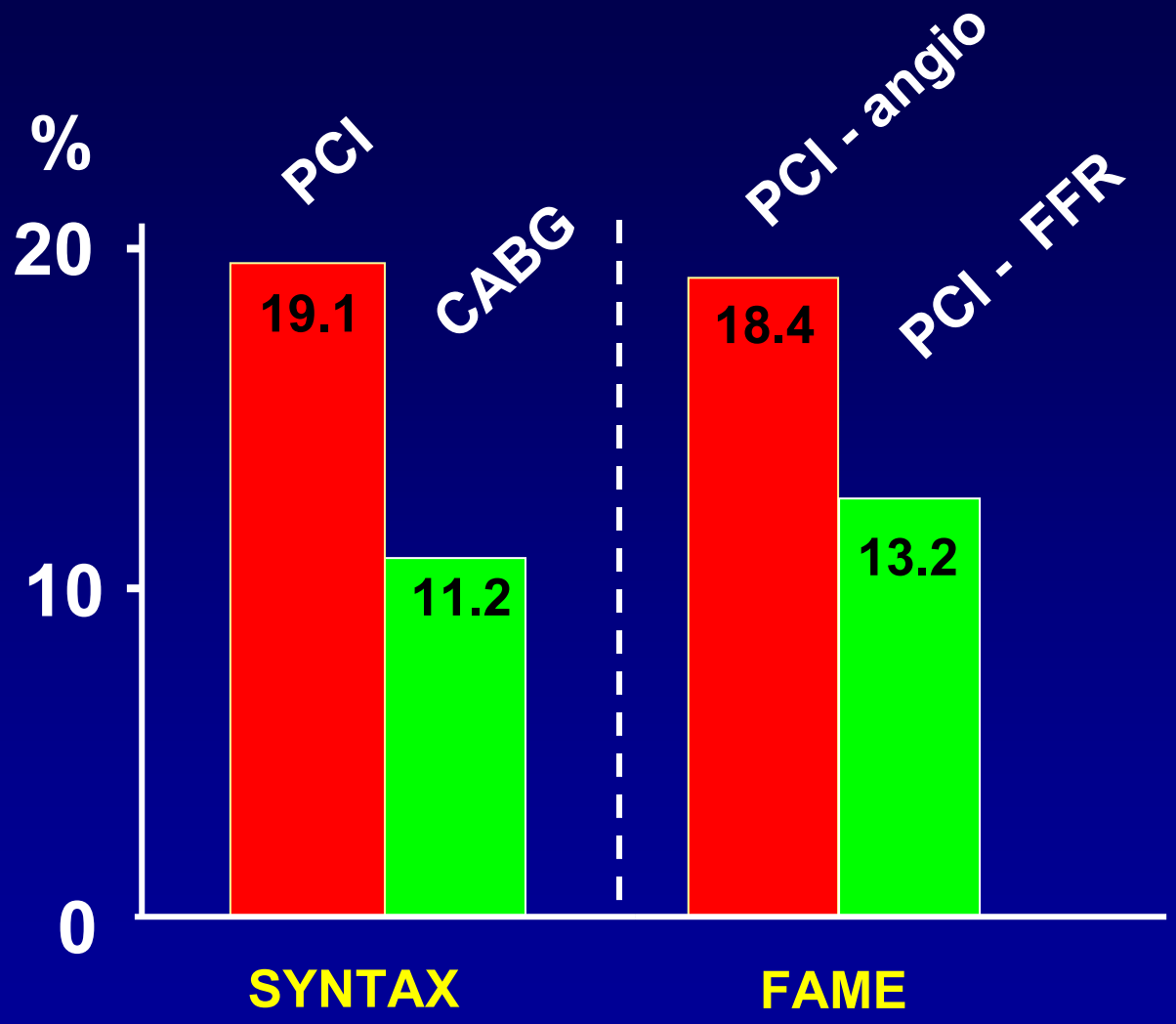
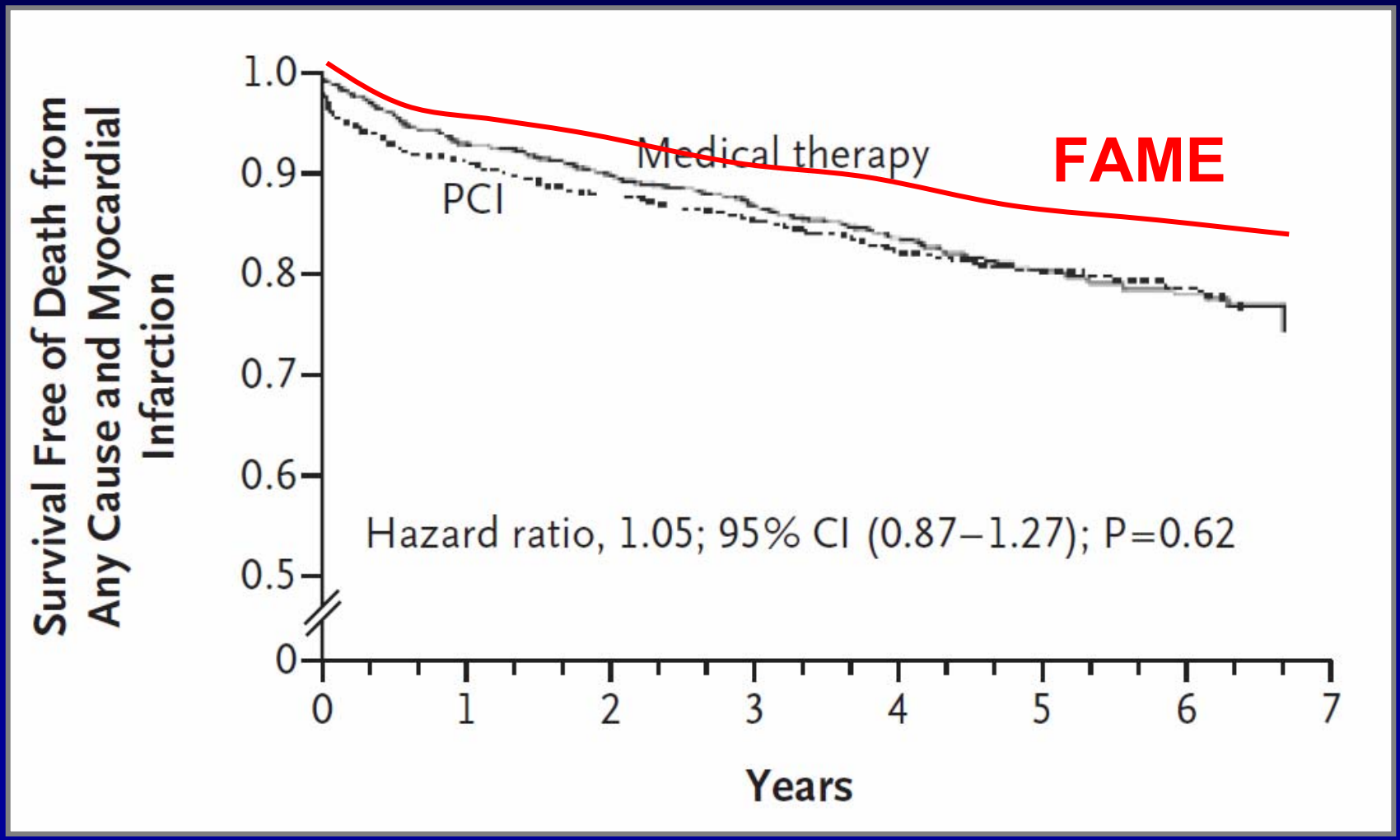
FFR-guidance may ↑ PCIs



1 year MACE Rates

FFR-guidance may ↑ PCIs

Death and MI in the COURAGE study



Boden et al., New Engl J Med 2007;356:1503-16.

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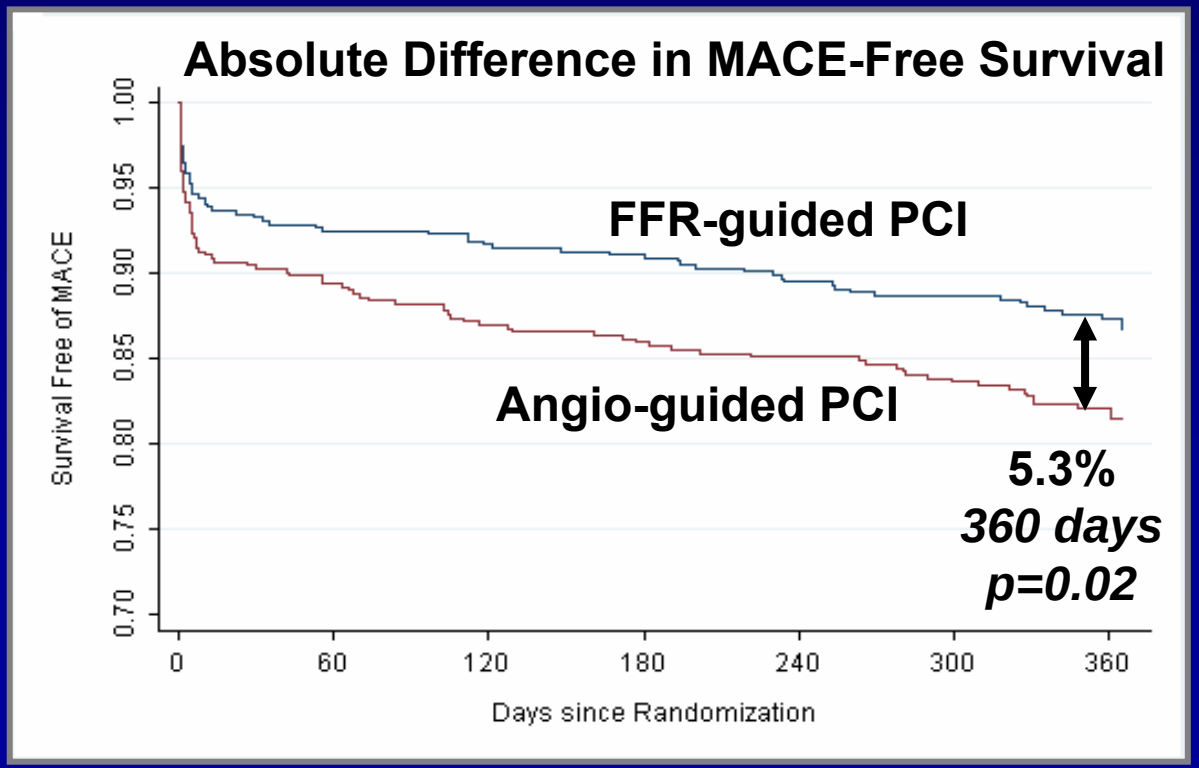
Final reason to adopt an FFR-guided strategy

Results of the FAME study:

1. Improved outcomes
2. Decreased cost
3. Less contrast use
4. Similar procedure time



Angio	FFR
$6,007	vs $5,332, p<0.001
302 ml	vs 272 ml, p<0.001
70 min	vs 71 min, p=0.51

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