The Role of CTA and MRI in the Workup of ACS

Gastón A. Rodriguez Granillo MD, PhD, FACC

Instituto Medico ENERI, Clinica La Sagrada Familia
Buenos Aires

grodriguezgranillo@gmail.com

SOLACI CACI`24
ARGENTINA
BUENOS AIRES HILTON
BUENOS AIRES, ARGENTINA

Disclosures

Caristo Diagnostics (Consultant)

MultiplAI Health (Consultant)

RDCom (Consultant)

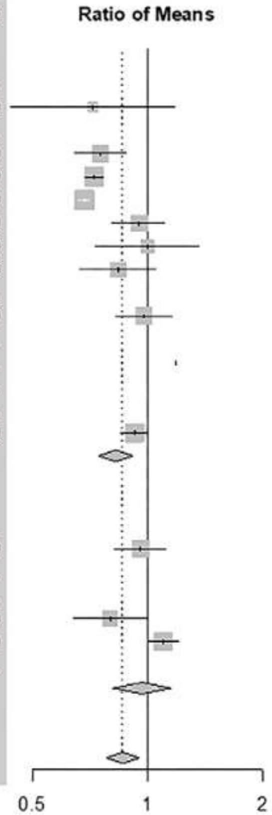
Randomized trials investigating the role of CCTA vs. SOC in patients with acute chest pain

22 studies (n=9379)

Length of stay ↓

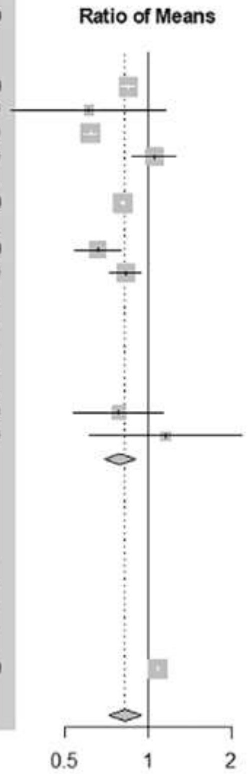
Low to Intermediate / High

Study	CCTA Total	CCTA Mean	CCTA SD	SOC Total	SOC Mean	SOC SD	ROM	95%-CI	Weight
Risk for ACS = Group 1									
Goldstein et al. (2007)	.	.	.	.	.	.			0.0%
Miller et al. (2011)	30	72.00	74.40	30	99.90	93.60	0.72	[0.44; 1.19]	2.9%
Goldstein et al. (2011)	.	.	.	.	.	.			0.0%
Hoffmann et al. (2012)	501	23.20	37.00	499	30.80	28.00	0.75	[0.64; 0.88]	8.7%
Litt et al. (2012)	908	18.00	14.50	462	24.80	8.40	0.73	[0.68; 0.77]	11.0%
Hamilton−Craig et al. (2014)	322	13.50	3.30	240	19.70	3.50	0.69	[0.66; 0.71]	11.3%
Levsky et al. (2015)	200	28.90	27.70	200	30.40	20.20	0.95	[0.81; 1.12]	8.7%
Dedic et al. (2016)	250	6.30	4.60	250	6.30	15.50	1.00	[0.73; 1.37]	5.2%
Nabi et al. (2016)	288	19.70	27.80	310	23.50	34.40	0.84	[0.67; 1.06]	7.0%
Hollander et al. (2016)	.	.	.	.	.	.			0.0%
Uretsky et al. (2017)	206	48.00	40.00	205	49.00	48.00	0.98	[0.82; 1.17]	8.4%
Chang et al. (2017)	.	.	.	.	.	.			0.0%
Levsky et al. (2018)	201	5.80	.	199	4.90	.	1.18		0.0%
Goldman et al. (2020)	.	.	.	.	.	.			0.0%
Pineiro−Portela et al. (2021)	.	.	.	.	.	.			0.0%
Aziz et al. (2022)	125	7.53	2.70	125	8.14	2.60	0.93	[0.85; 1.01]	10.6%
Random effects model	3031			2520			0.83	[0.74; 0.92]	73.7%
Heterogeneity: $I^2 = 88\%$, $\tau^2 = 0.0176$, $p < 0.01$									
Risk for ACS = Group 2									
Chang et al. (2008)	133	4.60	2.90	133	4.80	3.30	0.96	[0.82; 1.12]	8.8%
Linde et al. (2013)	.	.	.	.	.	.			0.0%
Linde et al. (2015)	.	.	.	.	.	.			0.0%
Smulders et al. (2019)	70	96.00	72.00	69	120.00	72.00	0.80	[0.64; 1.00]	7.1%
Gray et al. (2021)	877	52.80	52.80	871	48.00	48.00	1.10	[1.00; 1.21]	10.4%
Gray et al. (2022)	.	.	.	.	.	.			0.0%
Random effects model	1080			1073			0.97	[0.81; 1.15]	26.3%
Heterogeneity: $I^2 = 73\%$, $\tau^2 = 0.0171$, $p = 0.02$									
Random effects model	**4111**			**3593**			**0.86**	**[0.78; 0.95]**	**100.0%**
Heterogeneity: $I^2 = 92\%$, $\tau^2 = 0.0216$, $p < 0.01$									
Test for subgroup differences: $\chi^2_1 = 2.29$, df = 1 ($p = 0.13$)									



Costs ↓

Study	CCTA Total	CCTA Mean	CCTA SD	SOC Total	SOC Mean	SOC SD	ROM	95%-CI	Weight
Risk for ACS = Group 1									
Goldstein et al. (2007)	99	1586.00	461.00	98	1872.00	253.00	0.85	[0.80; 0.90]	13.1%
Miller et al. (2011)	30	10134.00	14239.00	30	16579.00	19148.00	0.61	[0.32; 1.17]	3.3%
Goldstein et al. (2011)	361	2137.00	1050.00	338	3458.00	1035.00	0.62	[0.58; 0.66]	13.2%
Hoffmann et al. (2012)	501	4289.00	7110.00	499	4060.00	5452.00	1.06	[0.88; 1.27]	10.8%
Litt et al. (2012)	.	.	.	.	.	.			0.0%
Hamilton−Craig et al. (2014)	322	1406.00	186.00	240	1734.00	141.00	0.81	[0.80; 0.83]	13.5%
Levsky et al. (2015)	.	.	.	.	.	.			0.0%
Dedic et al. (2016)	250	337.00	440.00	250	511.00	450.00	0.66	[0.54; 0.80]	10.6%
Nabi et al. (2016)	288	4242.00	3871.00	310	5104.00	3703.00	0.83	[0.73; 0.95]	12.0%
Hollander et al. (2016)	.	.	.	.	.	.			0.0%
Uretsky et al. (2017)	.	.	.	.	.	.			0.0%
Chang et al. (2017)	.	.	.	.	.	.			0.0%
Levsky et al. (2018)	.	.	.	.	.	.			0.0%
Goldman et al. (2020)	.	.	.	.	.	.			0.0%
Pineiro−Portela et al. (2021)	100	3003.00	4080.00	103	3834.00	5310.00	0.78	[0.54; 1.14]	6.7%
Aziz et al. (2022)	125	1475.00	2544.00	125	1272.00	4103.00	1.16	[0.61; 2.20]	3.4%
Random effects model	2076			1993			0.79	[0.70; 0.90]	86.5%
Heterogeneity: $I^2 = 91\%$, $\tau^2 = 0.0257$, $p < 0.01$									
Risk for ACS = Group 2									
Chang et al. (2008)	.	.	.	.	.	.			0.0%
Linde et al. (2013)	.	.	.	.	.	.			0.0%
Linde et al. (2015)	.	.	.	.	.	.			0.0%
Smulders et al. (2019)	.	.	.	.	.	.			0.0%
Gray et al. (2021)	.	.	.	.	.	.			0.0%
Gray et al. (2022)	877	7330.00	840.00	871	6767.00	743.00	1.08	[1.07; 1.09]	13.5%
Random effects model	**2953**			**2864**			**0.83**	**[0.72; 0.95]**	**100.0%**
Heterogeneity: $I^2 = 99\%$, $\tau^2 = 0.0363$, $p < 0.01$									
Test for subgroup differences: $\chi^2_1 = 23.02$, df = 1 ($p < 0.01$)									



Barbosa M, et al. Radiol Cardiothorac Imaging 2023; 5(4):e230022

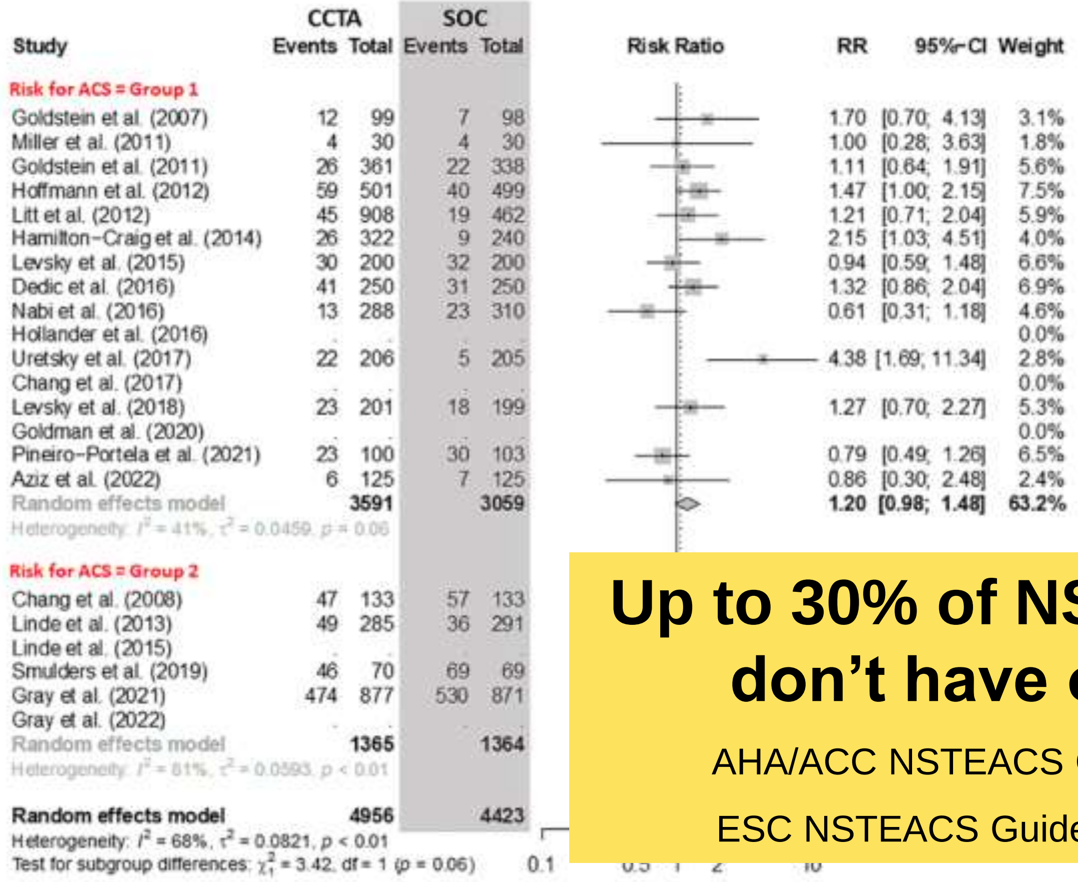
Randomized trials investigating the role of CCTA vs. SOC in patients with acute chest pain

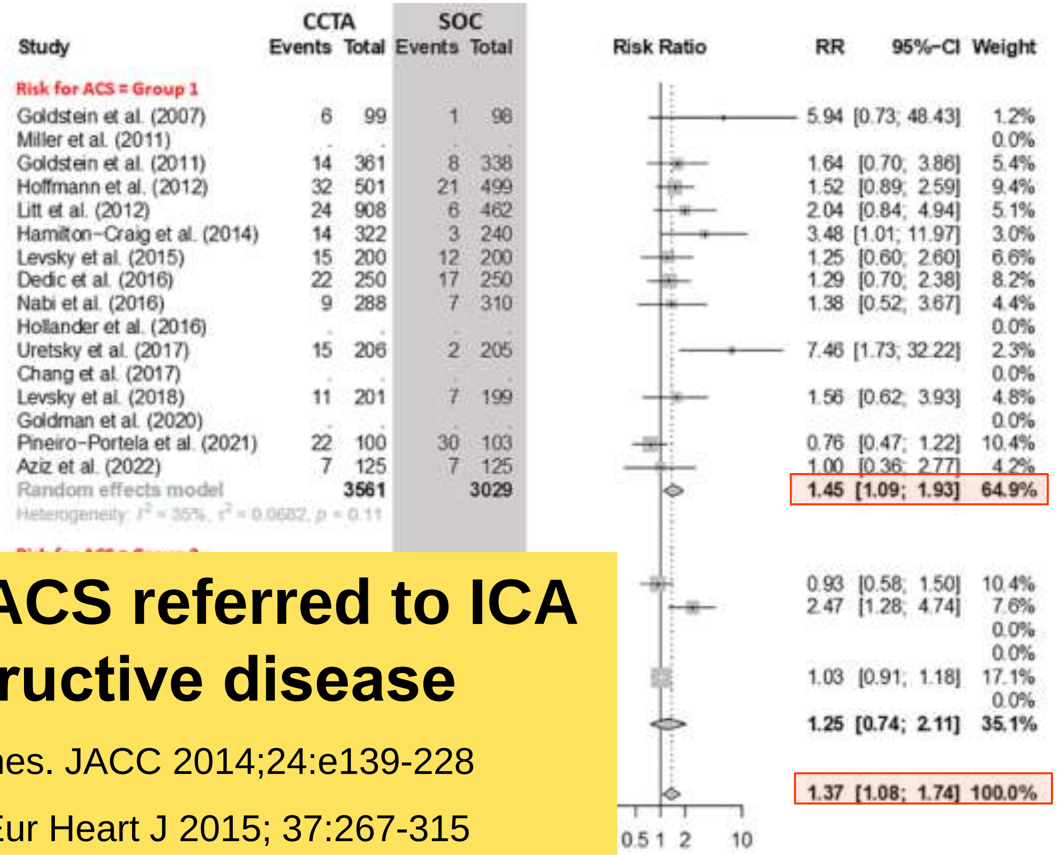
ICA =

Revascularization ↑

Low to Intermediate

High





Up to 30% of NSTEACS referred to ICA don't have obstructive disease

AHA/ACC NSTEACS Guidelines. JACC 2014;24:e139-228

ESC NSTEACS Guidelines. Eur Heart J 2015; 37:267-315

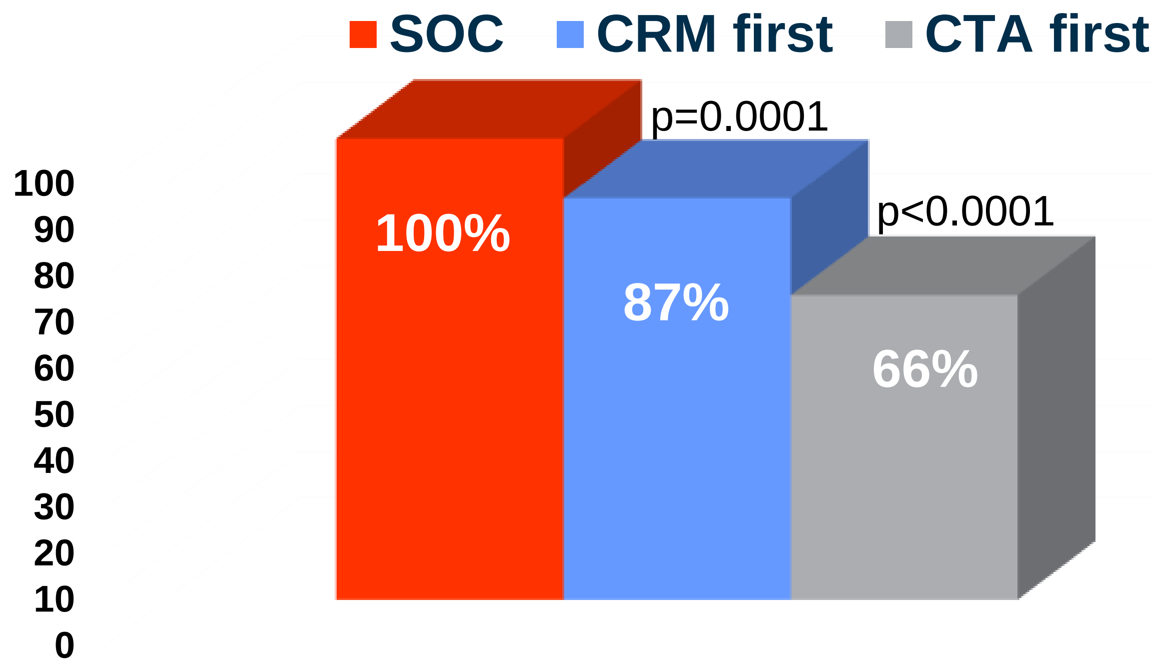
Barbosa M, et al. Radiol Cardiothorac Imaging 2023; 5(4):e230022

Initial Imaging-Guided Strategy Versus Routine Care in Patients With Non-ST-Segment Elevation Myocardial Infarction

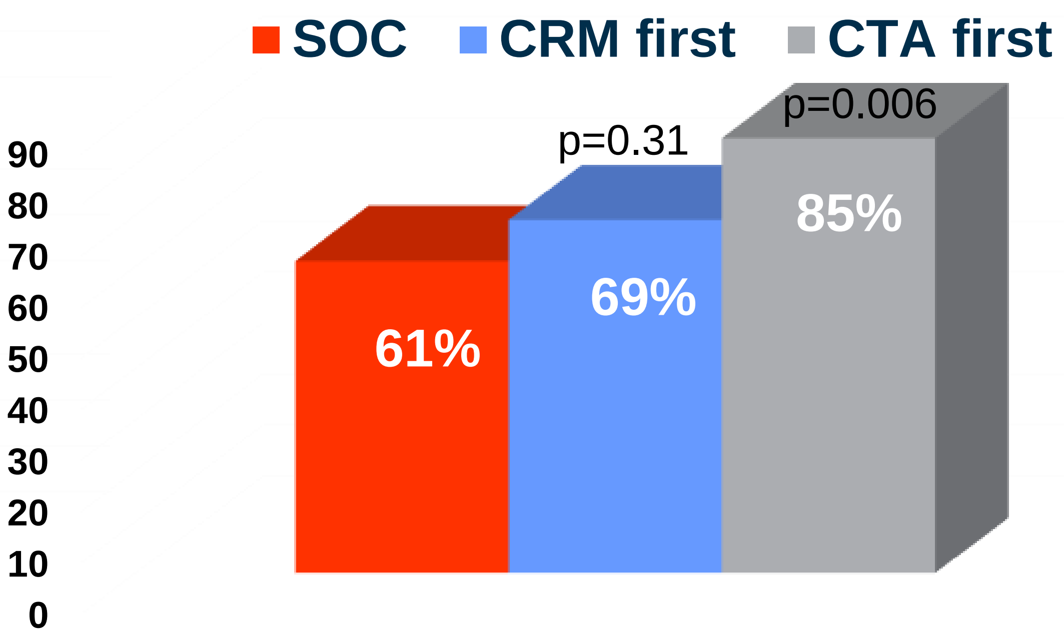
Martijn W. Smulders, MD,[a,b] Bas L.J.H. Kietselaer, MD, PhD,[a,b,c] Joachim E. Wildberger, MD, PhD,[b,c]
Pieter C. Dagnelie, PhD,[b,d] Hans-Peter Brunner-La Rocca, MD,[a,b] Alma M.A. Mingels, PhD,[e]
Yvonne J.M. van Cauteren, MD,[a,b,c] Ralph A.L.J. Theunissen, MD,[a] Mark J. Post, MD, PhD,[b,f]
Simon Schalla, MD, PhD,[a,b,c] Sander M.J. van Kuijk, PhD,[g] Marco Das, MD, PhD,[b,c,h] Raymond J. Kim, MD,[i]
Harry J.G.M. Crijns, MD, PhD,[a,b] Sebastiaan C.A.M. Bekkers, MD, PhD[a,b,c]

CARMENTA study

207 patients with acute chest pain, elevated hs/TnT and inconclusive ECG



Referral to ICA



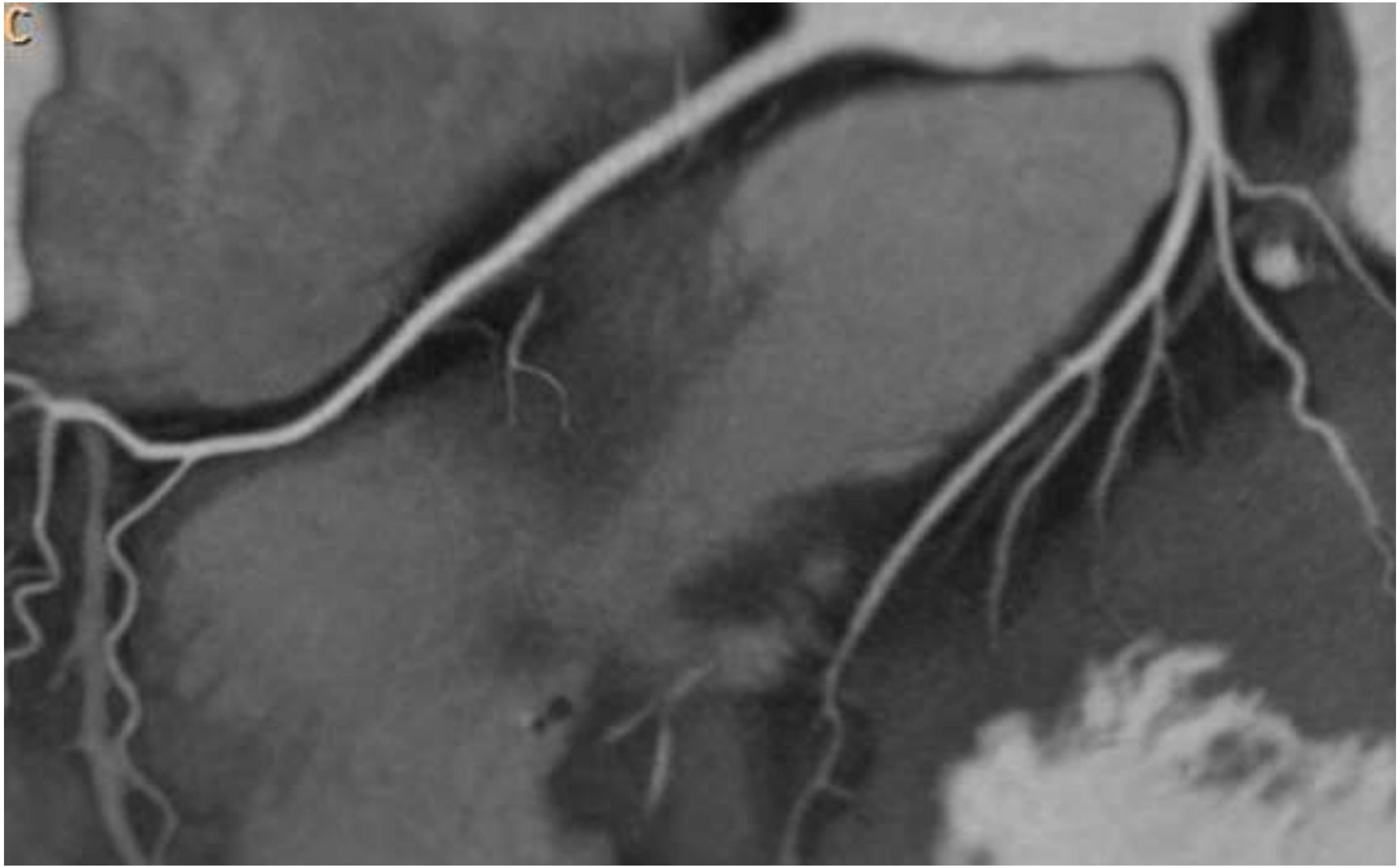
Obstructive CAD on ICA

Am Heart J 2013 Dec;166(6):968-75

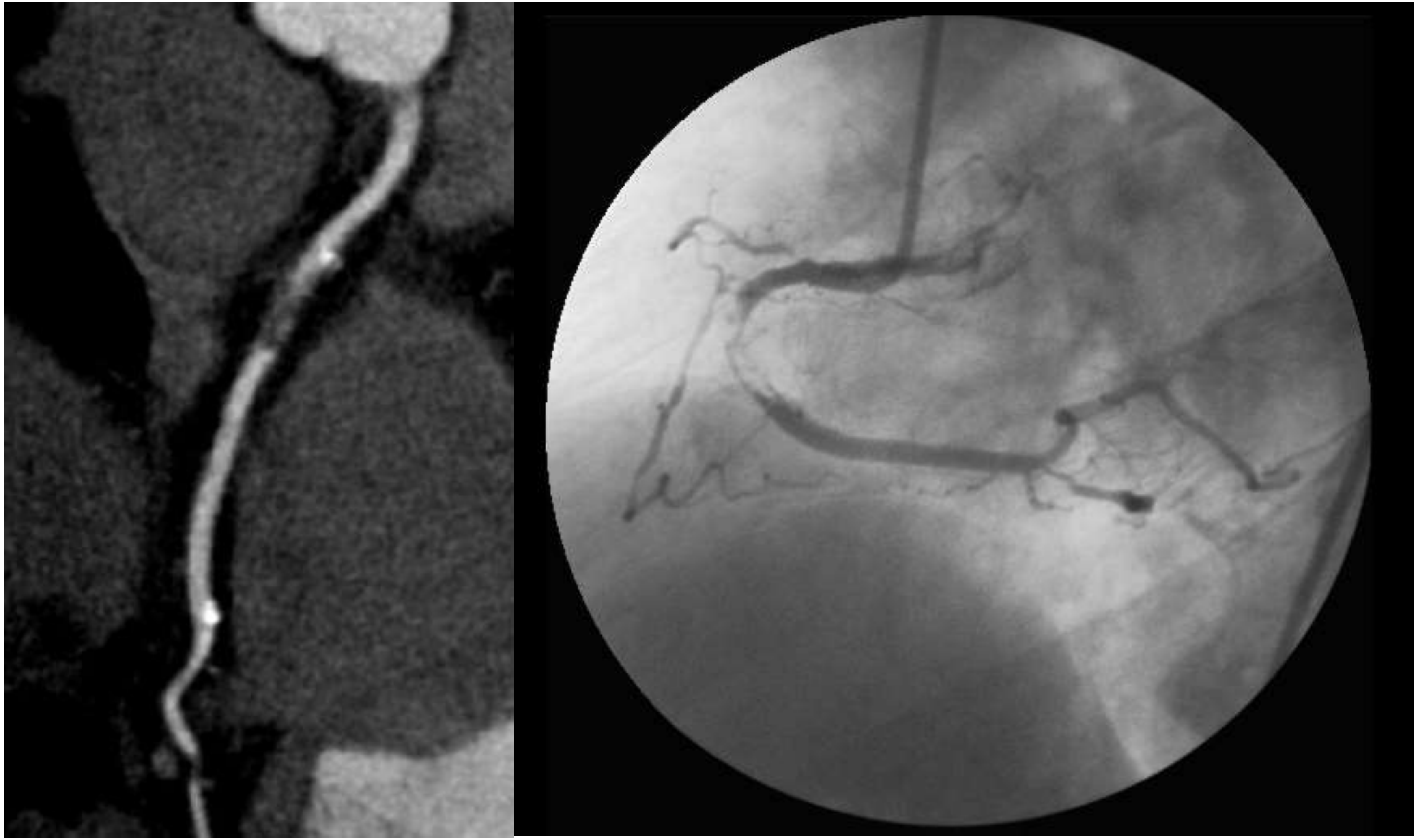
Normal

ACRIN-PA=

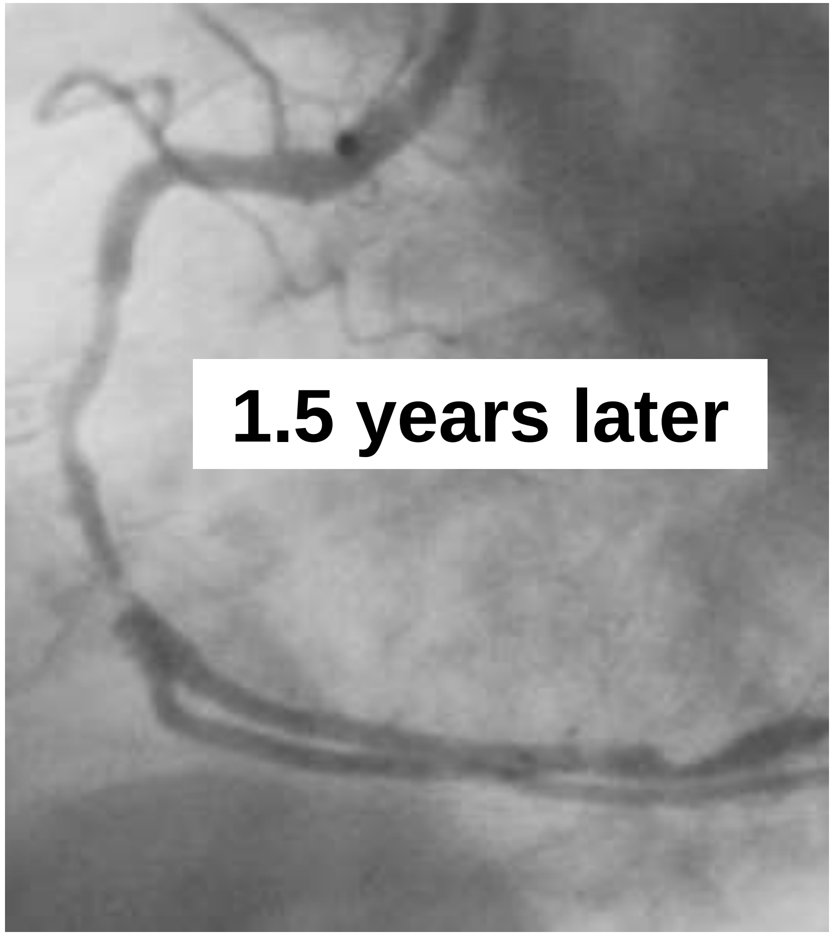
0% MACE in 640 patients with negative CTA



Obstructive

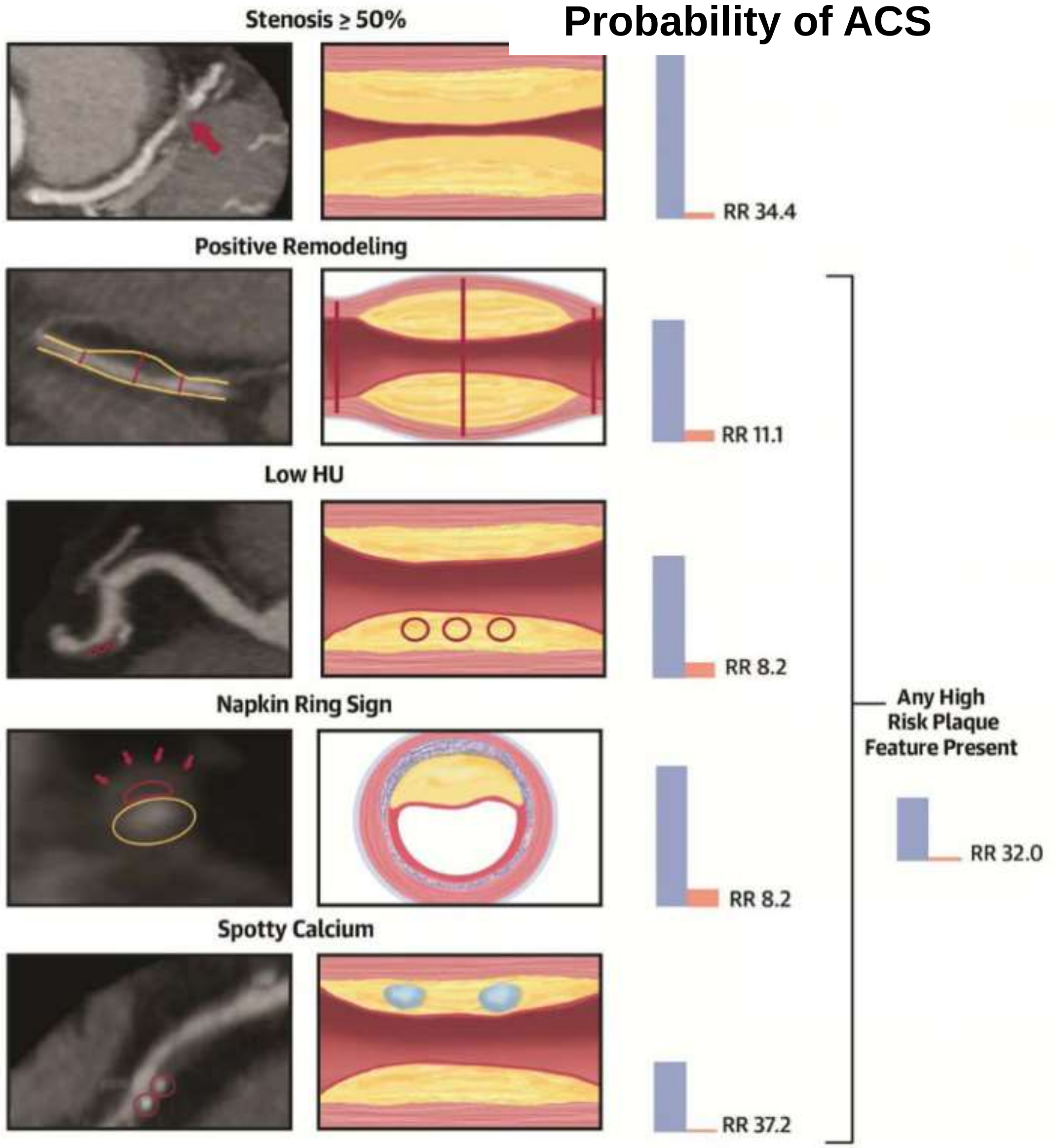


Non-obstructive

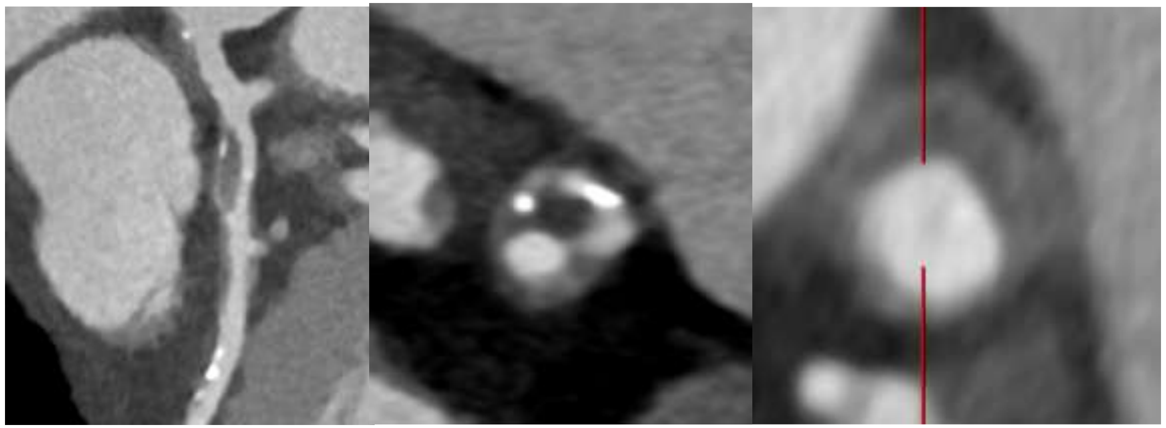


Functional tests
Advanced analysis (HRP)

ROMICAT II subanalysis (CT arm):



22% patients with ACS had stenosis <50%



HRP independent predictor of ACS

(OR 8.9, 95% CI 1.8-43.3, p=0.006) after adjusting for <u>% stenosis</u>, age, gender, and risk factors

Puchner SB, et al. J Am Coll Cardiol. 2014 Aug 19;64(7):684-92

JACC: CARDIOVASCULAR IMAGING

© 2019 BY THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION

PUBLISHED BY ELSEVIER

ORIGINAL RESEARCH

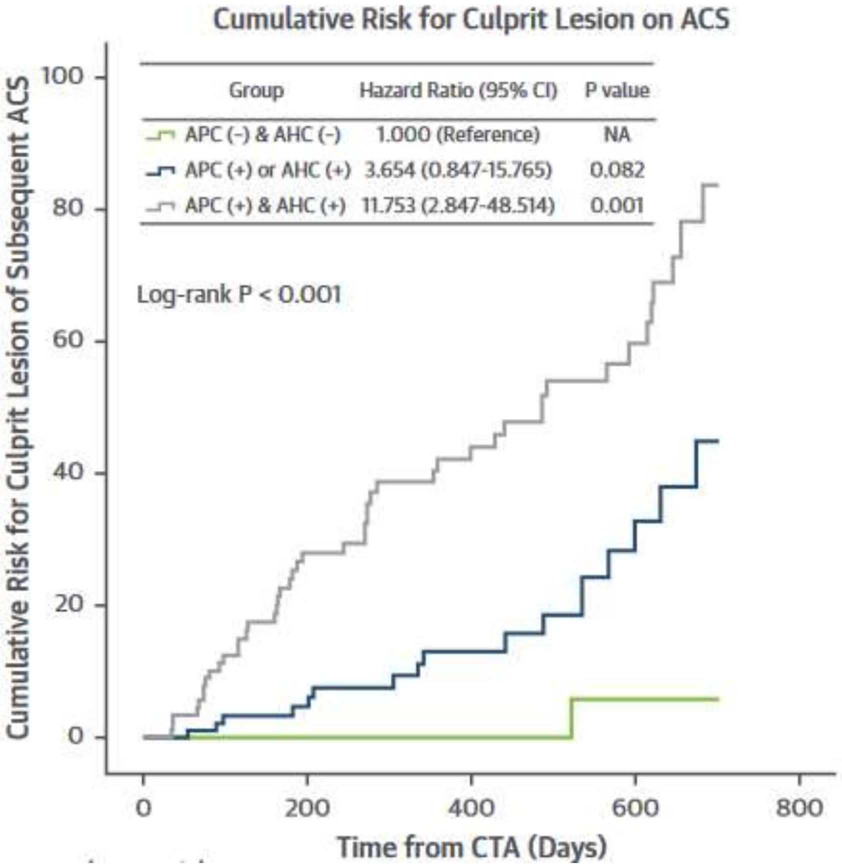
Identification of High-Risk Plaques Destined to Cause Acute Coronary Syndrome Using Coronary Computed Tomographic Angiography and Computational Fluid Dynamics

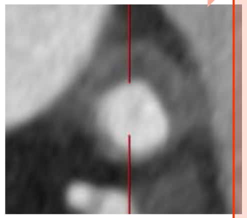
Joo Myung Lee, MD, MPH, PhD, Gilwoo Choi, PhD, Bon-Kwon Koo, MD, PhD, Doyeon Hwang, MD, Jonghanne Park, MD, PhD, Jinlong Zhang, MD, Kyung-Jin Kim, MD, Yaliang Tong, MD, Hyun Jin Kim, PhD, Leo Grady, PhD, Joon-Hyung Doh, MD, PhD, Chang-Wook Nam, MD, PhD, Eun-Seok Shin, MD, PhD,

EMERALD study (ACS with previous CT)

Prior CT 1-24 months

Culprit vs. non-culprit





	Nonculprit Lesion (n = 150)	Culprit Lesion (n = 66)	p Value
Vessel location			0.001
LAD	48 (32.0)	39 (59.1)	
LCX	39 (26.0)	9 (13.6)	
RCA	63 (42.0)	18 (27.3)	
Lesion location			0.193
Proximal	62 (41.3)	36 (54.5)	
Mid	61 (40.7)	20 (30.3)	
Distal	27 (18.0)	10 (15.2)	
Anatomical severity			
Lesion length, mm	12.1 ± 7.4	15.8 ± 8.4	0.002
MLA, mm^2	3.02 ± 1.58	2.11 ± 1.43	<0.001
Diameter stenosis, %	43.1 ± 15.0	55.5 ± 15.4	<0.001
Distance from ostium, mm	47.8 ± 20.4	45.5 ± 27.2	0.489
Adverse plaque characteristics			
Low-plaque density	43 (28.7)	41 (62.1)	<0.001
Positive remodeling	16 (10.7)	23 (34.8)	<0.001
Napkin-ring sign	13 (8.7)	22 (33.3)	<0.001
Spotty calcification	31 (20.7)	28 (42.4)	0.001
Any adverse plaque characteristics*	63 (42.0)	53 (80.3)	<0.001
Hemodynamic parameters			
FFR_{CT}	0.79 ± 0.14	0.72 ± 0.17	0.006
ΔFFR_{CT}	0.06 ± 0.07	0.17 ± 0.17	<0.001
Wall shear stress, dyn/cm^2	145.5 ± 87.6	221.8 ± 113.2	<0.001
Axial plaque stress, dyn/cm^2	1,734.7 ± 1,896.8	2,585.9 ± 2,401.3	0.006

Inflammatory risk and cardiovascular events in patients without obstructive coronary artery disease: the ORFAN multicentre, longitudinal cohort study

Kenneth Chan*, Elizabeth Wahome*, Apostolos Tsiachristas, Alexios S Antonopoulos, Parijat Patel, Maria Lyasheva, Lucy Kingham, Henry West, Evangelos K Oikonomou, Lucrezia Volpe, Michail C Mavrogiannis, Edward Nicol, Tarun K Mittal, Thomas Halborg, Rafail A Kotronias, David Adlam, Bhavik Modi, Jonathan Rodrigues, Nicholas Screaton, Attila Kardos, John P Greenwood, Nikant Sabharwal, Giovanni Luigi De Maria, Shahzad Munir, Elisa McAlindon, Yogesh Sohan, Pete Tomlins, Muhammad Siddique, Andrew Kelion, Cheerag Shirodaria, Francesca Pugliese, Steffen E Petersen, Ron Blankstein, Milind Desai, Bernard J Gersh, Stephan Achenbach, Peter Libby, Stefan Neubauer, Keith M Channon, John Deanfield, Charalambos Antoniades, on behalf of the ORFAN Consortium

ORFAN

Lancet 2024; 403: 2606–18

Cohort A=

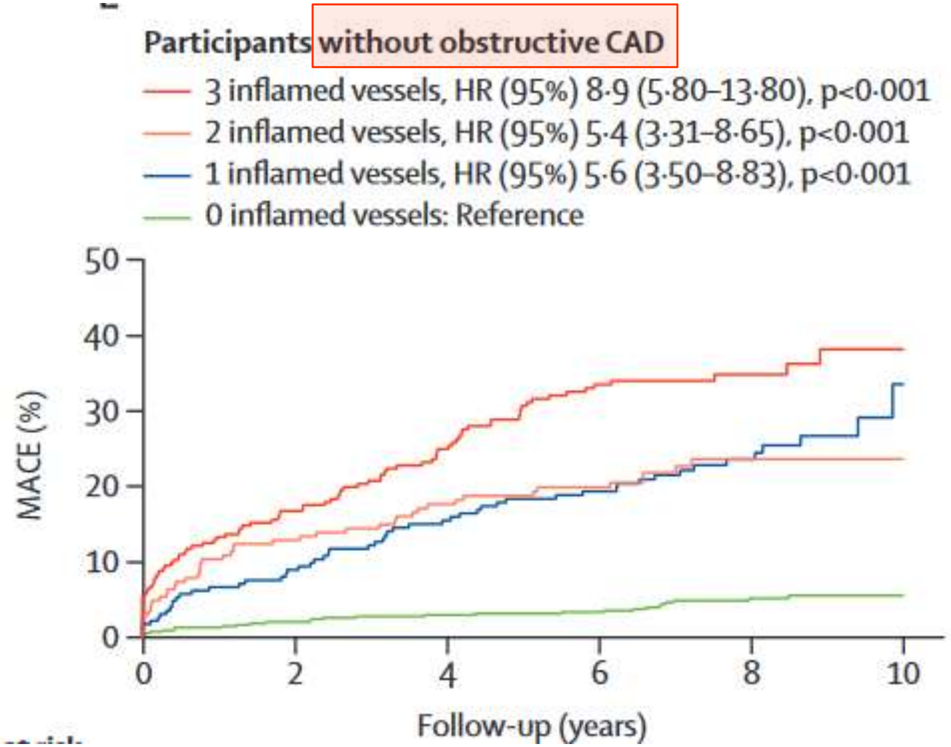
40 091 patients with median FUP 2.7 years

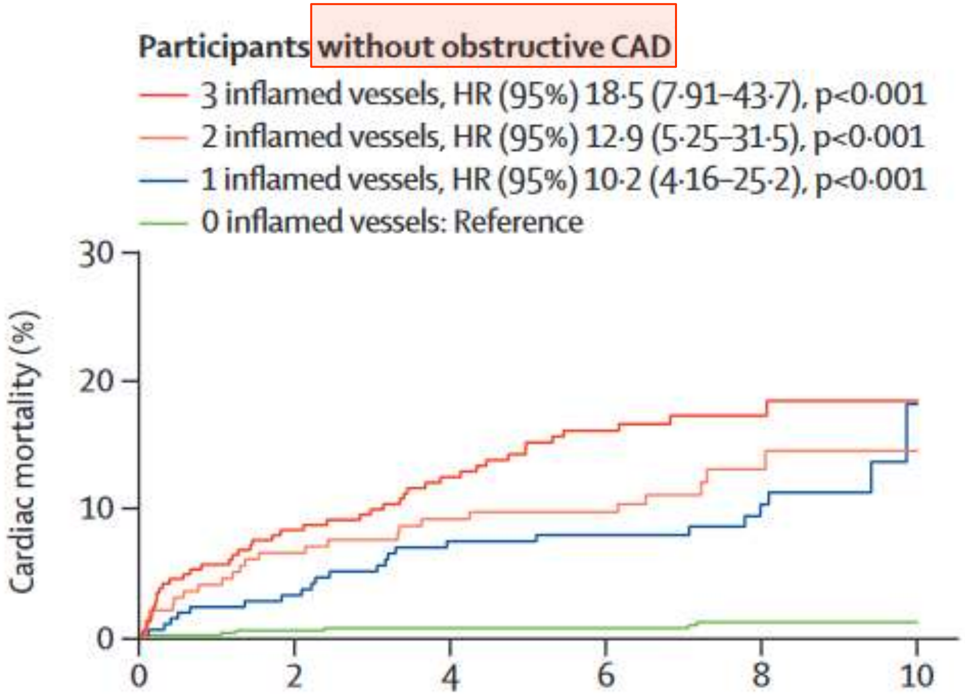
Cohort B=

3393 patients with median FUP 7.7 years

66% of MACE and 63% of deaths occurred in patients with non-obstructive CAD

FAI Score in any vessel predicted cardiac mortality and MACE independently from risk factors and the presence or extent of CAD





MINOCA (5-15% of AMI referred to ICA)

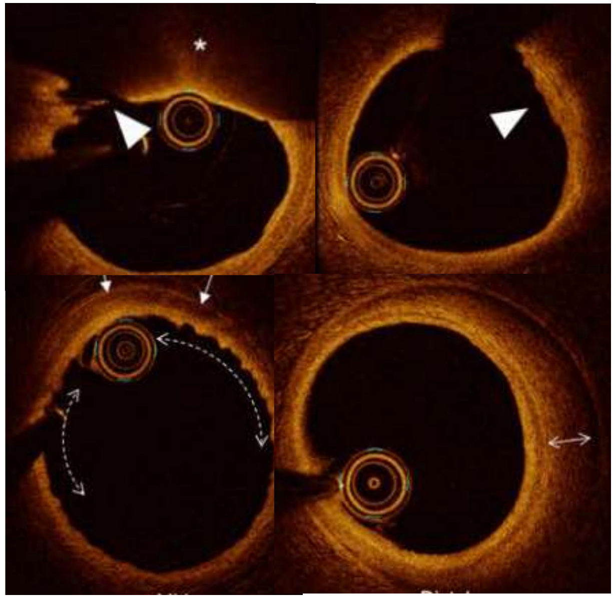
Bainey KR. COAPT study. Int J Cardiol. 2018;264:12–17
Lindahl B. Circulation. 2017;135:1481–1489.
Smilowitz NR. Am Heart J. 2011;161:681–688

Circulation

ORIGINAL RESEARCH ARTICLE

Coronary Optical Coherence Tomography and Cardiac Magnetic Resonance Imaging to Determine Underlying Causes of Myocardial Infarction With Nonobstructive Coronary Arteries in Women

116 women with MINOCA + 3V OCT + MRI



Combined OCT and MRI findings:

- Final diagnosis of MI, 64%
- Myocarditis, 15%
- Takotsubo 3%
- Non-ischemic CM 3%
- Unknown mechanism (16%)

	Normal ICA
Sites (n=16):	**53%**
Core lab:	**3%**

Reynolds H. Circulation. 2021;143:624–640.

55 year-old male. Smoker. Dyslipidemia

Acute chest pain with abnormal ECG (infra ST 0.5 mm DII, DIII y AvF) and enzyme elevation

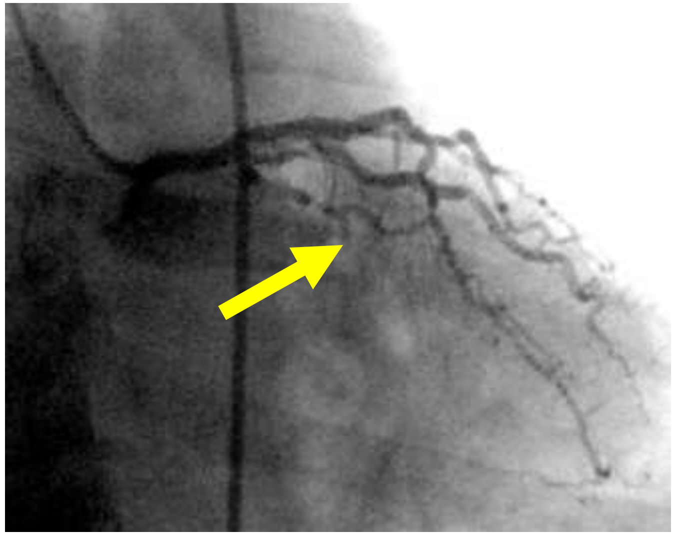
Invasive angiogram (05/05/24):

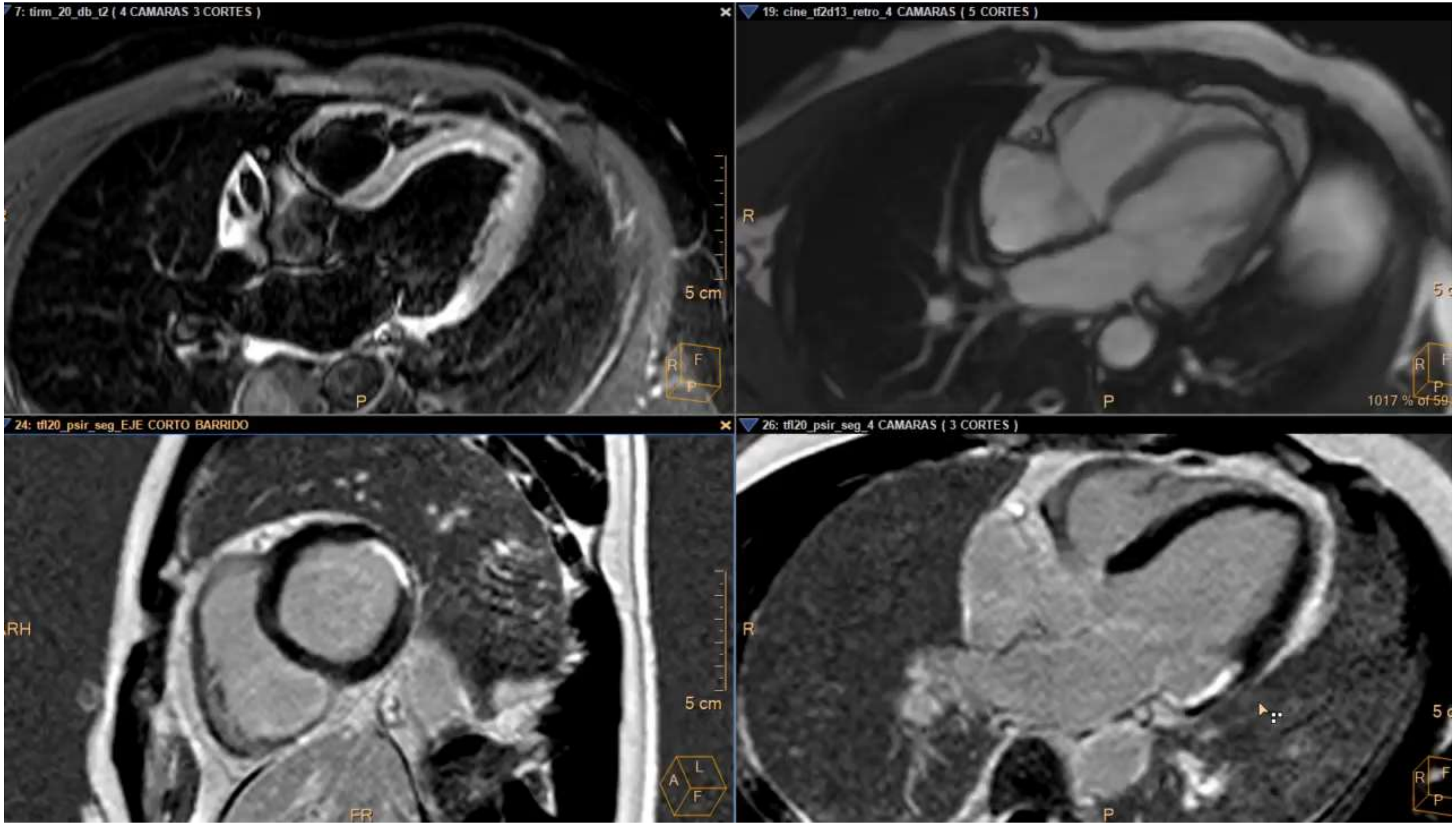
MINOCA

Echocardiogram (08/05/24): LVEF 64%, without wall motion abnormalities

MINOCA

Cardiac MR to define etiology (40 days later)





Circulation:
Cardiovascular Interventions

CURRENT

RESEARCH ARTICLE | Originally Published 30 April 2019 | Check for updates

Identifying the Infarct-Related Artery in Patients With Non–ST-Segment–Elevation Myocardial Infarction: Insights From Cardiac Magnetic Resonance Imaging

John F. Heitner, MD, Annamalai Senthilkumar, MD, J. Kevin Harrison, MD, Igor Klem, MD, Michael H. Sketch Jr, MD, Alexandr Ivanov, MD, Carine Hamo, MD, ... SHOW ALL ..., and Raymond J. Kim, MD | AUTHOR INFO & AFFILIATIONS

114 patients with first MI (NSTEMI)

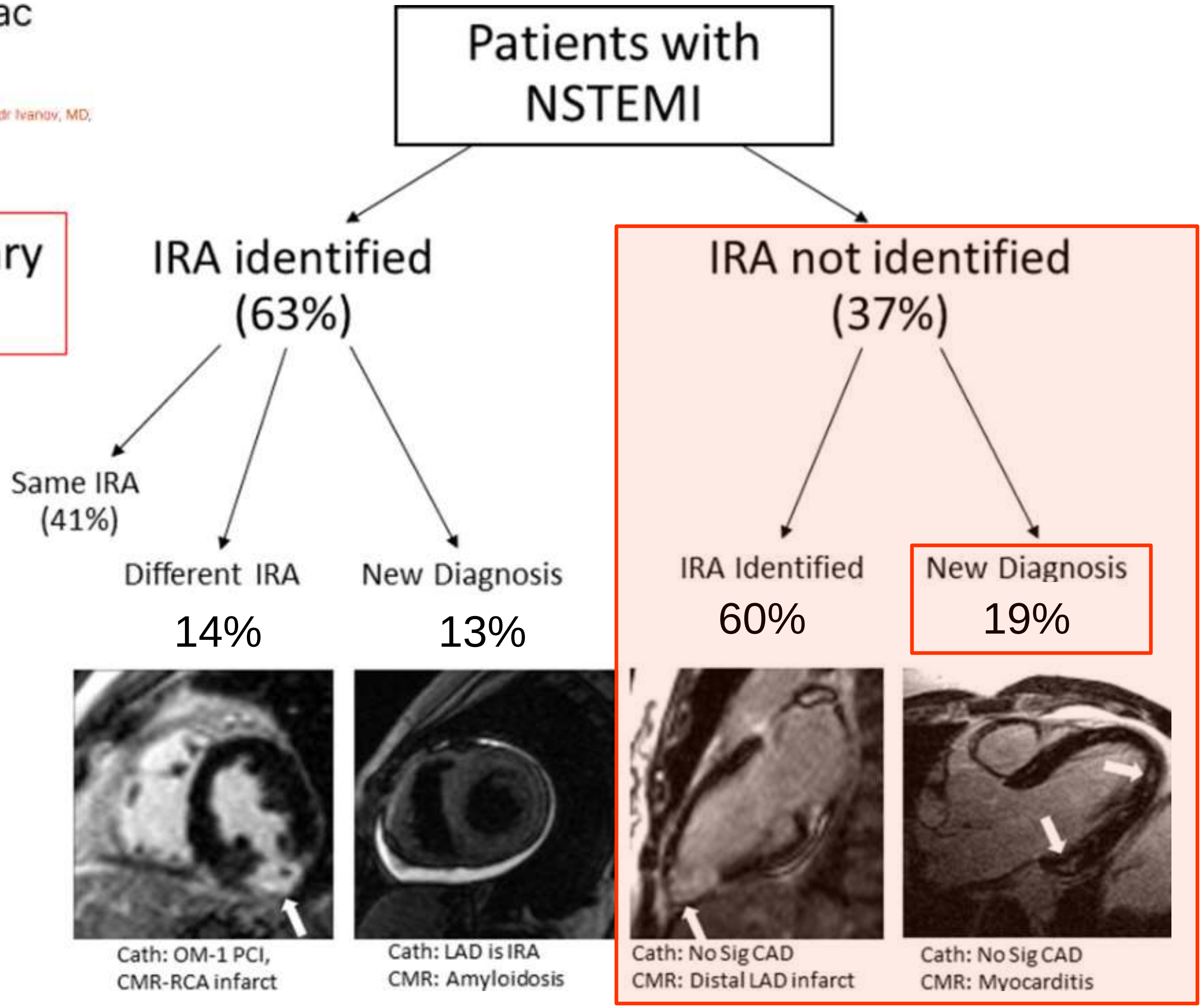
MRI

↓

ICA

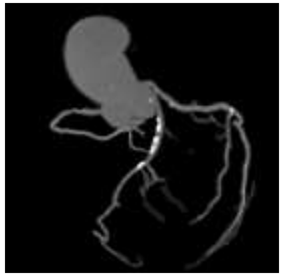
Invasive Coronary Angiography

DE-CMR

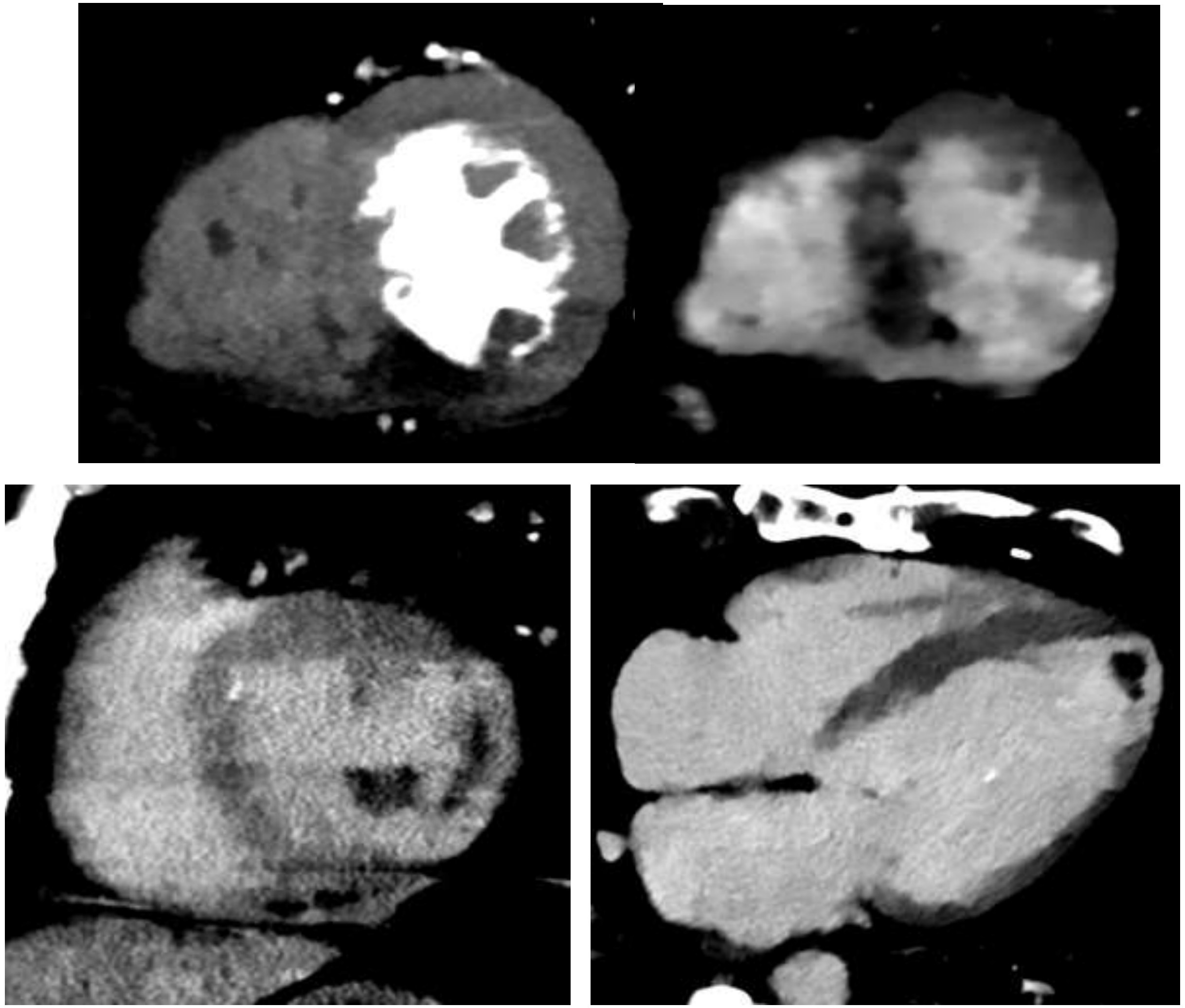


Heitner JF, at el. Circ Cardiovasc Interv. 2019 May;12(5):e007305

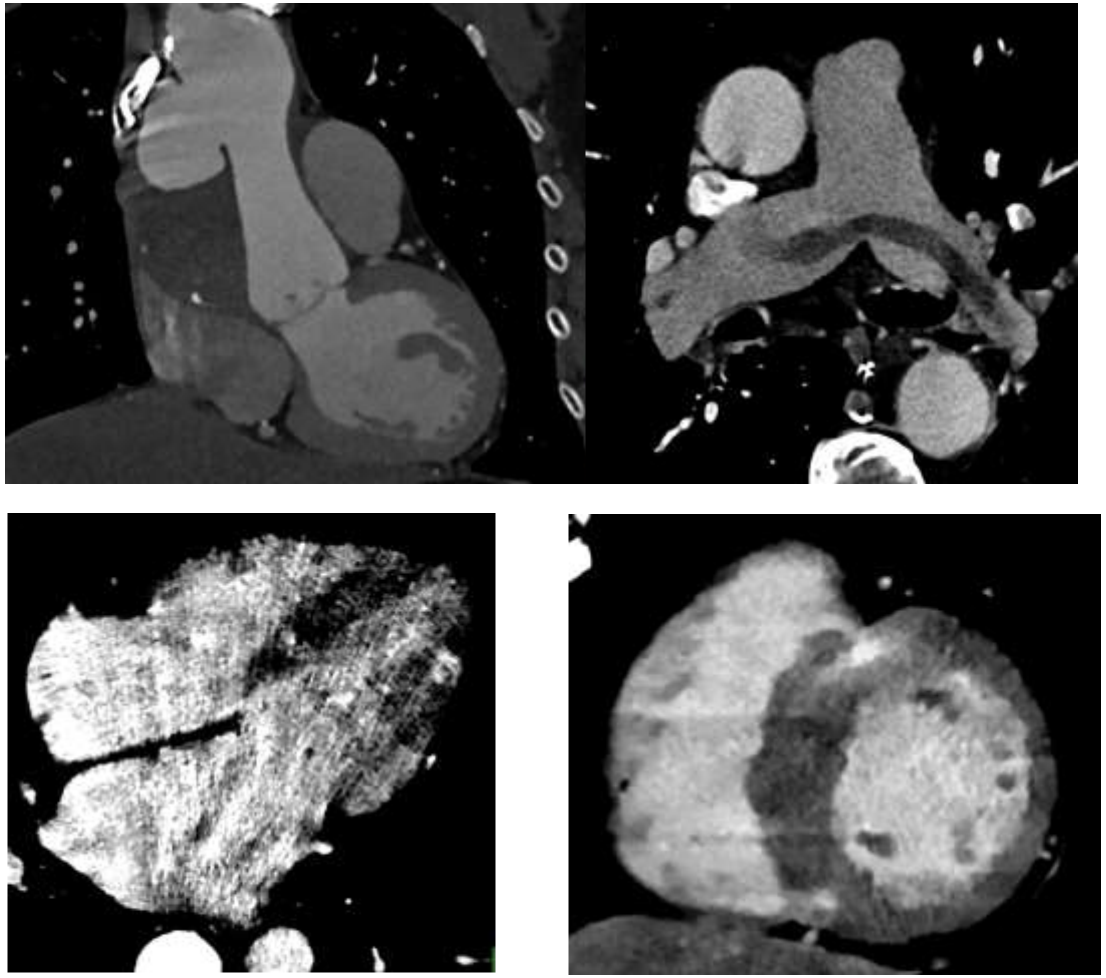
CTCA:



Coronary



Non-coronary

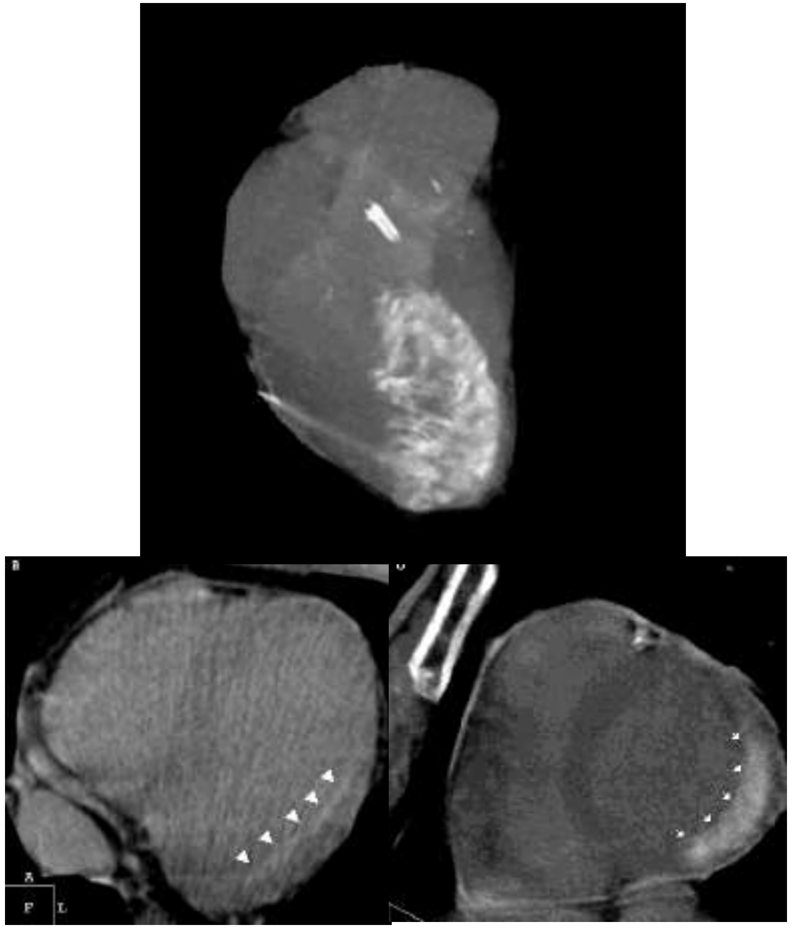


Early Assessment of Myocardial Viability by the Use of Delayed Enhancement Computed Tomography After Primary Percutaneous Coronary Intervention

Gastón A. Rodriguez-Granillo, MD, PhD,*§ Miguel A. Rosales, MD,* Santiago Baum, MD,†
Paola Rennes, MD,† Carlos Rodriguez-Pagani, MD,† Valeria Curotto, MD,†
Carlos Fernandez-Pereira, MD,‡ Claudio Llaurado, BSc,‡ Gustavo Risau, MD,‡
Elina Degrossi, MD,* Hernán C. Doval, MD, PhD,† Alfredo E. Rodriguez, MD, PhD*‡
Buenos Aires, Argentina

Role in STEMI:
Early Assessment of Myocardial Viability

Microvascular reperfusion failure, poor ST resolution, higher enzyme levels, higher in-hospital complication rates, and lower functional recovery at 6 months



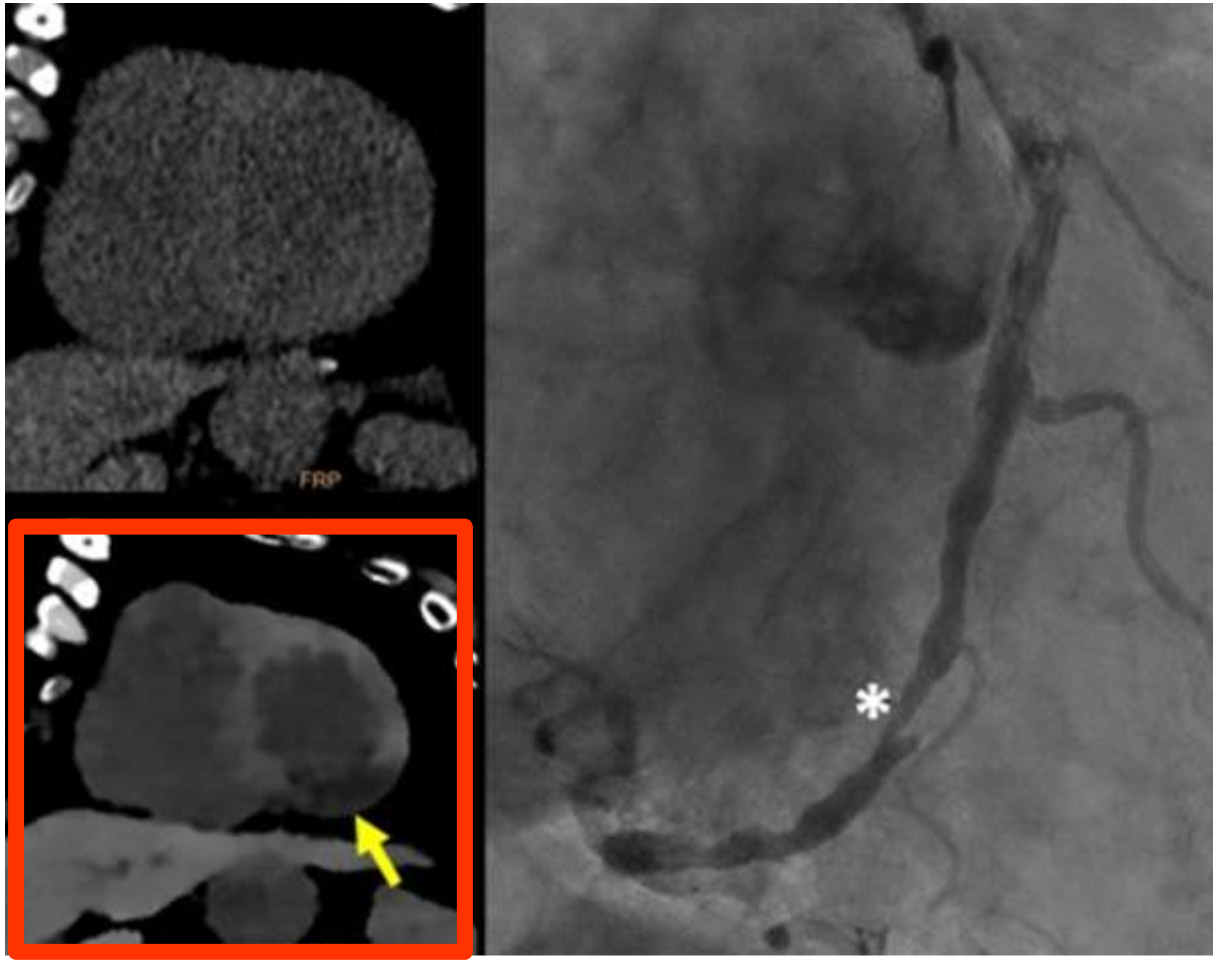
EARLY STRATIFICATION IN STEMI

JACC cardiovascular Imaging

Rodriguez-Granillo GA, et al. J Am Coll Cardiol Img. 2009;2;1072-1081

Early myocardial tissue changes related to AMI with Non-contrast CT

Electron density enabled the identification in 11/15 (73%) affected coronary territories



Rodriguez-Granillo GA. J Thorac Imaging. 2024 May 1;39(3):173-177

Gracias!!
Thank you!!

grodriguezgranillo@gmail.com

SOLACI CACI`24 ARGENTINA

BUENOS AIRES HILTON
BUENOS AIRES, ARGENTINA