Επιστημονική Εκδήλωση

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Συνεδριακό Κέντρο Διάσελο
Μέτσοβο

Latest Data in Physiology Assessment (FFR): *iFR, CT-FFR, Angio-FFR*

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Fractional Flow Reserve

The "Gold Standard" for Invasive Functional Assessment

- **FFR** = Pd/Pa during hyperemia
- FFR to detect coronary lesions that would benefit from revascularisation
- **FFR-guided PCI**
  - Improves patient outcomes
  - Reduces stent implantations
  - Is cost-effective

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 15, 2009 VOL. 360 NO. 3

Fractional Flow Reserve versus Angiography for Guiding Percutaneous Coronary Intervention

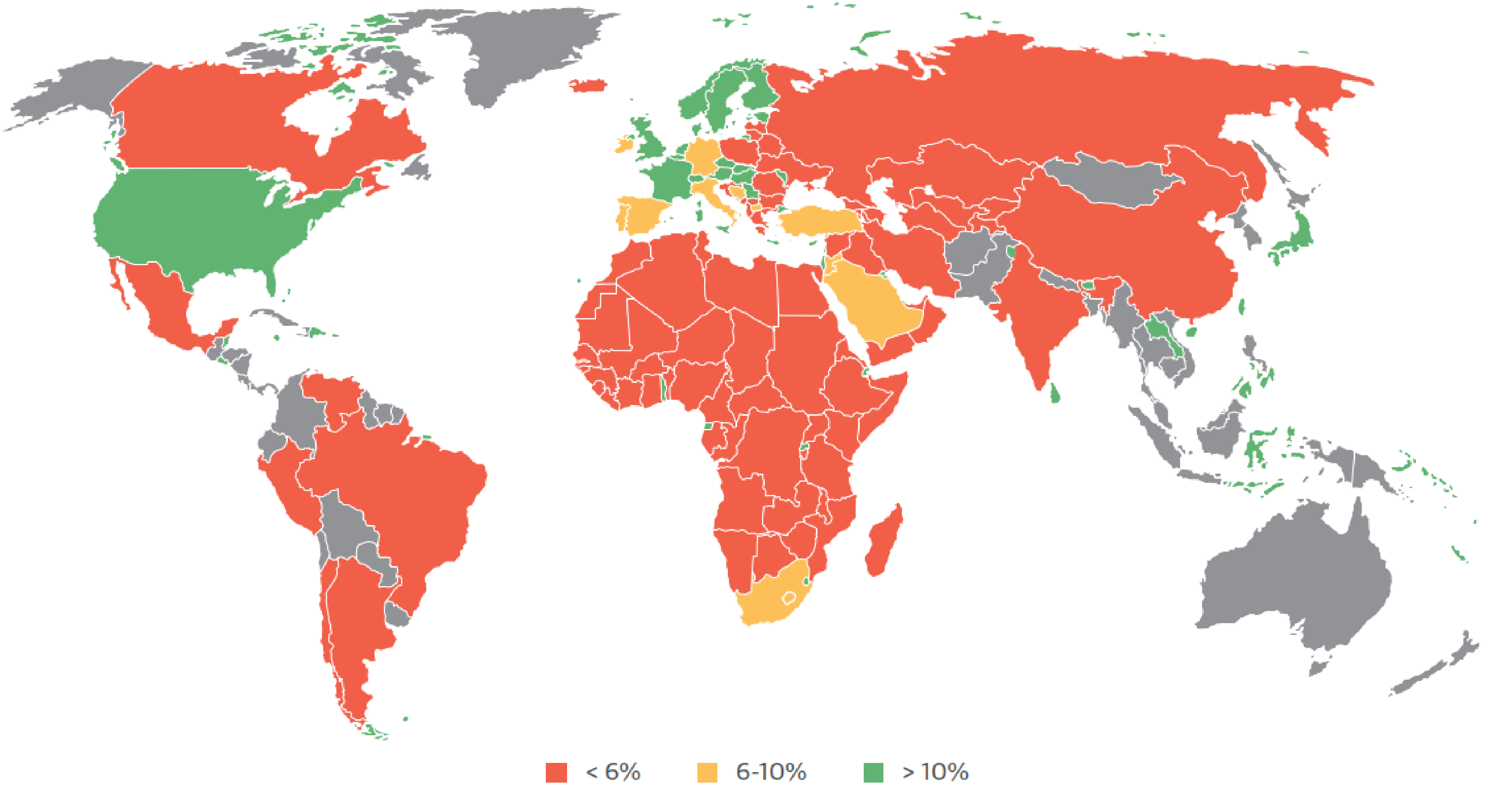
The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 SEPTEMBER 13, 2012 VOL. 367 NO. 11

Fractional Flow Reserve–Guided PCI versus Medical Therapy in Stable Coronary Disease

Pijls NH, et al. *J Am Coll Cardiol* 2007
Tonino PA, et al. *N Engl J Med* 2009
De Bruyne B, et al. *N Engl J Med* 2012

Global Adoption of FFR in Catheter Laboratories in 2016



Gotberg M, et al. *J Am Coll Cardiol* 2017

Low Adoption of FFR in Clinical Practice

- More invasive – More risk
  - Intracoronary manipulation of the pressure wire
  - Administration of vasodilators (adenosine)

AV block (2-8%)
Bronchospasm
Headache, flush

- Additional time

- Additional cost

- Operator's choice: confidence in visual assessment

Gotberg M, et al. *J Am Coll Cardiol* 2017
Tebaldi, M, et al. *JACC Intv* 2018

Resting (non-hyperemic) pressure-derived indices as an alternative for hemodynamic severity of coronary artery disease

Resting Pd/Pa

Contrast FFR

instantaneous wave-Free Ratio (iFR)

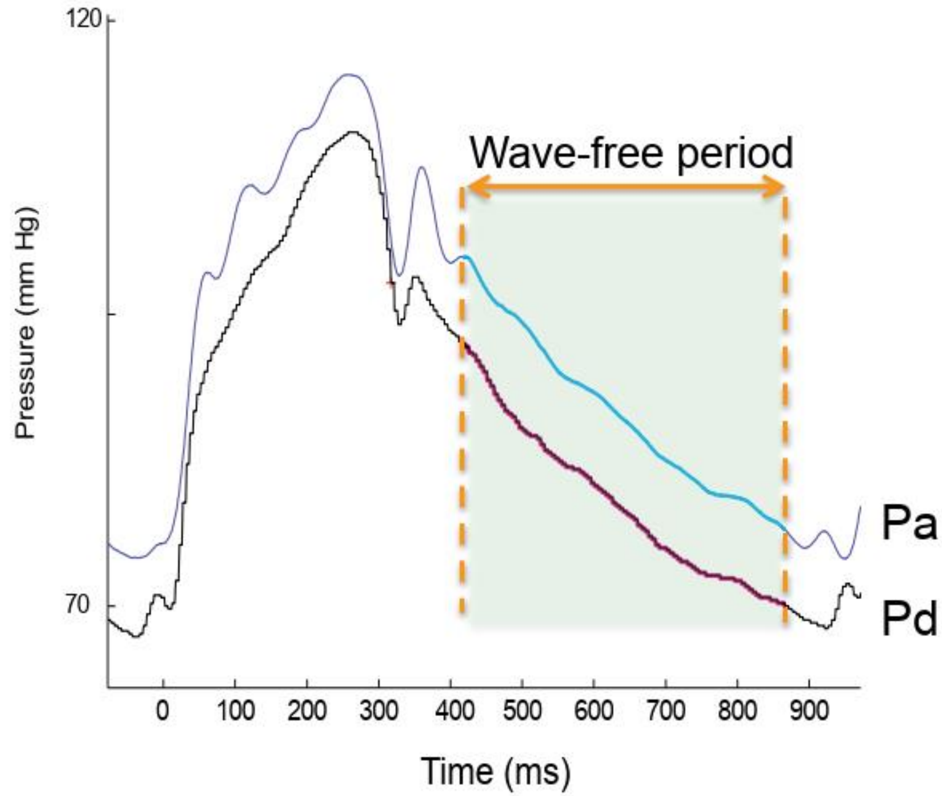
Resting Full-cycle Ratio (RFR)

diastolic Pressure Ratio (dPR)

No administration of adenosine

iFR (instantaneous wave-Free Ratio)

Definition: Instantaneous pressure ratio, across a stenosis during the wave-free period, when ***resistance is more constant*** and minimized in the cardiac cycle



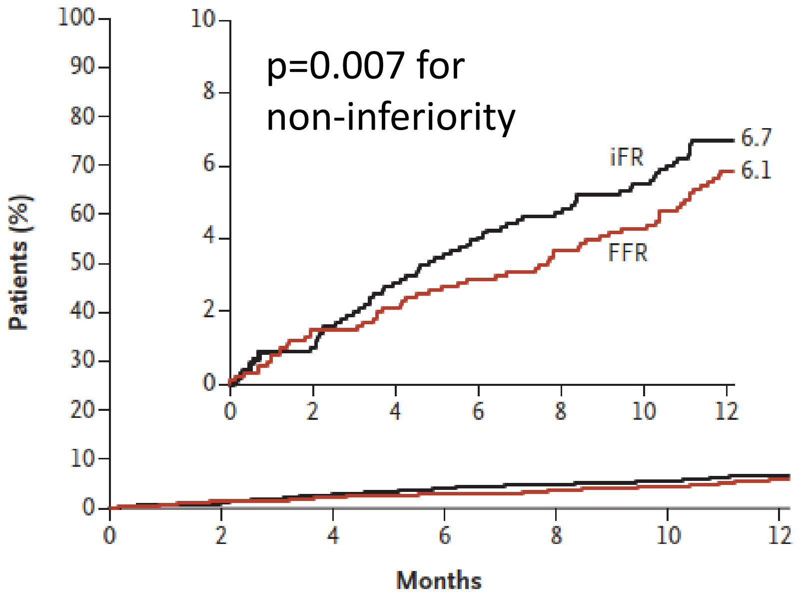
wave-free period:
25% of the way into diastole and ending 5 ms before the end of diastole

Sen S, et al. *J Am Coll Cardiol* 2012

Non-inferiority of iFR vs FFR for MACE

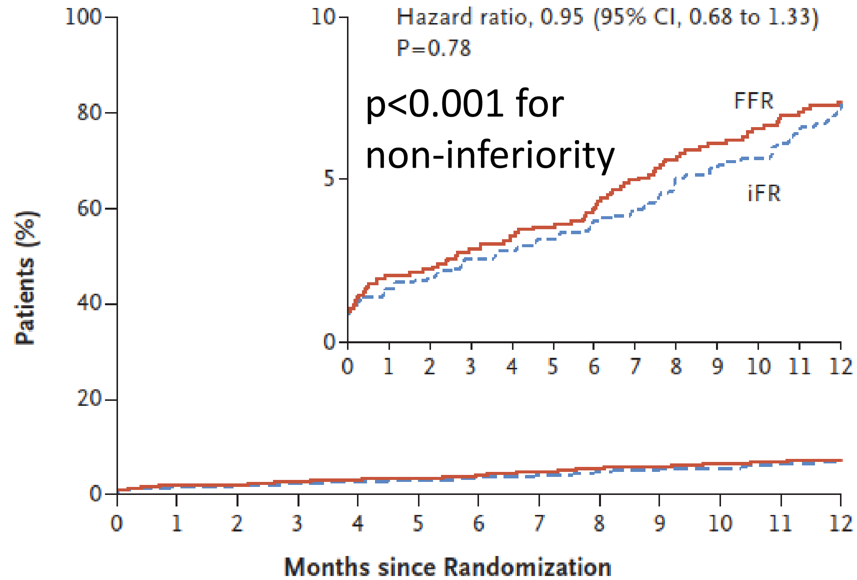
iFR-SWEDEHEART RCT

MACE



No. at Risk							
iFR	1012	1002	984	971	963	956	944
FFR	1007	990	984	976	968	961	946

DEFINE-FLAIR RCT



No. at Risk													
iFR	1242	1149	1131	1122	1118	1111	1088	1052	1037	1027	1019	995	764
FFR	1250	1169	1156	1149	1144	1141	1119	1081	1066	1055	1046	1017	793

MACE: death from any cause, nonfatal myocardial infarction, or unplanned revascularization

FFR cut-off =0.80
iFR cut-off =0.89

Gotberg M, et al. *N Engl J Med* 2017
Davies J, et al. *N Engl J Med* 2017

iFR in ESC Guidelines

When to perform revascularisation?

Indications for revascularization in patients with stable angina or silent ischaemia

Extent of CAD (anatomical and/or functional)		Class[a]	Level[b]
For prognosis	Left main disease with stenosis >50%.[c 68–71]	I	A
	Proximal LAD stenosis >50%.[c 62,68,70,72]	I	A
	Two- or three-vessel disease with stenosis >50% with impaired LV function (LVEF ≤35%).[c 61,62,68,70,73–83]	I	A
	Large area of ischaemia detected by functional testing (>10% LV) or abnormal invasive FFR.[d 24,59,84–90]	I	B
	Single remaining patent coronary artery with stenosis >50%.[c]	I	C
For symptoms	Haemodynamically significant coronary stenosis[c] in the presence of limiting angina or angina equivalent, with insufficient response to optimized medical therapy.[e 24,63,91–97]	I	A

[c]With documented ischaemia or a haemodynamically relevant lesion defined by FFR ≤0.80 or iwFR ≤0.89

When physiology?

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

ESC Guidelines on Myocardial Revascularisation. 2018

iFR in SCAI Position paper

Focused update of expert consensus statement: Use of invasive assessments of coronary physiology and structure

A position statement of the society of cardiac angiography and interventions

Recommendations
FFR/iFR
Definitely beneficial:
In SIHD, when non-invasive stress imaging is uncertain, non-diagnostic or unavailable, FFR/iFR can be used to assess the functional significance of intermediate coronary stenoses.
In SIHD, PCI of lesions found significant by FFR/iFR improves symptom control and decreases the need for hospitalization requiring urgent revascularization when compared to medical therapy alone. Abnormal values should be considered in context of the patient's entire clinical picture.
In SIHD, medical therapy is indicated for an angiographically intermediate non-LMCA stenosis when FFR >0.80 or iFR >0.89.
In SIHD, medical therapy is indicated for an angiographically intermediate LMCA stenosis when FFR >0.80.
In SIHD, to assess the severity of stenoses in series and select targets for stenting
In multivessel coronary disease, PCI guided by FFR measurement improves outcomes and saves resources when compared to angiography guided PCI.
Probably beneficial
In multivessel coronary disease, measuring FFR/iFR may allow reclassification of number of vessels diseased (Functional SYNTAX score), and consequently guide decisions regarding revascularization by CABG or PCI.

Lotfi et al. *Coron Artery Dis* 2018

Meta-analysis of Death and MI in iFR vs FFR RCTs

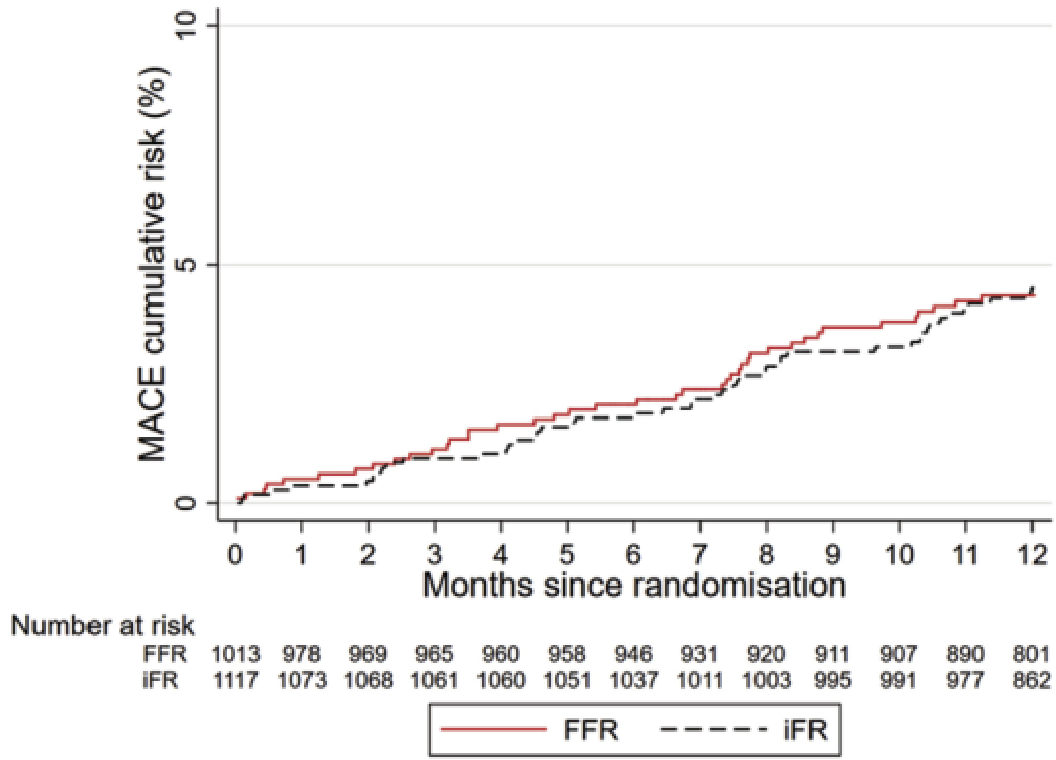
	iFR n (%)	FFR n (%)	Risk Ratio	95% CI	*P* Value
Unplanned revascularization					
DEFINE-FLAIR	46 (4.0)	63 (5.3)	0.75	(0.52–1.09)	0.13
iFR-SWEDEHEART	47 (4.6)	46 (4.6)	1.02	(0.68–1.51)	0.94
Overall			0.87	(0.65–1.16)	0.34
Test for heterogeneity: χ^2 = 1.18 df=1 (*P*=0.277), I^2 = 15.6%					
Nonfatal myocardial infarction					
DEFINE-FLAIR	31 (2.7)	28 (2.4)	1.14	(0.69–1.89)	0.61
iFR-SWEDEHEART	22 (2.2)	17 (1.7)	1.29	(0.69–2.41)	0.43
Overall			1.20	(0.81–1.77)	0.37
Test for heterogeneity: χ^2 = 0.09 df=1 (*P*=0.767), I^2 = 0%					
Death					
DEFINE-FLAIR	22 (1.9)	13 (1.1)	1.74	(0.88–3.44)	0.11
iFR-SWEDEHEART	15 (1.5)	12 (1.2)	1.24	(0.59–2.64)	0.57
Overall			1.50	(0.90–2.48)	0.12
Test for heterogeneity: χ^2 = 0.42 df=1 (*P*=0.516), I^2 = 0%					
Death or myocardial infarction					
DEFINE-FLAIR	53 (4.6)	41 (3.5)	1.33	(0.89–1.98)	0.16
iFR-SWEDEHEART	37 (3.7)	29 (2.9)	1.27	(0.79–2.05)	0.33
Overall	**90 (~4.2%)**	**70 (~3.2%)**	1.30	(0.96–1.77)	0.09

Berry C, et al. *Circulation* 2017

Deferral of Revascularisation: FFR vs iFR

FIGURE 3 **Cumulative Risk for Primary Endpoint (Major Adverse Cardiac Events) by Physiological Technique in the Deferred Population**

Pooled analysis of FFR-iFR RCTs



Shown is the cumulative risk for the composite of death from any cause, nonfatal myocardial infarction, or unplanned revascularization at 1 year. MACE = major adverse cardiac event(s); other abbreviations as in Figure 1.

Escaned J, et al. *JACC Intv* 2018

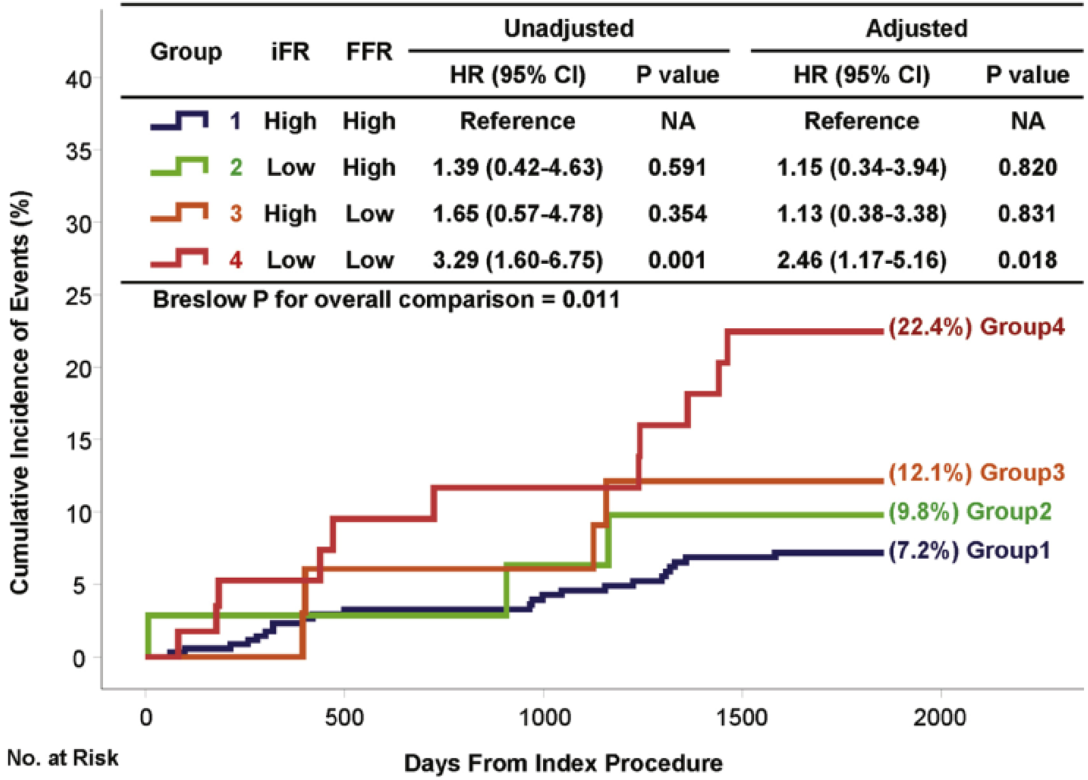
Discordance between FFR and iFR: Clinical Outcomes of Deferred Patients

FIGURE 5 Comparison of Patient-Oriented Composite Outcome Among Patients With Deferred Lesions According to Classification by FFR and iFR

840 vessels (596 pts)

Group	iFR	FFR	Unadjusted HR (95% CI)	Unadjusted P value	Adjusted HR (95% CI)	Adjusted P value
1	High	High	Reference	NA	Reference	NA
2	Low	High	1.39 (0.42-4.63)	0.591	1.15 (0.34-3.94)	0.820
3	High	Low	1.65 (0.57-4.78)	0.354	1.13 (0.38-3.38)	0.831
4	Low	Low	3.29 (1.60-6.75)	0.001	2.46 (1.17-5.16)	0.018

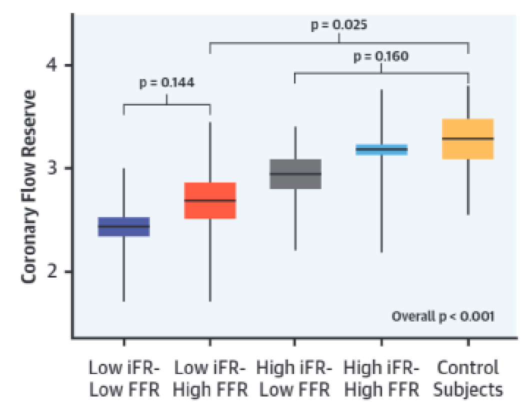
Breslow P for overall comparison = 0.011



No. at Risk	0	500	1000	1500	2000
Group 1	344	300	295	287	286
Group 2	35	28	27	26	26
Group 3	38	31	31	29	29
Group 4	57	42	41	36	36

Kaplan-Meier curves are shown for the 5 groups of patients with deferred lesions according to classification by iFR and FFR. Adjusted covariates in multivariable model included age, sex, hypertension, hypercholesterolemia, and diameter stenosis. Abbreviations as in Figures 1 and 4.

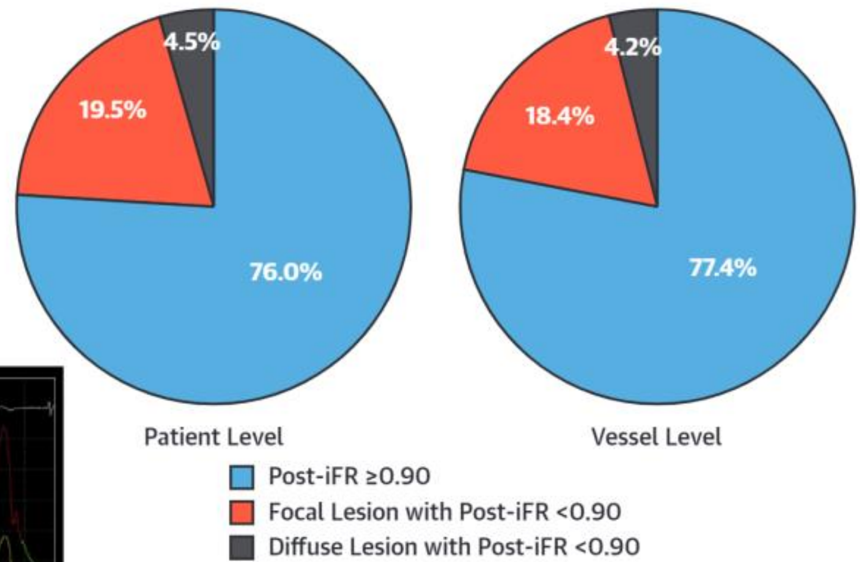
Differences in vasodilatory capacity

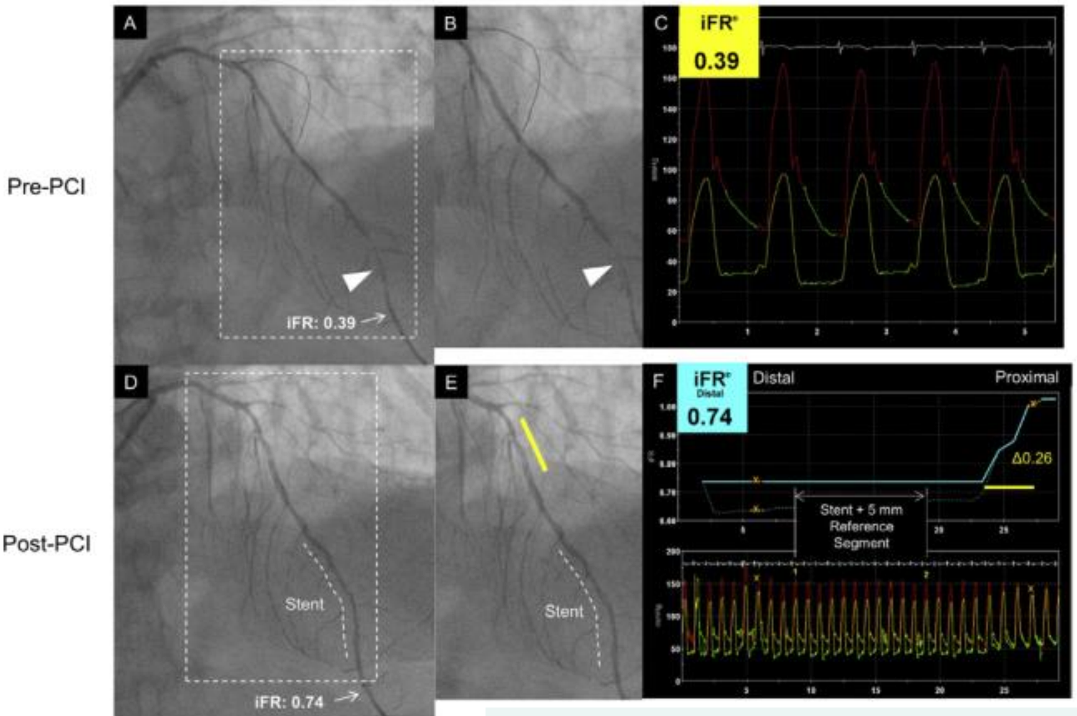


Lee SH, et al. *JACC Intv* 2019

Residual Ischemia After Successful Angiographic PCI: DEFINE-PCI Study

CENTRAL ILLUSTRATION Post-Percutaneous Coronary Intervention Coronary Physiology





CONCLUSIONS Blinded post-PCI physiological assessment detected residual ischemia in nearly 1 in 4 patients after coronary stenting despite an operator-determined angiographically successful result. Most cases of residual ischemia were due to inapparent focal lesions potentially amenable to treatment with additional PCI. (Physiologic Assessment of Coronary Stenosis Following PCI [DEFINE PCI]; NCT03084367) (J Am Coll Cardiol Intv 2019;12:1991-2001) © 2019 by the American College of Cardiology Foundation.

Jeremias A, et al. *JACC Intv* 2019

Adenosine-free Indices

Resting Pd/Pa

Contrast FFR

instantaneous wave-Free Ratio (iFR)

Resting Full-cycle Ratio (RFR)

diastolic Pressure Ratio (dPR)

THEY Negate the use of vasodilators (adenosine) for induction of hyperemia

BUT

THEY Require a *pressure wire* for invasive measurements

Circulation

EDITORIAL

From Lumenogram to "Functional Angiography" and the Evolution of Virtual Fractional Flow Reserve

Has the Time Come for Outcome-Based Trials?

Michail I. Papafaklis, MD, PhD
Andreas Baumbach, MD

THE ADVENT OF FUNCTIONAL ANGIOGRAPHY

Angiography-based FFR

- Add a functional component to angiography by using a computer-simulated index
- No need for coronary instrumentation and adenosine infusion
- Obtain an FFR-equivalent color-coded coronary artery map

Papafaklis and Baumbach. *Circulation* 2019

Imaging ➔ Functional Assessment
≈ *Functional Coronary Imaging*

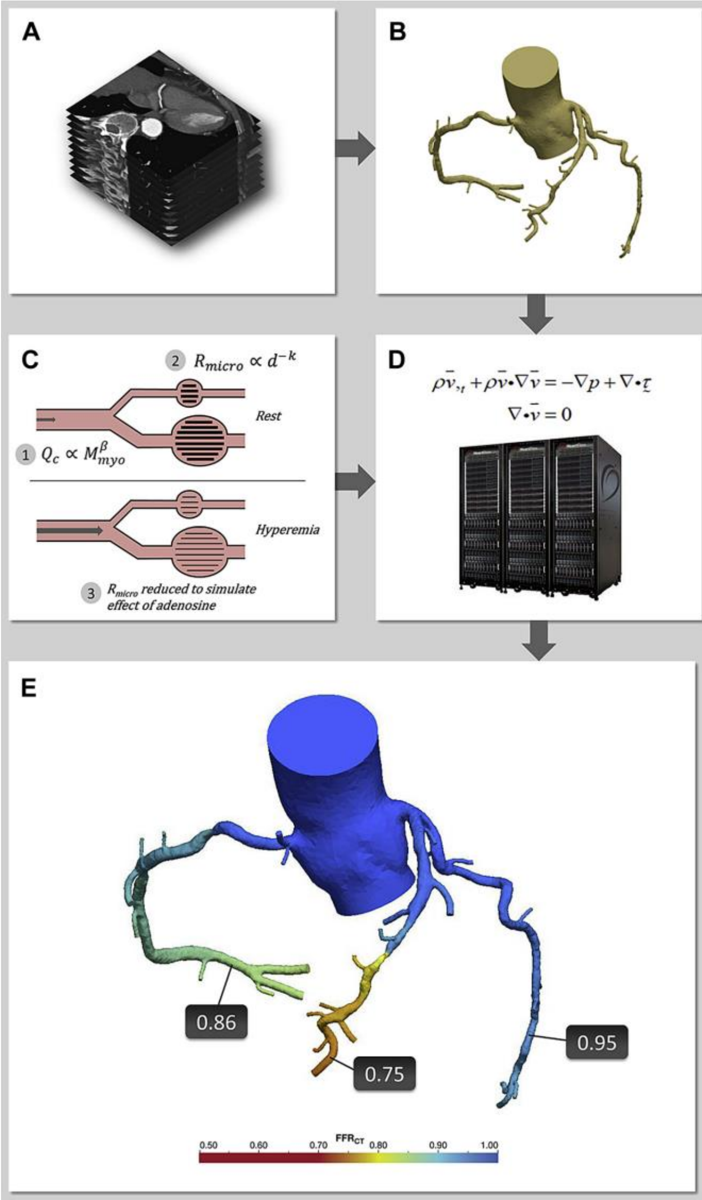
- Methodologies to **compute FFR surrogates** using ***principles of fluid dynamics*** applied to ***vascular geometries*** derived either from noninvasive CTCA or from invasive angiography
  - **Step 1: Construct a computer (*in silico*) model of the 3-dimensional geometry**
  - **Step 2: Prescribe inflow and outflow (boundary conditions)**
    - Simplified boundary conditions
    - **OR** Physiologic model of the heart and arterial system as a closed hydraulic circuit (Windkessel parameters of arterial compliance, microvascular resistance)
  - **Step 3: Implement a calculation method (principles of fluid dynamics)**
    - Computational Fluid Dynamics (CFD) techniques = Finite elements and Numerical solution of 3-D Navier-Stokes equations (differential equations of fluid motion)
    - **OR** Approximate algebraic method using simple equations

Giddens DP. *JACC Intv* 2016
Papafaklis M et al. *Expert Rev Cardiovasc Ther* 2017

Computed Tomography Coronary Angiography

FFR-CT

- CT coronary angiographic dataset
- Sophisticated 3-dimensional mathematical modelling of coronary flow, pressure and resistance (CFD and Windkessel model)
- 1-4 hrs of processing time
- **Validated in prospective multicentre trials against invasive FFR in stable patients with suspected CAD**
- Improved diagnostic accuracy over CTCA alone
- FDA-approved class II Coronary Physiological Simulation Software

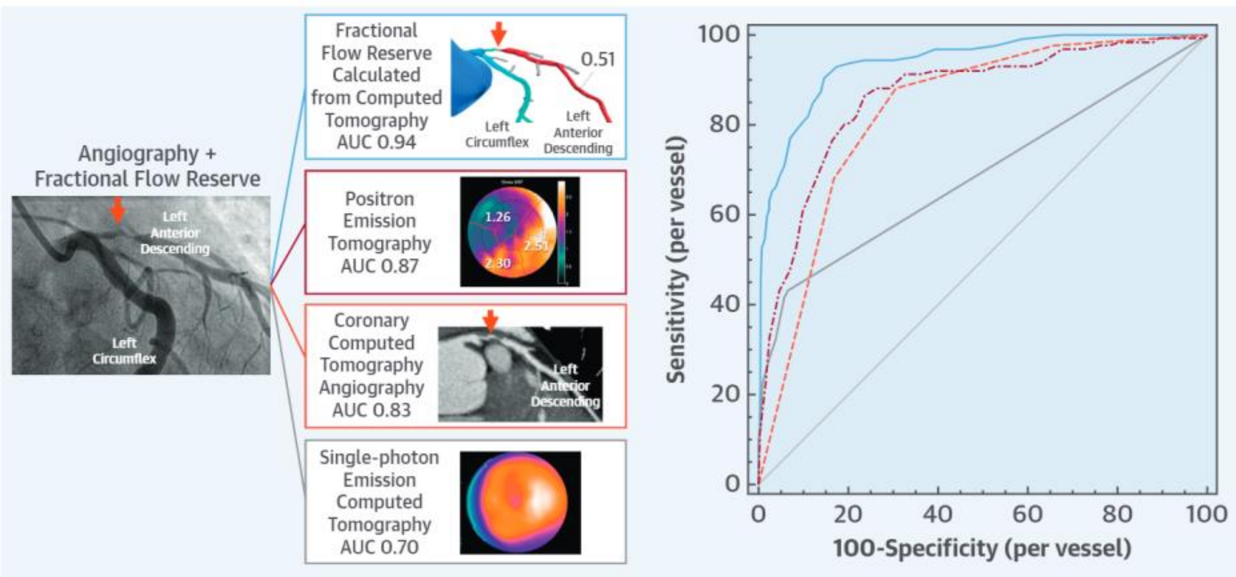


Taylor CA et al. *J Am Coll Cardiol* 2013
Norgaard BL et al. *J Am Coll Cardiol* 2014

FFR-CT vs Perfusion Imaging: PACIFIC Trial substudy

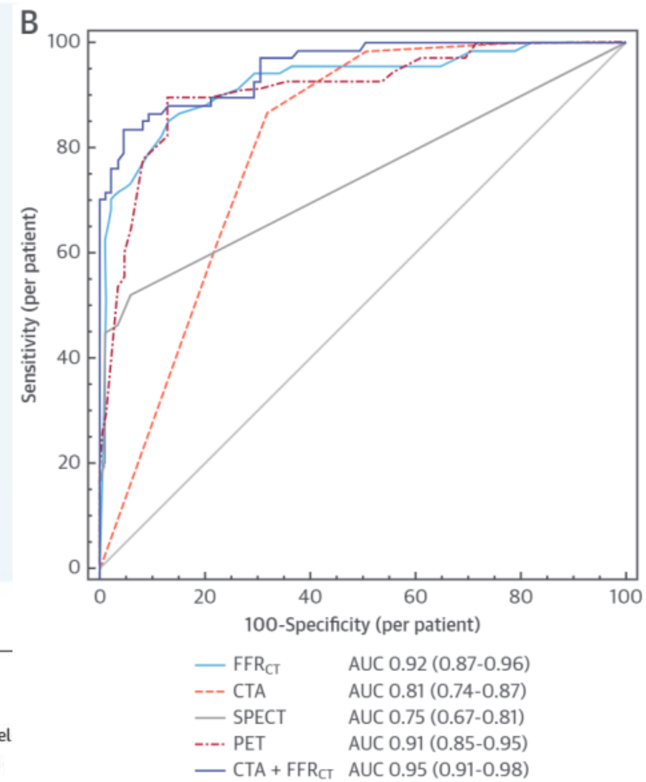
157 patients: FFR, SPECT, PET, and CTA with evaluable FFR-CT
(51 patients were not fully [3-vesssel]evaluable by FFR-CT)

CENTRAL ILLUSTRATION Discriminative Ability of Imaging Modalities for the Detection of Per-Vessel Fractional Flow Reserve-Defined Ischemia



Driessen, R.S. et al. J Am Coll Cardiol. 2019;73(2):161-73.

Significance of stable coronary artery disease, as defined by invasive FFR, was prospectively tested with several noninvasive imaging modalities. Each patient underwent FFR_{CT}, PET, coronary CTA, SPECT, and ICA with FFR, regardless of imaging results as illustrated by the typical imaging findings of a severe left anterior descending artery stenosis in the **colored boxes. Curves with corresponding colors** indicate that FFR_{CT} demonstrated the greatest AUC for the detection of per-vessel ischemia. CTA = coronary computed tomography angiography; FFR = fractional flow reserve; FFR_{CT} = fractional flow reserve calculated from computed tomography; ICA = invasive coronary angiography; PET = positron emission tomography; SPECT = single-photon emission computed tomography.



Driessen RS et al. *J Am Coll Cardiol* 2019

FFR-CT Diagnostic Strategy vs Usual Care in Suspected CAD: PLATFORM study

Rate of invasive catheterisation without obstructive coronary artery disease

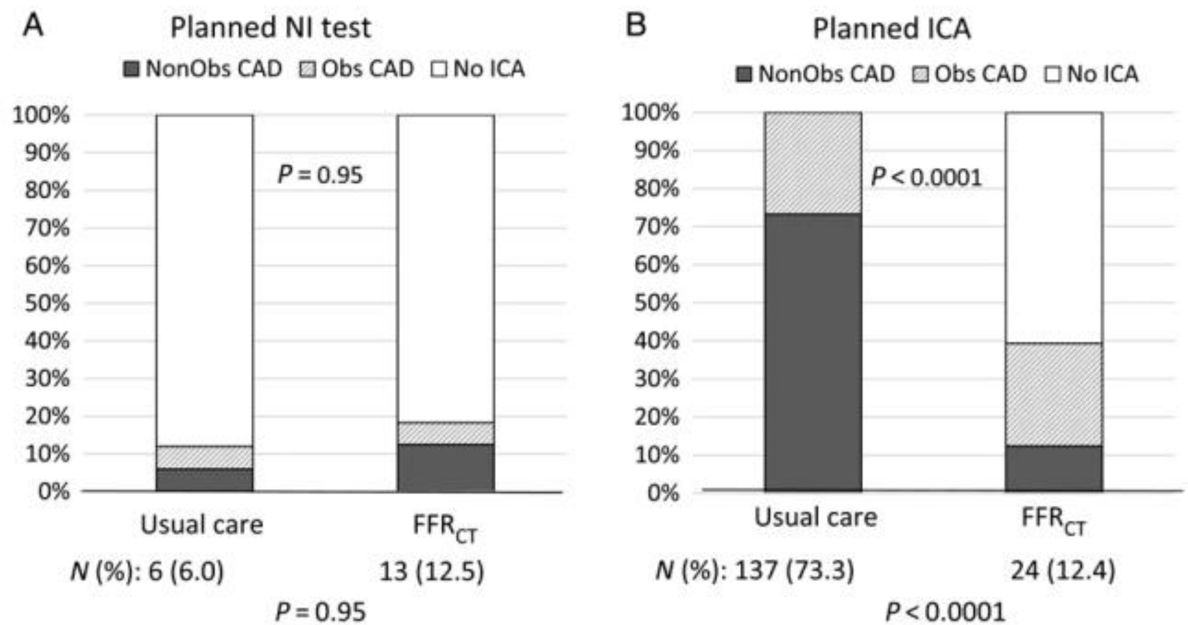


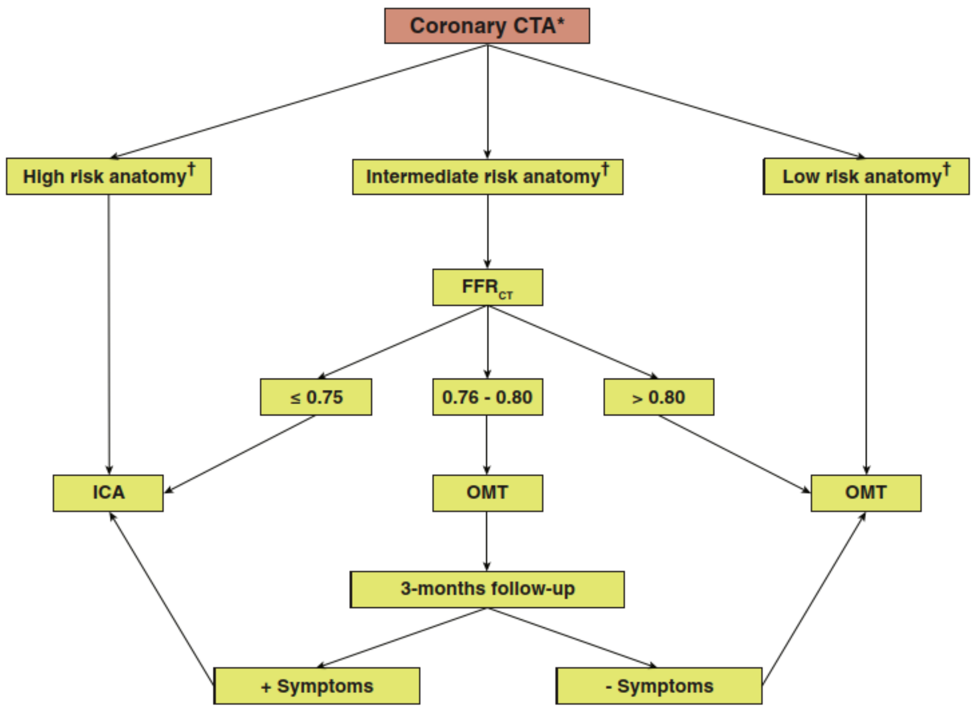
Figure 2 Determination of the rate of invasive catheterization without obstructive coronary artery disease. NI, non-invasive; ICA, invasive coronary angiography; Obs CAD, obstructive coronary artery disease; FFR_{CT}, computation of fractional flow reserve from coronary computed tomographic angiography data.

Conclusions Computed tomographic angiography/fractional flow reserve by CTA was a feasible and safe alternative to ICA and was associated with a significantly lower rate of invasive angiography showing no obstructive CAD.

Douglas PS et al. *Eur Heart J* 2015

Decision-Rule Algorithm based on CTCA

FIGURE 6 The "Aarhus" FFR_{CT} Decision-Rule Algorithm



Noorgard BL et al. *J Am Coll Cardiol Img* 2016

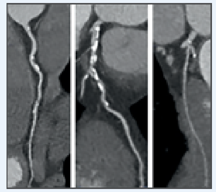
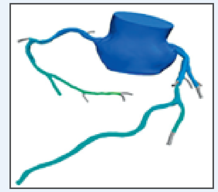
*Patients with new-onset chest pain without known coronary artery disease, low to intermediate pre-test probability of disease, and in whom a diagnostic coronary CTA result can be expected. †"High risk anatomy" is defined as the presence of left main, 3-vessel and/or high-grade left anterior descending artery stenosis; "intermediate risk anatomy" as 1 or 2 intermediate stenoses (30% to 70%); and "low risk anatomy" as normal or stenosis <30%. Abbreviations as in Figures 2 and 4.

CONCLUSIONS FFR_{CT} testing is feasible in real-world symptomatic patients with intermediate-range stenosis determined by coronary computed tomography angiography. Implementation of FFR_{CT} for clinical decision-making may influence the downstream diagnostic workflow of patients. Patients with an FFR_{CT} value >0.80 being deferred from invasive coronary angiography have a favorable short-term prognosis. (J Am Coll Cardiol Img 2016;■:■-■) © 2016 by the American College of Cardiology Foundation.

Diagnostic and Management Strategy for Suspected CAD: Selective FFR-CT Testing

CENTRAL ILLUSTRATION Diagnostic and Management Strategy With Clinical Outcomes in Patients Undergoing First-Line Coronary Computed Tomography Angiography With Selective FFR_{CT} Testing

I. Diagnostic Strategy

Clinical Presentation +  + (CTA stenosis 30%-70%) 

II. Post-test Management

- CTA stenosis <30%: No additional testing, OMT
- FFR_{CT} >0.80: OMT
- FFR_{CT} ≤0.80: OMT, or OMT + ICA

III. Clinical Outcomes

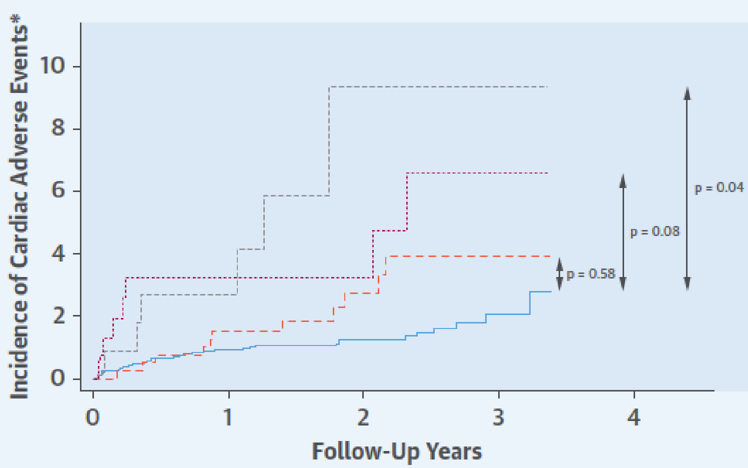
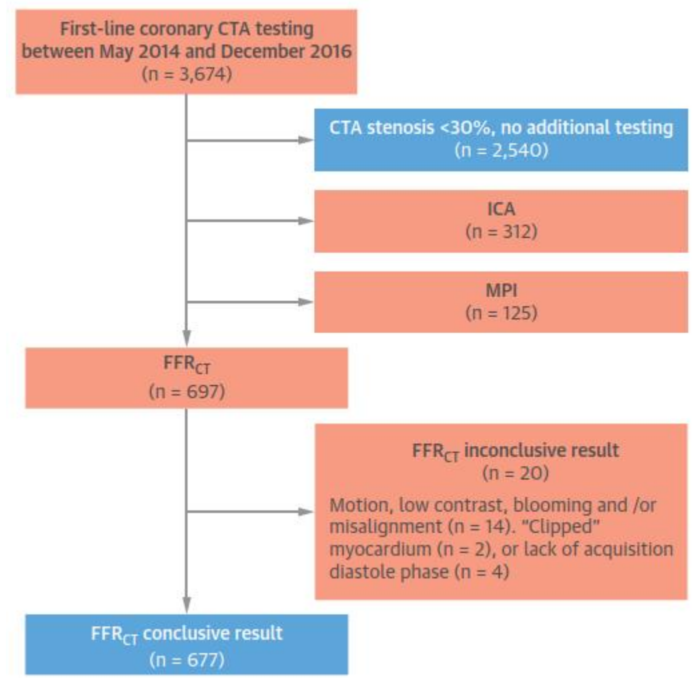


FIGURE 2 Flow Chart of Study Patients



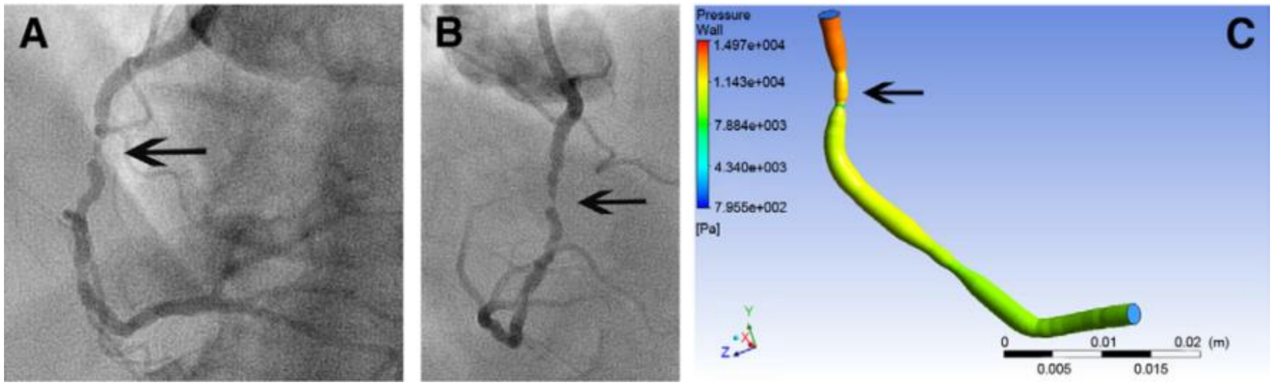
Main study cohorts are presented in **blue boxes**. ICA = invasive coronary angiography; MPI = myocardial perfusion imaging; other abbreviations as in Figure 1.

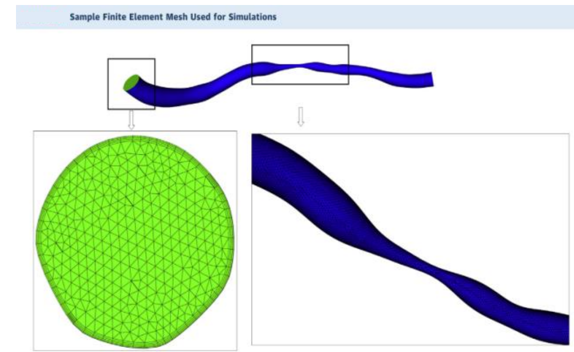
CONCLUSIONS In patients with intermediate-range coronary stenosis, FFR_{CT} is effective in differentiating patients who do not require further diagnostic testing or intervention (FFR_{CT} >0.80) from higher-risk patients (FFR_{CT} ≤0.80) in whom further testing with invasive coronary angiography and possibly intervention may be needed. Further studies assessing the risk and optimal management strategy in patients undergoing first-line CTA with selective FFR_{CT} testing are needed. (J Am Coll Cardiol 2018;72:2123-34) © 2018 The Authors. Published by Elsevier on behalf of

Norgaard BL et al. *J Am Coll Cardiol* 2018

Virtual FFR Surrogates From Invasive Angiography

vFFR





vFFR (VIRTU-1 and VIRTU-Fast studies)

- Early experience in 19 patients
- *Rotational* angiography (3-D geometry)
- Computational fluid dynamics
  (Navier-Stokes equations of fluid motion)
- Patient-specific Model of microvascular resistance (parameters inferred from invasive measurements)
- >24 hrs can be reduced to <4 min by simplification in the flow simulation

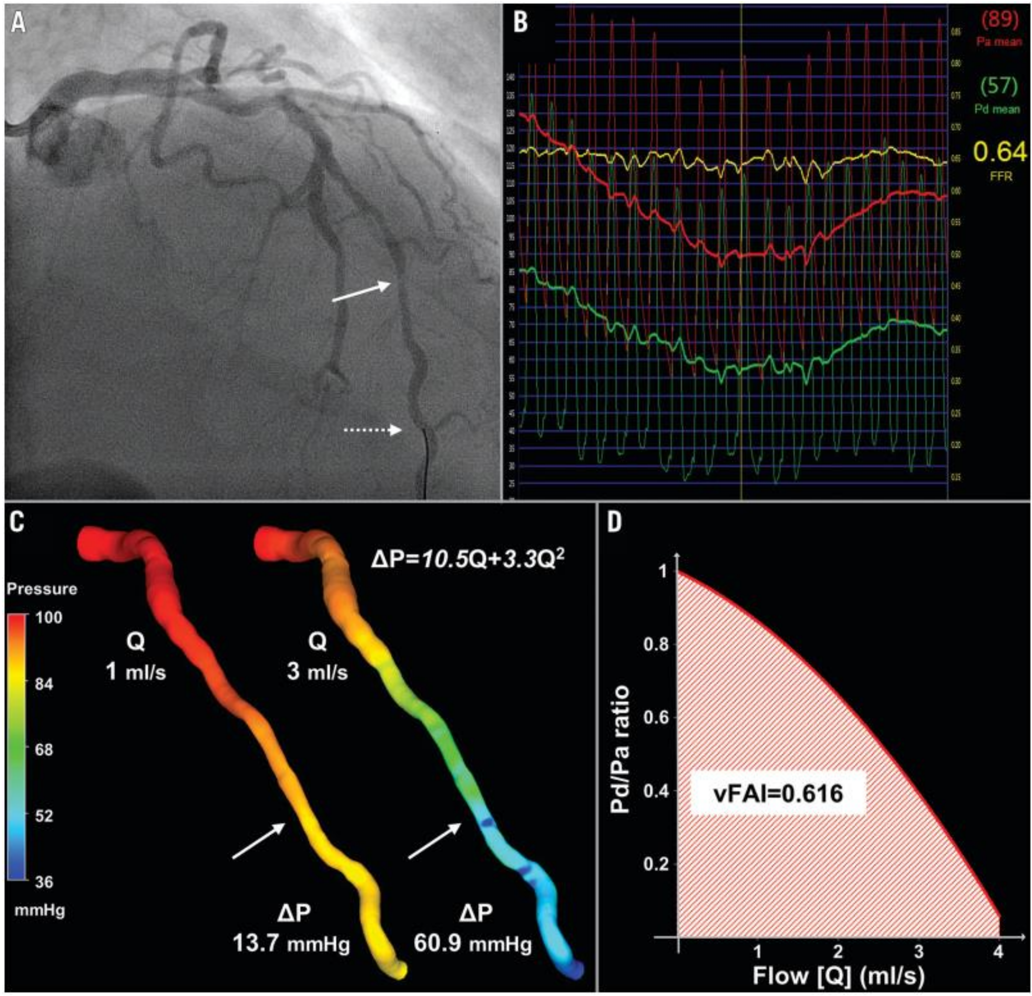
Morris P et al. *JACC Intv* 2013
Morris P et al. *JACC Basic Transl Sci* 2017

Virtual FFR Surrogates From Invasive Angiography

vFAI

Virtual functional assessment index (vFAI)

- Validation in 120 patients
- 3-D QCA geometry (routine angiography)
- Navier-Stokes equations of fluid motion
- Generic/universal boundary conditions
    - Quadratic equation for pressure drop across a range of coronary flow values
- Computational time: 7 min

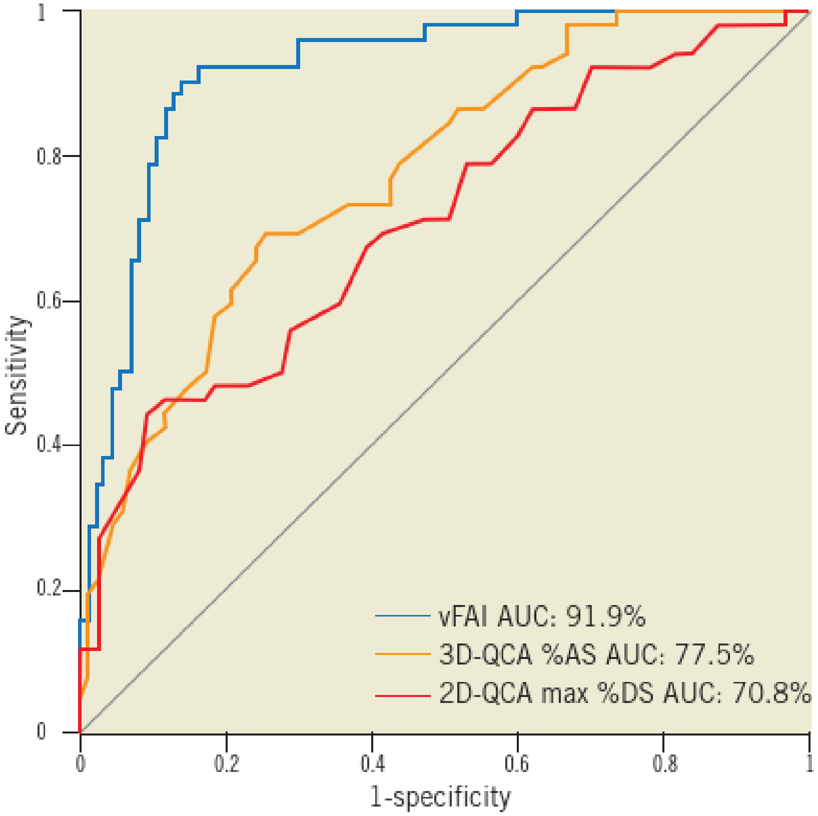


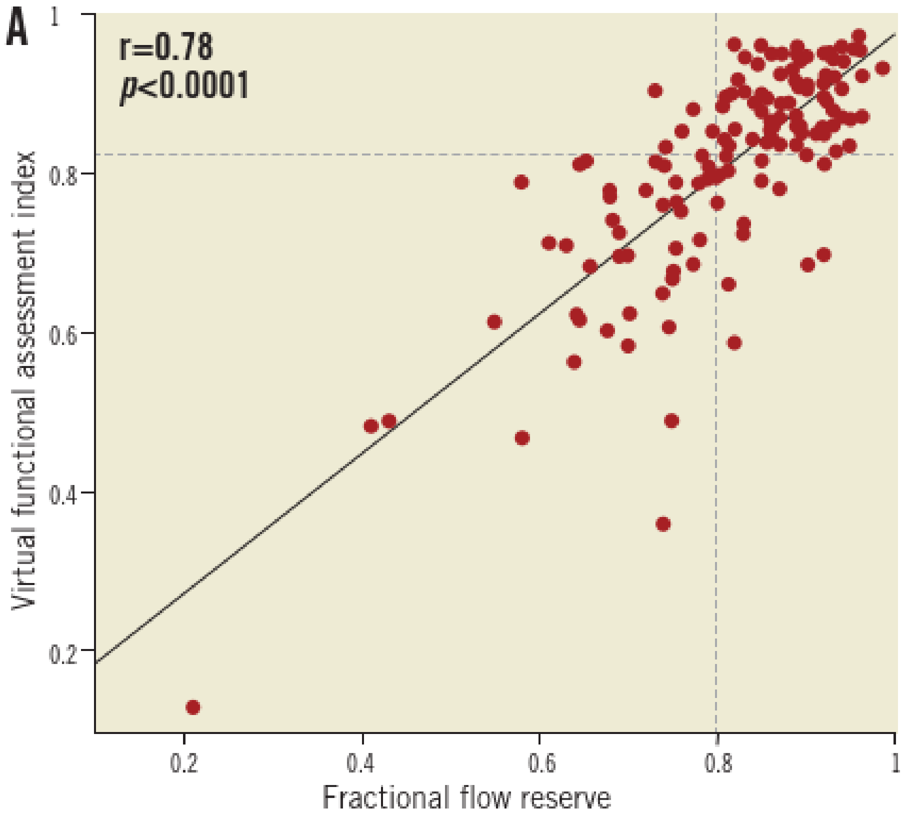
Papafaklis M et al. *EuroIntervention* 2014

Virtual FFR Surrogates From Invasive Angiography
vFAI vs FFR

- High diagnostic performance
- Incremental value to angiography %stenosis (QCA)

Good correlation to FFR



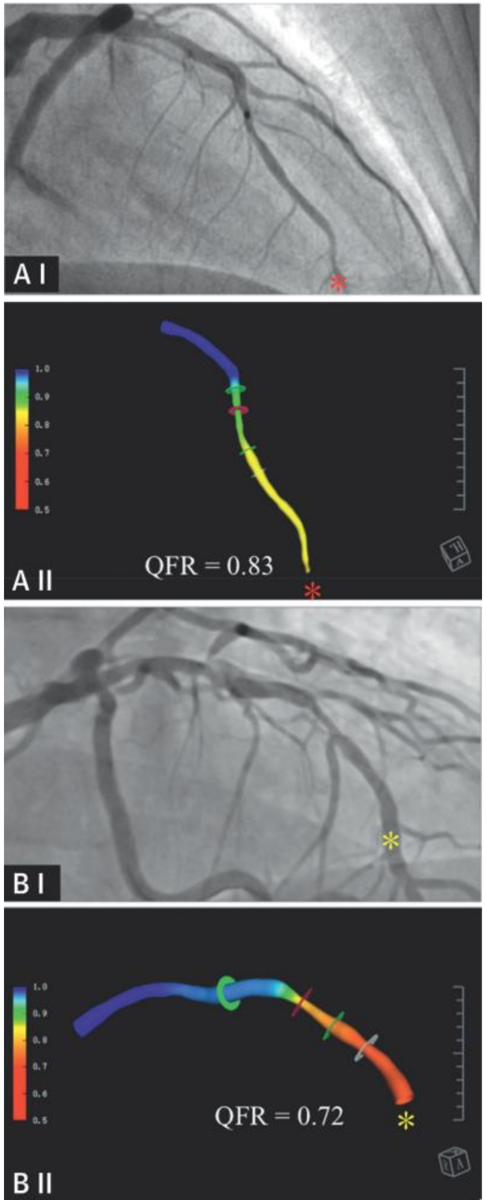


Papafaklis M et al. *EuroIntervention* 2014

QFR From Invasive Angiography

Quantitative Flow Ratio (QFR)

- 3-D QCA geometry (routine angiography)
- Approximate algebraic method of fluid dynamics: quadratic equation with empirically derived coefficients for pressure drop
- Contrast-flow (cQFR): a hyperaemic flow determined from baseline (resting) conditions (simple frame counting of contrast)
- Time for QFR results: 5 min in online QFR application (FAVOR II Europe-Japan study)



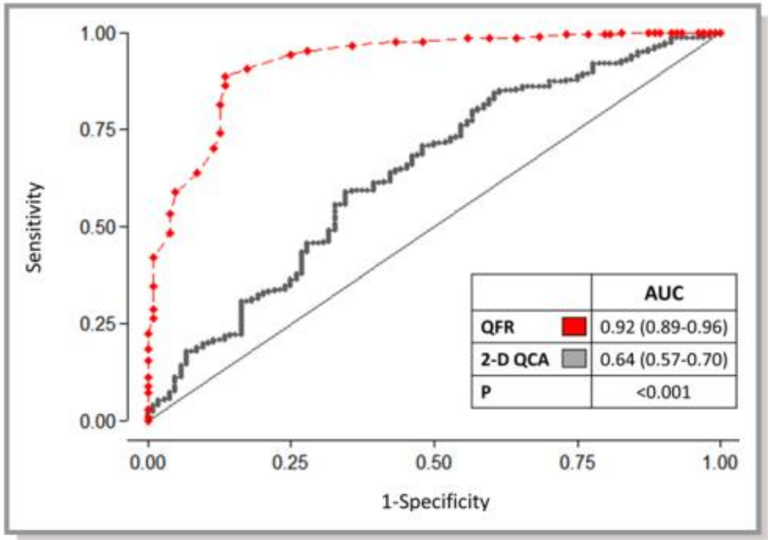
Tu S et al. *JACC Intv* 2016

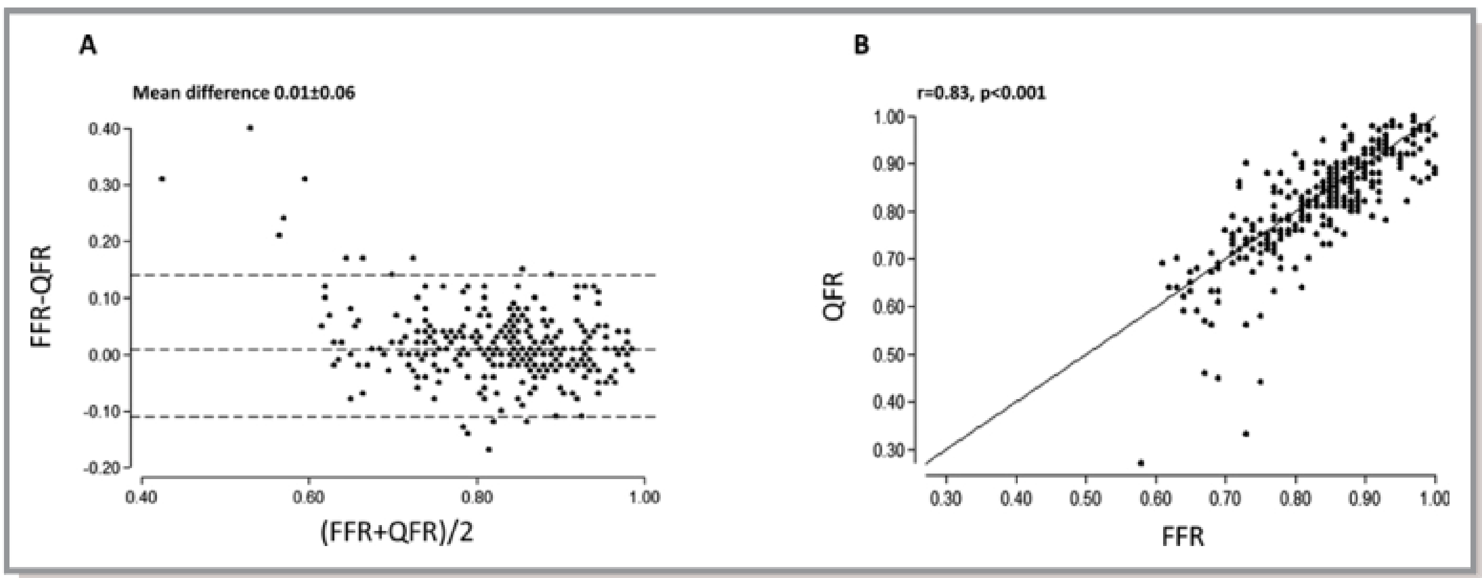
Xu B et al. *J Am Coll Cardiol* 2017

Westra J et al. *J Am Heart Assoc* 2018

QFR vs FFR

FAVOR II Europe-Japan study
329 patients





Westra J et al. *J Am Heart Assoc* 2018

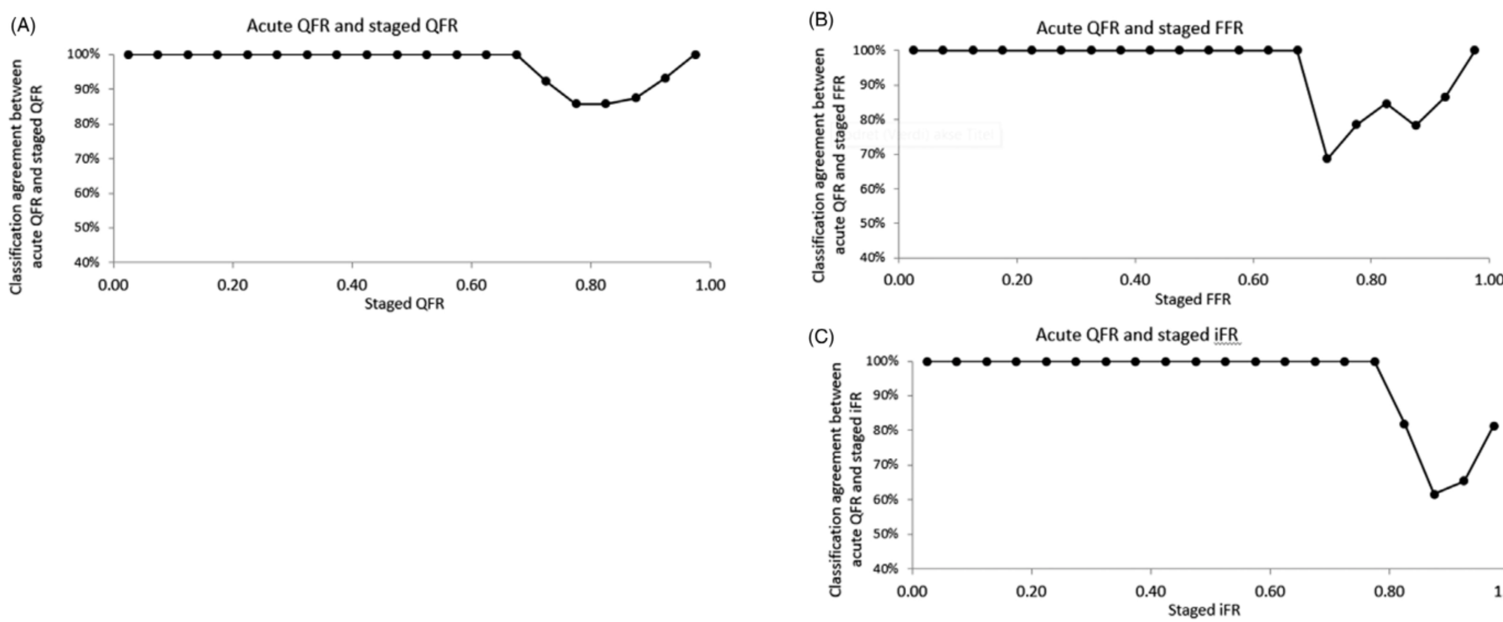
QFR: Immediate Assessment of NonCulprit Lesions in STEMI

iSTEMI substudy 112 patients (146 lesions)

TABLE 2 Diagnostic performance of acute phase QFR

Diagnostic modality	Reference	Classification agreement	Sensitivity	Specificity	PPV	NPV
Acute QFR	Staged QFR	93% (87–99)	92% (78–98)	94% (80–99)	94% (81–99)	91% (76–98)
Acute QFR	Staged FFR	84% (76–90)	83% (69–93)	84% (72–92)	81% (57–92)	86% (76–95)
Acute QFR	Staged iFR	74% (65–83)	73% (58–85)	74% (62–85)	69% (54–81)	78% (66–88)

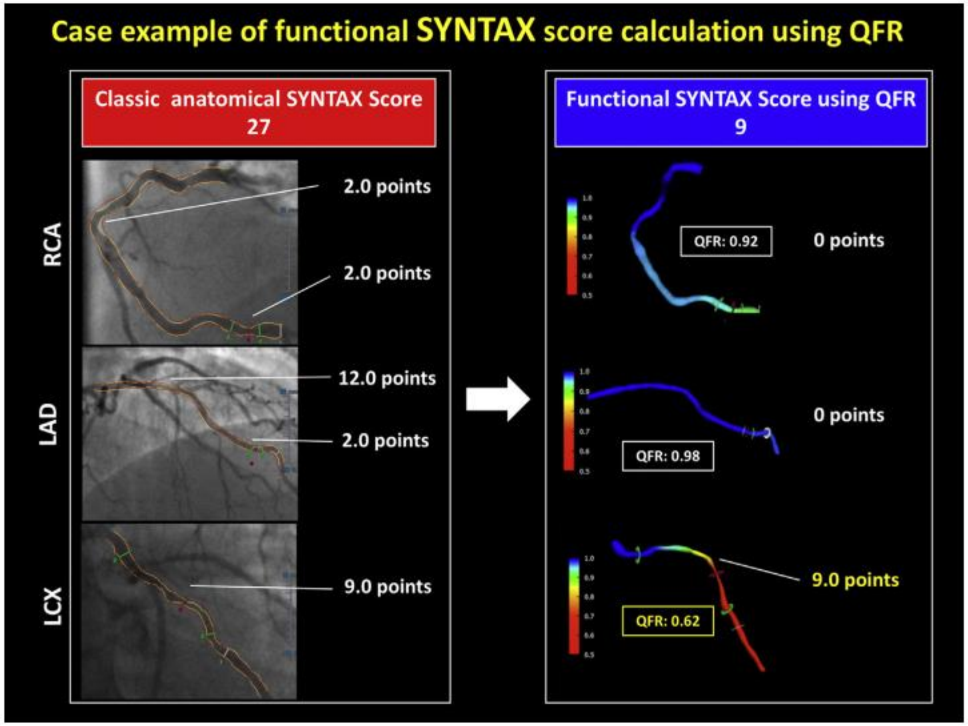
Diagnostic performance of acute QFR presented as percentage (95% confidence interval) with staged QFR, staged FFR, and staged iFR as references. FFR: fractional flow reserve; iFR: instantaneous wave-free ratio; NPV: negative predictive value; PPV: positive predictive value; QFR: quantitative flow ratio.



Sejr-Hansen M et al. *Cath Cardiovasc Interv* 2019

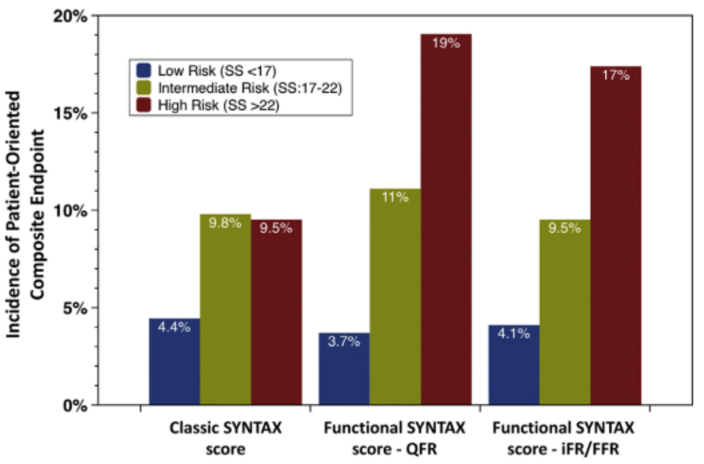
Functional SYNTAX score using QFR (fSS$_{QFR}$)

FIGURE 4 Representative Case of Functional SYNTAX Score Calculation Derived From Quantitative Flow Ratio



A patient with 3-vessel disease yielded a classic anatomical SYNTAX (Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery) score of 27, which was classified in the high-risk group. In the patient, the functional SYNAX score derived from quantitative flow ratio (QFR) was as low as 9 (low-risk group) because the functional assessment using QFR revealed that the lesions in the right coronary artery (RCA) and left anterior descending coronary artery (LAD) were not significant.

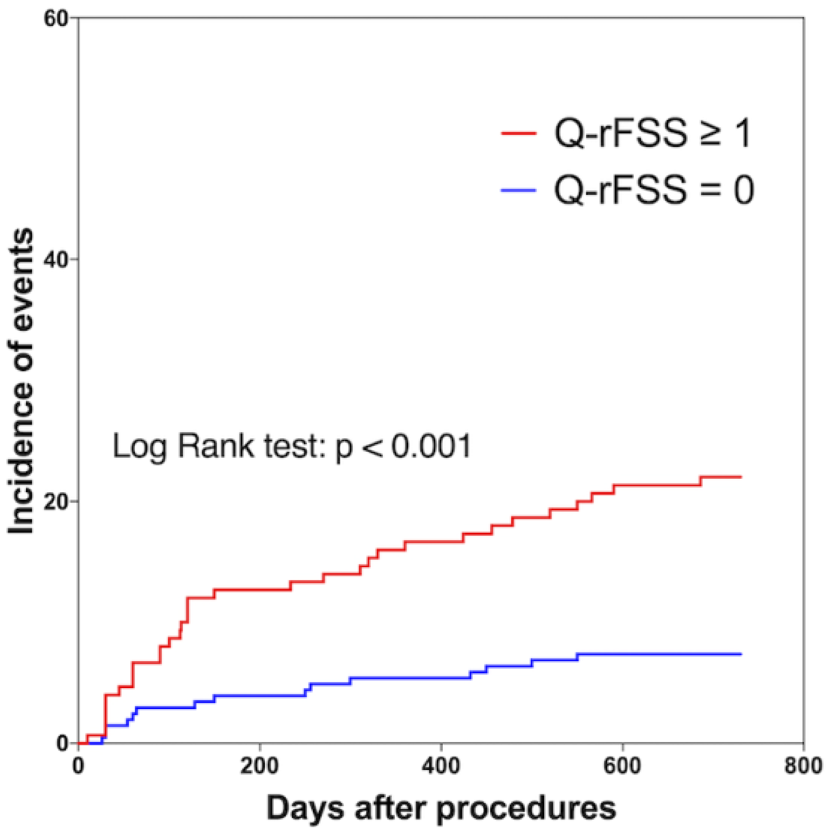
FIGURE 6 Incidence of Patient-Oriented Composite Endpoint Stratified According to Classic Anatomic SYNTAX Score, Functional SYNTAX Score Derived From Quantitative Flow Ratio, and Functional SYNTAX Score Derived From Instantaneous Wave-Free Ratio/Fractional Flow Reserve

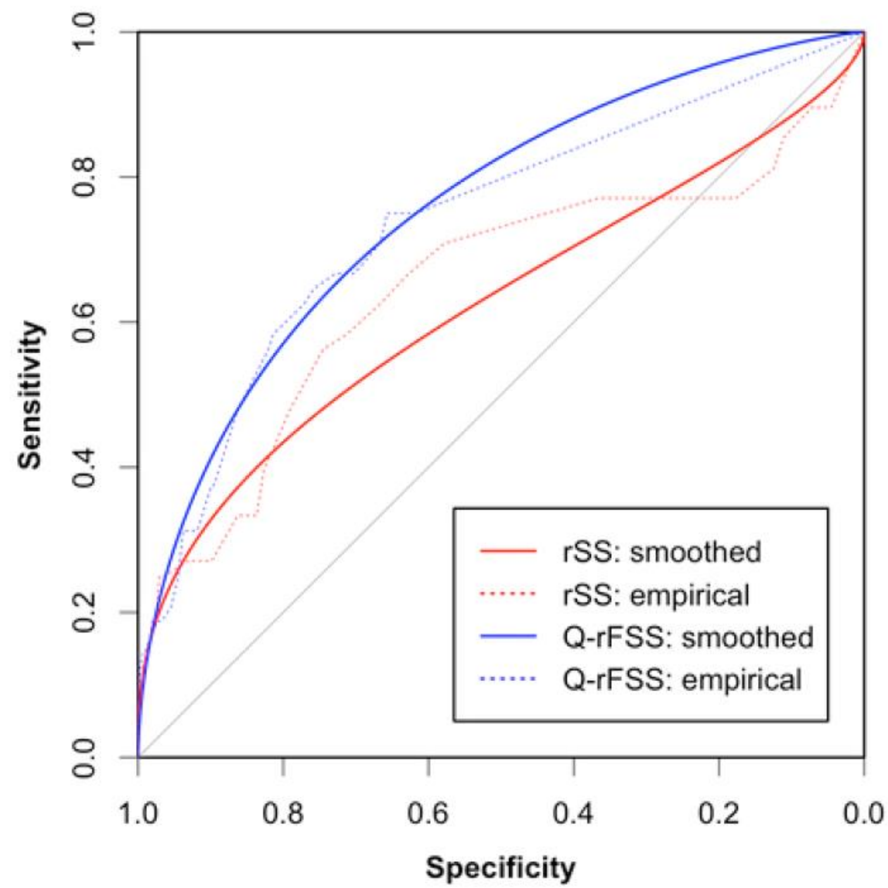


FFR = fractional flow reserve; iFR = instantaneous wave-free ratio; QFR = quantitative flow ratio, SS = SYNTAX (Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery) score.

Asano T et al. *JACC Intv* 2019

Residual Functional SYNTAX Score Using QFR (Q-rFSS) After STEMI



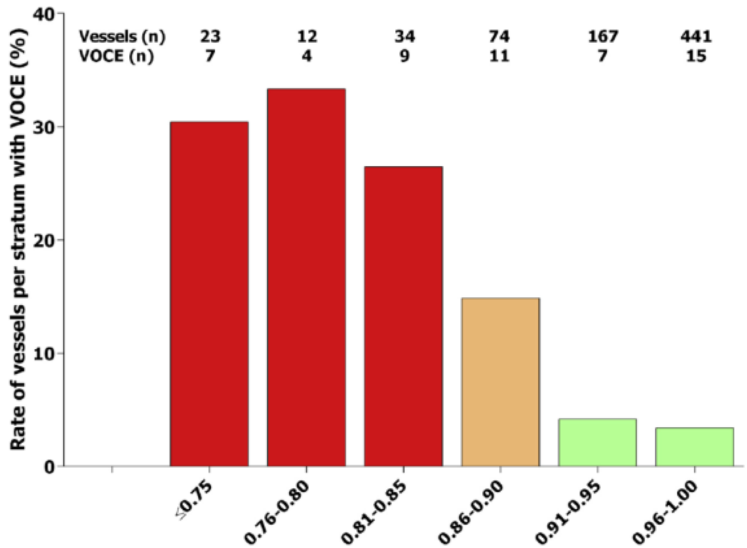


Tang J et al. *EuroIntervention* 2019

Prognostic value of QFR after Successful PCI

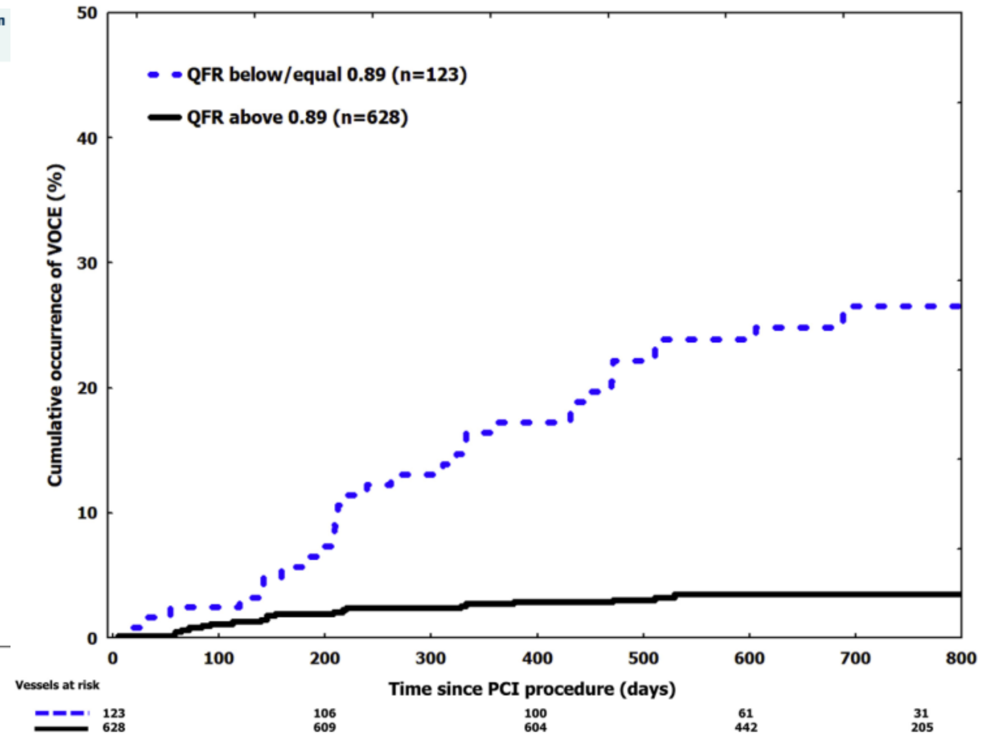
Multicenter HAWKEYE study (602 pts, 751 lesions)

FIGURE 2 Rate of Vessels With the Vessel-Oriented Composite Endpoint in the Different Post-Percutaneous Coronary Intervention Quantitative Flow Ratio Strata



Colors indicate the distribution according the best cutoff (≤0.89) for the prediction of the vessel-oriented composited endpoint (VOCE): **green** for values higher than the cutoff, **orange** for values near the cutoff, and **red** for values less than the cutoff.

FIGURE 3 Cumulative Occurrence of the Vessel-Oriented Composite Endpoint in Vessels Stratified According the Best Cutoff

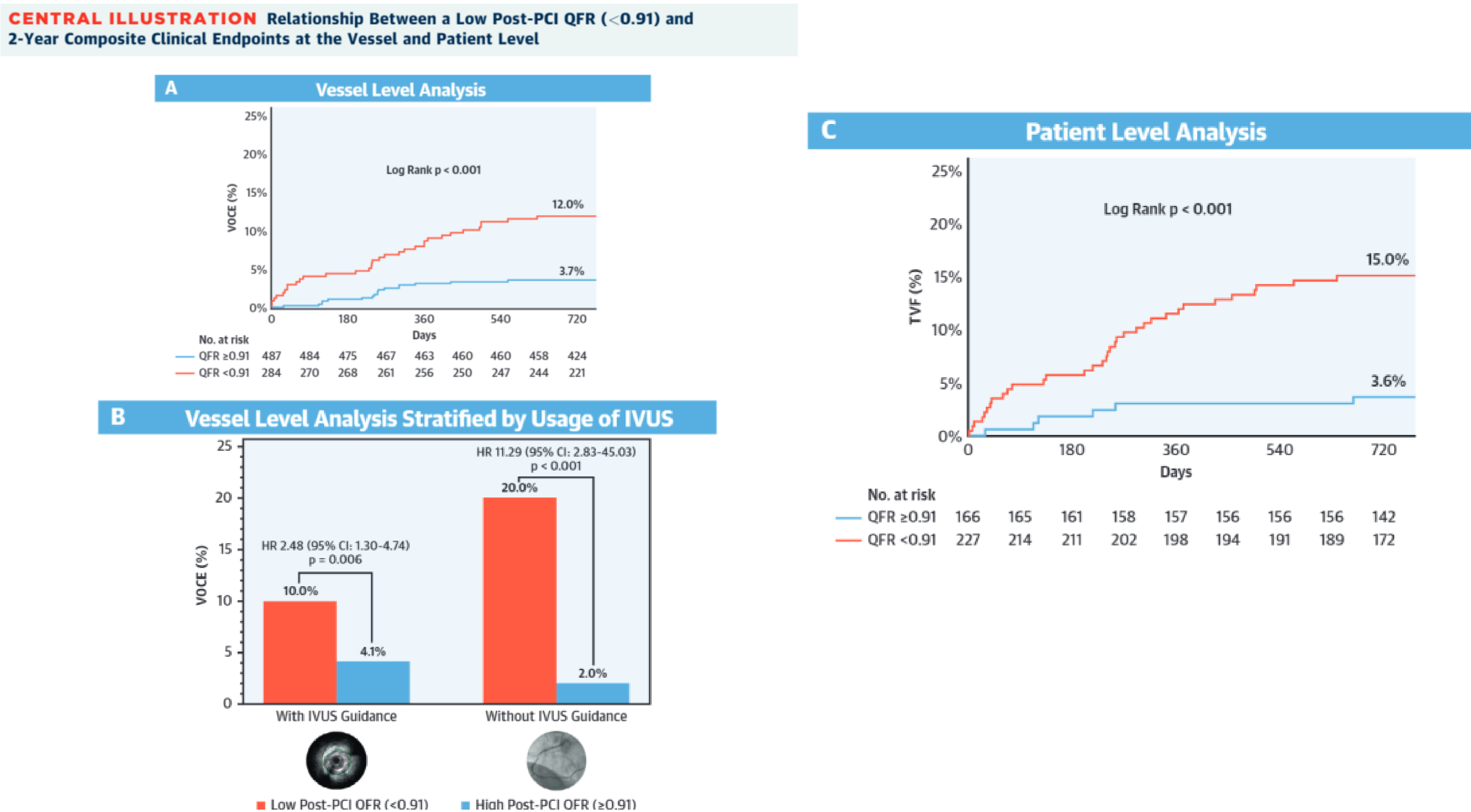


Black continuous line = vessels with values of post-percutaneous coronary intervention (PCI) quantitative flow ratio (QFR) ≤0.89. **Blue dotted line** = vessels with values >0.89. The cutoff of 0.89 was obtained by receiver-operating characteristic curve analysis for the best prediction of the vessel-oriented cardiac endpoint (VOCE).

Biscaglia S et al. *JACC Intv* 2019

Prognostic value of QFR after Successful PCI

SYNTAX II substudy (all vessels treated with PCI)



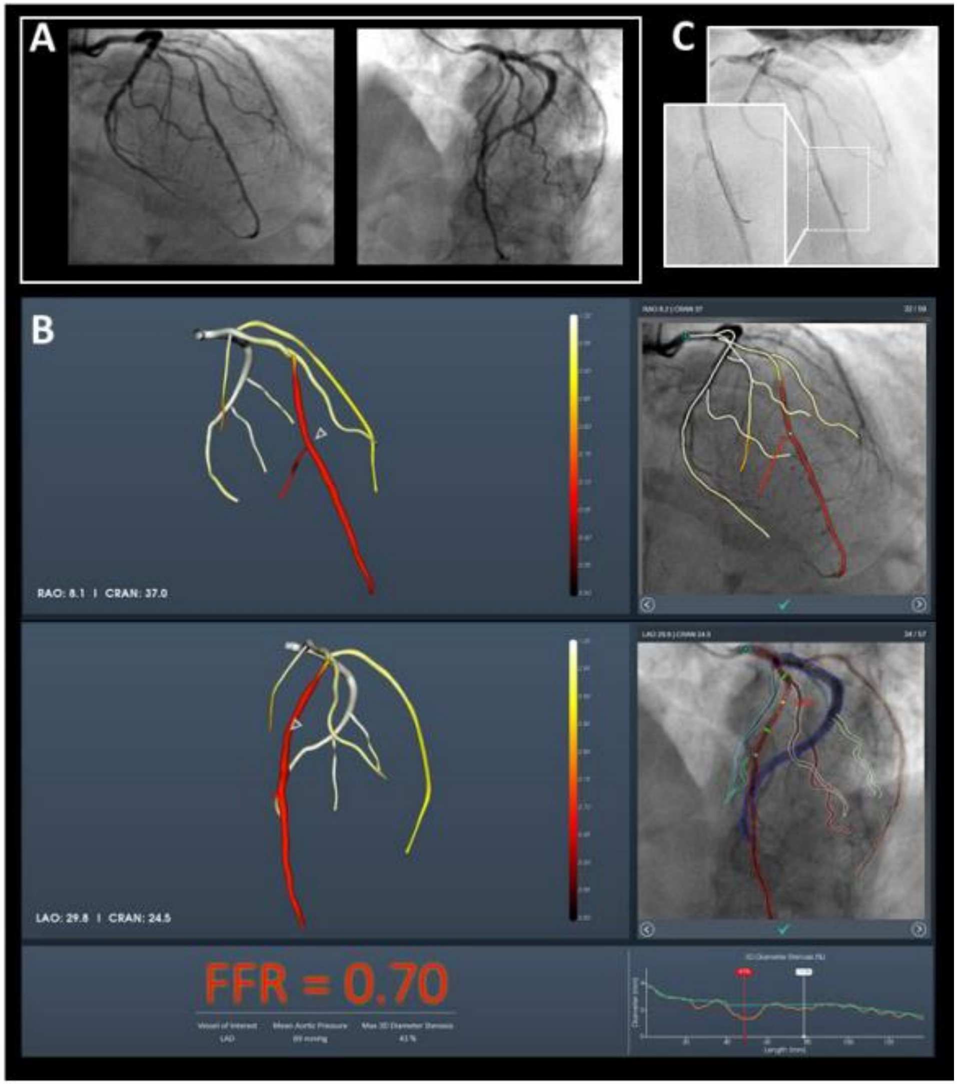
Kogame N et al. *JACC Intv* 2019

Virtual FFR Surrogates From Invasive Angiography

FFR_{angio}

FFR_{angio} tool

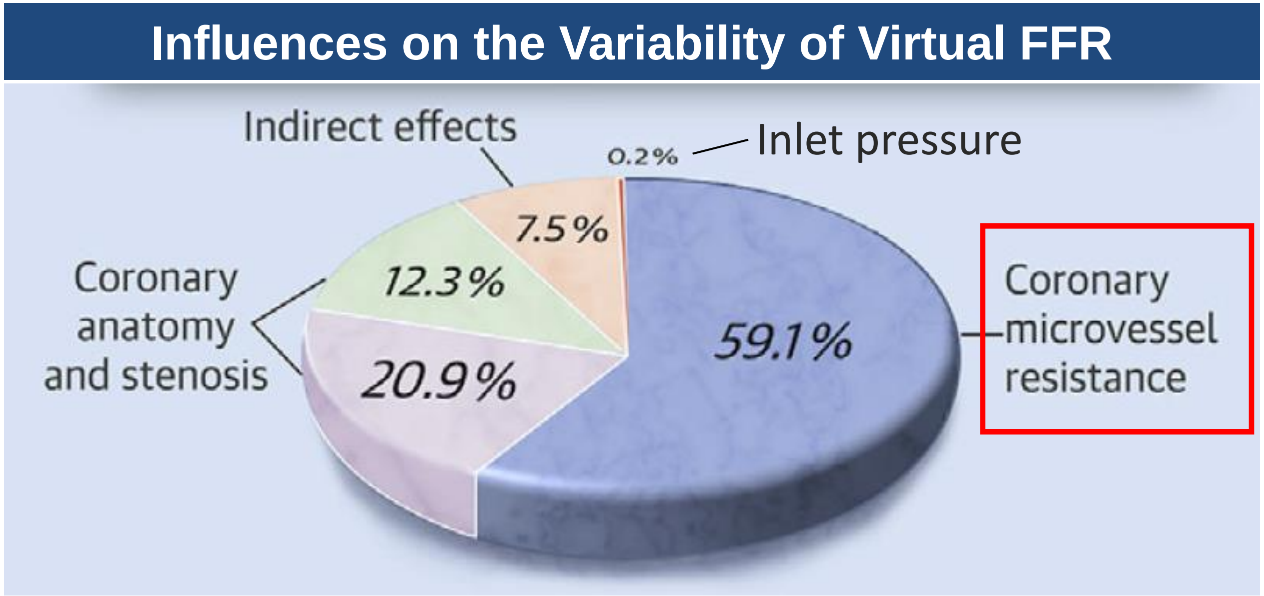
- Accuracy studied in 301 patients
- Allows the simulation of FFR in the entire coronary tree including side branches
- Diagnostic accuracy 92%



Fearon W et al. *Circulation* 2019

Functional Angiography: Challenges

- Time required for the analysis
- Ability of techniques to realistically simulate the *in vivo* conditions
  - Anatomic accuracy of the 3-D coronary and lesion geometry
  - "Physiologic" accuracy of the model computing the virtual index: use of physiological parameters – application of boundary conditions



Morris P et al. *JACC Basic Transl Sci* 2017

Take-home Messages

- Fractional Flow Reserve
  - Gold standard for invasive functional assessment
  - BUT the adoption of FFR in catheter laboratories remains low
- Instantaneous Wave-Free Ratio (iFR)
  - Large body of clinical studies and available randomized data showing non-inferiority in MACE – Adoption in Current Guidelines
- Functional Angiography
  - Can provide an ***option without using pressure wires and adenosine***
  - **Opportunity to increase coronary physiology assessment in patients**
  - **FFR-CT** could play an important role as gate-keeper for coronary catheterisation
  - **FFR based on Invasive Angiography** is feasible and provides an *approximation* to wire-FFR with good diagnostic performance
  - ***Need for randomised clinical trials of angio-based FFR and patient outcomes***

ΕΛΛΗΝΙΚΟ ΚΟΛΛΕΓΙΟ
ΚΑΡΔΙΟΛΟΓΙΑΣ

Επιστημονική Εκδήλωση

Σεμινάριο Επιστημονικών Ενώσεων Ελληνικού Κολλεγίου Καρδιολογίας

22-23
Νοεμβρίου 2019
Συνεδριακό Κέντρο Διάσελο
Μέτσοβο