Synergetic Approach for Discordant Lesions Between FFR and Non-Hyperemic Indexes

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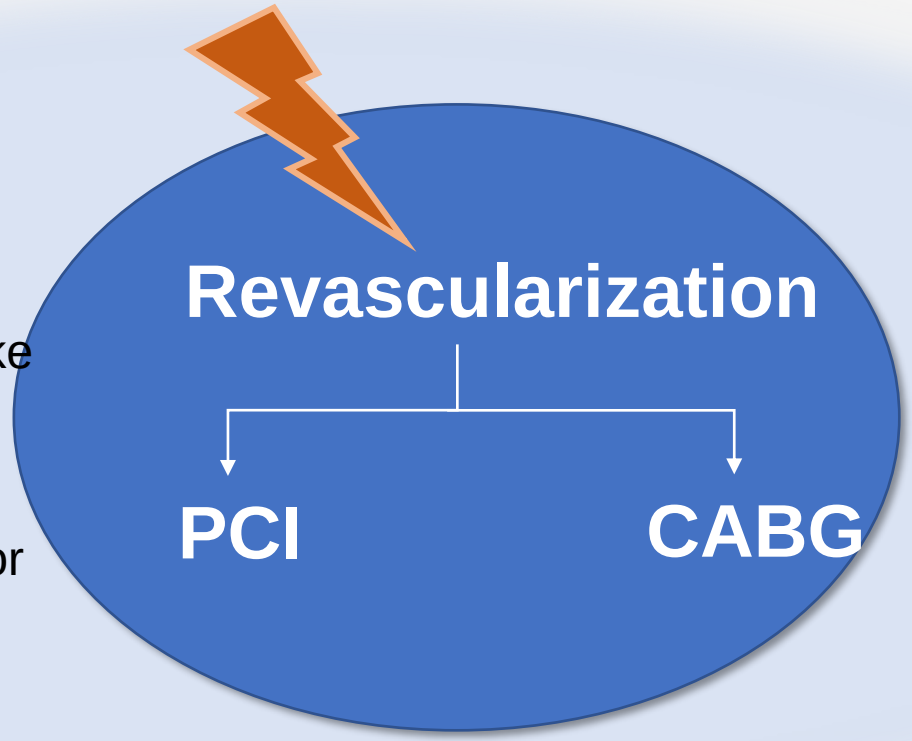
Treatment of SIHD

OMT plus Risk Factor Modification (Default Treatment)

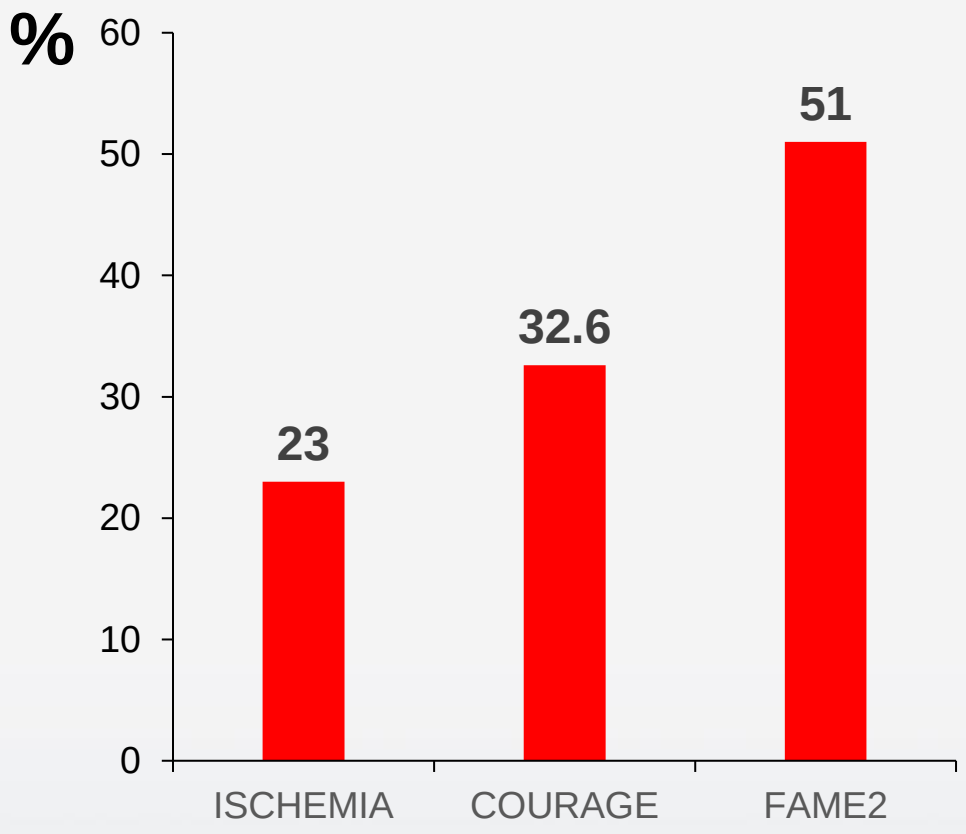
Behavioral risk factor
- Smoking cessation
- Physical activity
- Reduced saturated fat intake



Pharmacologic Targets
- Aspirin
- Statin
- Ezetimibe
- ACEi/ARB
- Beta blocker

Physiologic risk factor
- BP control
- Lipid control
- BMI control

Revascularization in Medication Group



Reduction of Spontaneous MI

	Hazard Ratio
COURAGE Trial	≈ 0.89 (?)
FAME2 Trial	0.62 (0.39-0.99)
Meta*	0.59 (0.42-0.83)
ISCHEMIA Trial	0.67 (0.53-0.83)
COMPLETE Trial	0.68 (0.53-0.86)

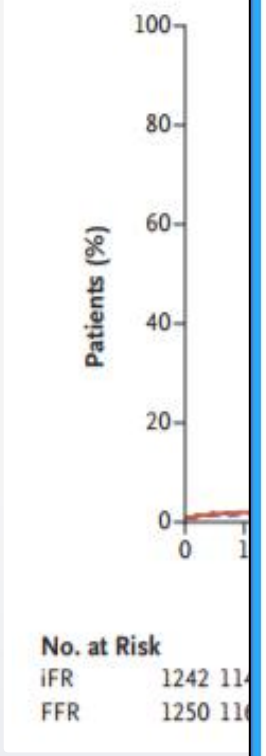
Non culprit lesion revascularization in STEMI with MV

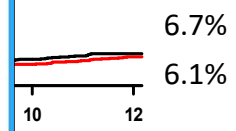
* Meta-analysis from FAME2, DANAMI, COMPARE-Acute
Eur Heart J . 2019 Jan 7;40(2):180-186.

ACC 2017,

ESC Guideline 2018

Recommendations	Class[a]	Level[b]
When evidence of ischaemia is not available, FFR or iwFR are recommended to assess the haemodynamic relevance of intermediate-grade stenosis.[15,17,18,39]	I	A
FFR-guided PCI should be considered in patients with multivessel disease undergoing PCI.[29,31]	IIa	B
IVUS should be considered to assess the severity of unprotected left main lesions.[35–37]	IIa	B





956 944
961 946

N Engl J 1813-1823

Since 2017,

Many Non-Hyperemic Pressure Ratios (NHPR)

ORIGINAL INVESTIGATION

Agreement of
to Aortic Coro
the Instantane

ABSTRACT

Comparison
Diastolic Res
Are They All Equal

ABSTRACT

euro PCR 2018 LATE BREAKING TRIALS

Validation of a novel non-hy
artery stenosis severity: the
(VALIDATE RFR) study

KEYWORDS

- fractional flow reserve
- innovation
- other imaging modalities

ESC European Society of Cardiology

Diastolic pressure ratio
validation vs. the instan

Introduction

ORIGINAL ARTICLE

Validation of Resting Diastolic Pressure Ratio Calculated by a Novel Algorithm and Its Correlation With Distal Coronary Artery Pressure to Aortic Pressure, Instantaneous Wave–Free Ratio, and Fractional Flow Reserve

The dPR Study

See Editorial by Kern and Seto

BACKGROUND: Instantaneous wave–free ratio (iFR) offers a reliable non–hyperemic assessment of coronary physiology but requires dedicated proprietary software with a fully automated algorithm. We hypothesized that dPR (diastolic pressure ratio), calculated with novel universal software, has a strong correlation with iFR, similar diagnostic accuracy relative to resting distal coronary artery pressure/aortic pressure and fractional flow reserve (FFR).

METHODS AND RESULTS: The dPR study is an observational, retrospective, single-center cohort study including patients who underwent iFR or FFR. Dedicated software was used to calculate the dPR from Digital Imaging and Communications in Medicine (DICOM) pressure waveforms. The flat period on the pressure difference between sample (dP) to the time difference between the same sample points (dt) signal was used to detect automatically the period, where the resistance is low and constant, and to calculate the dPR, which is an average over 5 consecutive heartbeats. The software was validated by correlating iFR results with dPR. Software validation was done by comparing 78 iFR measurements in 44 patients who underwent iFR. Mean iFR and dPR were 0.91±0.10 and 0.92±0.10, respectively, with a significant linear correlation (R=0.997; P<0.001). Diagnostic accuracy was tested in 100 patients who underwent FFR. Mean FFR, resting distal coronary artery pressure/aortic pressure, and dPR were 0.85±0.09, 0.94±0.05, and 0.93±0.07, respectively. There was a significant linear correlation between dPR and FFR (R=0.77; P<0.001). Both distal coronary artery pressure/aortic pressure and dPR had good diagnostic accuracy in the identification of lesions with an FFR ≤0.80 (area under the curve, 0.84; 95% CI, 0.76–0.92 and 0.86; 95% CI, 0.78–0.93, respectively).

CONCLUSIONS: dPR, calculated by a novel validated software tool, showed a strong linear correlation with iFR. dPR correlated well with FFR with a good diagnostic accuracy to identify positive FFR.

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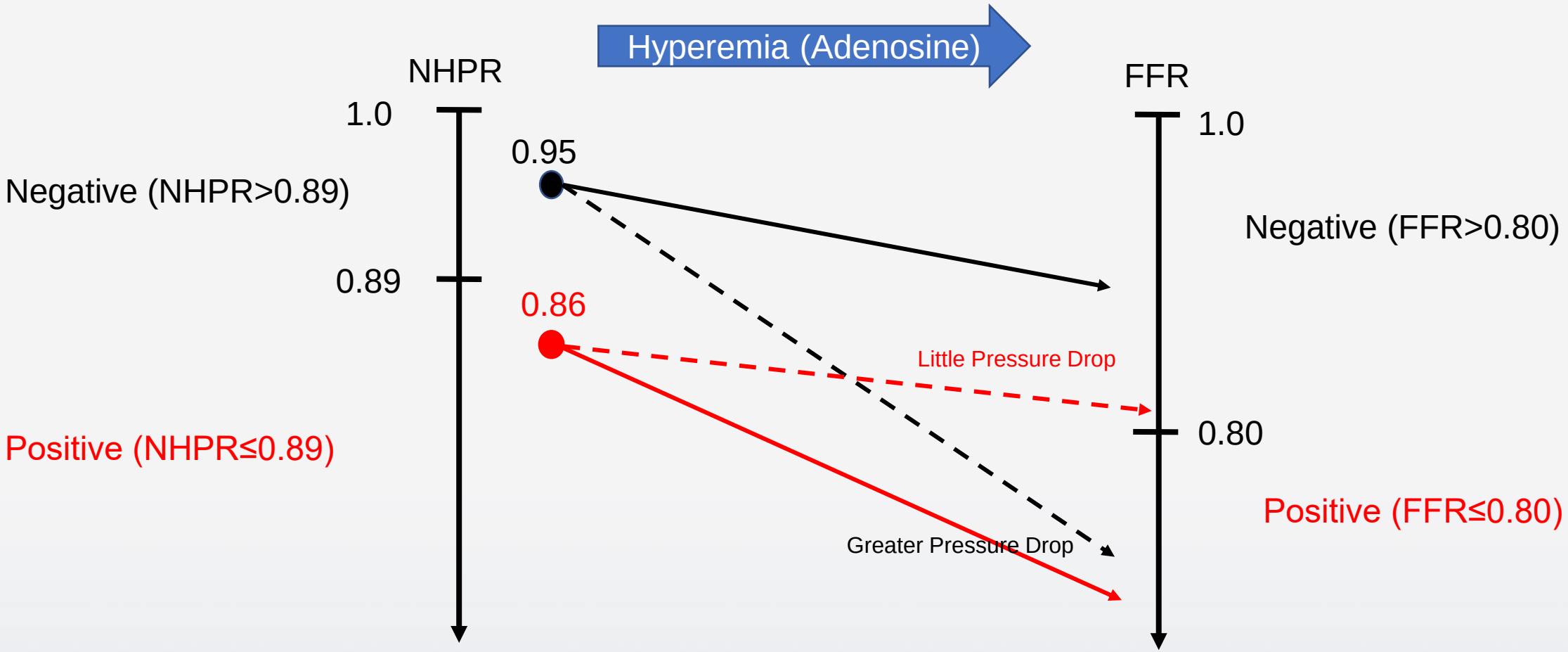
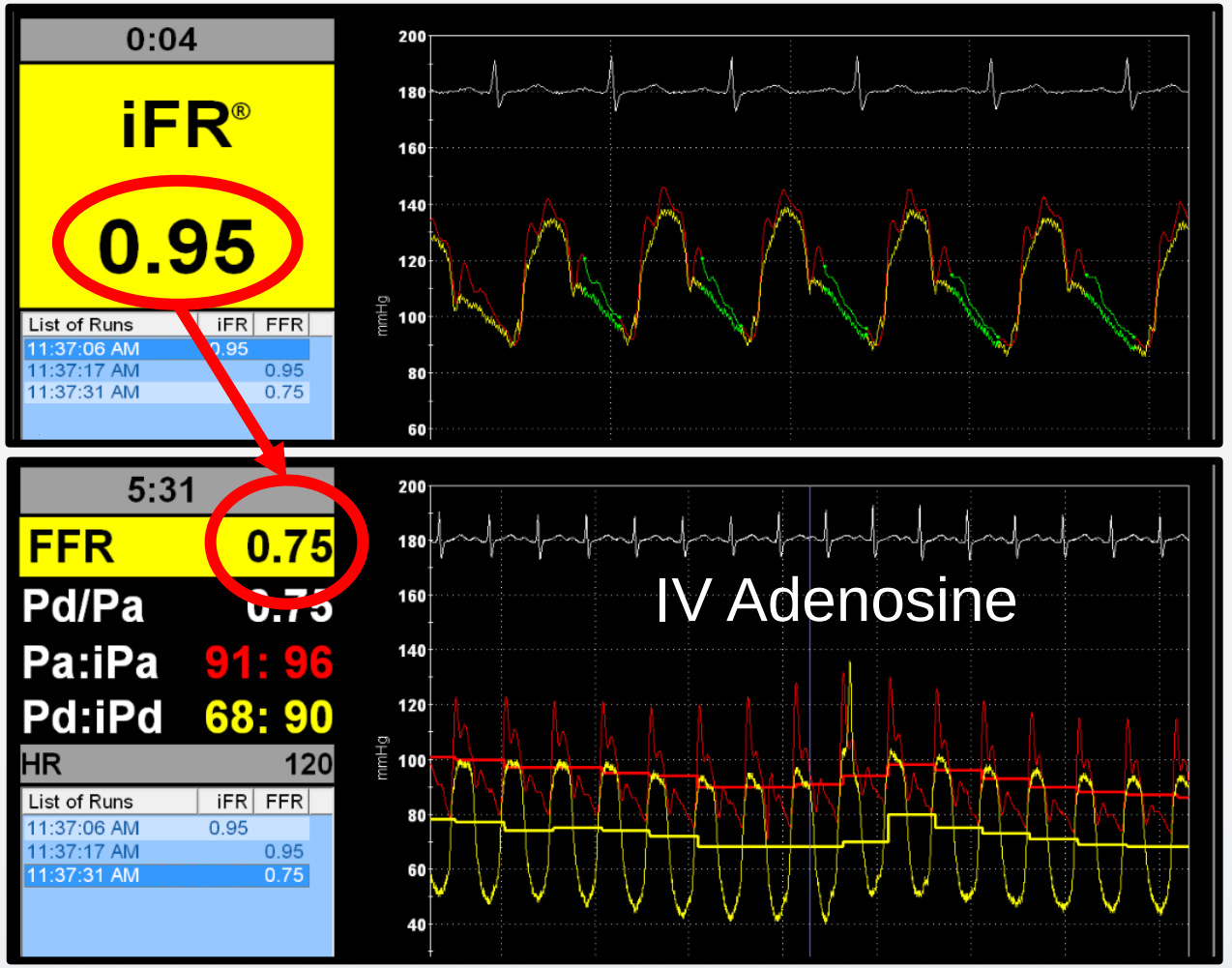
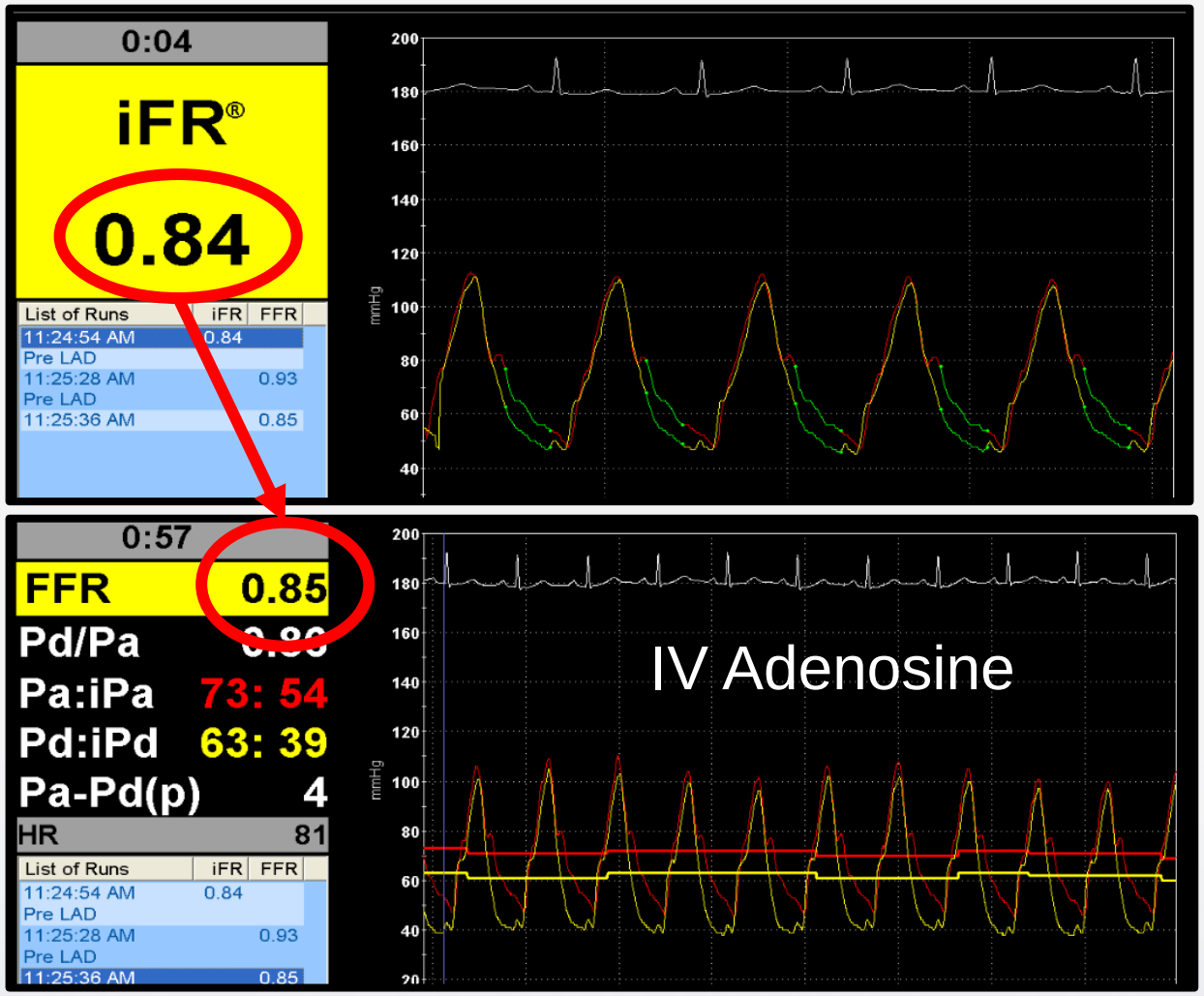
FFR and NHPR Discordance



61 YO/Male with Effort Related Chest Pain (iFR 0.95 ➡ FFR 0.75)

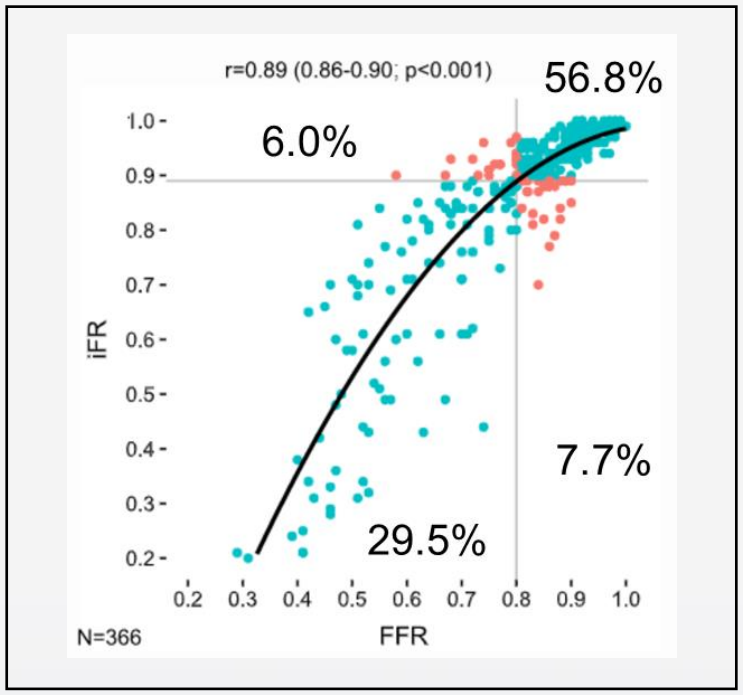


83 YO/Male with Severe AS (iFR 0.84 ➡ FFR 0.85)



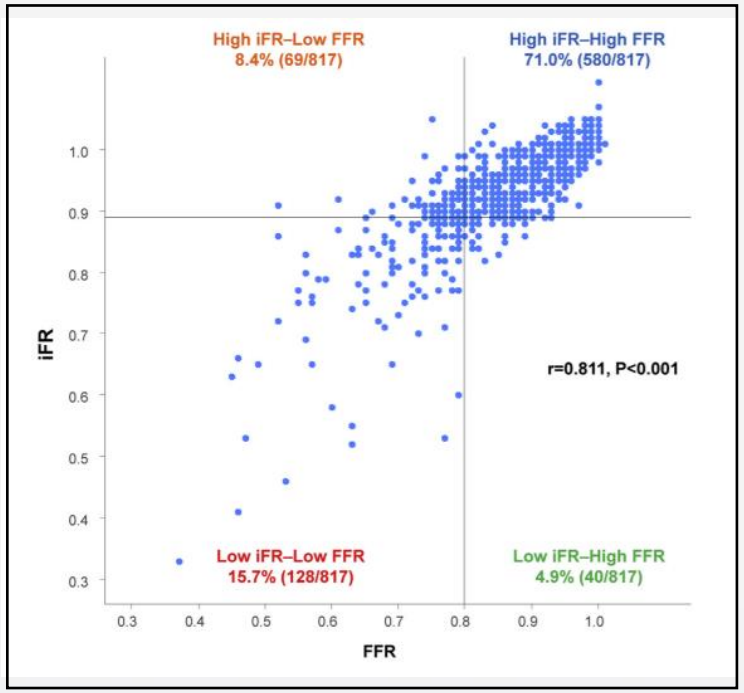
Incidence (1)

13.7 %



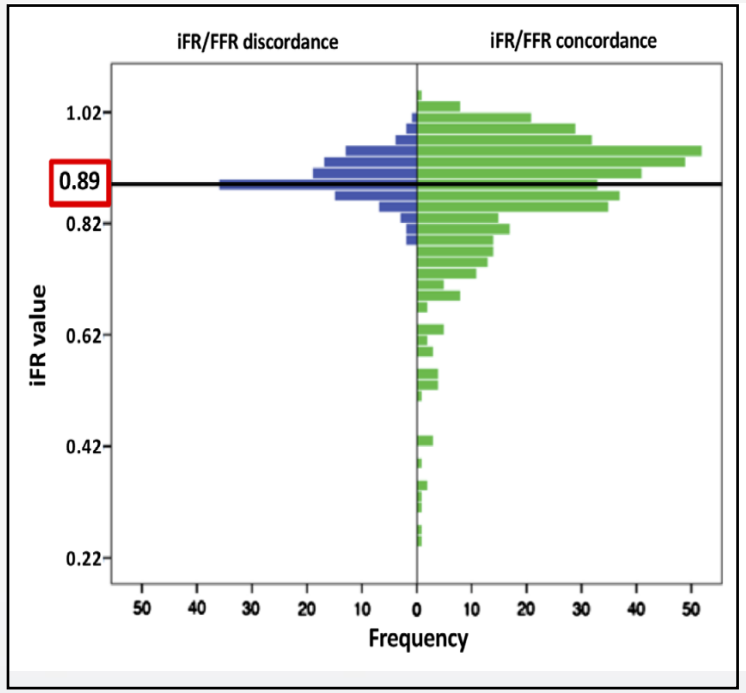
Cook CM et al.
JACC Cardiovasc Interv. 2017;10(24):2514-2524

13.3 %



SH Lee et al.
JACC Cardiovasc Interv. 2019;12(20):2018-2031

20.6 %



Derimay F et al.
Catheter Cardiovasc Interv. 2019 Sep 1;94(3):356-363

Incidence (2)

Meta-analysis
from 16 studies comprising 5756

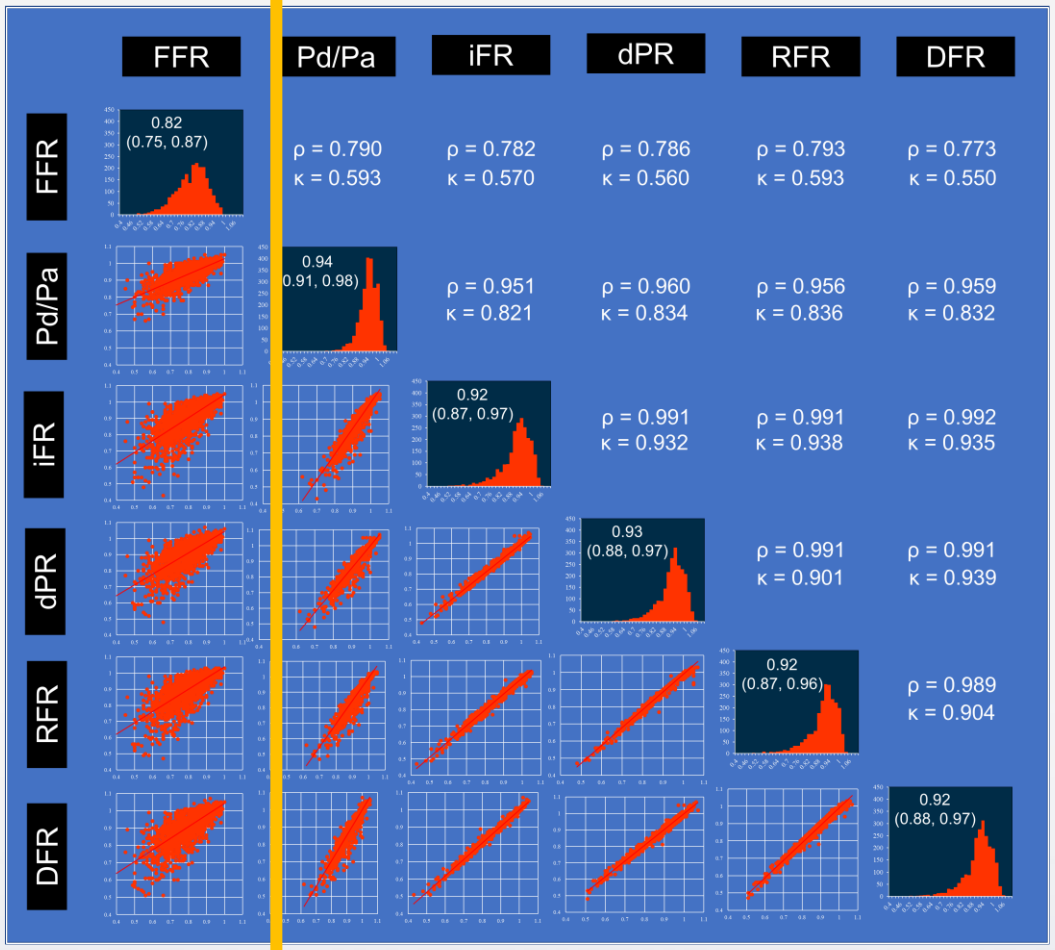
Diagnostic Accuracy: 81%

Measure	Value (95% CI[c])
Diagnostic accuracy	0.81 (0.78–0.84)
Sensitivity	0.78 (0.76–0.79)
Specificity	0.83 (0.81–0.84)
Positive likelihood ratio	4.54 (3.85–5.35)
Negative likelihood ratio	0.28 (0.24–0.32)
Diagnostic odds ratio	17.38 (14.16–21.34)

About 20% Discordance

Cardiovasc Revasc Med. Jul-Aug 2018;19(5 Pt B):613-620

82% Accuracy



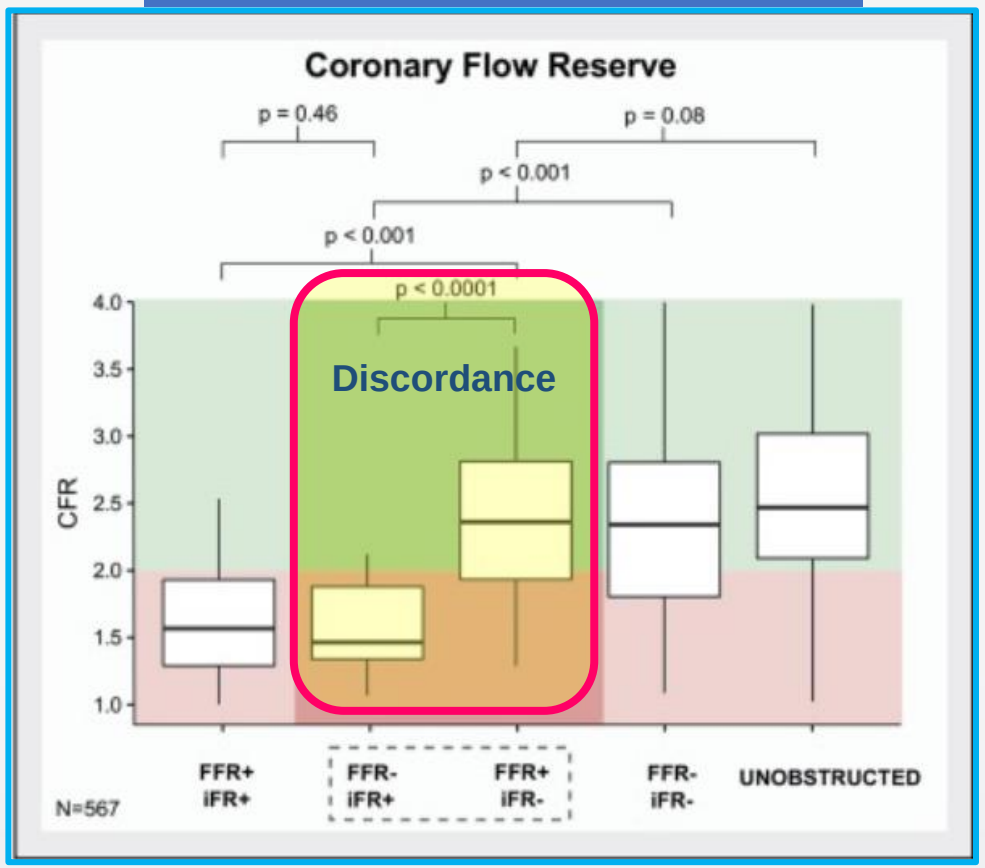
Unpublished Data From IRIS FFR Registry

Incidence (3)

15-20%

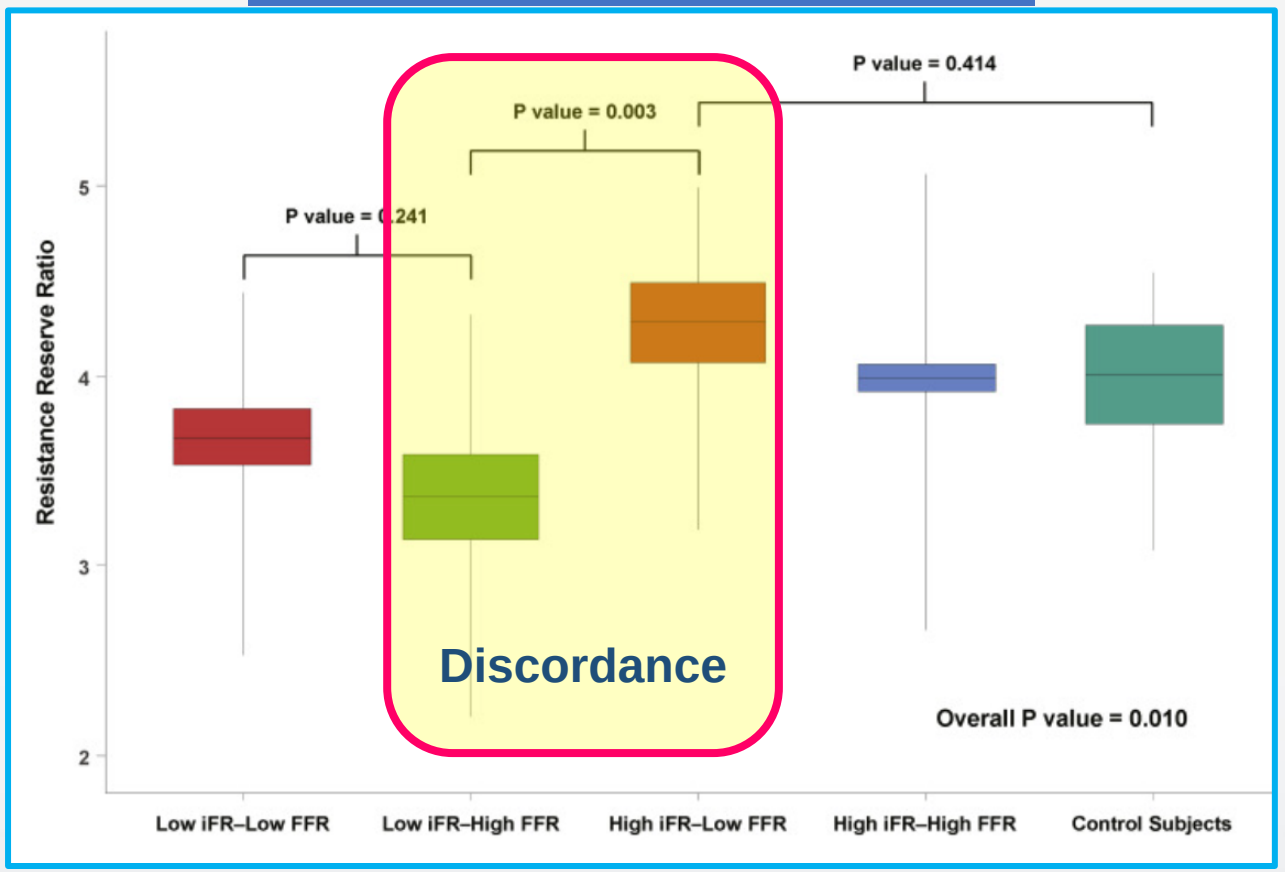
Underlying Mechanism (1) Physiologic Characteristics

Coronary Flow Reserve



Cook CM et al.
JACC Cardiovasc Interv. 2017;10(24):2514-2524

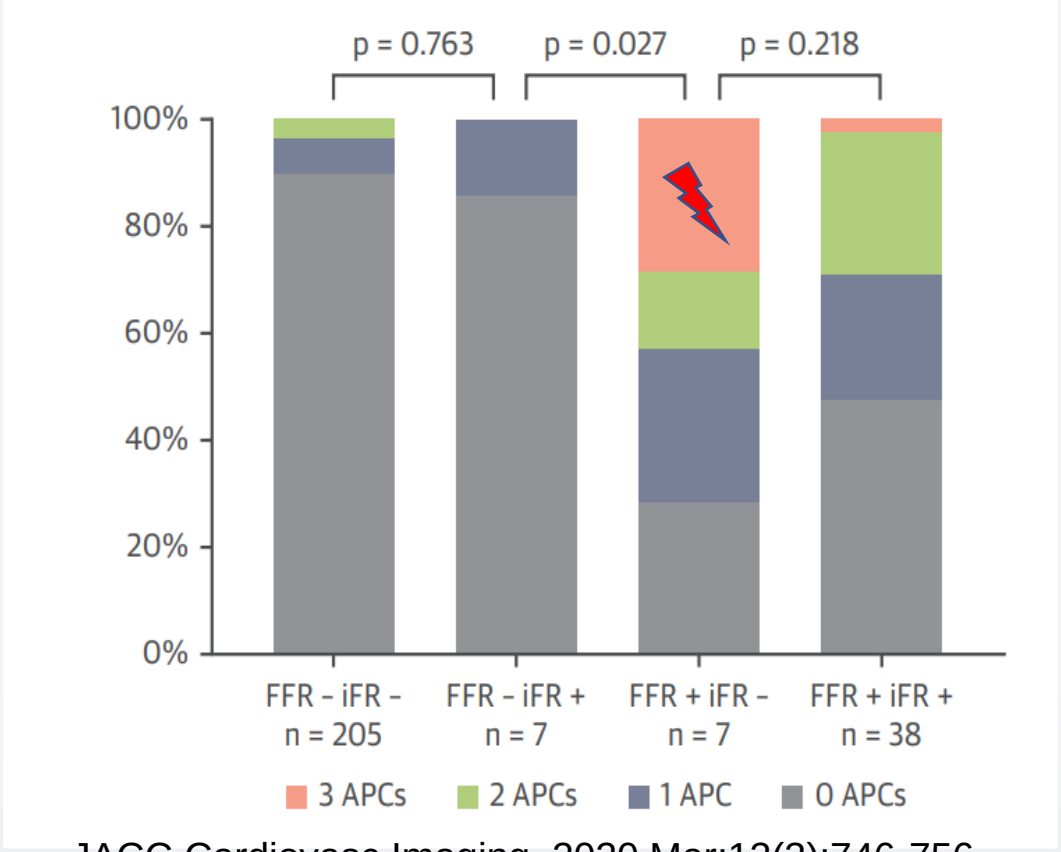
Resistance Reserve Ratio



SH Lee et al.
JACC Cardiovasc Interv. 2019;12(20):2018-2031

Underlying Mechanism (2) Anatomical Characteristics

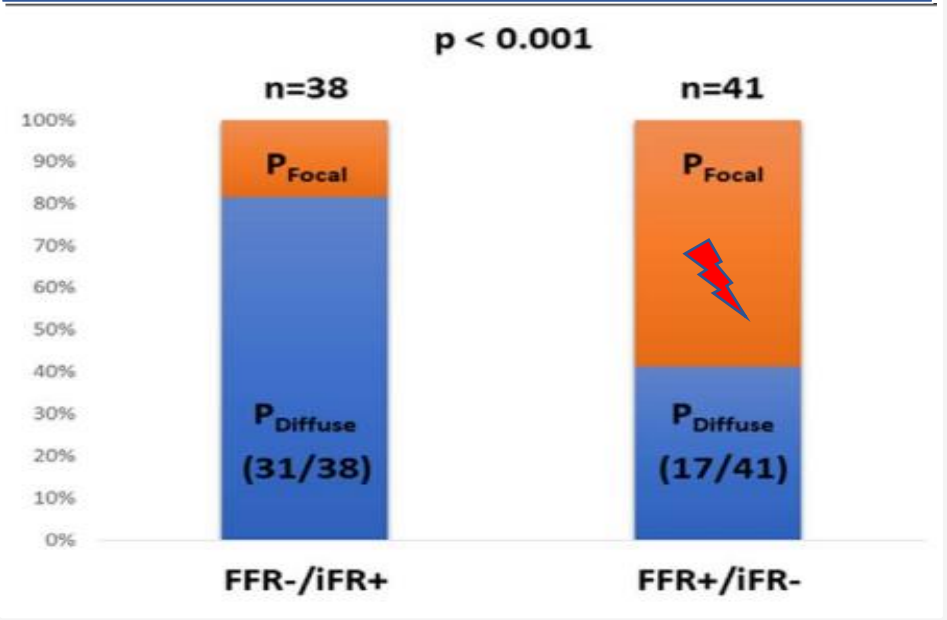
Adverse Plaque Characteristics Relate More Strongly With FFR than iFR*

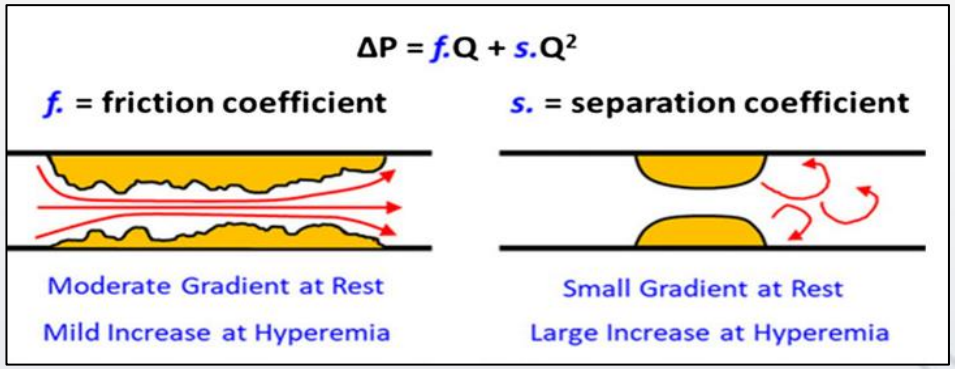


JACC Cardiovasc Imaging. 2020 Mar;13(3):746-756.

*Adverse plaque characteristics include low-attenuation plaque, positive remodeling, spotty calcification, and napkin risk sign

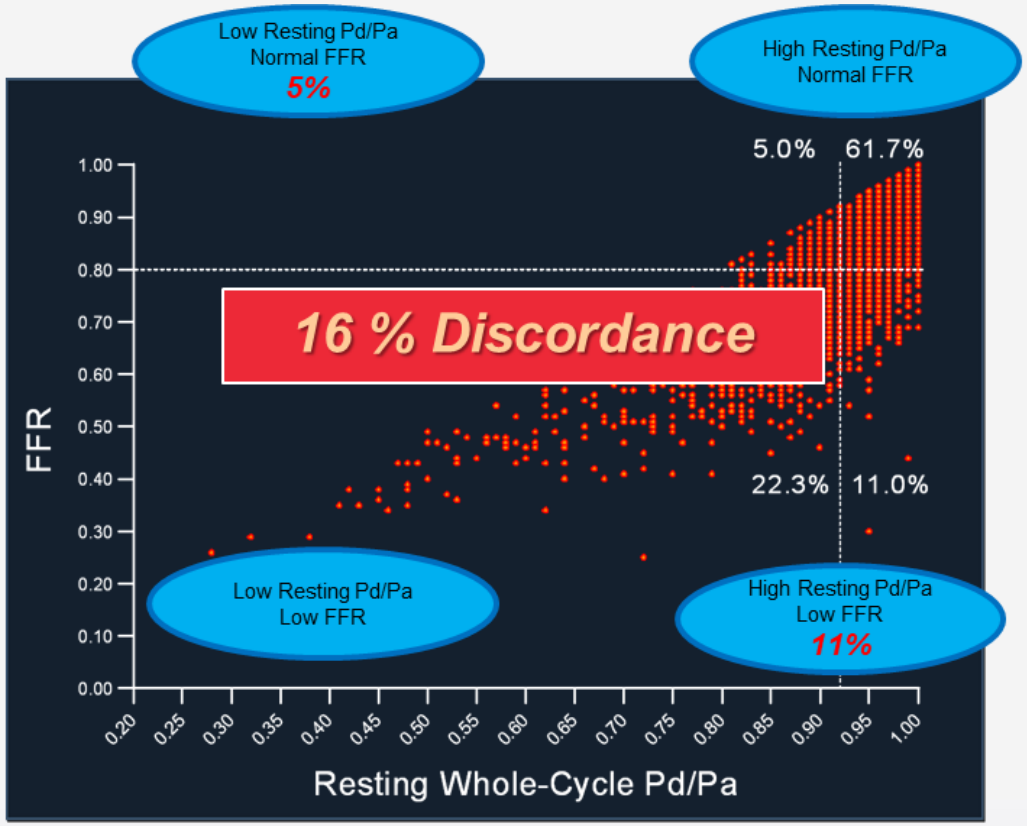
FFR+ iFR− : Focal Disease
FFR− iFR+ : Diffuse Disease





Circ Cardiovasc Interv. 2019;12:e007494

Underlying Mechanism (3) Clinical Characteristics



	Odds Ratio	95% CI	P Value
Resting Pd/Pa≤0.92 and FFR>0.80 **Very Small Hyperemic Pressure Drop**			
Age	1.02	1.01-1.03	0.004
Gender (Male)	74	0.59-0.94	0.012
Diabetes	1.50	1.19-1.89	0.001
Hyperlipidemia	0.72	0.57-0.91	0.005
Proximal location (vs. mid to distal)	0.60	0.49-0.78	<0.001
Resting Pd/Pa>0.92 and FFR≤0.80 **Very Big Hyperemic Pressure Drop**			
Age	0.98	0.97-0.99	<0.001
Gender (Male)	1.79	1.45-2.22	<0.001
Diabetes		0.66-0.96	0.016
Family history		0.50-0.87	0.003
Chronic renal failure	0.32	0.14-0.75	0.008
Diameter stenosis (≥50%)	4.06	3.16-5.21	<0.001
AHA/ACC B2C lesion	1.44	1.20-1.71	<0.001

Low CFR phenotype

Super normal CFR phenotype

Old Age, Male Sex, DM, Hyperlipidemia, Family Hx, Chronic renal failure, Proximal Location, Severe Stenosis, AHA/ACC B2C lesion

Red: Pd/Pa- FFR+, **Blue**: Pd/Pa+ FFR-

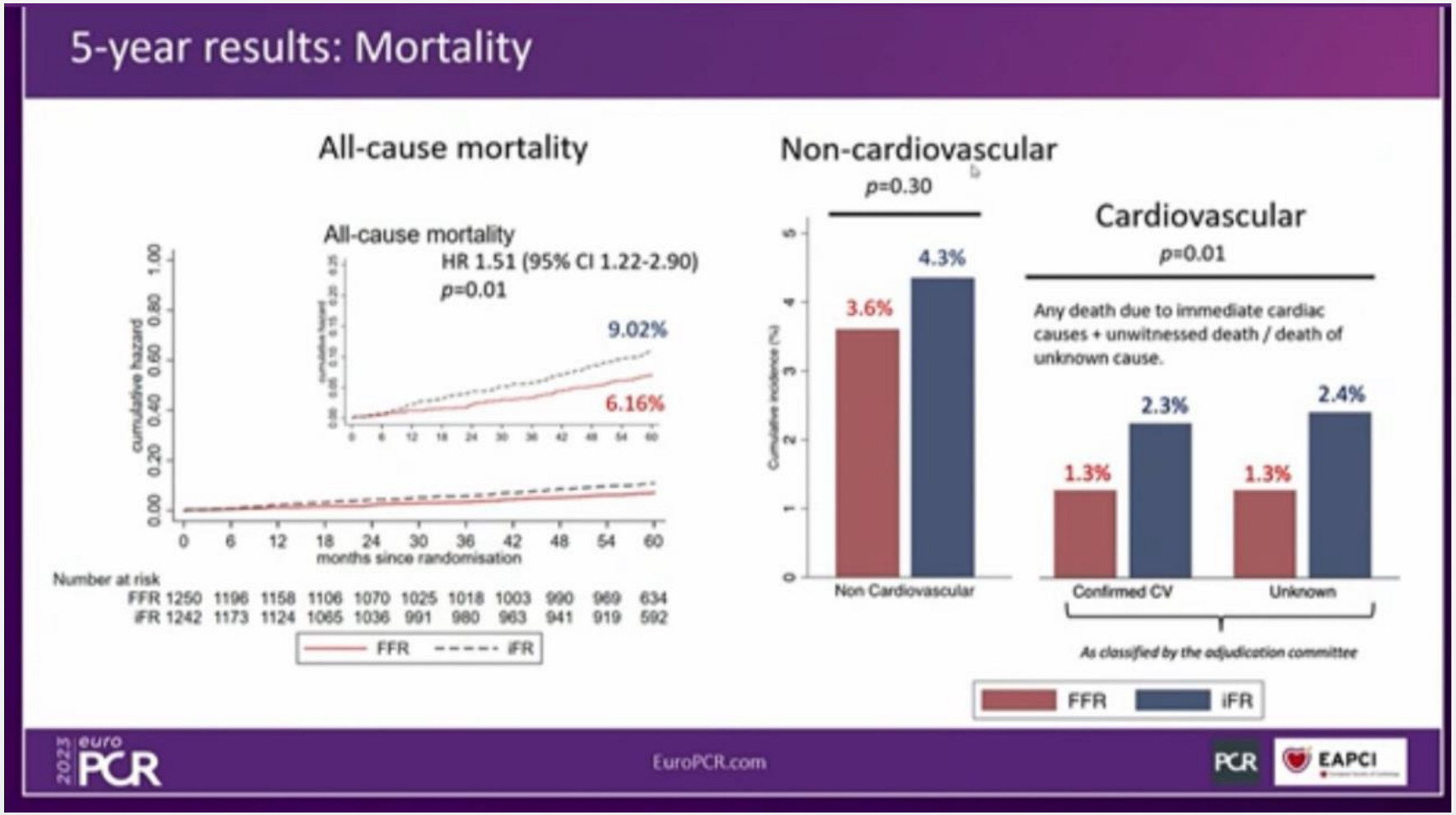
Ahn JM, Park SJ et al. Circ Cardiovasc Interv. 2020;13(5);e007868

Underlying Mechanism: Summary

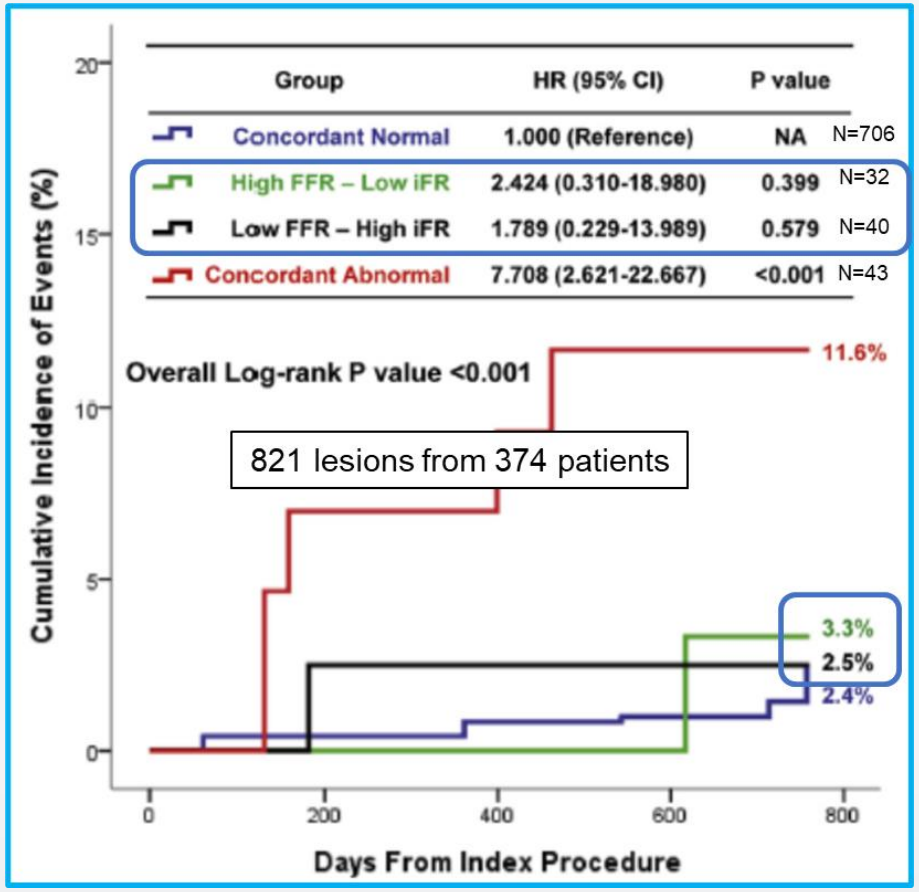
NHPR/FFR Discordance

	NHPR+ FFR-	NHPR- FFR+
Coronary physiology	**Un**-Healthy Vascular Status	**More** Complex Atherosclerosis
Coronary anatomy		
Clinical Characteristics		

DEFINE FLARE 5-year FU

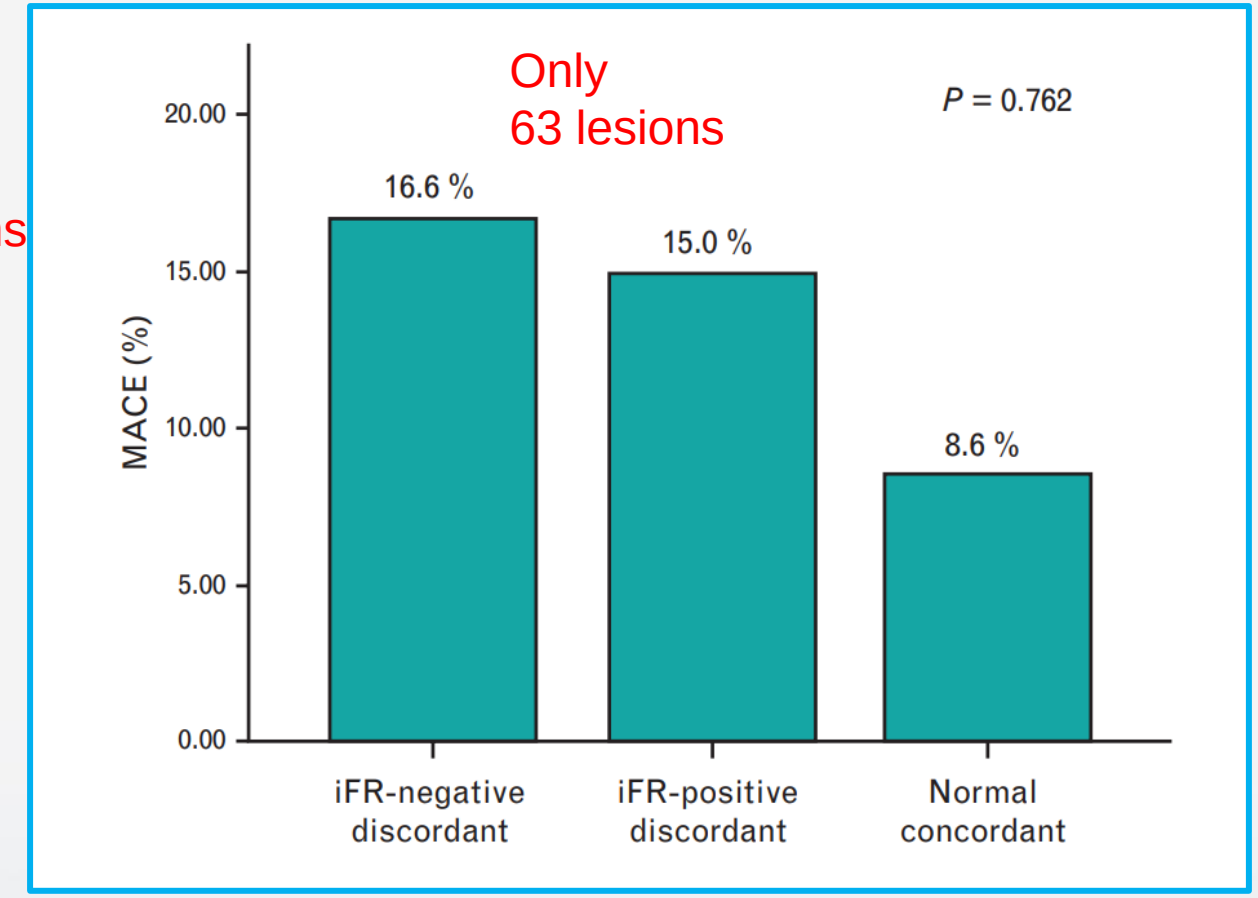


Prognosis of Discordant Lesion…..Very Limited Data



Only
72 lesions

Only
63 lesions



J Am Coll Cardiol Intv 2017, 10: 2502

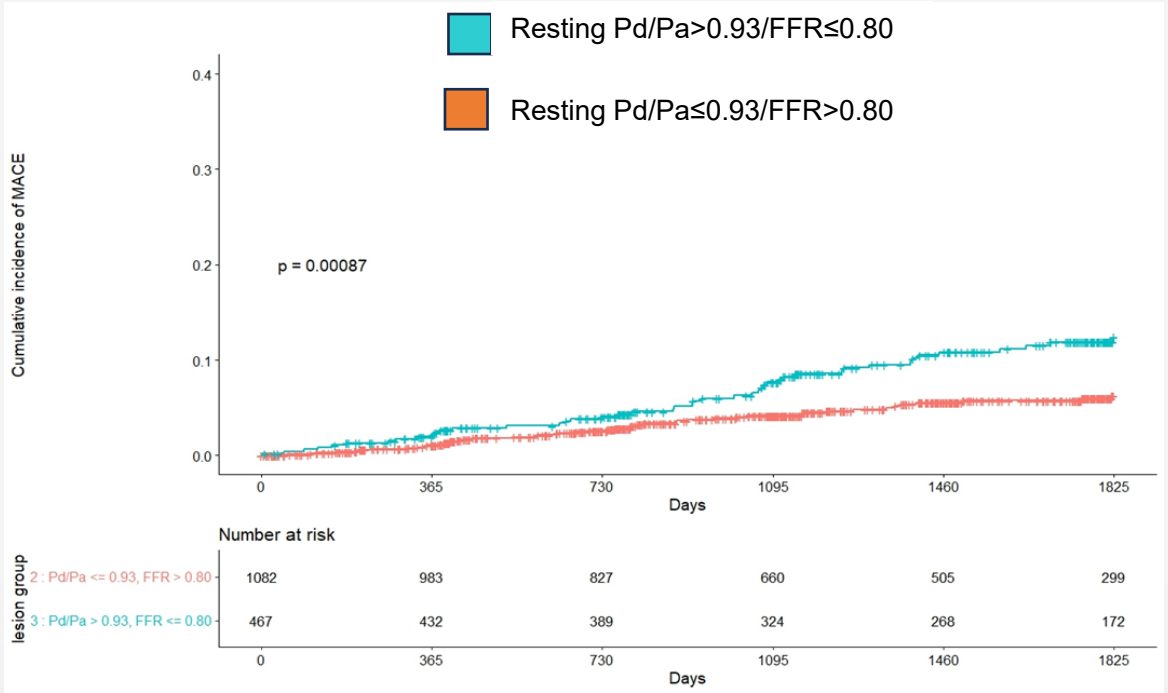
Journal of Cardiovascular Medicine 23(2):p 106-115, February 2022

FFR and iFR value of Discordant Lesions

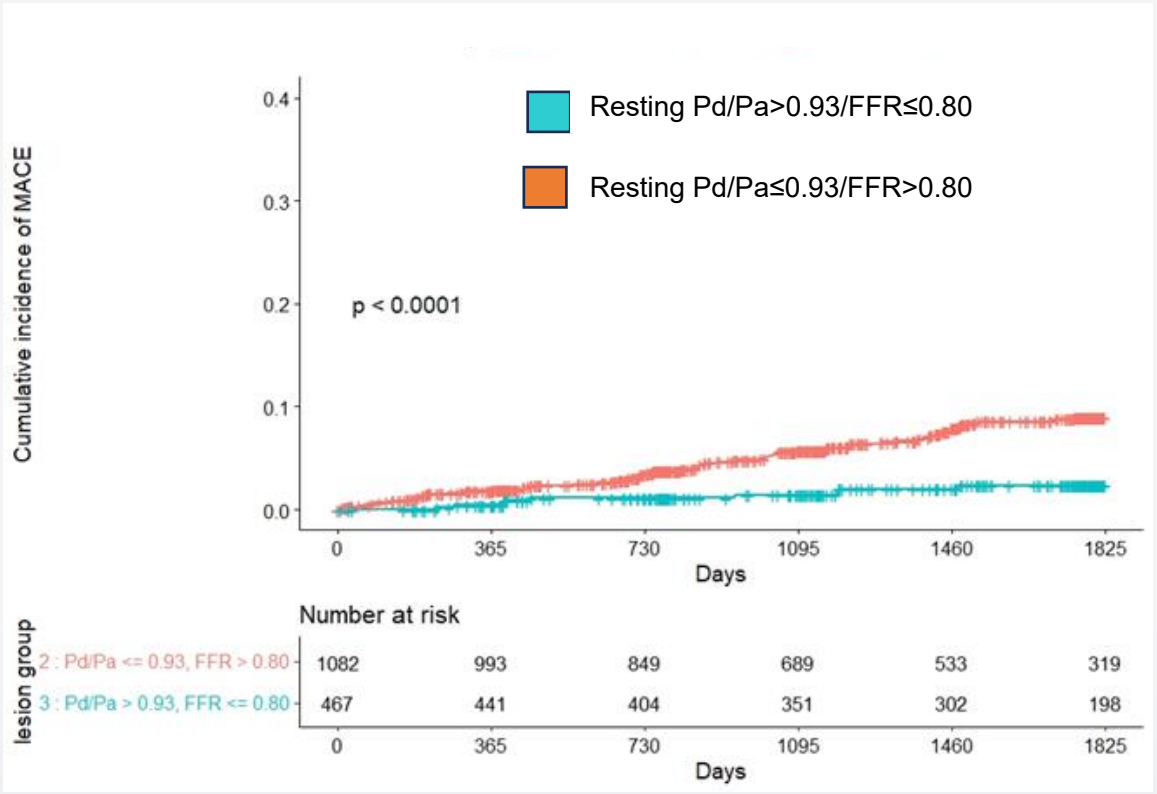
	FFR		iFR	
	iFR+ FFR-	iFR- FFR+	iFR+ FFR-	iFR- FFR+
Cook CM et al. JACC Cardiovasc Interv. 2017;10(24):2514-2524	0.86 (0.84-0.88)	0.77 (0.74-0.80)	0.88 (0.84-0.89)	0.92 (0.91-0.93)
SH Lee et al. JACC Cardiovasc Interv. 2019;12(20):2018-2031	0.85 (0.84-0.86)	0.76 (0.75-0.78)	0.88 (0.87-0.88)	0.93 (0.92-0.93)
Derimay F et al. Catheter Cardiovasc Interv. 2019;94(3):356-363	0.84±0.03	0.77±0.04	0.87±0.03	0.92±0.03
Filippo et al. J Cardiovasc Med. 2022;23(2):106-115	0.87±0.03	0.76±0.05	0.86±0.02	0.92±0.02
Aoi et al. Cardiovasc Revasc Med. 2021;24:57-64.	0.85±0.04	0.77±0.04	0.85±0.04	0.88±0.04

Contrasting Prognotic Value of Discordant Lesion/Patient Outcome

Target Vessel **MI** and **RR**



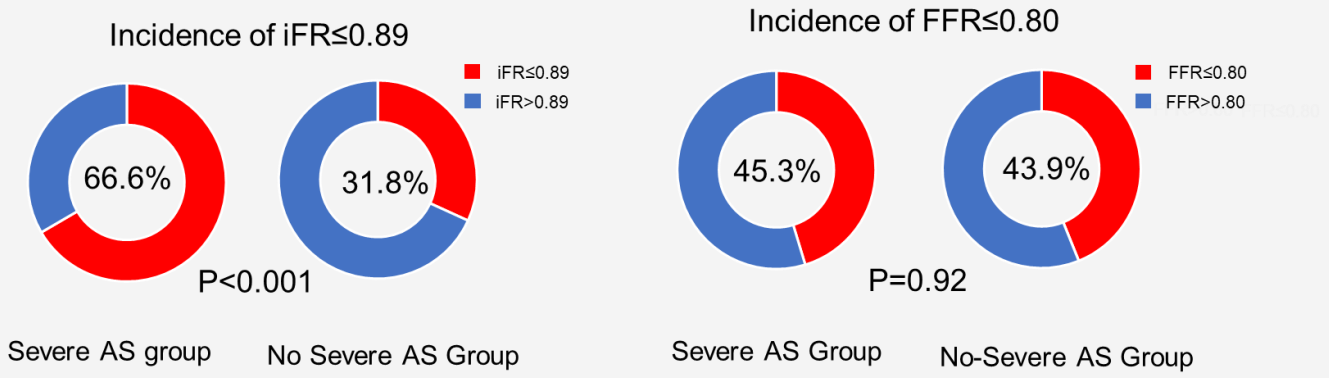
Death From Any Cause



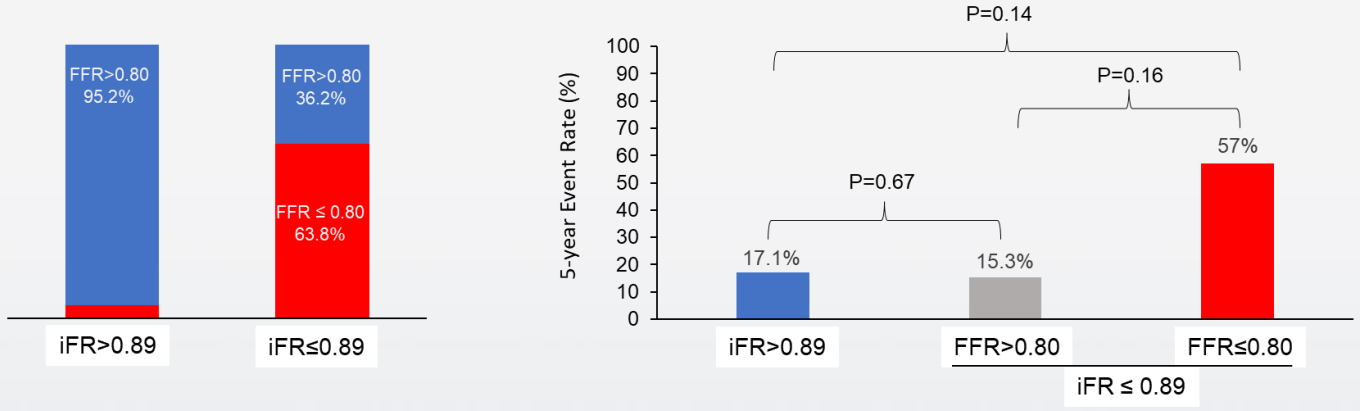
Unpublished Data from IRIS-FFR

IRIS-FFR Registry – Severe AS Subgroup

Incidence of Hemodynamically Significant Stenosis in Severe AS Group and No Severe AS Group



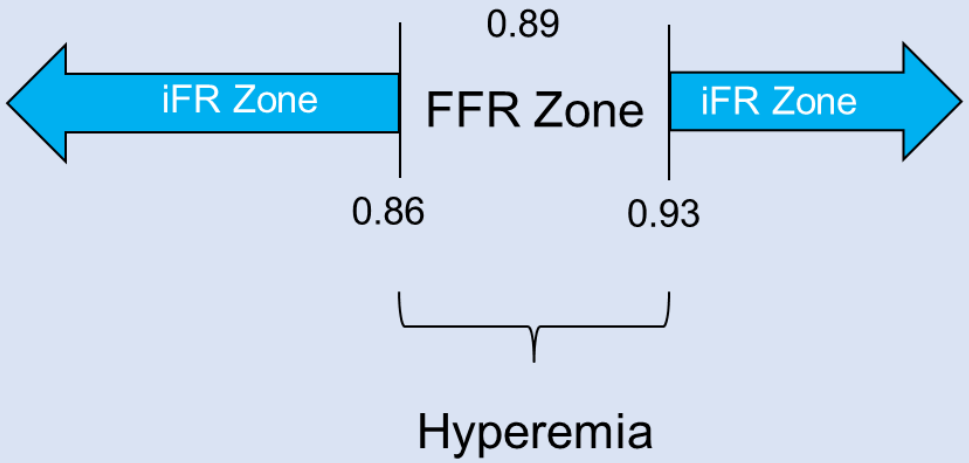
Prognostic Value of iFR and FFR in Severe AS Group



HH Jo, JM Ahn, et al Circulation Cardiovascular Intervention. **2024;0:e013237**

When To Use Hyperemia

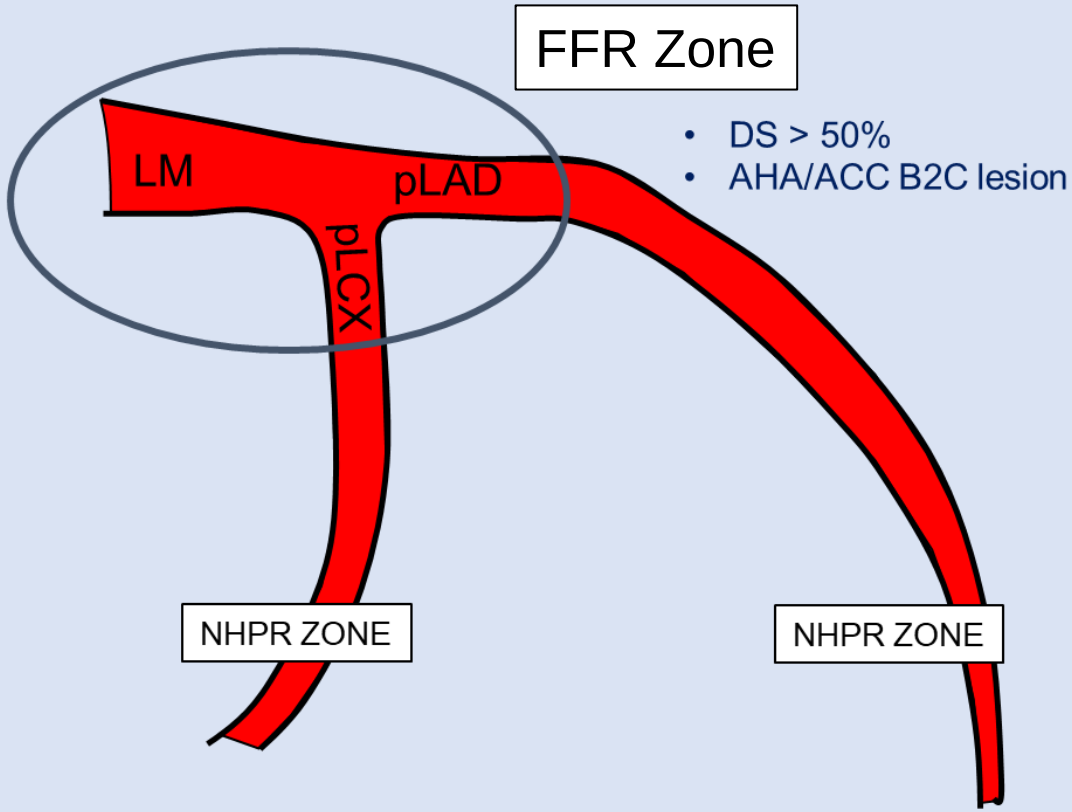
Physiologic Consideration



Clinical Consideration

- Young age
- Male
- Diabetes, Chronic Kidney Disease

Anatomical Consideration



- DS > 50%
- AHA/ACC B2C lesion

FFR/NHPR Discordance = about 20%

Is iFR the Same as FFR? - Still?

NHPR/FFR Discordance

	NHPR+ FFR-	NHPR- FFR+
Coronary physiology	**Un**-Healthy Patient Status Related with **Death**	**More** Complex Atherosclerosis Related with **TV-MI** and **RR**
Coronary anatomy		
Clinical Characteristics		

Summary

- Incidence of FFR-NHPR discordance = 15-20%
- The FFR-NHPR discordance is associated with distinct physiologic, anatomic and clinical characteristics.
- However, there is currently no evidence (only limited number of studies with very small population) to suggest any prognostic differences between the two discordant patterns. In addition, FFR values in FFR+NHPR- discordant lesion are located in “grey-zone” FFR, indicating that the clinical implications may be less critical.
- Nevertheless, FFR should be preferred in stenoses of LM or pLAD, where FFR+ iFR- discordance is more common, and where revascularization has been shown to impact survival.
- Further study focusing on discordant lesions including larger population with long-term follow-up would be necessary.