CTA koronárních tepen a kalkulace frakční průtokové rezervy (CT-FFR)

Jan Baxa

Klinika zobrazovacích metod, FN Plzeň a LF UK v Plzni

technologický posun

“high-end” přístroje

bez nutnosti redukce srdeční frekvence

poruchy rytmu včetně FIS

obézní pacienti

vysoká kvalita s nízkou zátěží

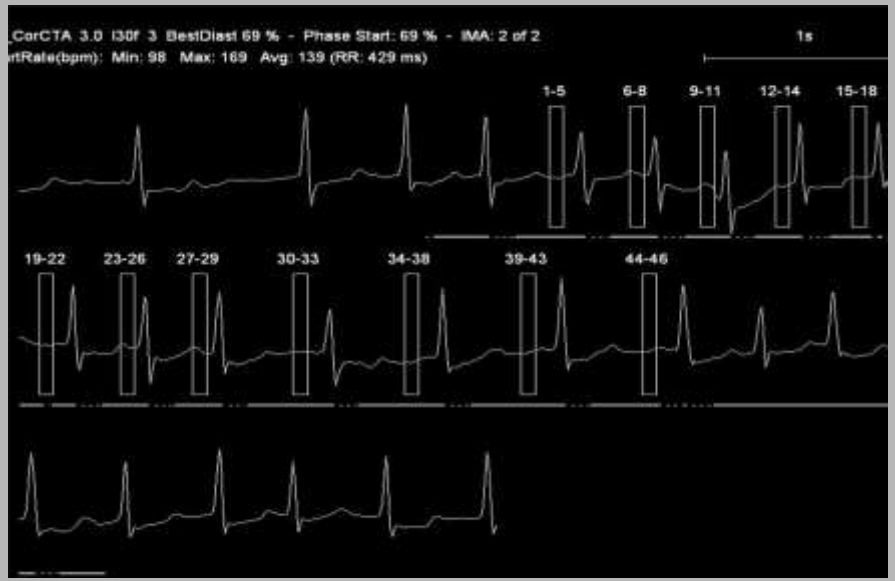
senzitivita 90 - 98 %, specificita 80 - 95 %

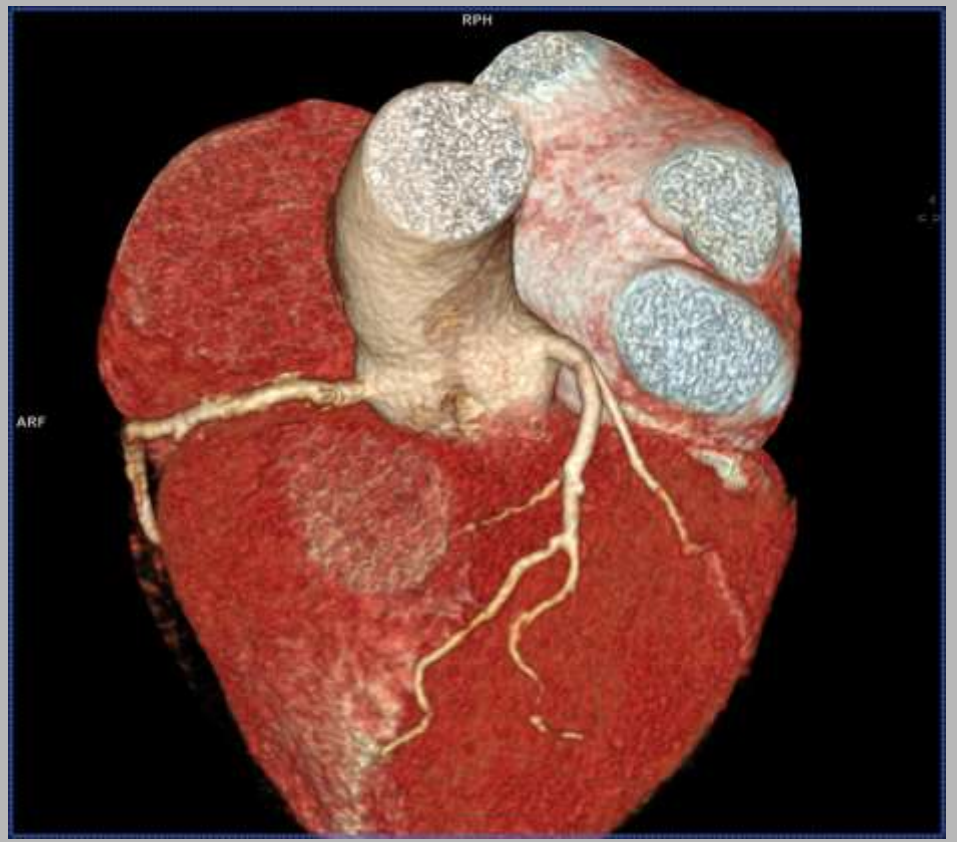
průměr od 2 do 5 mSv

Salavati A. Dual-source computed tomography angiography for diagnosis and assessment of coronary artery disease: systematic review and meta-analysis. J Cardiovasc Comput Tomogr. 2012

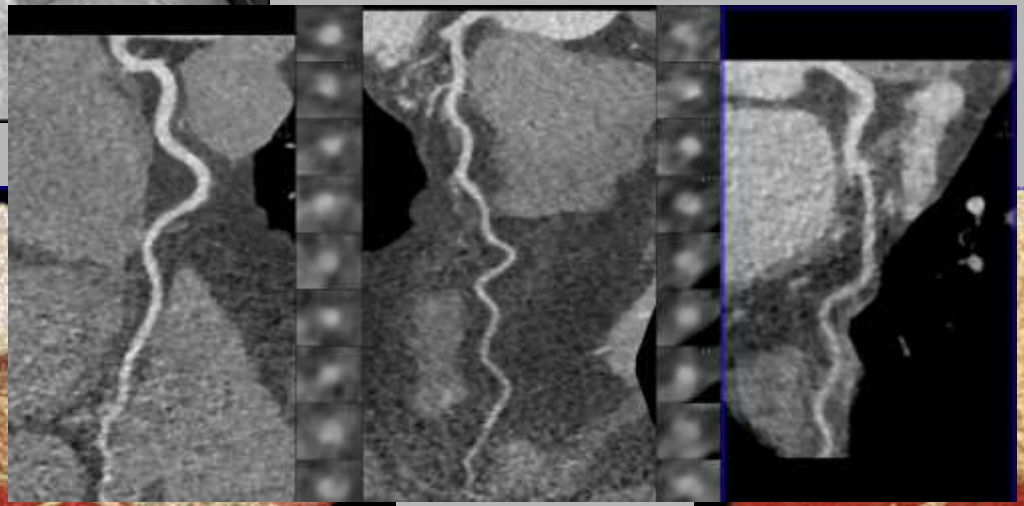
akutní disekce 118/min, EF 15 %

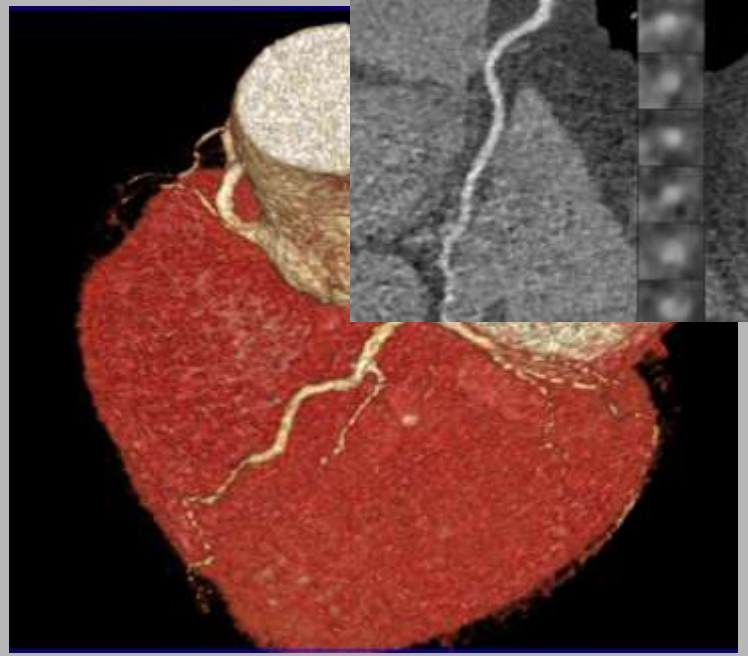
bolest na hrudi
dysfunkce dle TTE

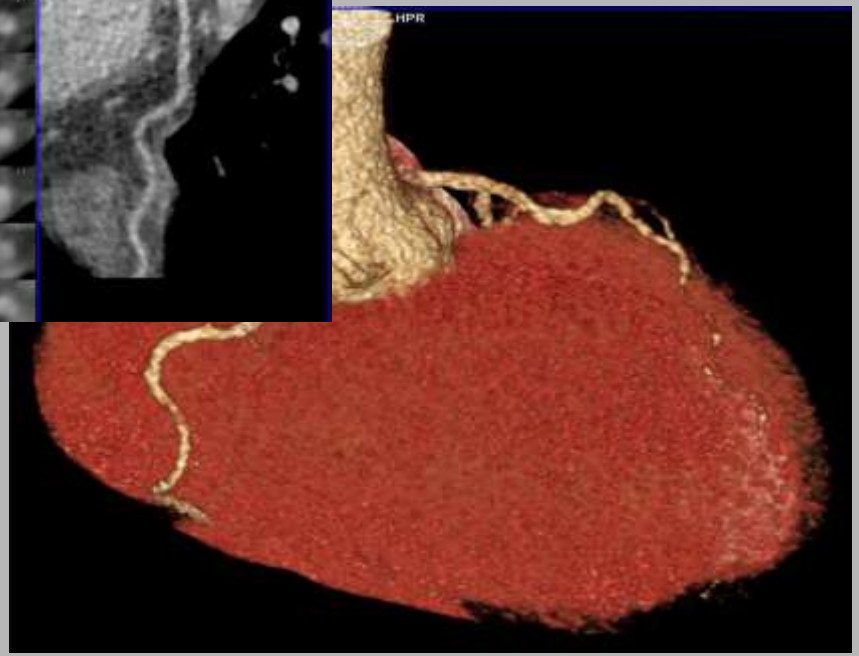




150 kg, bolest na hrudi
dysfunkce dle TTE







Acute Coronary Syndromes (ACS) in patients presenting without persistent ST-segment elevation (Management of)

ESC Clinical Practice Guidelines

MDCT coronary angiography should be considered as an alternative to invasive angiography to exclude ACS when there is a low to intermediate likelihood of CAD and when cardiac troponin and/or ECG are inconclusive.	IIa	A

PROMISE (10 003 pacienti)

CTA vs. funkční testy

2 leté sledování

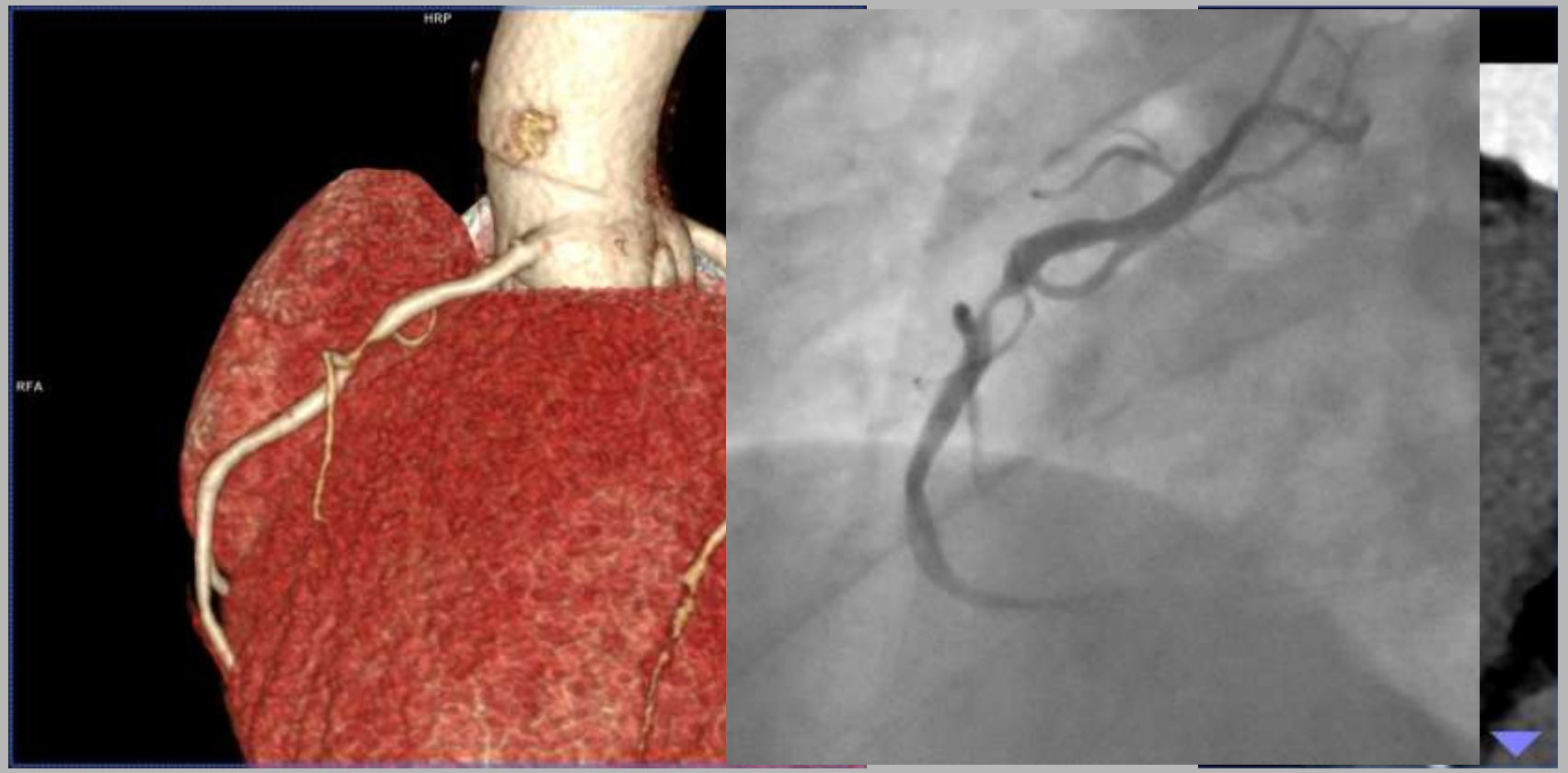
negativní SKG - 28 % vs. 53 %

SCOT-HEART (4146 pacientů)

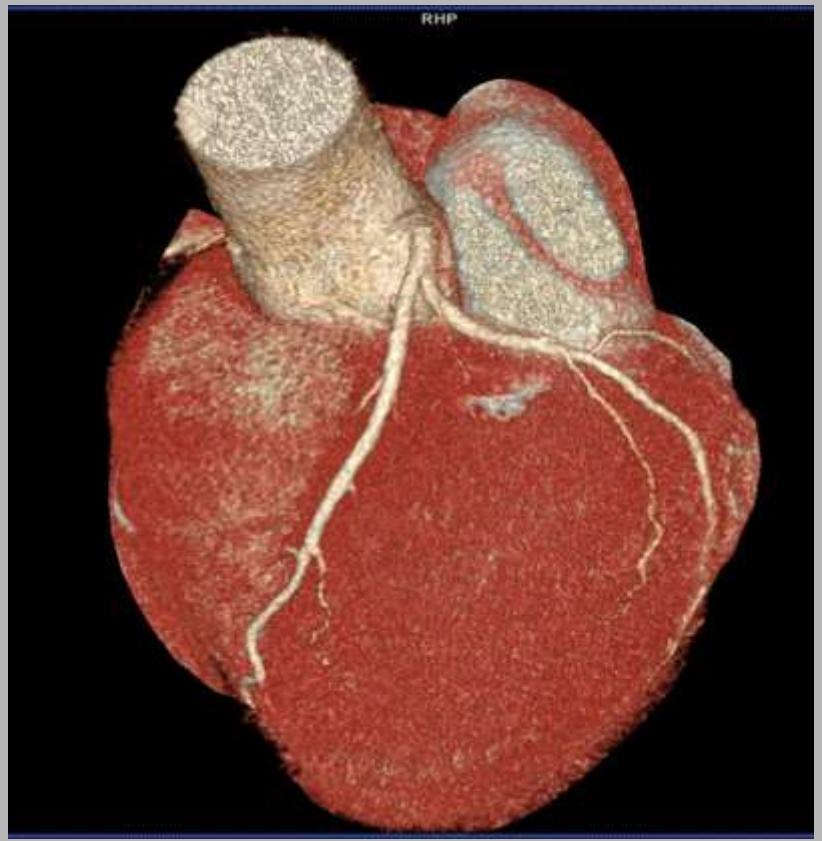
redukce IM ve sledovaném období

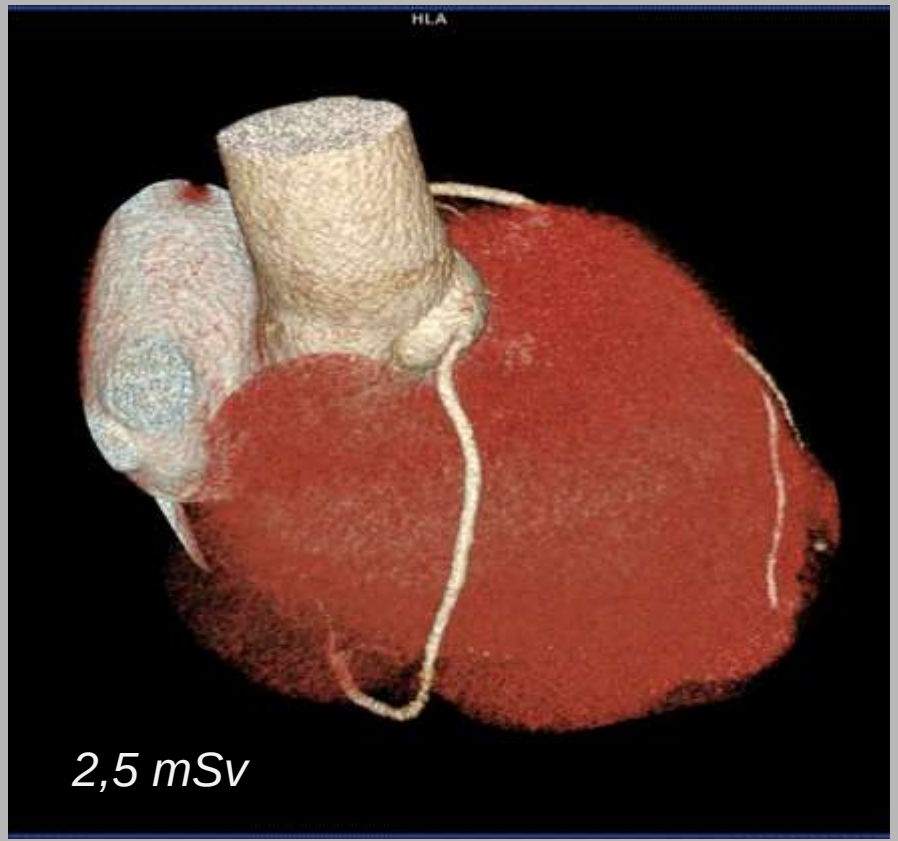
Williams MC et al. Use of coronary computed tomographic angiography to guide management of patients with coronary disease. *Curr Cardiovasc Imaging Rep. 2016*

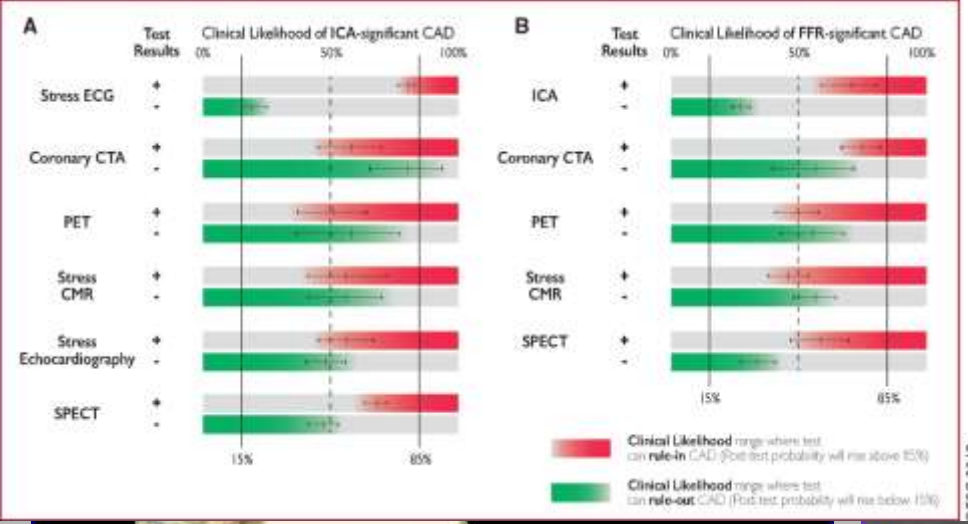
42 let, intermitentní bolest na hrudi
7:30...9:53 (T hs 4)...11:13 (T hs 4)



37 let, intermitentní bolest na hrudi
STE v terénu RBBB, T hs 3...T hs 12







GUIDELINES

2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes: The Task Force for the diagnosis and management of chronic coronary syndromes of the European Society of Cardiology (ESC) FREE

[redacted]

ble chest pain and low prevalence of CAD, coronary
inctional testing for detecting significant CAD defined

ESC 2019

Offer diagnostic testing

No diagnostic testing mandated

Coronary CTA[f]

Choice of the test based on clinical likelihood, patient characteristics and preference, availability, as well as local expertise[d]

Testing for ischaemia (imaging testing preferred)

Invasive angiography (with iwFR/FFR)[e]

Very low — Clinical likelihood of obstructive CAD — Very high

limitace CTA

specificita

nadhodnocování stenozy

morfologické hodnocení

malé rozměry koronárních tepen

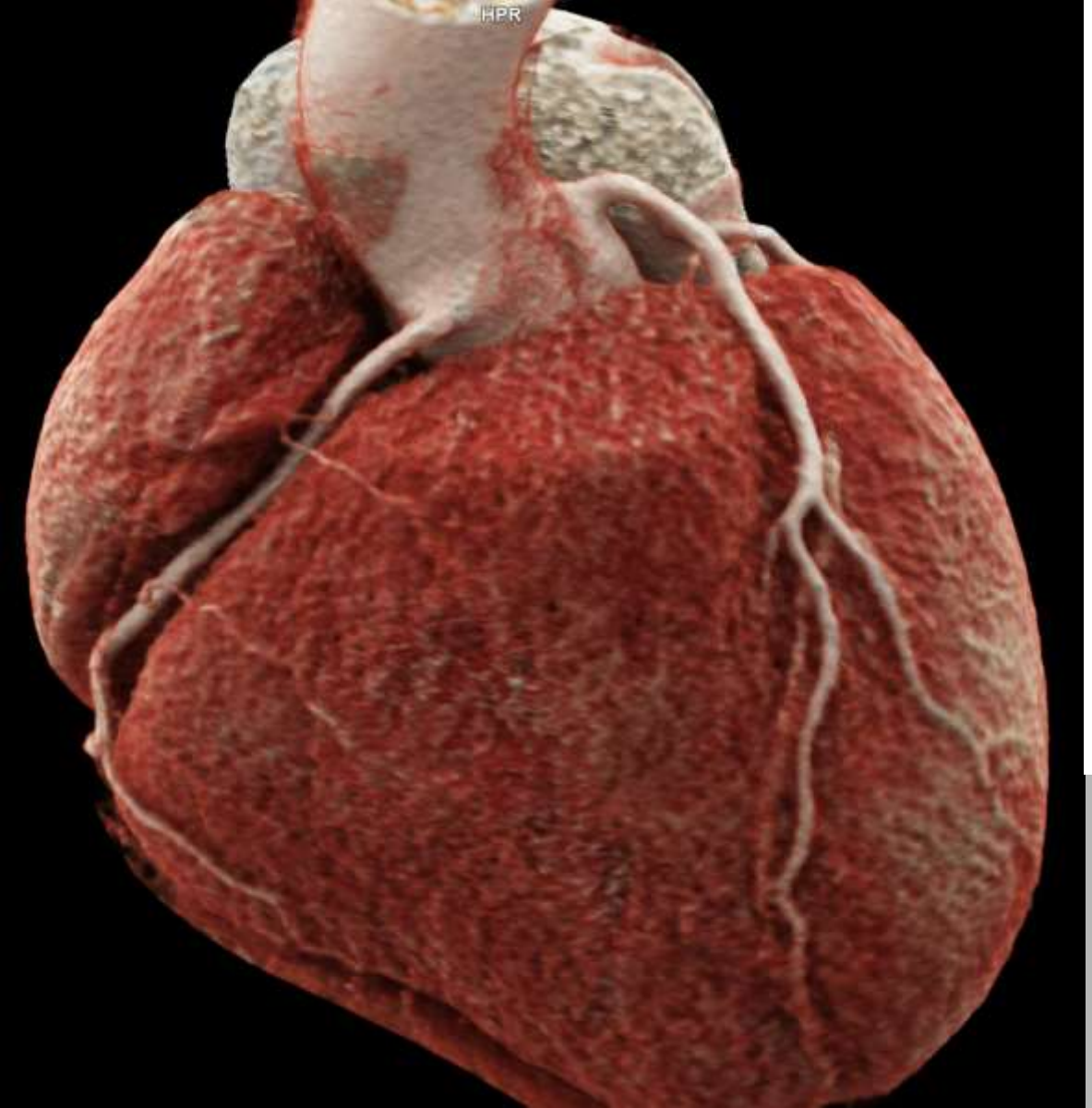
kalcifikace

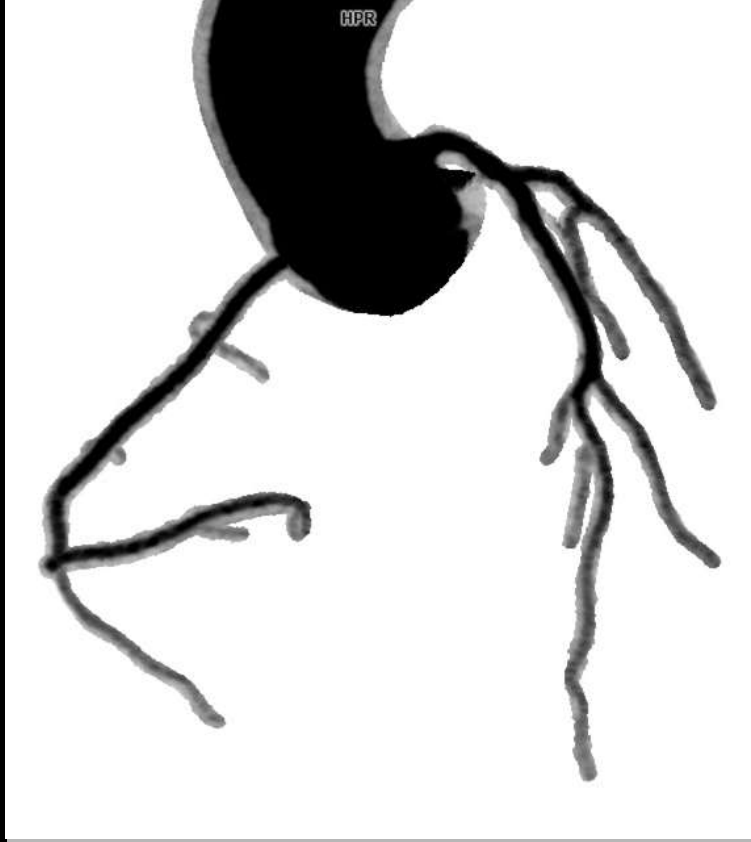
artefakty

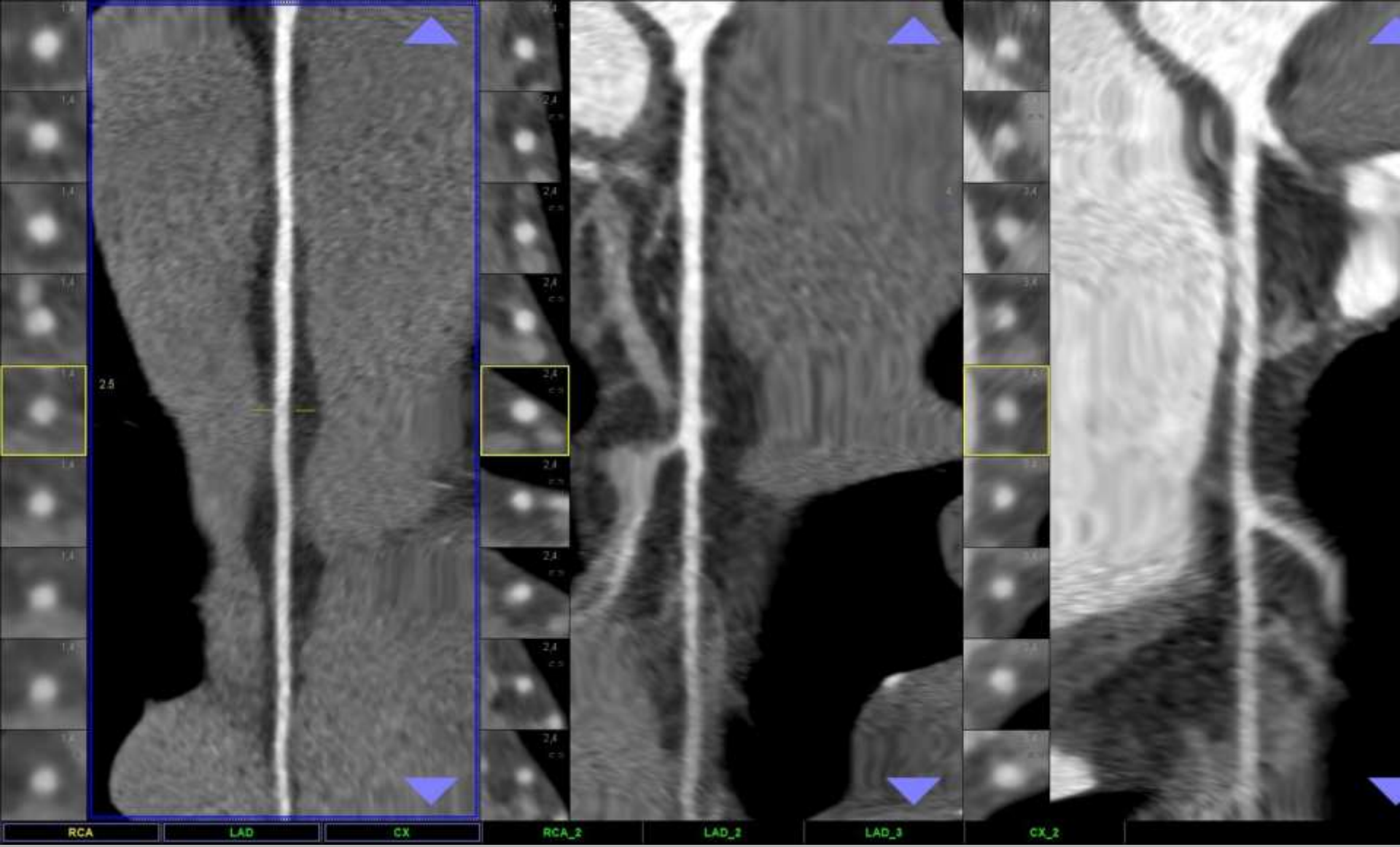
SKG

FFR

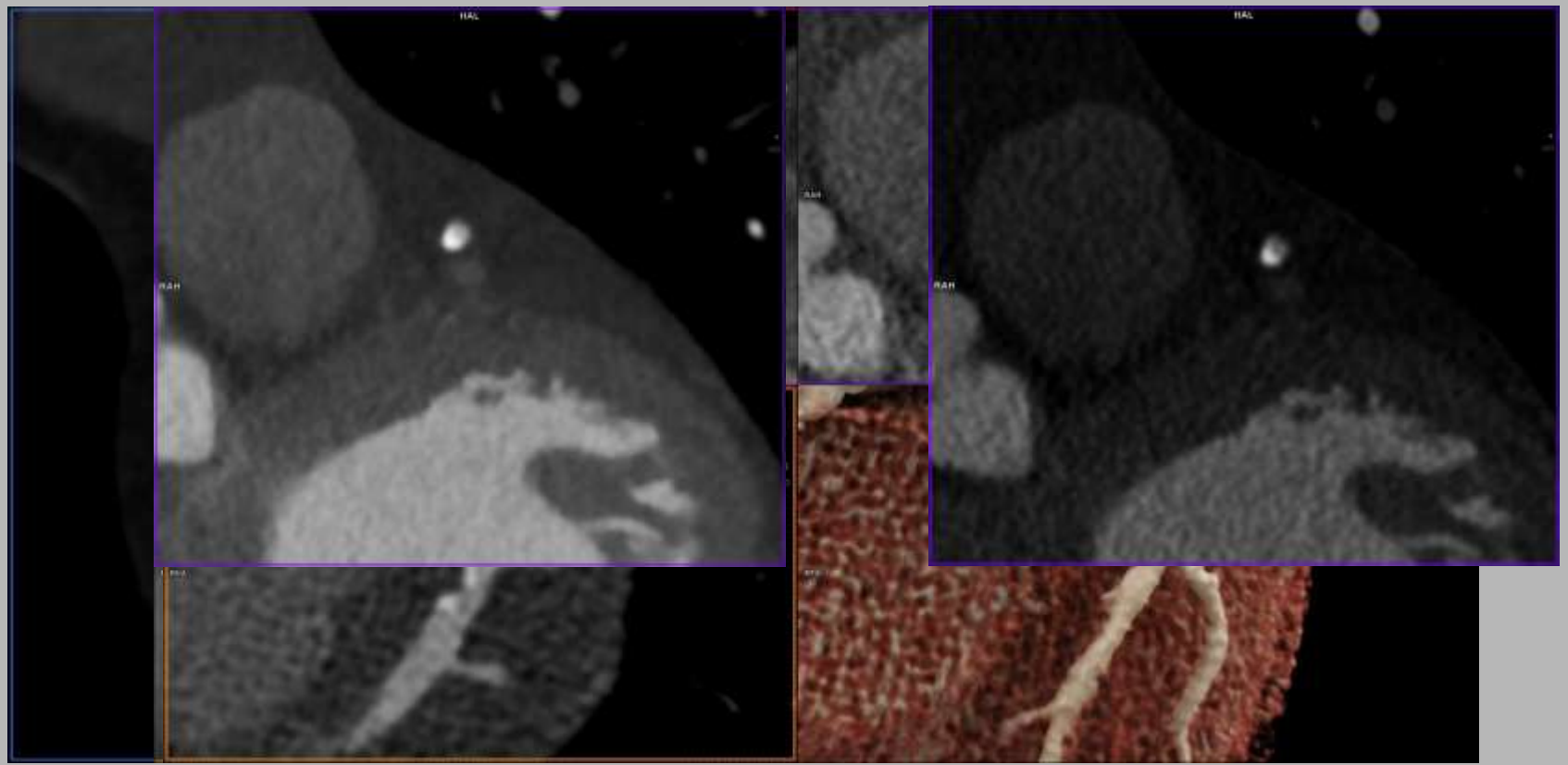
Gonzalez JA, et al. Meta-Analysis of Diagnostic Performance of Coronary CTA, CTP, and Computed Tomography-Fractional Flow Reserve in Functional Myocardial Ischemia Assessment Versus Invasive Fractional Flow Reserve. Am J Cardiol. 2015

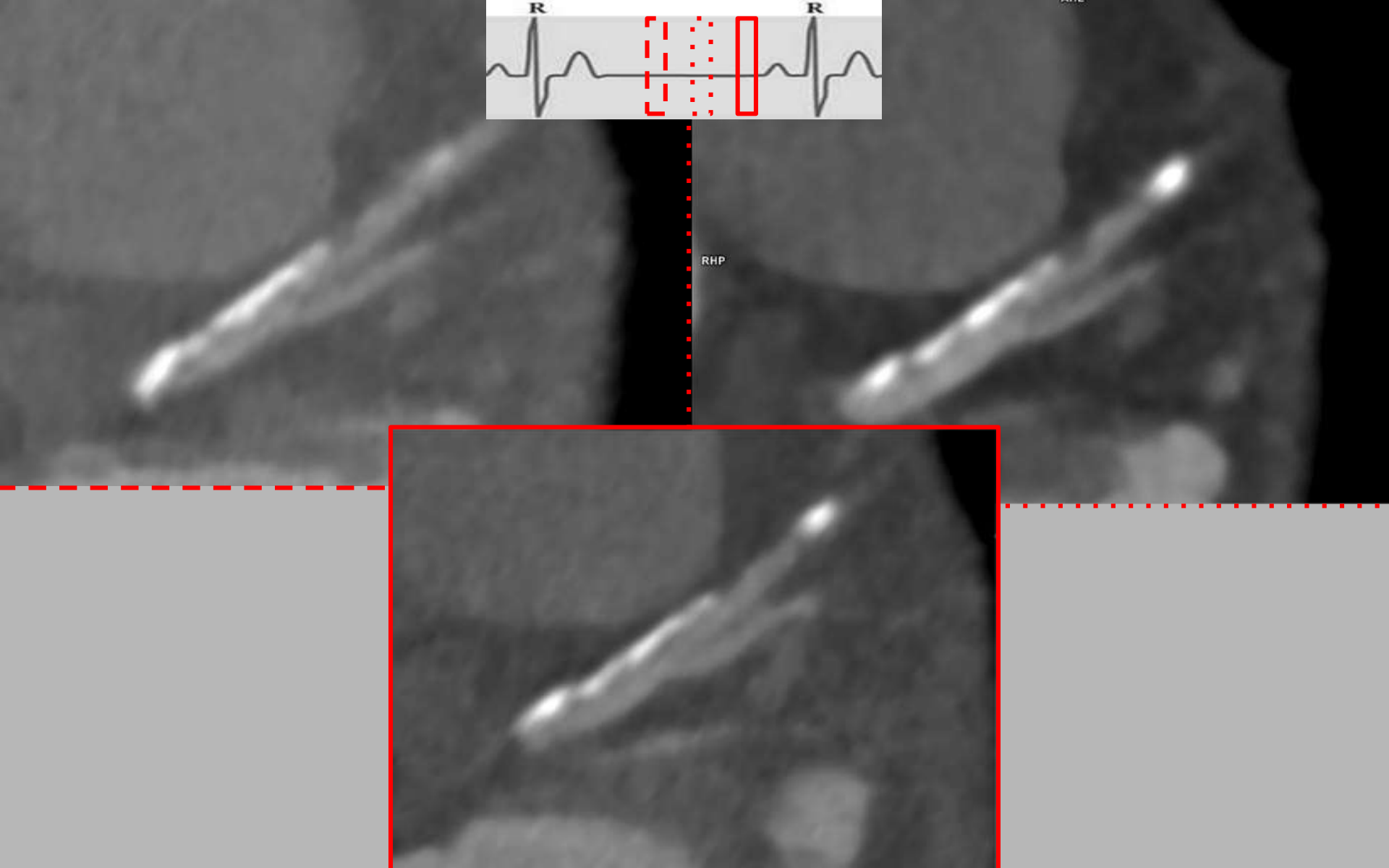

HPR


HPR


RCA
LAD
CX
RCA_2
LAD_2
LAD_3
CX_2

kalcifikace




R
R
RHP

“nízká” specificita

technická kvalita

limitace “pacientem”

hodnocení

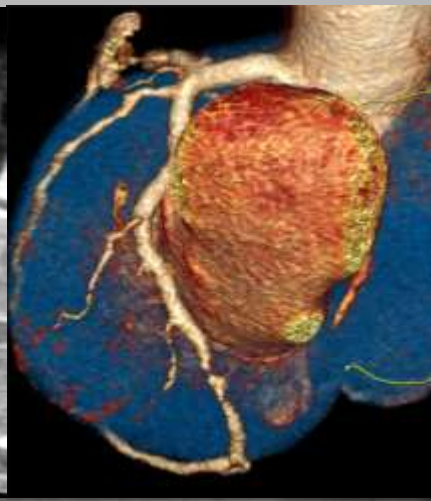
rozměry + kalcifikace

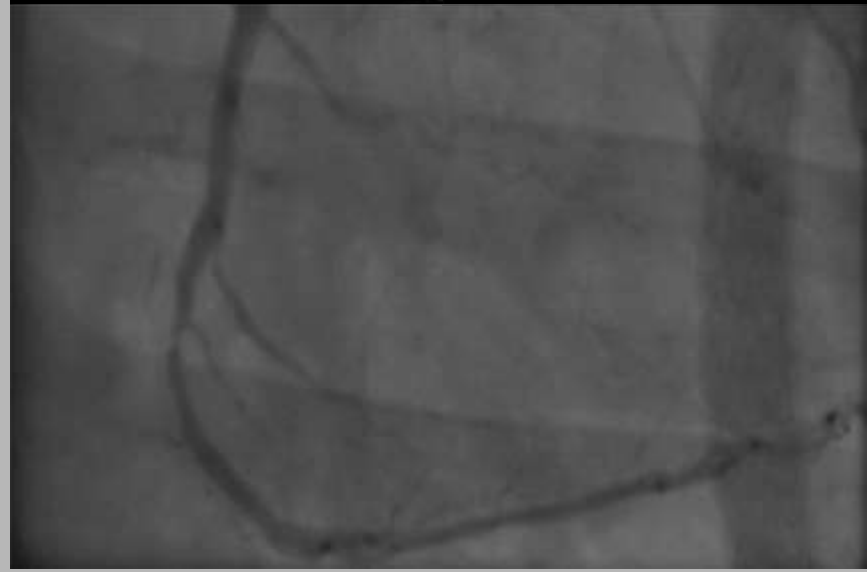
limitace hodnotitele

(ne)znalost klinické symptomatologie

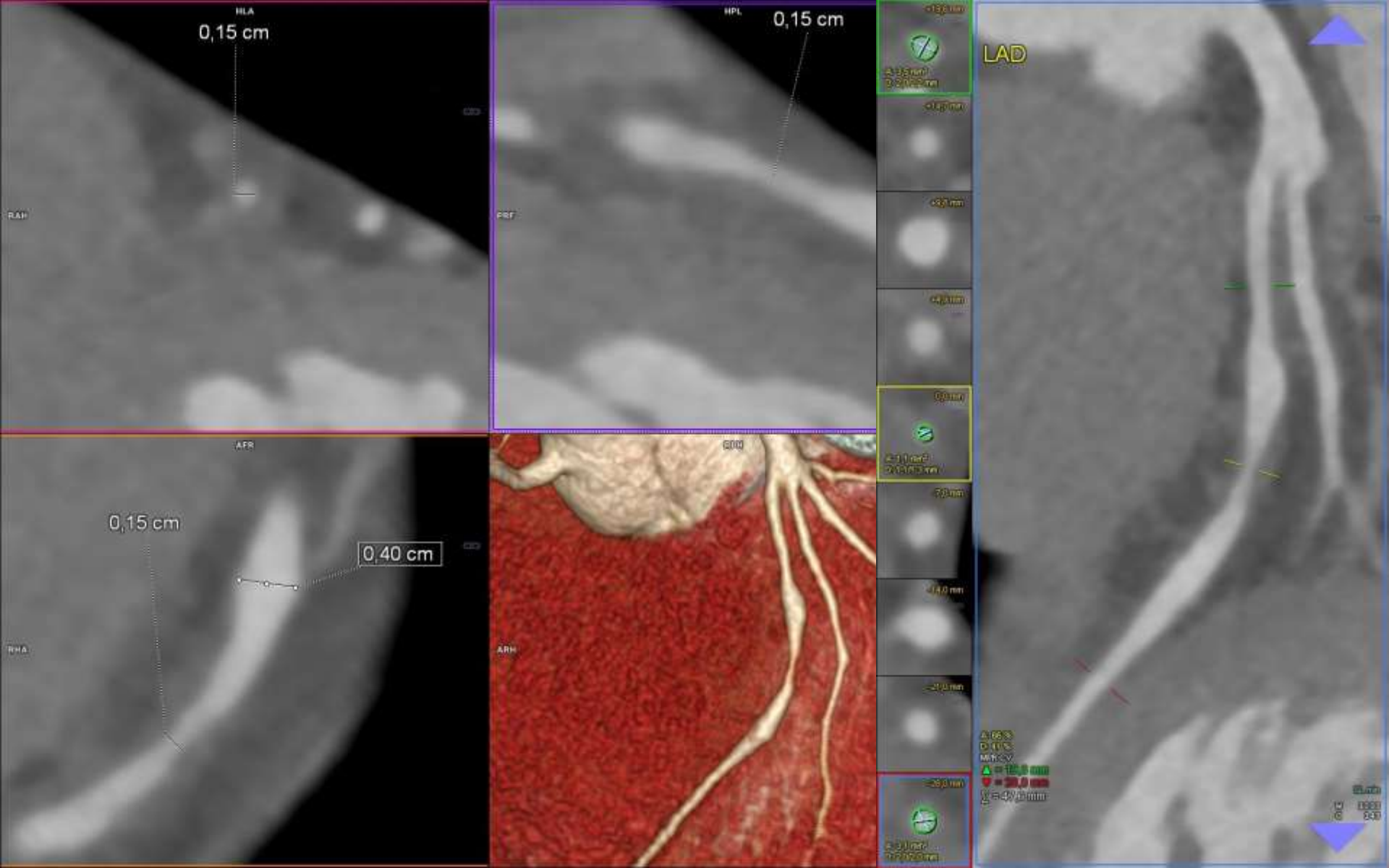
“kvantifikace” a popis

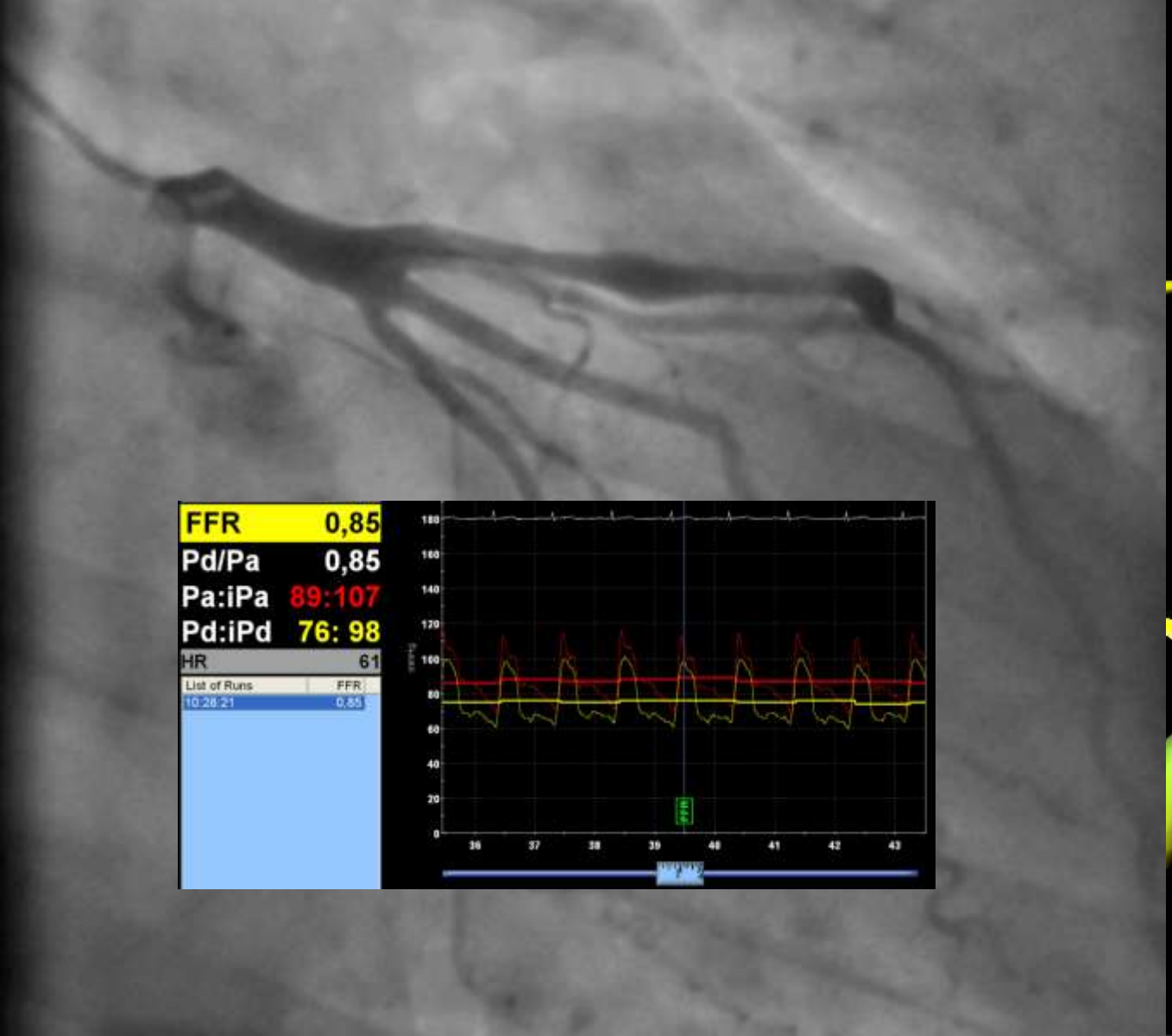
nastavená komunikace

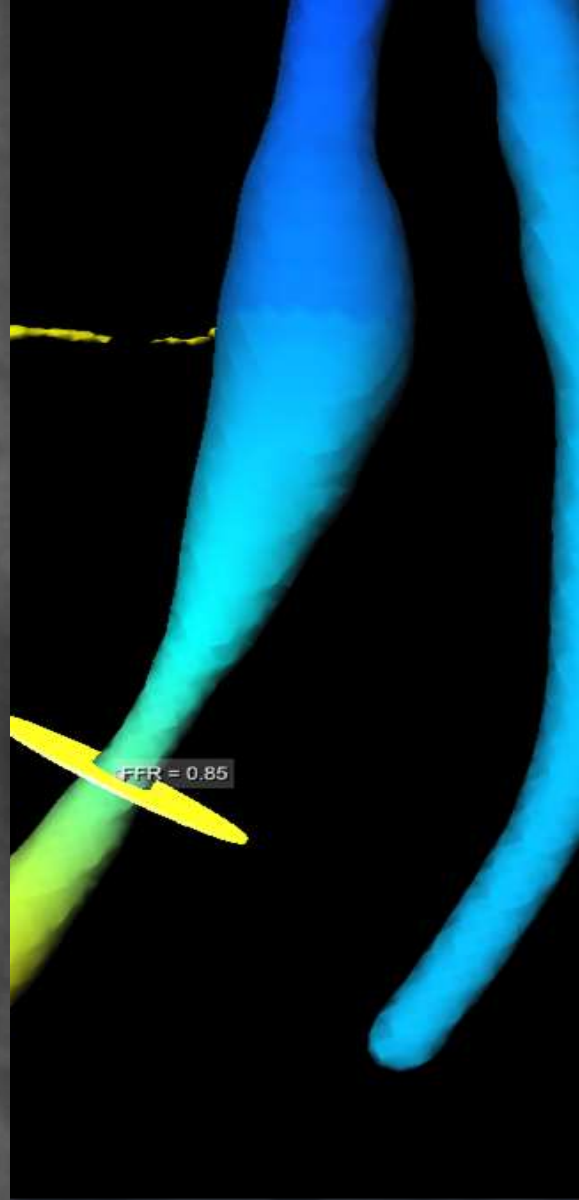




Salavati A. Dual-source computed tomography angiography for diagnosis and assessment of coronary artery disease: systematic review and meta-analysis. J Cardiovasc Comput Tomogr. 2012


HLA
0,15 cm
RAH
HPL
0,15 cm
PRF
AFR
0,15 cm
0,40 cm
RHA
CRN
ARH
LAD


FFR 0,85
Pd/Pa 0,85
Pa:iPa 89:107
Pd:iPd 76: 98
HR 61
List of Runs FFR
10:28:21 0,85
180
160
140
120
100
80
60
40
20
0
36
37
38
39
40
41
42
43
FFR


FFR = 0,85

“vzhled následuje funkci”

anatomický model

obsahuje “funkční” informaci

průtok a odpor

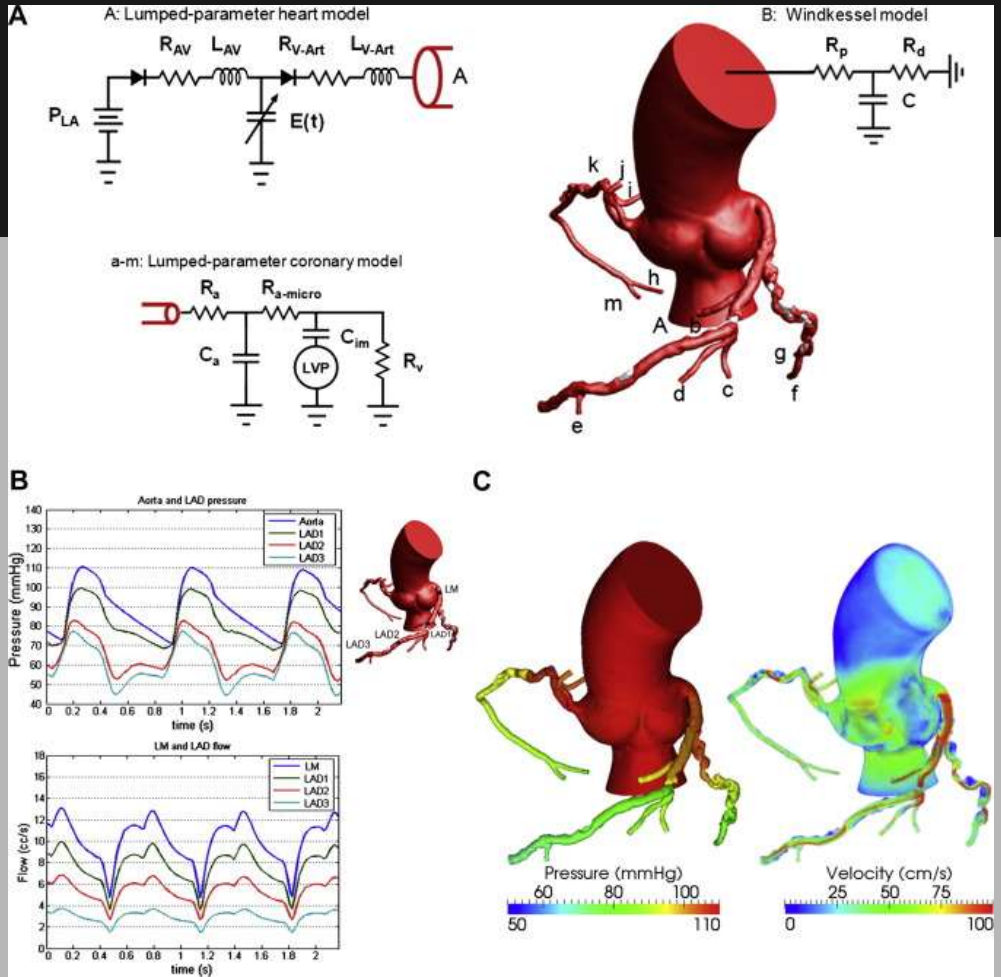
proporční k rozměrům aorty a koronárních tepen

celkový koronární průtok

proporční k objemu myokardu

Secchi F, et al. Fractional flow reserve based on computed tomography: an overview. Eur Heart J Suppl. 2016

cFFR



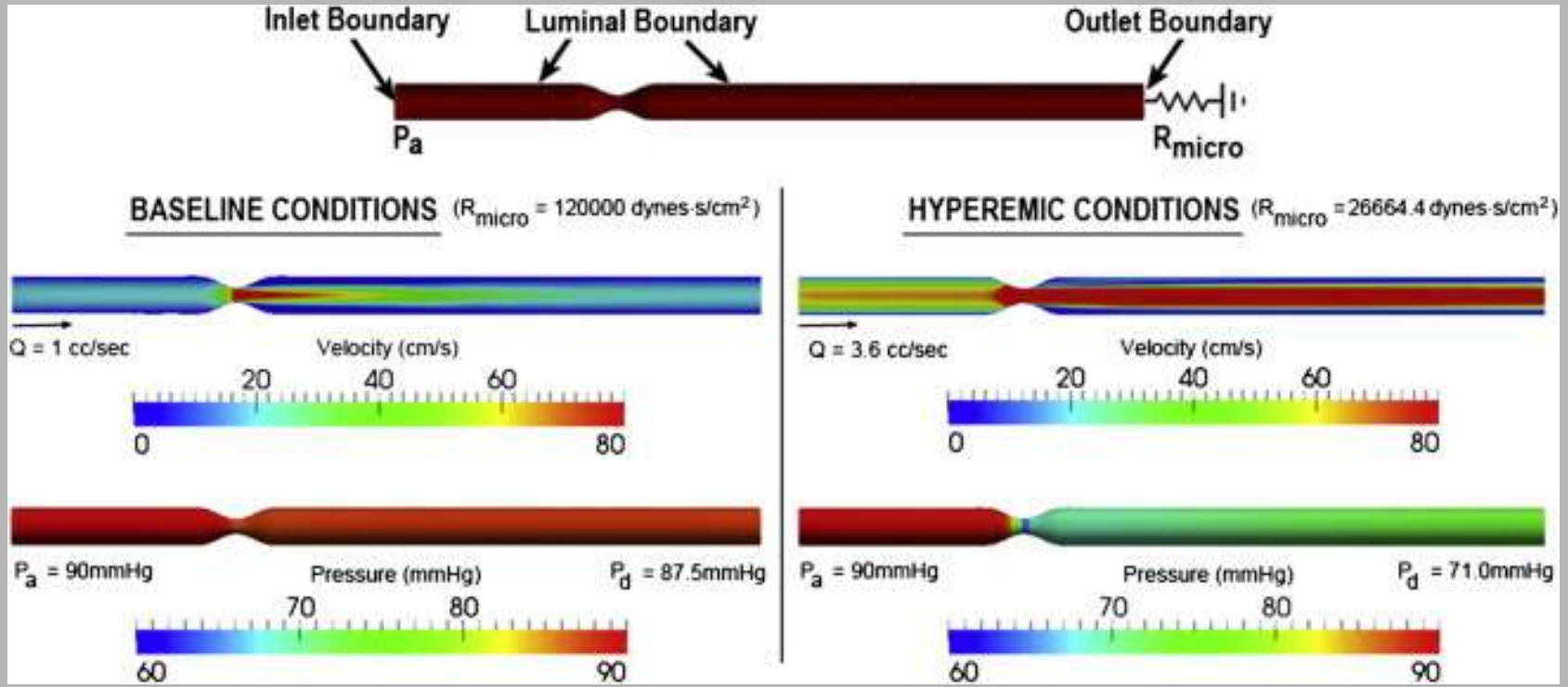
CT-FFR / FFR_{CT}

computed FFR

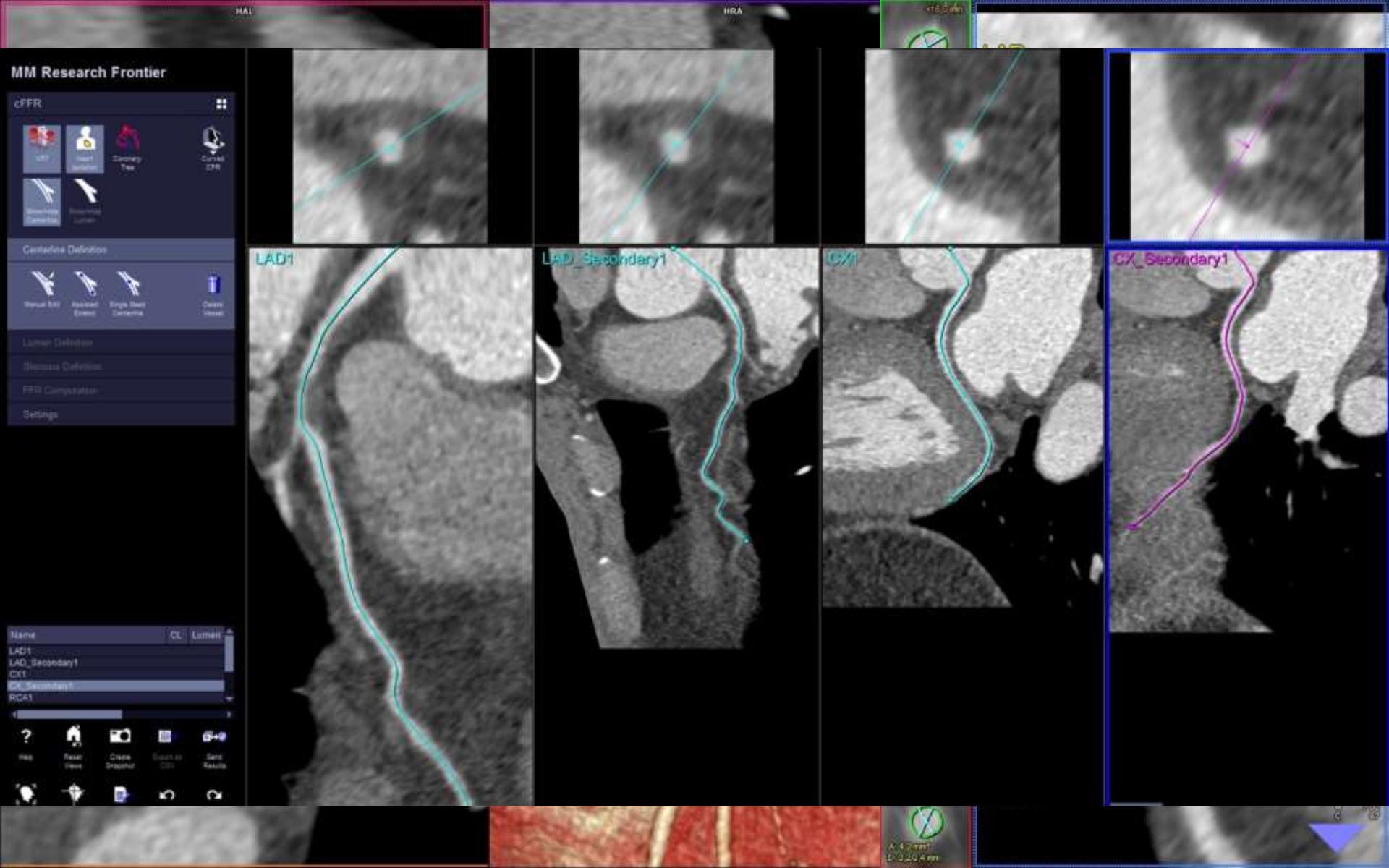
HeartFlow▫
(Redwood,CA)

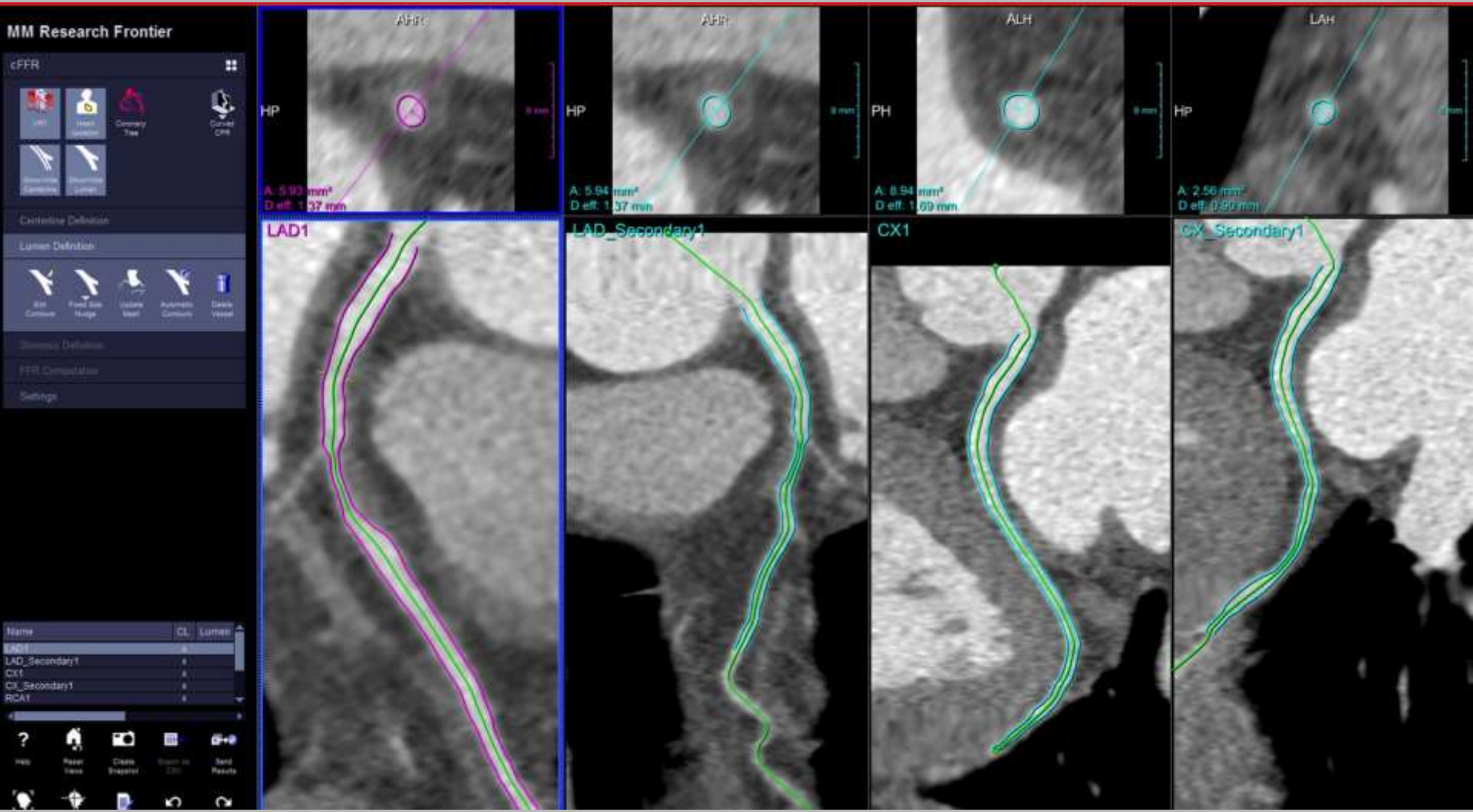
Zarins CK, Taylor CA, Min JK. Computed fractional flow reserve (FFTCT) derived from coronary CT angiography. J Cardiovasc Transl Res. 2013

“computational fluid dynamics”



Taylor CA, Fonte TA, Min JK. Computational fluid dynamics applied to cardiac computed tomography for noninvasive quantification of fractional flow reserve: scientific basis. J Am Coll Cardiol. 2013


MM Research Frontier
cFFR
Centerline Definition
Lumen Definition
Stenosis Definition
FFR Computation
Settings
Name
CL
Lumen
LAD1
LAD_Secondary1
CX1
CX_Secondary1
RCA1
LAD1
LAD_Secondary1
CX1
CX_Secondary1


MM Research Frontier
cFFR
Centerline Definition
Lumen Definition
Stenosis Definition
FFR Computation
Settings
Name
CL
Lumen
LAD1
LAD_Secondary1
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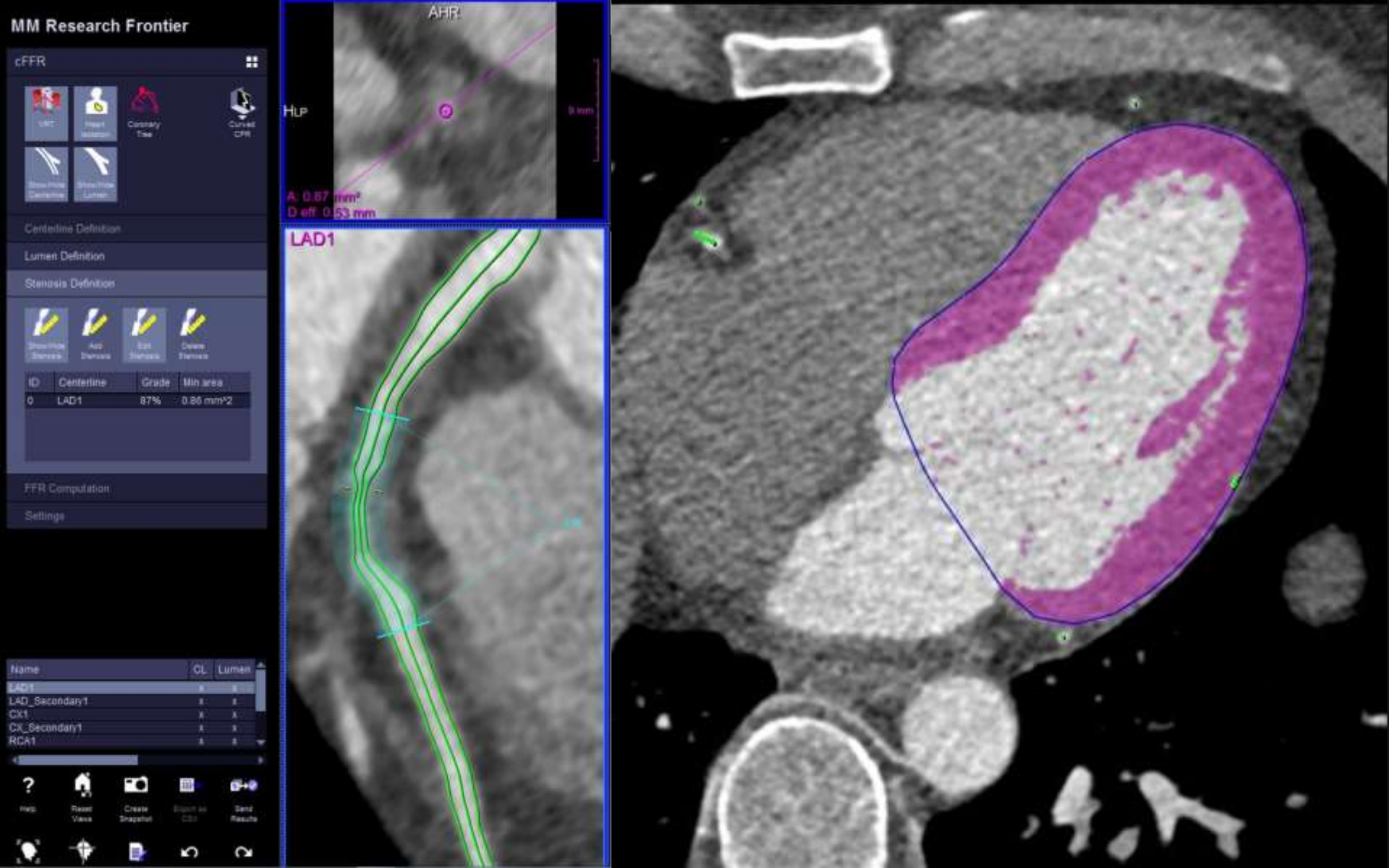
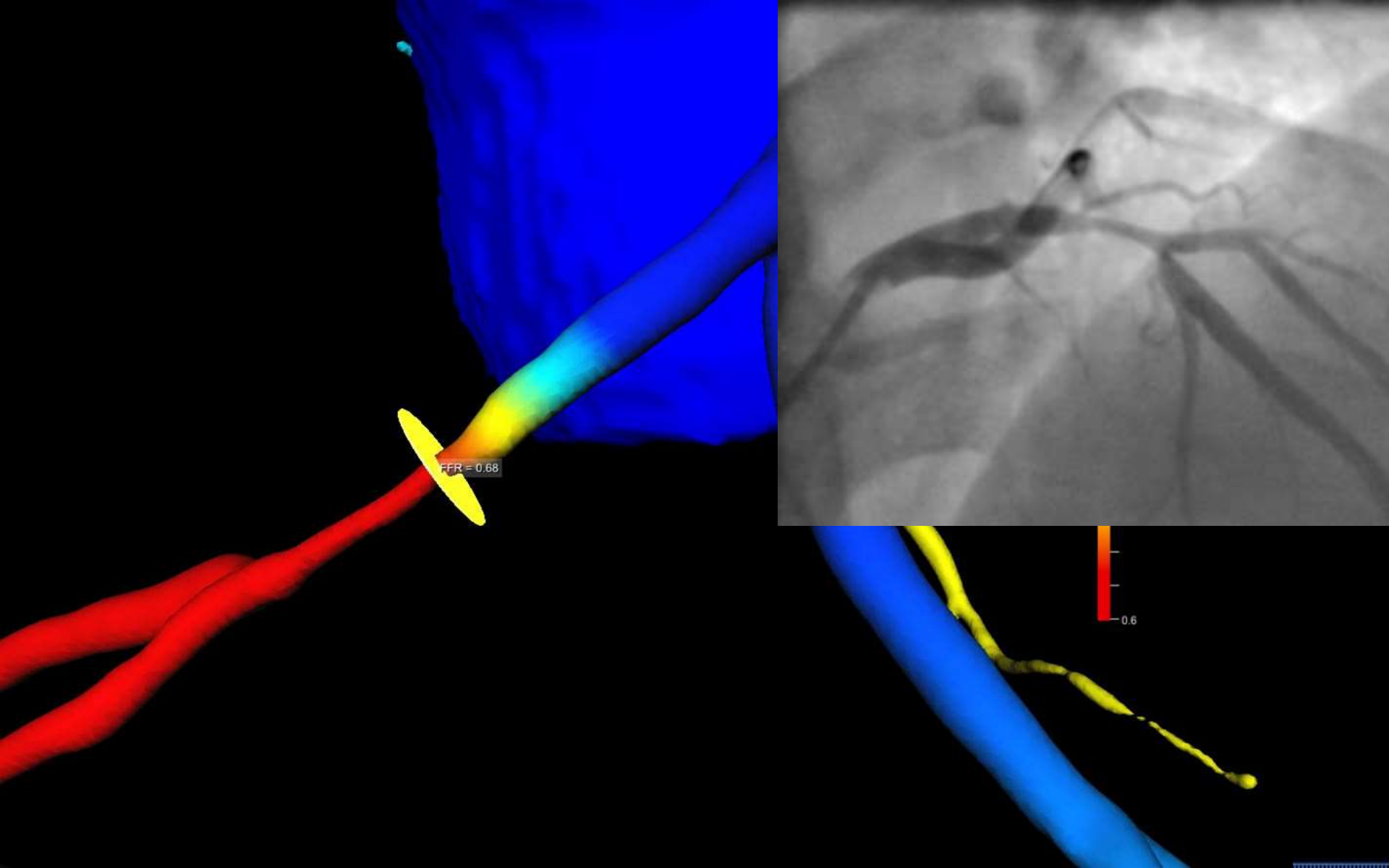
PH
ALH
LAH
LAD1
LAD_Secondary1
CX1
CX_Secondary1


MM Research Frontier
cFFR
Centerline Definition
Lumen Definition
Stenosis Definition
ID
Centerline
Grade
Min area
0
LAD1
87%
0.86 mm^2
FFR Computation
Settings
AHR
HLP
LAD1
Name
CL
Lumen
LAD1
LAD_Secondary1
CX1
CX_Secondary1
RCA1
Help
Reset Views
Create Snapshot
Send Results


FFR = 0.68
0.6

linická relevance

FFR-CT AI vs. observer scoring for lesion-specific ischemia			
	CCTA analysis and stenosis scoring by experienced observers alone	FFR-CT analysis on CCTA studies calculated by machine-learning algorithm	p-value
Men	0.76	0.83	p = 0.007
Women	0.74	0.83	p = 0.12

DISCOVER-FLOW

Diagnosis of Ischemia-Causing Stenoses Obtained Via Noninvasive Fractional Flow Reserve

DeFACTO

Determination of Fractional Flow Reserve by Anatomic Computed Tomographic Angiography

accuracy: 84 % vs. 59 %

stenozy 30 % - 70 %: 82 % senzitivita

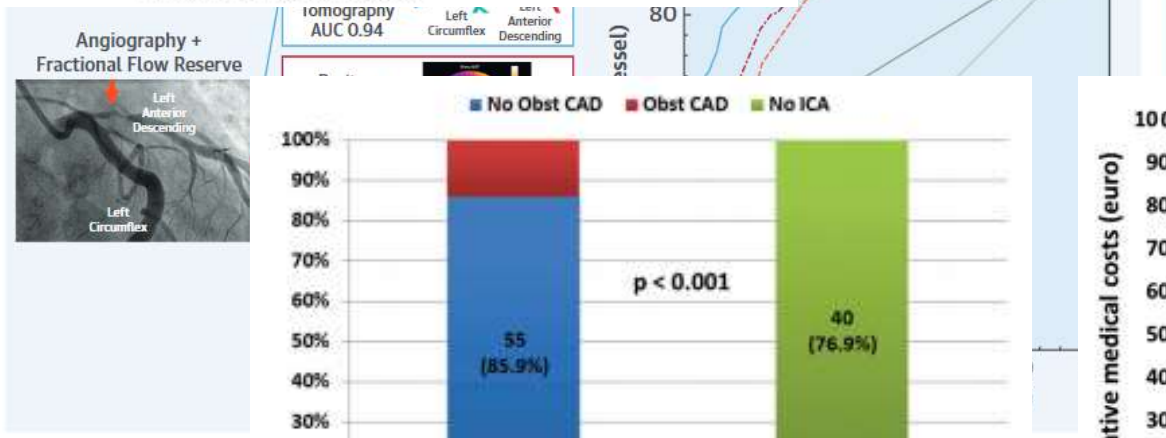
Koo HJ, et al. CT-based myocardial ischemia evaluation: quantitative angiography, transluminal attenuation gradient, myocardial perfusion, and CT-derived fractional flow reserve. Int J Cardiovasc Imaging. 2016

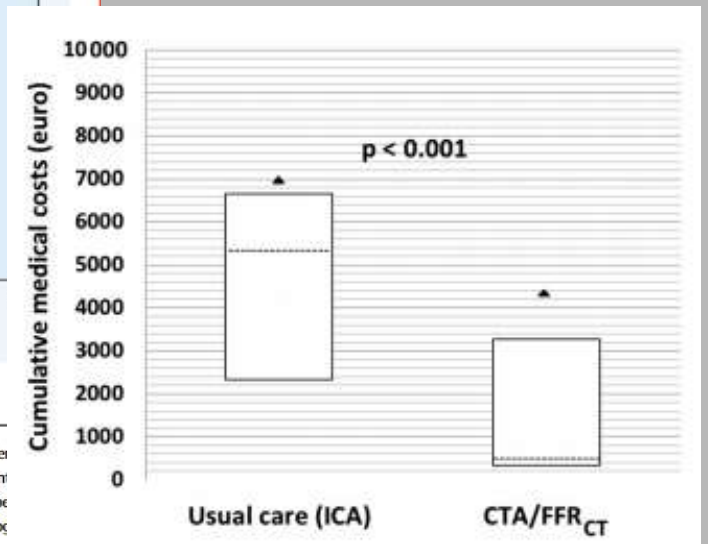
CT-FFR

openheart

An FFR_{CT} diagnostic strategy versus usual care in patients with suspected coronary artery disease planned for invasive coronary angiography at German sites: one-year results of a subgroup analysis of the PLATFORM (Prospective Longitudinal Trial of FFR_{CT}: Outcome and Resource Impacts) study

Roisin Colleran,[1] Pamela S Douglas,[2] Martin Hadamitzky,[1] Matthias Gutberlet,[3] Lukas Lehmkuhl,[3] Borek Foldyna,[3] Michael Woinke,[4] Ulrich Hink,[5] Jonathan Nadjiri,[1] Alan Wilk,[6] Furong Wang,[6] Gianluca Pontone,[7] Mark A Hlatky,[8] Campbell Rogers,[6] Robert A Byrne[1]

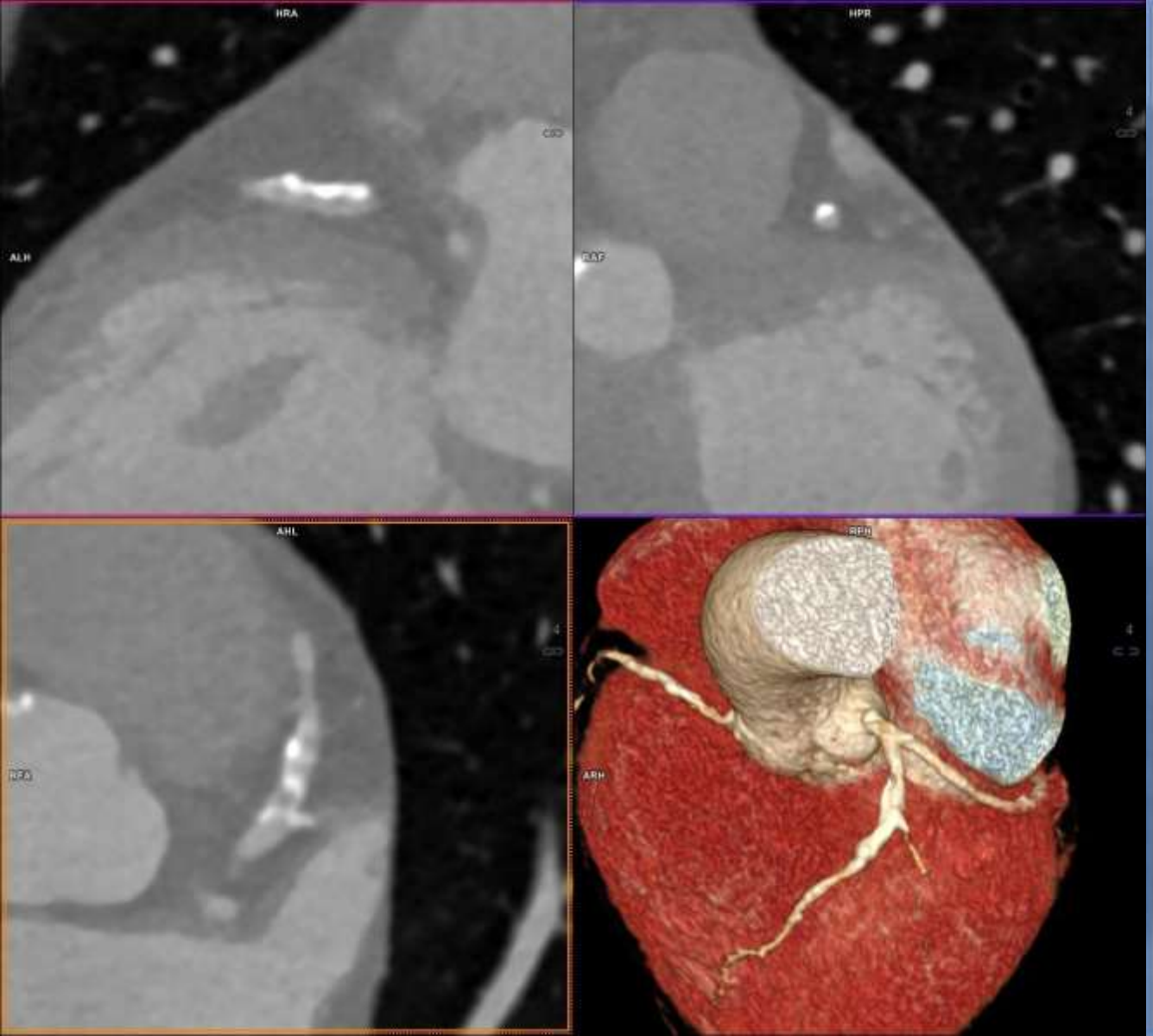


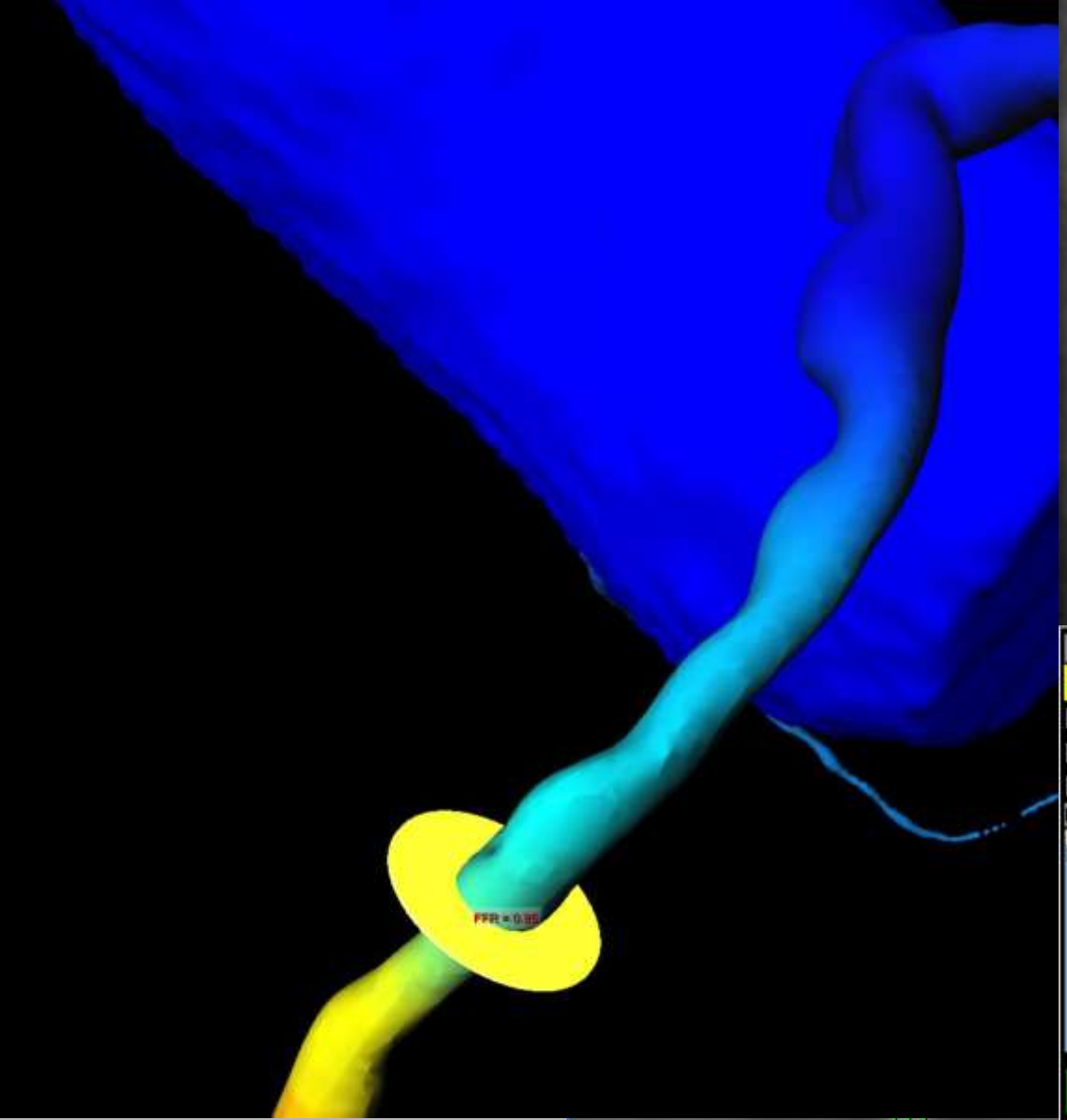


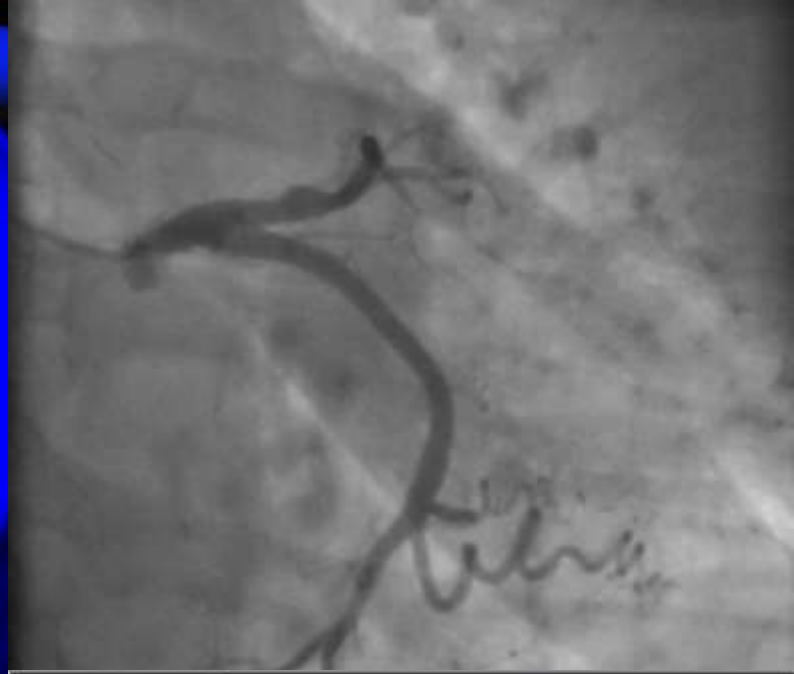
Driessen, R.S. et al. J Am Coll C

Significance of stable coronary arte
derwent FFR_{CT}, PET, coronary CTA,
descending artery stenosis in the col
ischemia. CTA = coronary computed

ICA = invasive coronary angiography; PET = positron emission tomography; SPECT = single-photon emission computed tomography.


HRA
ALH
HPR
RAF
AHL
RFA
RPH
ARH


FFR = 0.88




0:11
FFR 0,88
Pd/Pa 0,88
Pa:iPa 136:172
Pd:iPd 120:174
HR 66
List of Runs
FFR
09:58:09 0.88
Live
Options
Save Frame

limitace

kvalita anatomického modelu

kvalitní kontrastní náplň

artefakty (pohybové)

kalcifikace

kalkulace

variabilita (myocardial mass / flow)

mikroangiopatie (nadhodnocení)

stenty, CABG ???

Leipsic J, Weir-McCall J, Blanke P. FFR(CT) for Complex Coronary Artery Disease Treatment Planning: New Opportunities. Interv Cardiol. 2018

ISCT: Machine-learning FFR-CT expedites heart evaluation

September 19, 2018 -- Machine-learning fractional flow reserve CT (FFR-CT) may help clinicians overcome key barriers to conventional FFR-CT, including the lengthy amount of time required to obtain measurements, according to a presentation at the 2018 International Society for Computed Tomography (ISCT) symposium. 💬 **Discuss**

CTA + FFR_{CT}

velký potenciál

dominantní neinvazivní metoda v diagnostice ICHS

změna přístupu k revaskularizaci

další vývoj

zdokonalení algoritmů a dostupnost

“machine learning” technika

Nous FMA, et al. Comparison of the Diagnostic Performance of Coronary Computed Tomography Angiography-Derived Fractional Flow Reserve in Patients With Versus Without Diabetes Mellitus (from the MACHINE Consortium). Am J Cardiol. 2019

Deklarace konfliktu zájmů

	Nemám konflikt zájmů	Mám konflikt zájmů	Specifikace konfliktu (vyjmenujte subjekty, firmy či instituce, se kterými Vaše spolupráce může vést ke konfliktu zájmů)
Zaměstnanecký poměr	✓		
Vlastník / akcionář	✓		
Konzultant	✓		
Přednášková činnost	✓		
Člen poradních sborů (advisory boards)	✓		
Podpora výzkumu / granty	✓		
Jiné honoráře (např. za klinické studie či registry)	✓		