Low FFR But Normal Thallium: How to Evaluate, Interpret and Treat It?

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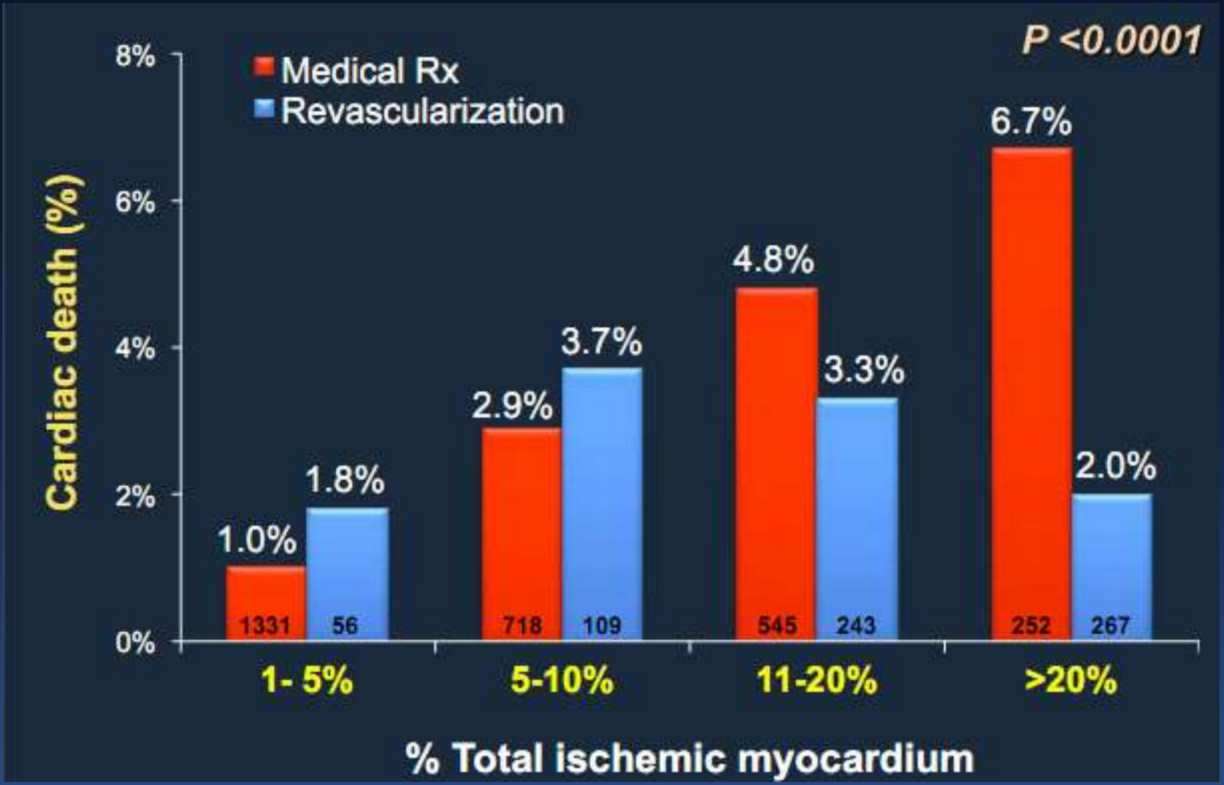
Disclosure Statement of Financial Interest

I, Soo-Jin Kang DO NOT have a financial interest /arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation

Survival Benefit with Revascularization

at 1.9-year **F/U**



Revascularization reduced cardiac mortality only in patients with moderate-to-large ischemic myocardium (>10-20% of total myocardium)

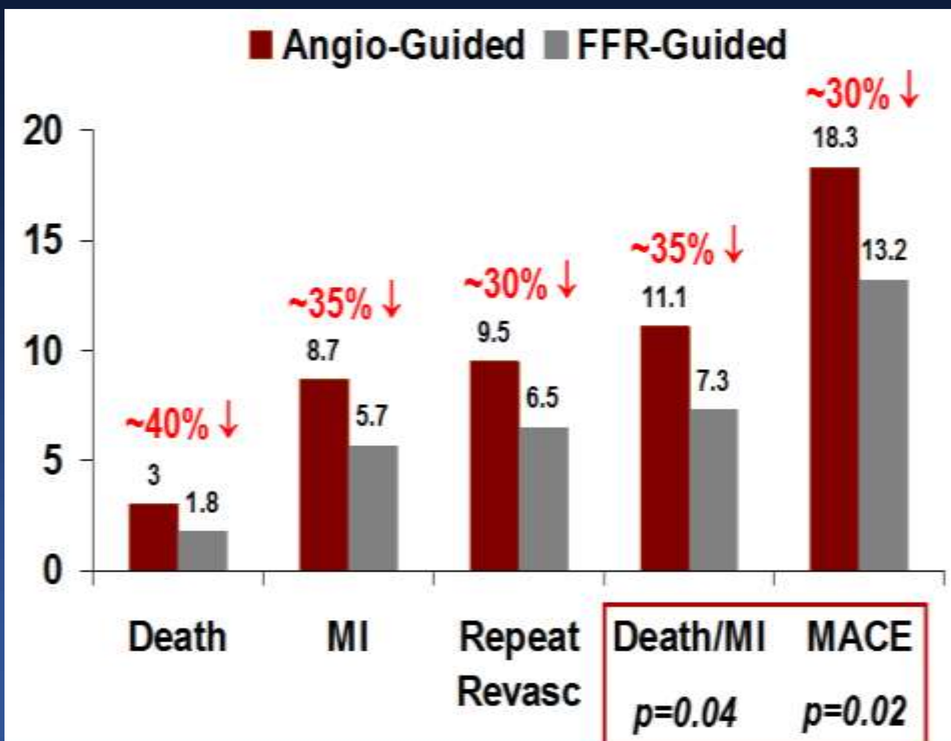
Hachamovitch et al. Circulation 2003;107:2900-7

FFR is a Sensitive Index of Ischemia

FAME

FFR- vs. Angio-guided

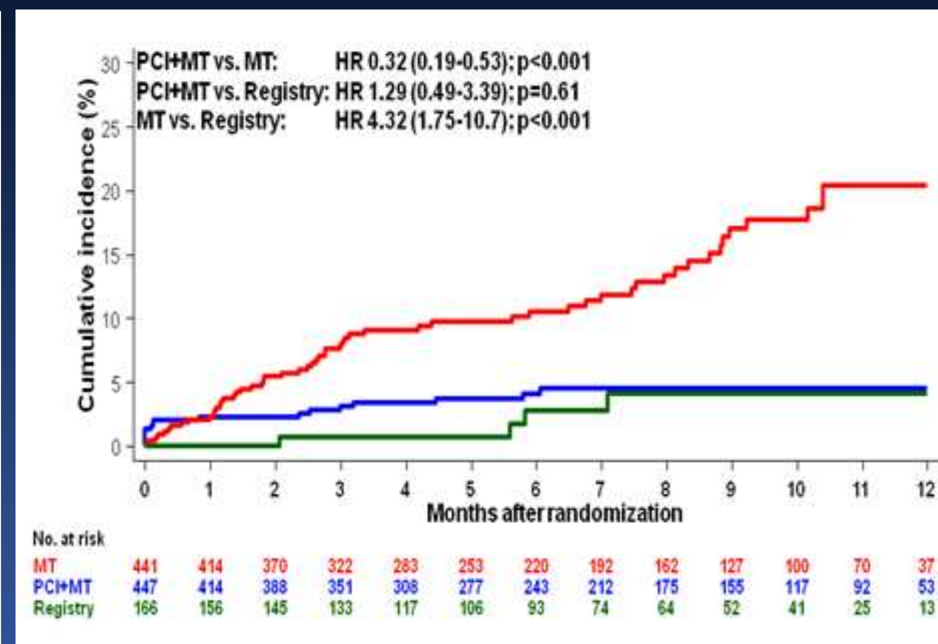
1-year MACE



FAME II

PCI vs. Medical (FFR<0.80)

Primary Endpoint



* Composite of all cause death, myocardial infarction, unplanned hospitalization with urgent revascularization

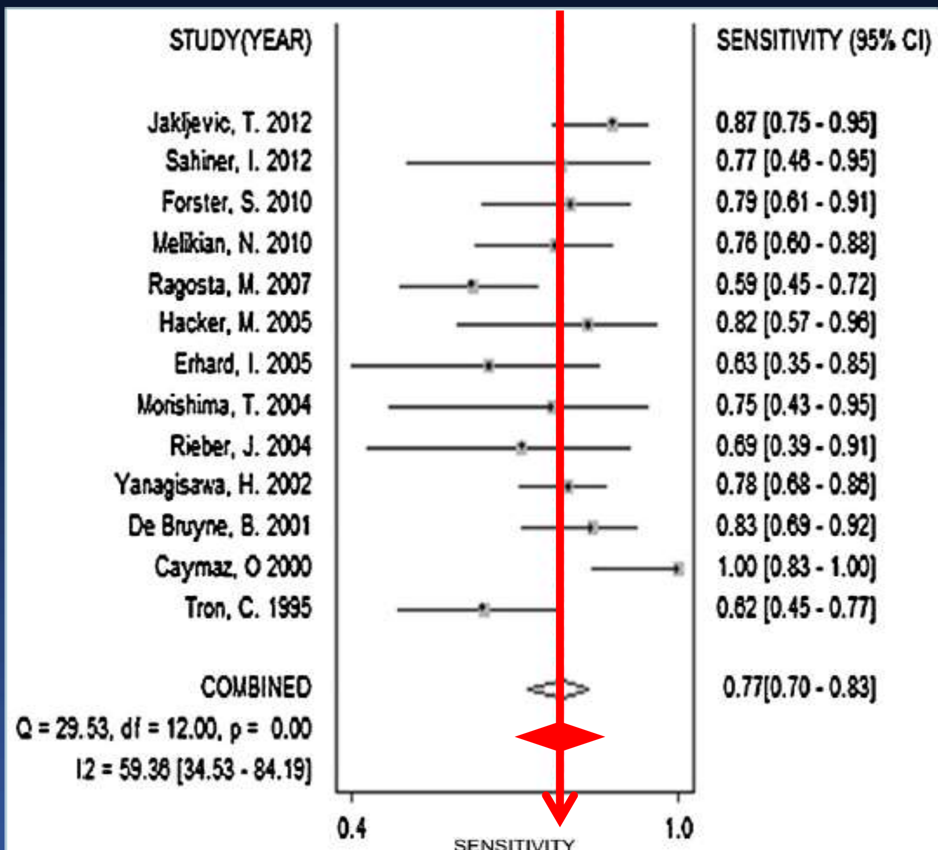
Tonino et al/ New Engl J med 2009;213-26

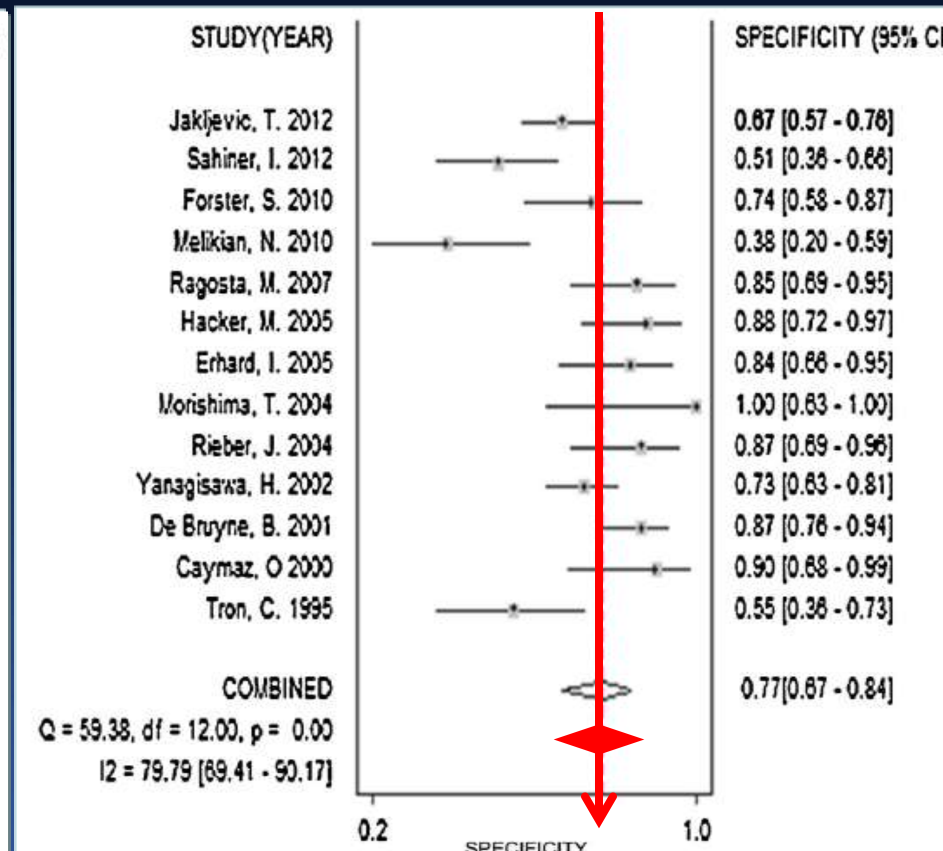
Flow vs. Pressure

- Lesion assessment focuses in identifying ischemia-producing epicardial stenoses as targets for revascularization
- Impairment of myocardial blood flow has a multi-level origin: <u>at an epicardial vessel</u> (focal or diffuse narrowing) and <u>at a microcirculatory level</u> (increased resistance due to structural remodeling and vasoconstriction with endothelial dysfunction)

SPECT myocardial perfusion versus fractional flow reserve for evaluation of functional ischemia: A meta analysis

Tao Zhou[a,1], Lin-feng Yang[a,1], Ji-liang Zhai[b], Jiang Li[c], Qi-meng Wang[d], Rui-jie Zhang[a], Sen Wang[a], Zhao-hui Peng[a], Min Li[a,*], Gang Sun[a,*]





- **Pt-level: pooled sensitivity 77%**
- **Ve-level: pooled sensitivity 66%**

- **Pt-level: pooled specificity 77%**
- **Ve-level: pooled specificity 81%**

Zhou et al. European Journal of Radiology 2014;83:951–6

Fractional Flow Reserve and Myocardial Perfusion Imaging in Patients With Angiographic Multivessel Coronary Artery Disease

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Olivier De Winter, MD, PhD,† Eric Wyffels, MD,* Jozef Bartunek, MD, PhD,*
Guy R. Heyndrickx, MD, PhD,* William F. Fearon, MD,‖ Nico H. J. Pijls, MD, PhD,§
William Wijns, MD, PhD,* Bernard De Bruyne, MD, PhD*

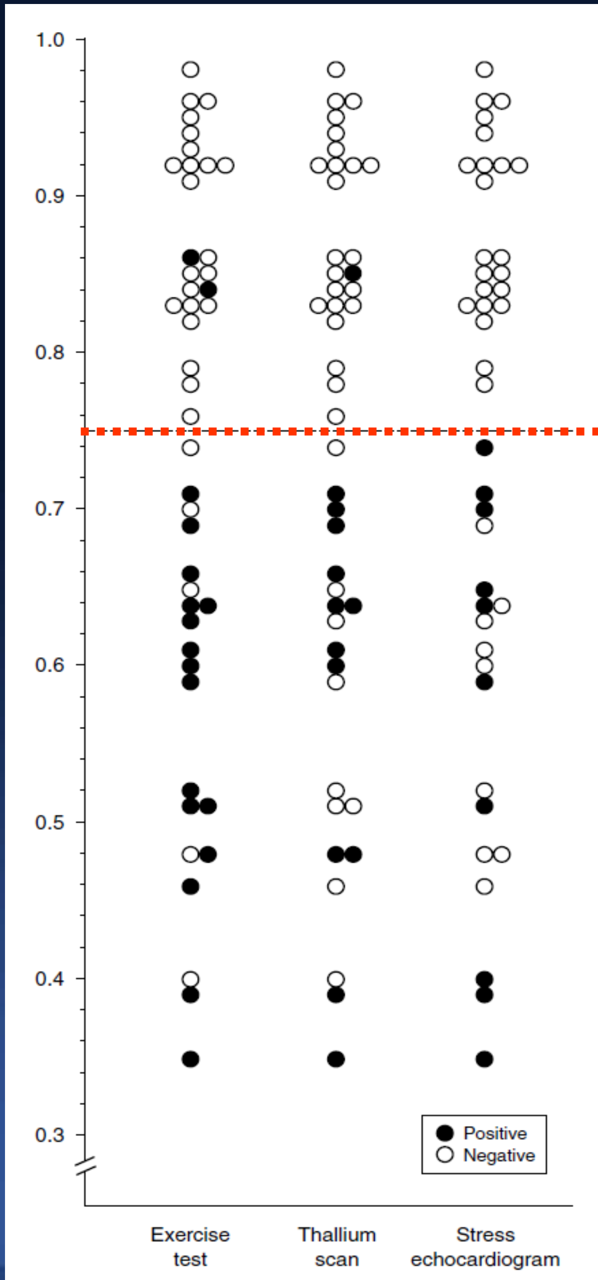
Per-patient Concordance **61%**

	FFR<0.80	FFR>0.80
MPI (+)	**46%**	**15%**
MPI (-)	**24%**	**15%**

Per-vessel Concordance **67%**

	FFR<0.80	FFR>0.80
MPI (+)	**19%**	**12%**
MPI (-)	**21%**	**48%**

Melikian et al. JACC Intv 2010;3:307–14



Cut-off to predict at least one positive stress test

in single vessel disease

FFR <0.75

	Any test (+)	SPECT (+)
Sensitivity	88%	92%
Specificity	100%	72%
PPV	100%	57%
NPV	88%	96%

Agreement rate 78%

Pijls et al. New Engl J med 1996;334:1703-8

FFR cut-offs were originally validated with SPECT result, thereby revealing logical inconsistency

0.75 0.80

Significant	Grey	Insignificant

Author	Number	Stress Test	BCV	Accuracy
Caymaz et al.	40	SPECT	0.76	95
Pijls et al.	45	X-ECG/SPECT/DSE	0.75	93
Abe et al.	46	SPECT	0.75	91
Chamuleau et al.	127	SPECT	0.74	77
Usui et al.	167	SPECT	0.75	79
Yanagisawa et al.	167	SPECT	0.75	76
Meuwissen et al.	151	SPECT	0.74	85

Diagnosis of Myocardial Ischemia by FFR and Thallium SPECT in Patients with Single-Vessel Coronary Disease

- Aims 1) to see the frequency of FFR–SPECT mismatch and 2) to identify determinants of the discordances
- 301 patients who had a <u>single vessel disease</u> (DS 30–85%) and underwent adenosine stress thallium SPECT, IVUS and FFR were included

*Exclusion criteria: multi-vessel or LM disease, ISR, previous PCI, TIMI<3, AMI, EF <40%, valvular disease, scarred myocardium or RWMA, LVH…

Methods

- Using 17-segment AHA model, perfusion defects were assigned to the coronary territories
- **Positive SPECT**: summed difference score (SDS) ≥2 allocated to target vessel territory
- **Moderate-to-severe perfusion defect**: SDS ≥7 (equivalent to >10% ischemic myocardium)

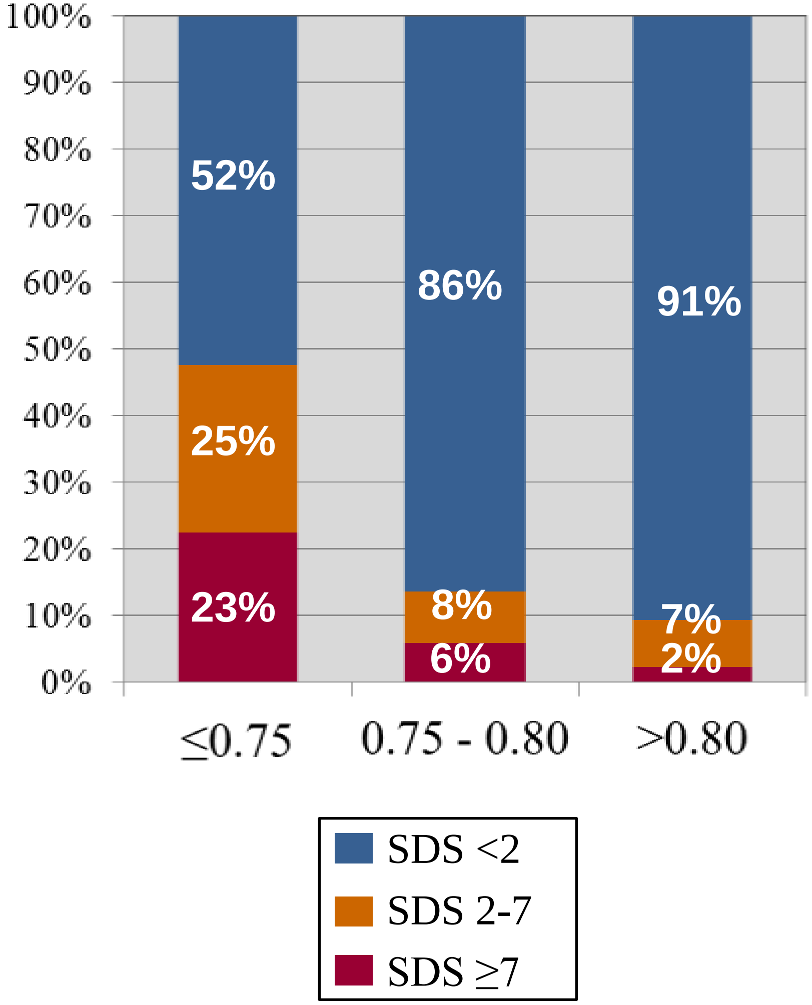
Baseline Characteristics

in 301 Patients with Single Vessel Disease

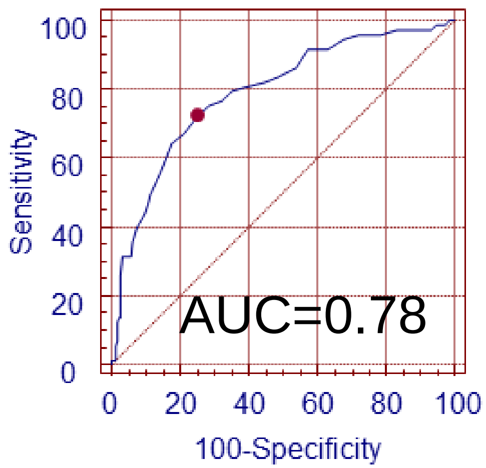
Age (years)	61.8±10.0
Men	205 (68.1%)
Diabetes mellitus	78 (25.8%)
Hypertension	156 (51.8%)
Acute coronary syndrome	81 (26.9%)
LAD	248 (82.5%)
LCX	21 (6.9%)
RCA	32 (10.6%)
Proximal location	159 (52.8%)
Mid segment	128 (42.5%)

Relation Between FFR vs. Stress Test

Predict Positive SPECT
(Summed Difference Score ≥2)



FFR ≤0.75



Sensitivity 73%
Specificity 75%
PPV 48%
NPV 90%

Discordance Between FFR vs. SPECT

Agreement rate 74%

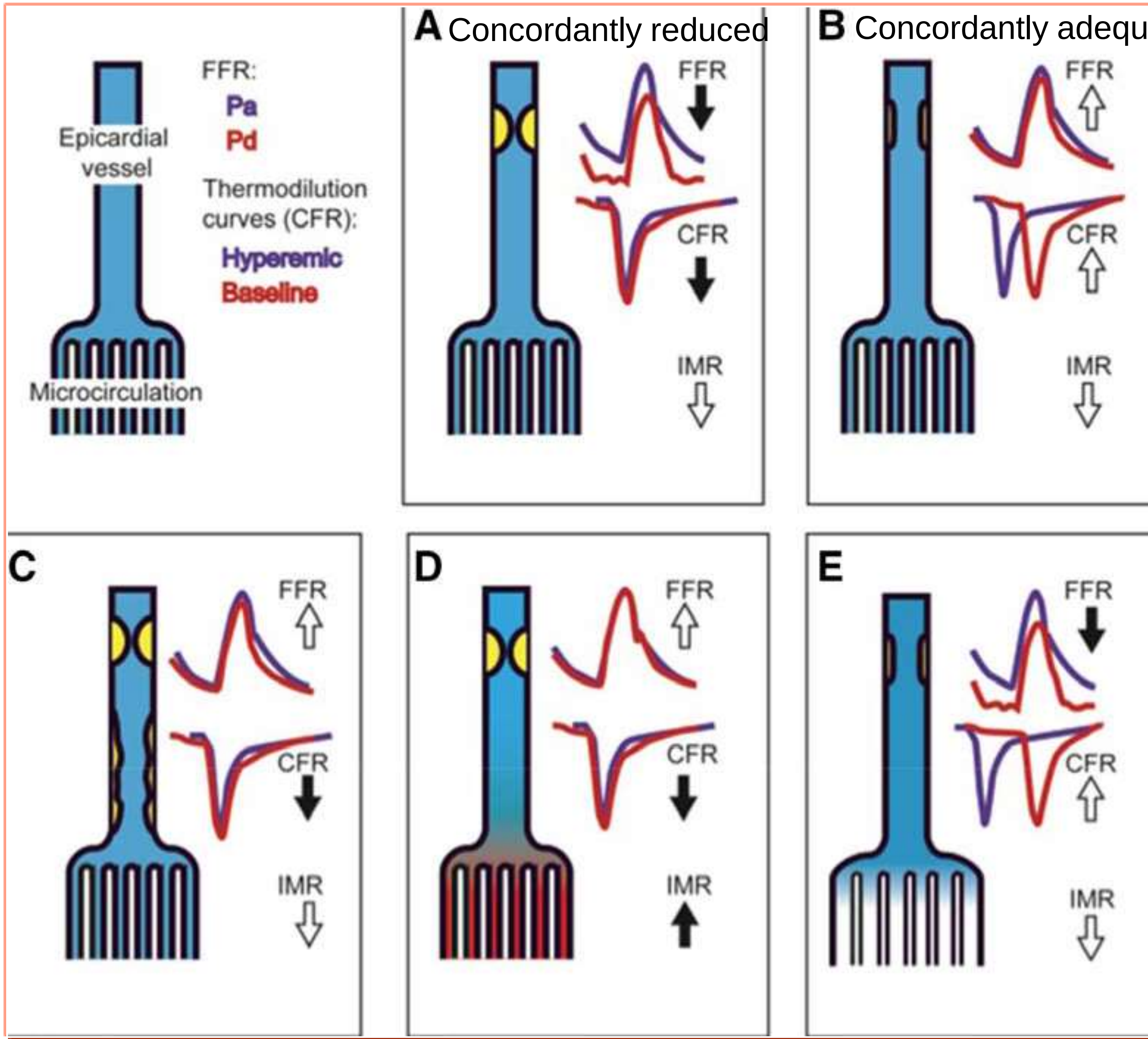
	FFR ≤0.75			FFR >0.75		
	SPECT (+)	SPECT (-)	P	SPECT (+)	SPECT (-)	P
N	**53 (48%)**	**58 (52%)**		**20 (11%)**	**170 (89%)**	
treadmill (+)	19 (51%)	10 (22%)	0.022	3 (21%)	24 (19%)	0.964
FFR	0.65±0.09	0.69±0.08	0.011	0.83±0.05#	0.85±0.06*	0.096
LAD	50 (94%)	45 (77%)	0.012	18 (90%)	135 (79%)	0.258
proximal	37 (70%)	31 (53%)	0.077	11 (55%)	79 (47%)	0.470
QCA-DS,%	61±13	56±12	0.020	53±9#	51±10*	0.458
lesion length, mm	33±18	34±18	0.786	26±13	24±12*	0.504
IVUS-MLA, mm^2	1.9±0.6	2.1±0.7	0.503	2.6±0.9#	2.8±1.0*	0.513
plaque burden,%	82±8	79±8	0.051	72±14#	72±12*	0.674

Multivariable Analysis

	FFR ≤0.75		Positive SPECT	
	A-OR (95% CI)	P	A-OR (95% CI)	P
Age	0.92 (0.88-0.95)	<0.001		
Male				
BSA	1.25 (1.01-1.56)	0.045		
LAD			6.82 (2.04-22.7)	0.002
Proximal	2.44 (1.24-4.80)	0.009	2.56 (1.34-4.89)	0.005
Angio DS	1.05 (1.01-1.08)	0.004		
Lesion length	1.04 (1.01-1.06)	0.001		
MLA	0.39 (0.24-0.66)	<0.001	0.22 (0.10-0.45)	<0.001

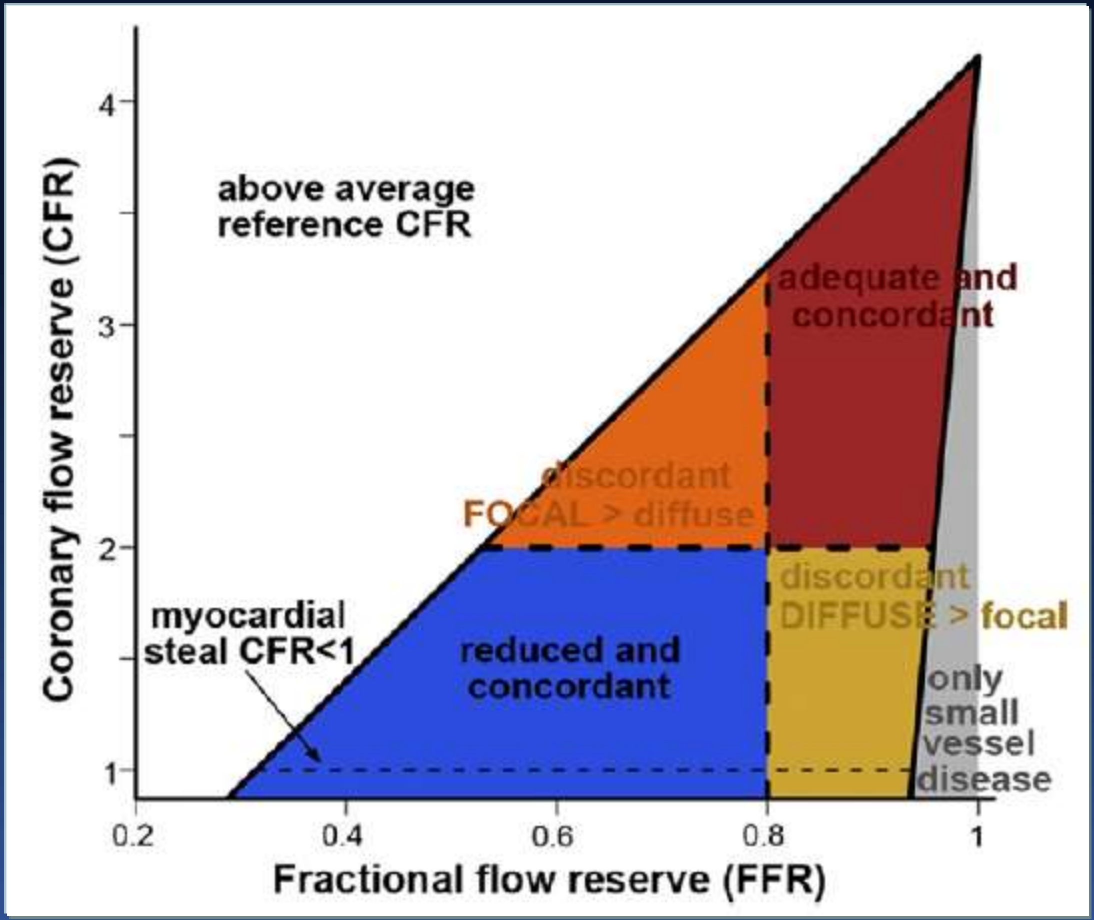
SPECT assesses the relative difference in myocardial perfusion and quantifies the perfusion defects relative to a given LV mass

Coronary Hemodynamic Patterns



Echavarria-Pinto et al. Circulation 2013;128:2557-66

Conceptual Plot of CFR vs. FFR



Johnson NP et al. J Am Coll Cardiol Img 2012;5:193–202

Conclusions

CFR - FFR discordance rarely means a failure of either tool, but reflects diverse patterns of atherosclerosis. Integration of FFR, CFR and IMR is useful to determine treatment

FFR>0.80 vs. SPECT (+)	FFR<0.80 vs. SPECT (-)
▪ Diffuse stenosis ▪ Small vessel disease	▪ Balanced ischemia (multivessel) ▪ Preserved microcirculation ▪ Abundant collateral flow
▪ Systemic > focal	▪ Consider clinical symptoms, treadmill test, subtended myocardial territories (LM or proximal LAD, vessel size, etc.), if the lesion is suitable for PCI