MRI of Coronary Atherosclerotic Plaques

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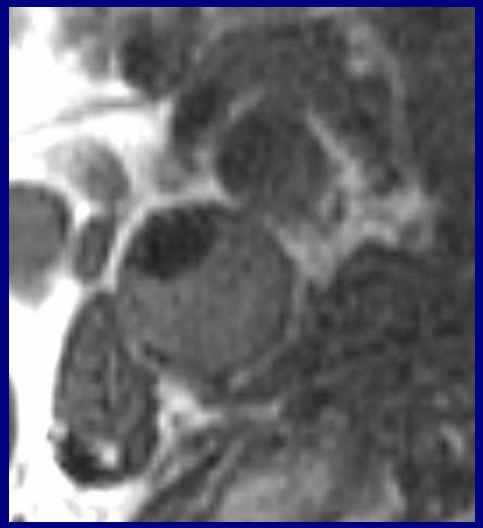
Capability of MRI for Atherosclerosis: Insights from High-resolution Carotid MRI

- Determination of plaque burden
- Analysis of plaque composition
- Identification of vulnerable plaques

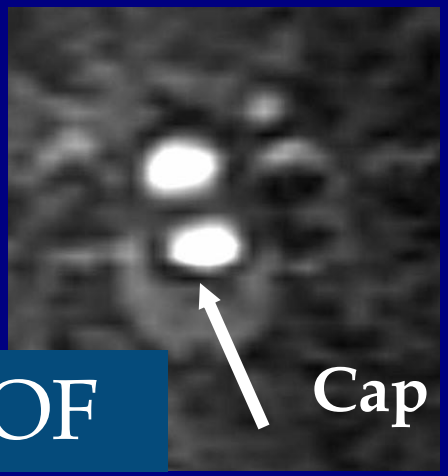
Lipid-rich Plaque

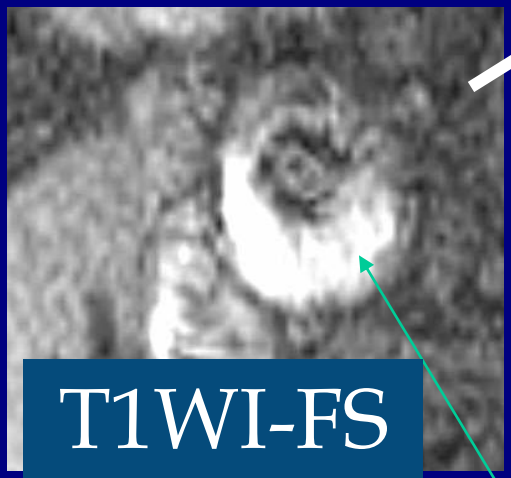


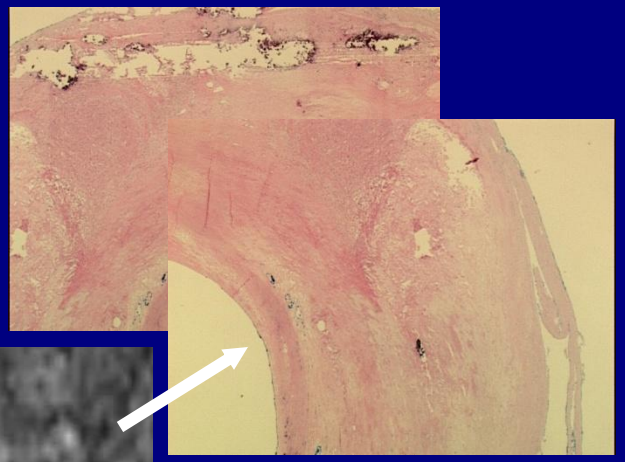
T1WI

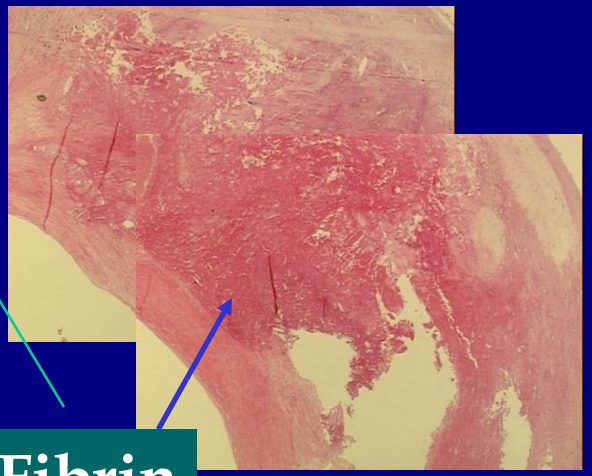
T2WI

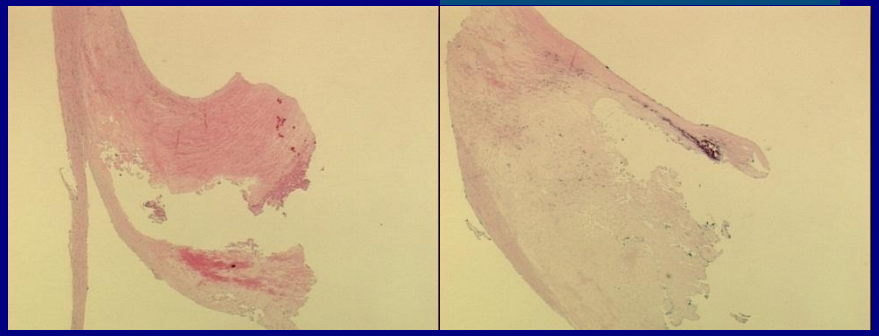
Intact Plaque Cap with Intraplaque Hemorrhage



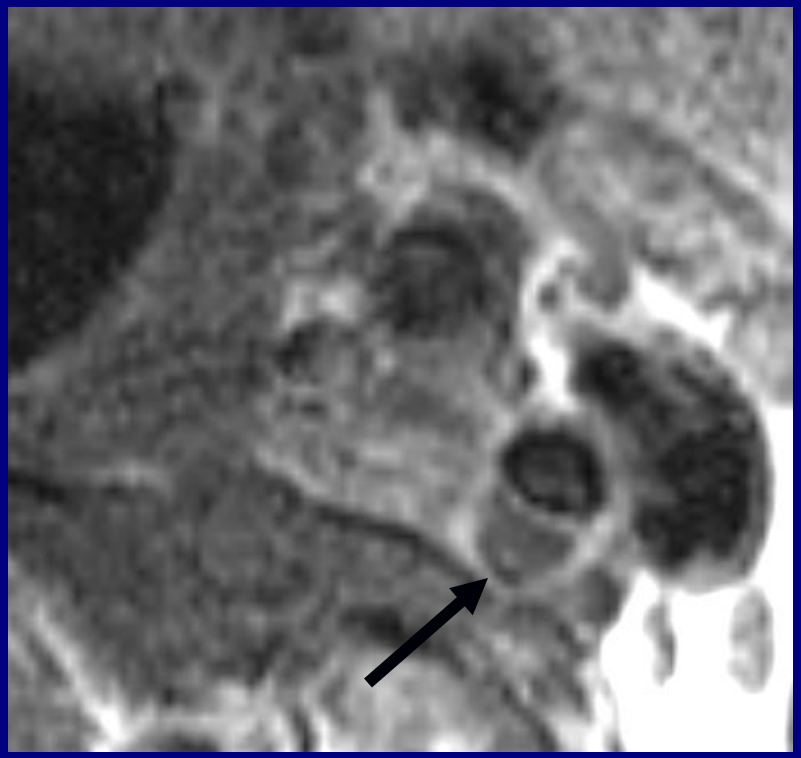


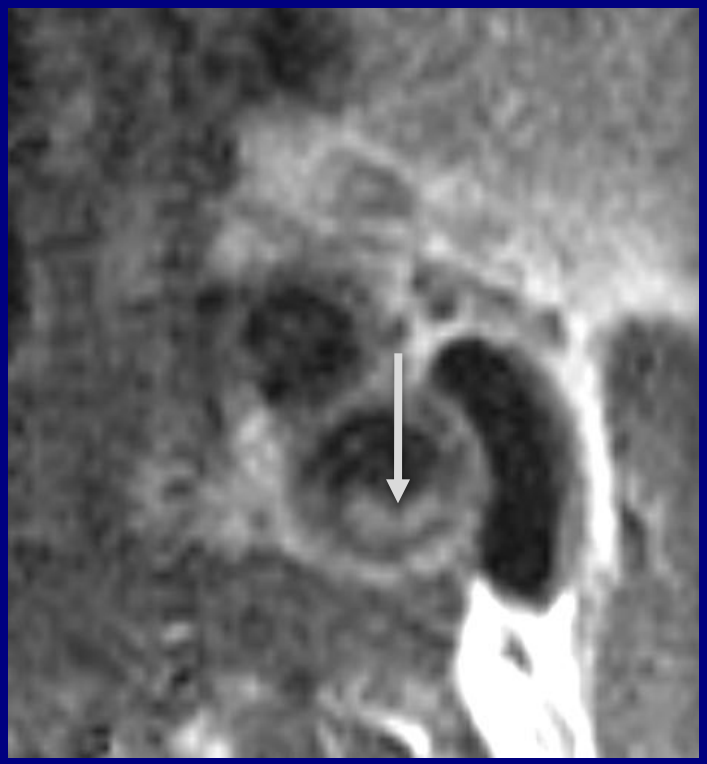






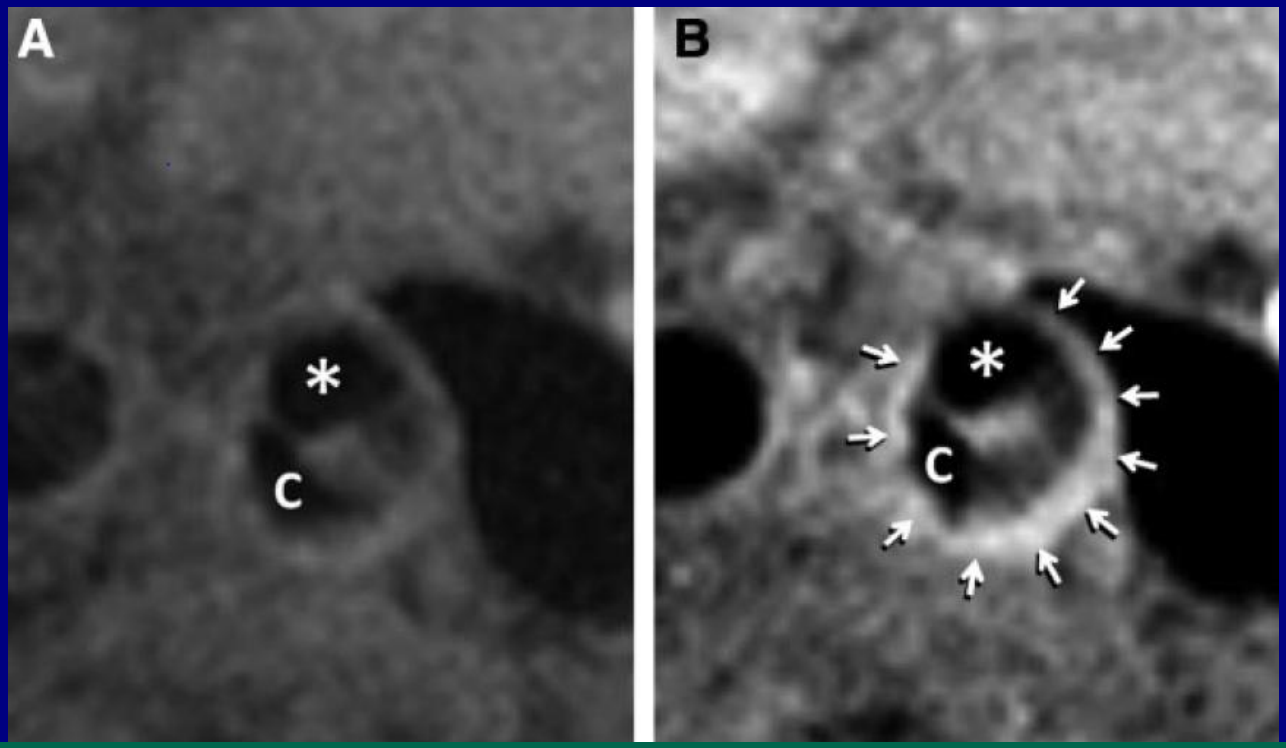
Necrotic vs. Fibrous/inflammatory Region





Gd-enhanced T1WI

Adventitial Enhancement



Associated with intraplaque neovascularization

Wasserman. ***Stroke*. 2010;41[suppl 1]:S12-S16.**

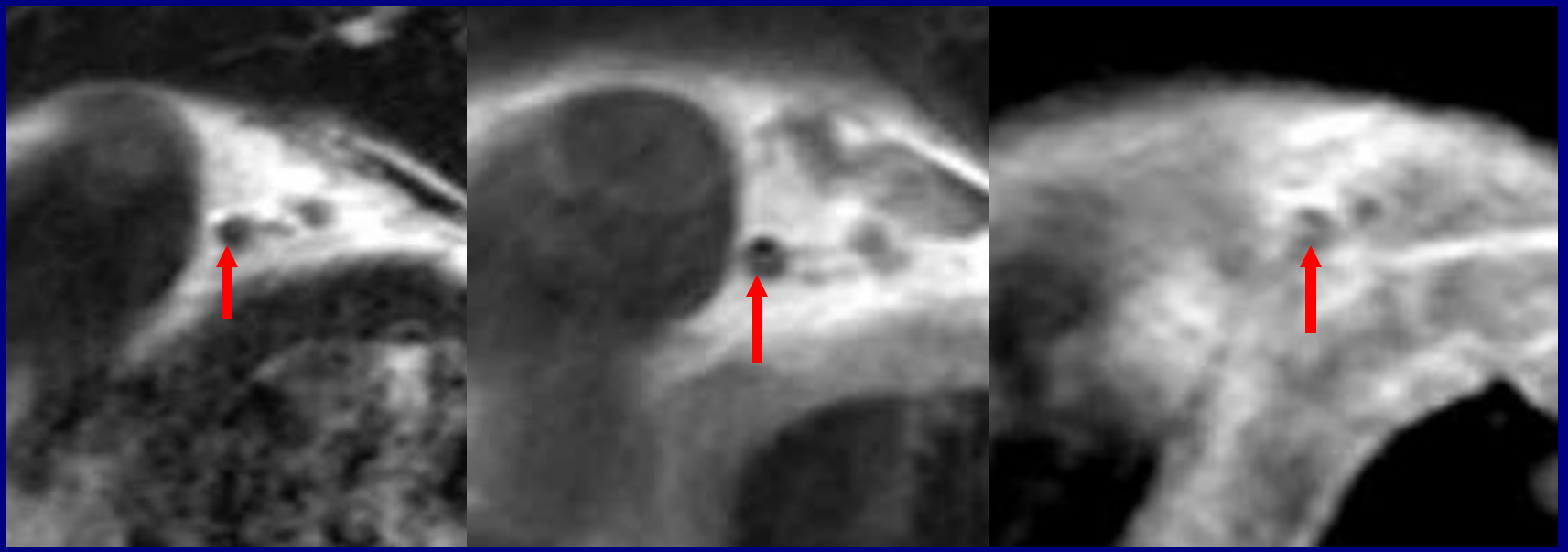
Coronary Artery Plaque MRI

- High-resolution of 3.0-T system is most beneficial in coronary artery plaque imaging.
- Can knowledge of carotid plaque MRI be applied to coronary artery imaging?

Imaging Protocol

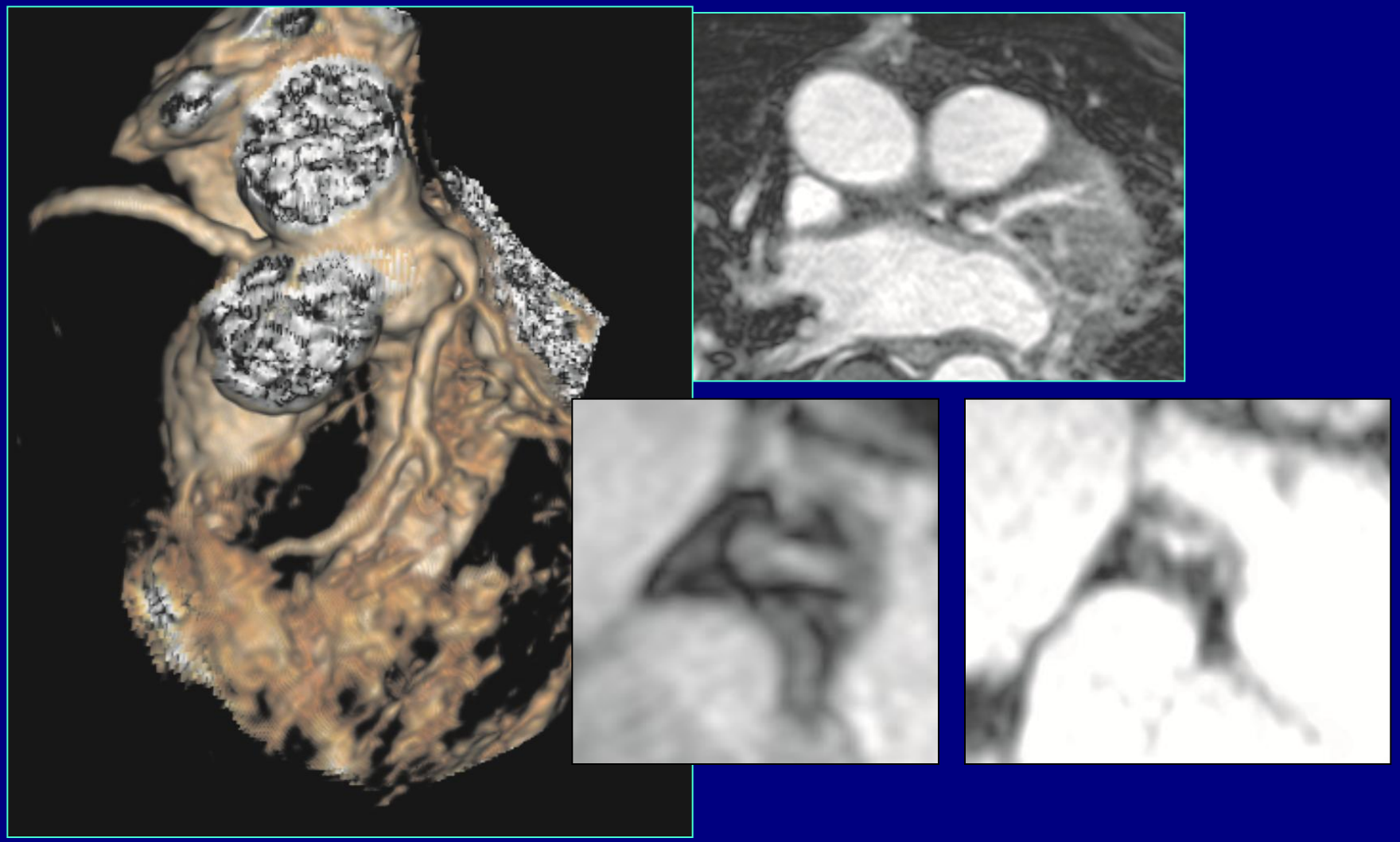
- Coronary MRA using 3-point technique
- Black-blood plaque imaging on the stenotic segments
  - T1WI, precontrast (DBIR)
  - T2WI
  - T1WI, postcontrast
  - TFE
- Slice thickness, 1.5-2 mm; image matrix, 256 × 256, FOV 35 cm, en = 1

Coronary Plaque Imaging at 3.0T

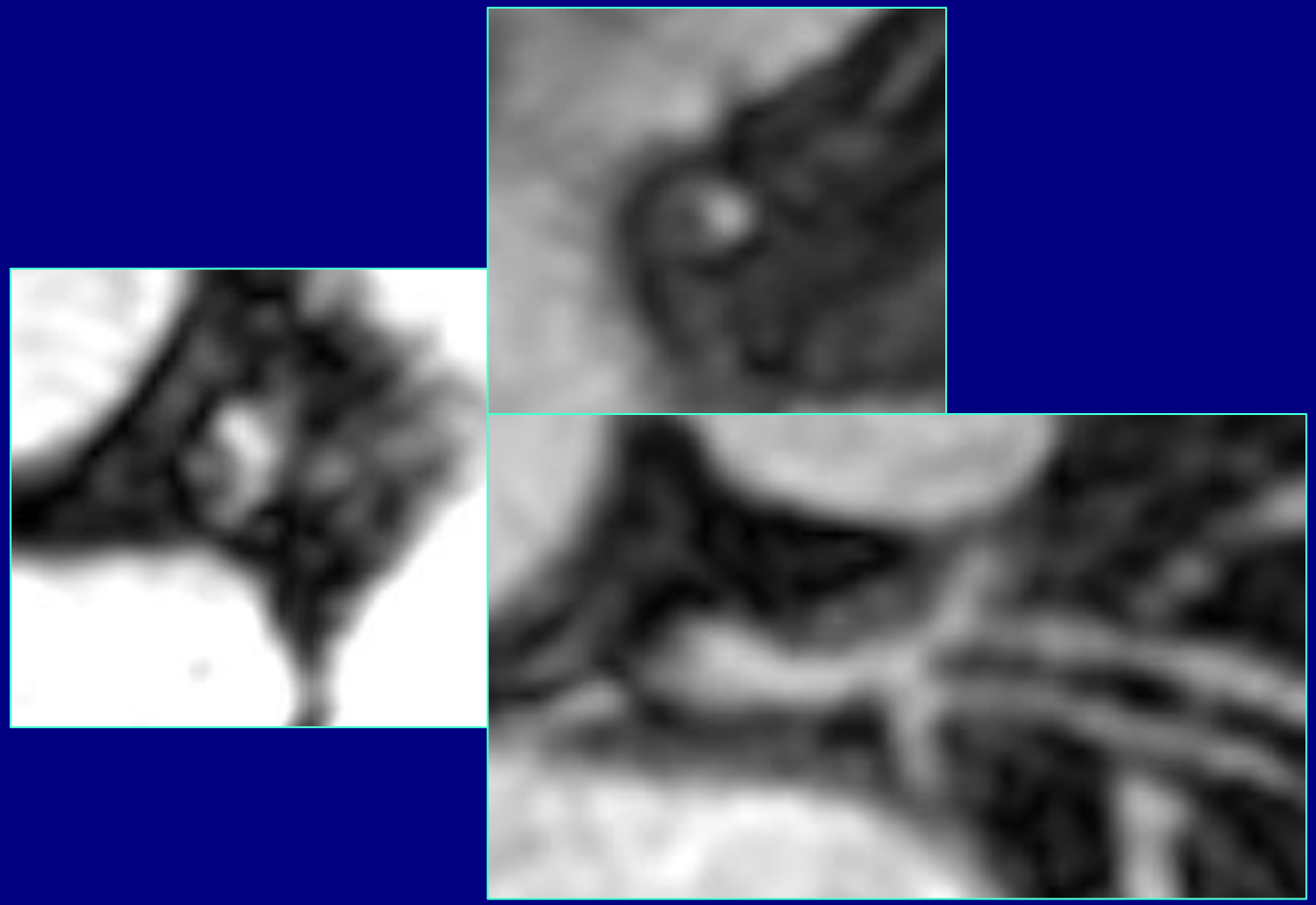


T2WI T1WI-preContrast T1WI-postContrast

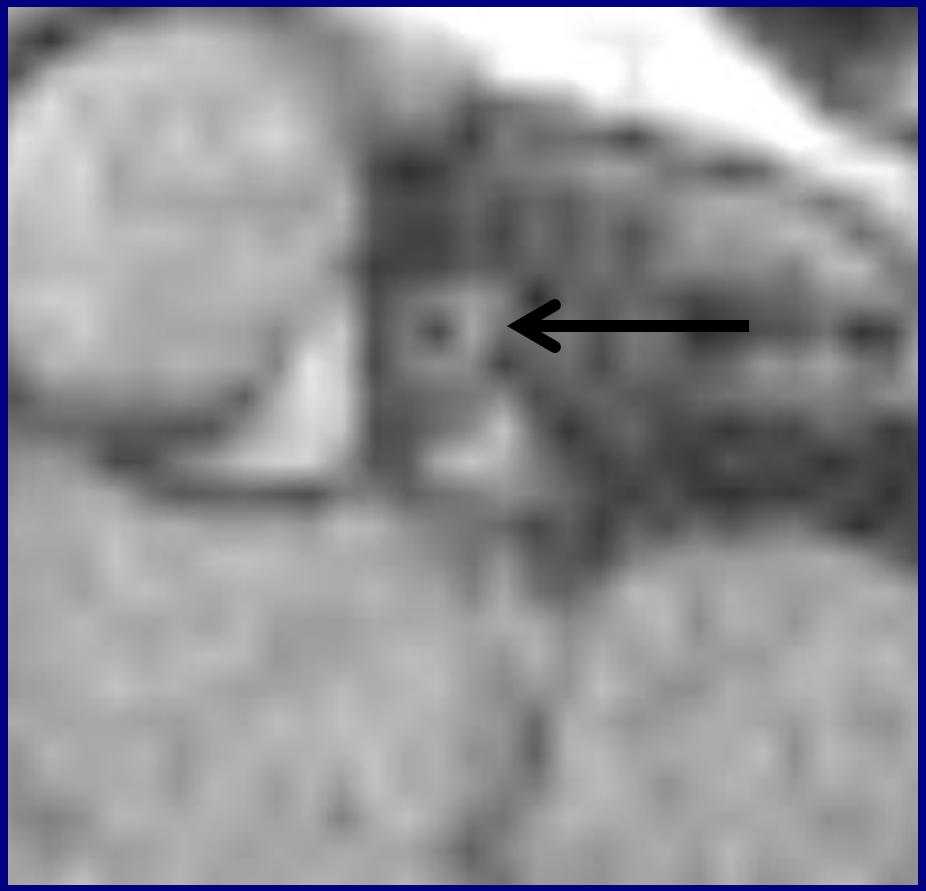
Coronary MRA (1.5 T) with Gd



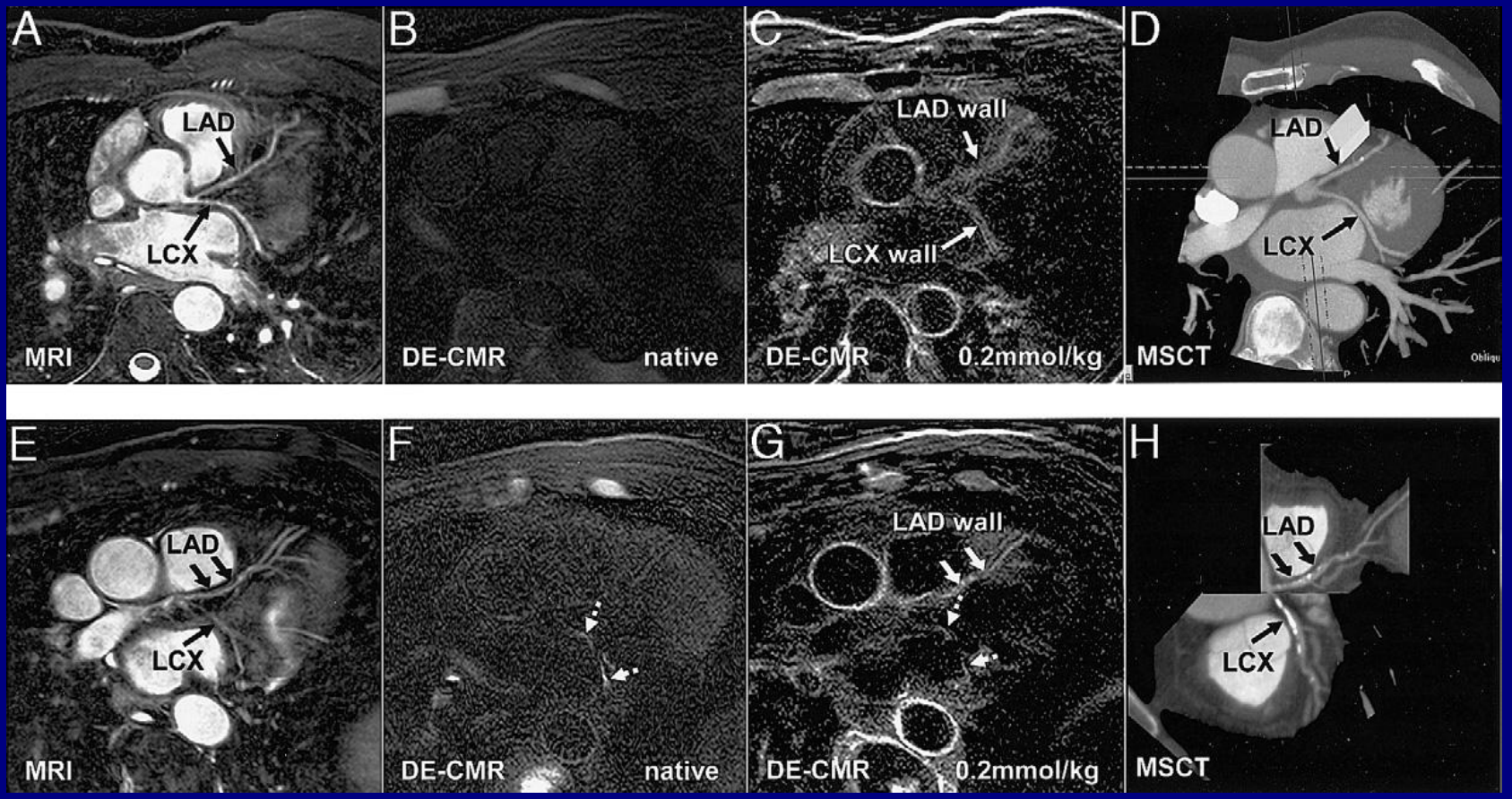
Coronary MRA with Gd



Late Gd Enhancement in patient with AMI

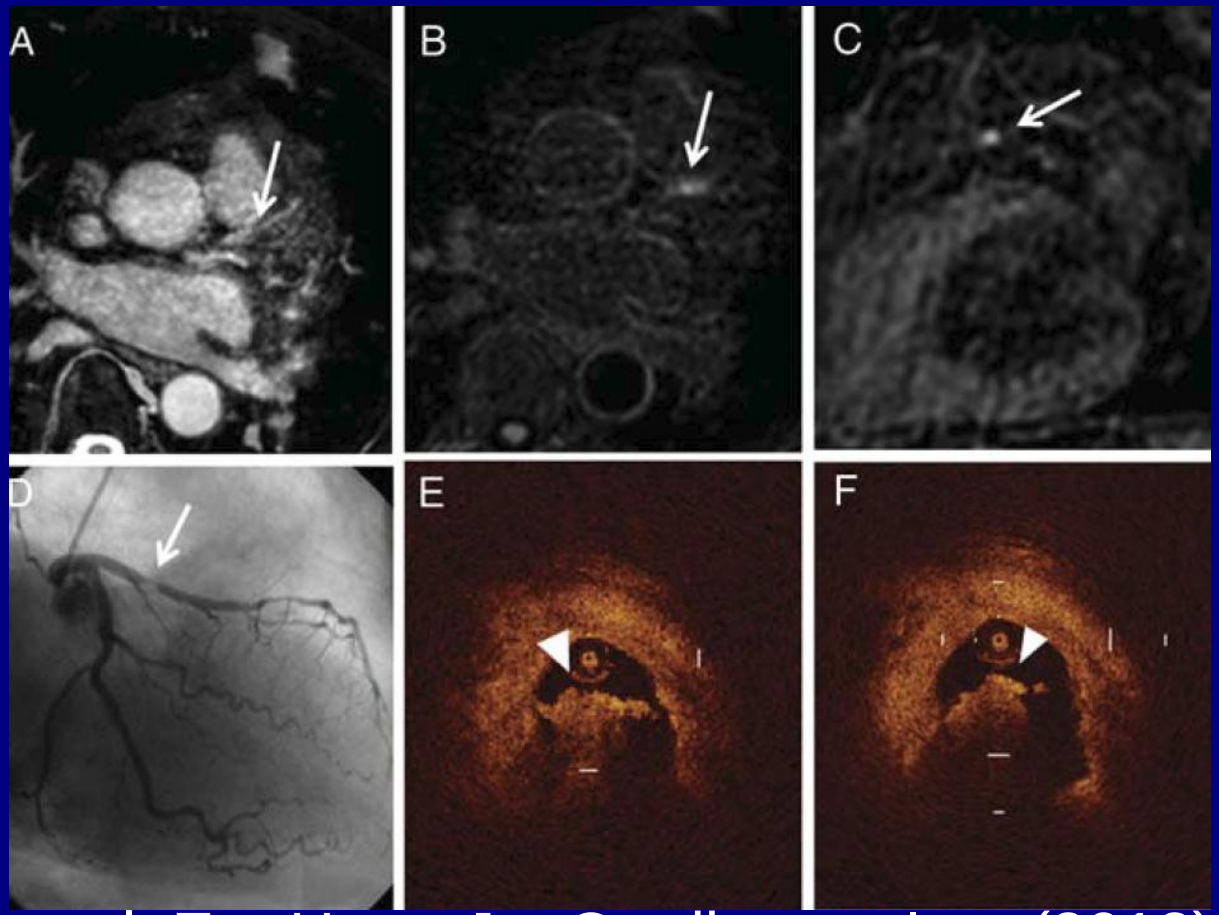


Delayed-Enhancement Cardiovascular Magnetic Resonance Coronary Artery Wall Imaging



Yeon S, et al. J Am Coll Cardiol 2007;50:441–7

Hyperintense plaque identified by MRI relates to intracoronary thrombus as detected by OCT in patients with angina pectoris



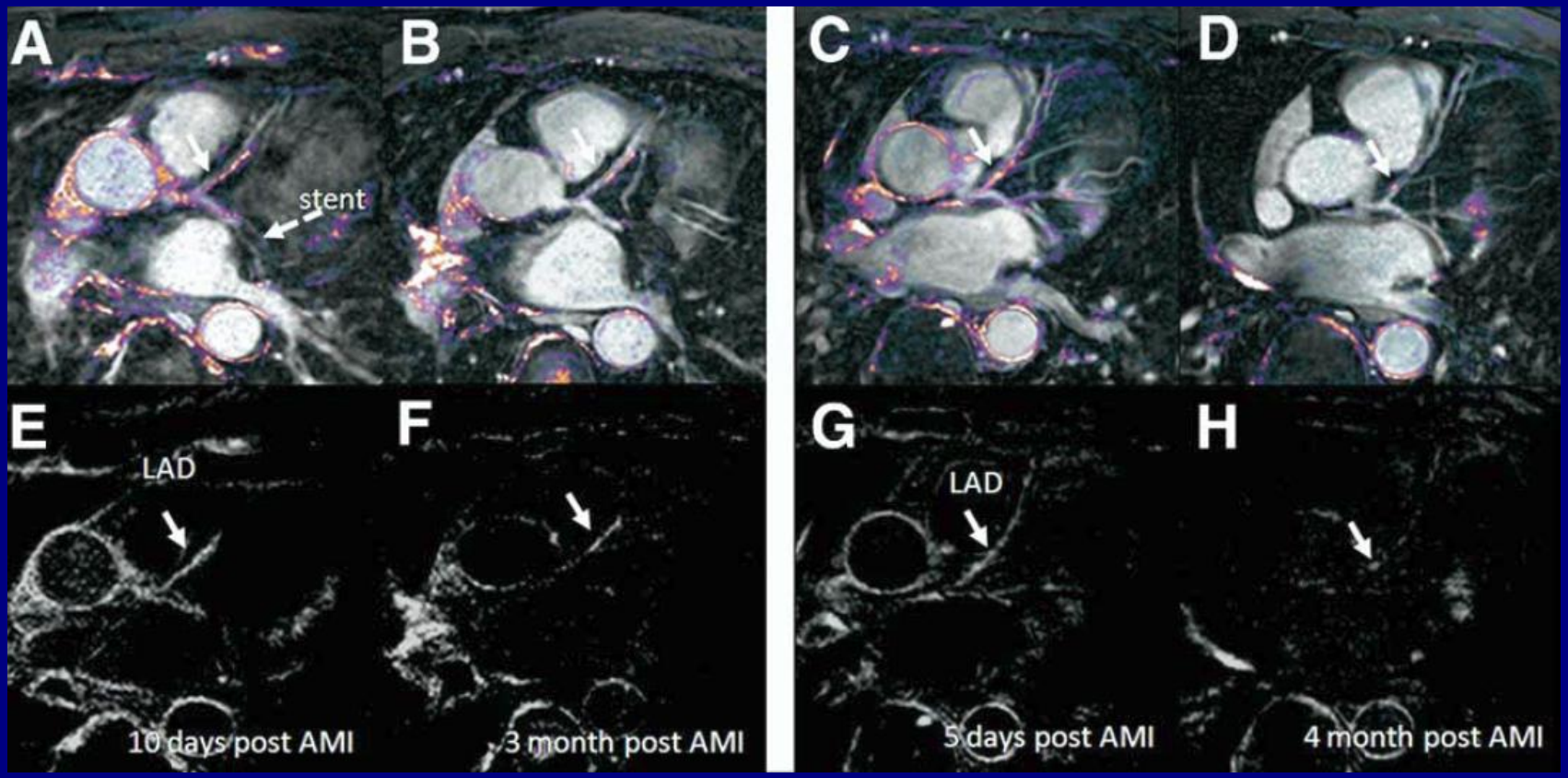
Ehara S, et al. Eur Heart J – Cardiovasc Img (2012) 13, 394–399

OCT findings in hyperintense and non-hyperintense plaque

	HIP ($n = 16$)	Non-HIP ($n = 10$)	*P*-value
Lipid-rich plaque	12 (75%)	5 (50%)	0.234
TCFA	6 (38%)	2 (20%)	0.420
Plaque rupture	7 (44%)	3 (30%)	0.683
Calcification	9 (56%)	7 (70%)	0.683
Thrombus	12 (75%)	1 (10%)	0.004
Red thrombus	7 (58%)	0 (0%)	
White thrombus	5 (42%)	1 (100%)	

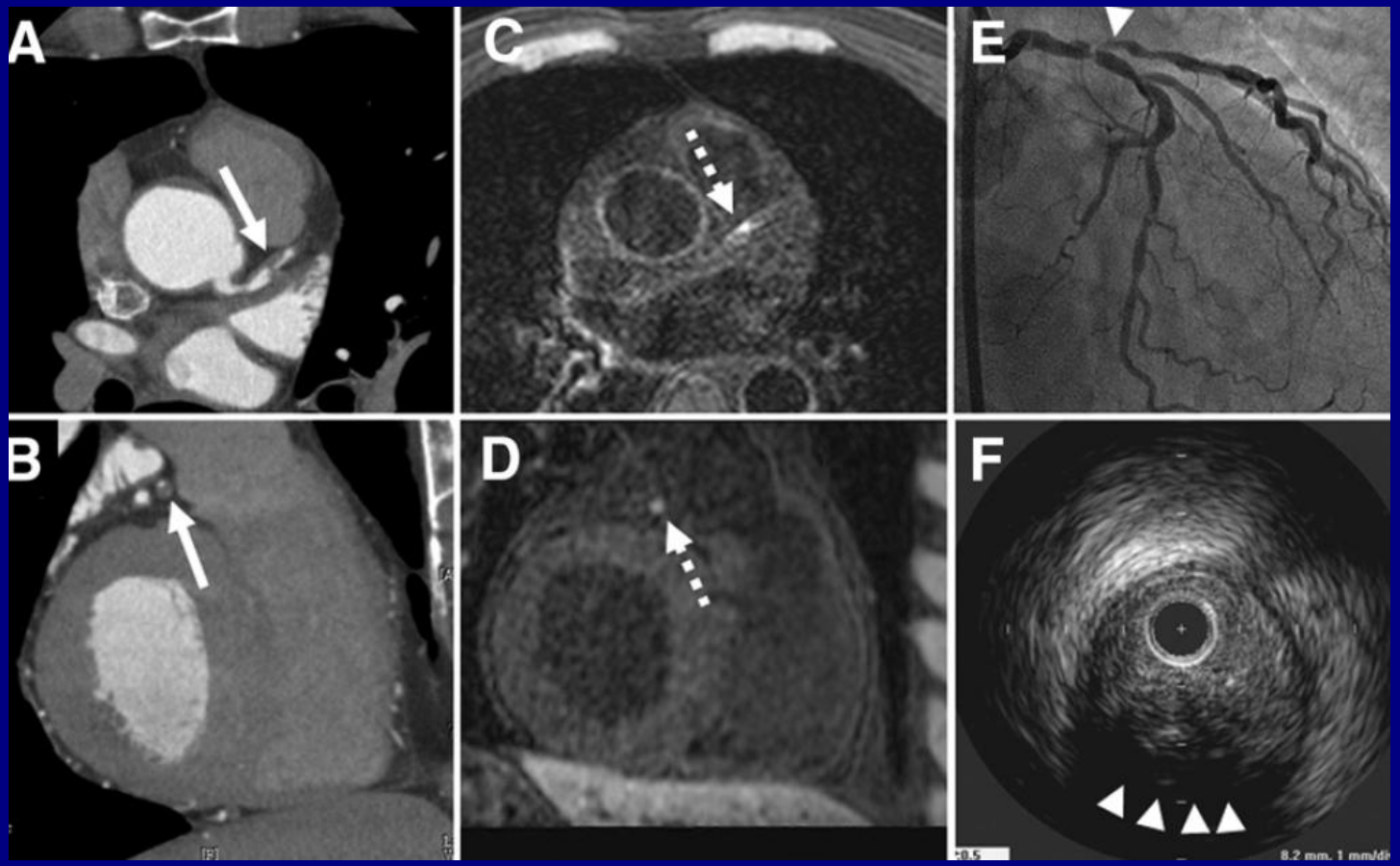
Ehara S, et al. Eur Heart J – Cardiovasc Img (2012) 13, 394–399

Serial Contrast-Enhanced Cardiac MRI Demonstrates Regression of Hyperenhancement Within the Coronary Artery Wall in Patients After Acute MI



Ibrahim et al. JACC Img 2009; 2:580-588

Characterization of Hyperintense Plaque With Noncontrast T1-Weighted Cardiac MR Coronary Plaque Imaging



Kawasaki *et al.* JACC Img 2009; 2: 720-728

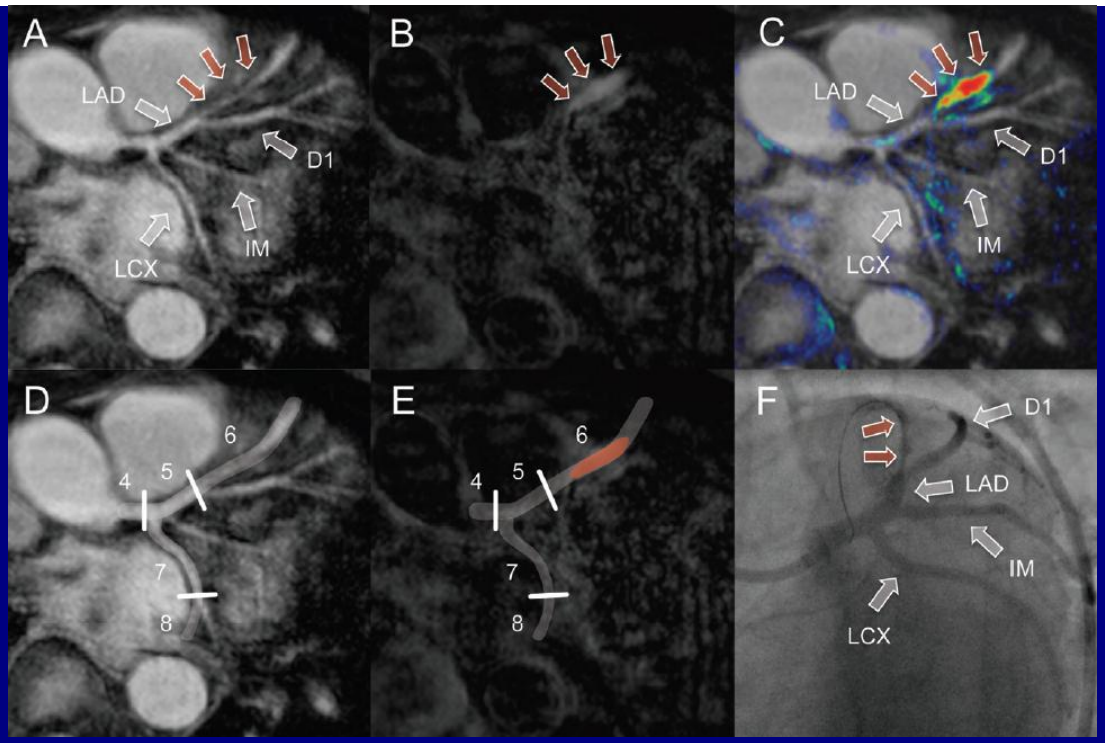
Characteristics in Hyperintense and Normointense Plaque

	HIP (n = 18)	Non-HIP (n = 7)	p Value
PMR	1.70 ± 0.71	0.90 ± 0.08	0.0081
MSCT			
Positive remodeling, yes/no	16/2	0/7	<0.0001
RI	1.19 ± 0.08	0.98 ± 0.05	<0.0001
Minimal CT density, HU	−23.2 ± 20.7	9.6 ± 20.5	0.0016
Spotty calcification, yes/no	16/2	3/3*	0.079
IVUS			
Positive remodeling, yes/no	17/1	1/6	<0.001
RI	1.15 ± 0.07	0.89 ± 0.11	<0.0001
Ultrasound attenuation, yes/no	18/0	1/6	<0.0001
Slow flow phenomenon, yes/no	15/3	1/6	0.003

Kawasaki *et al.* JACC Img 2009; 2: 720-728

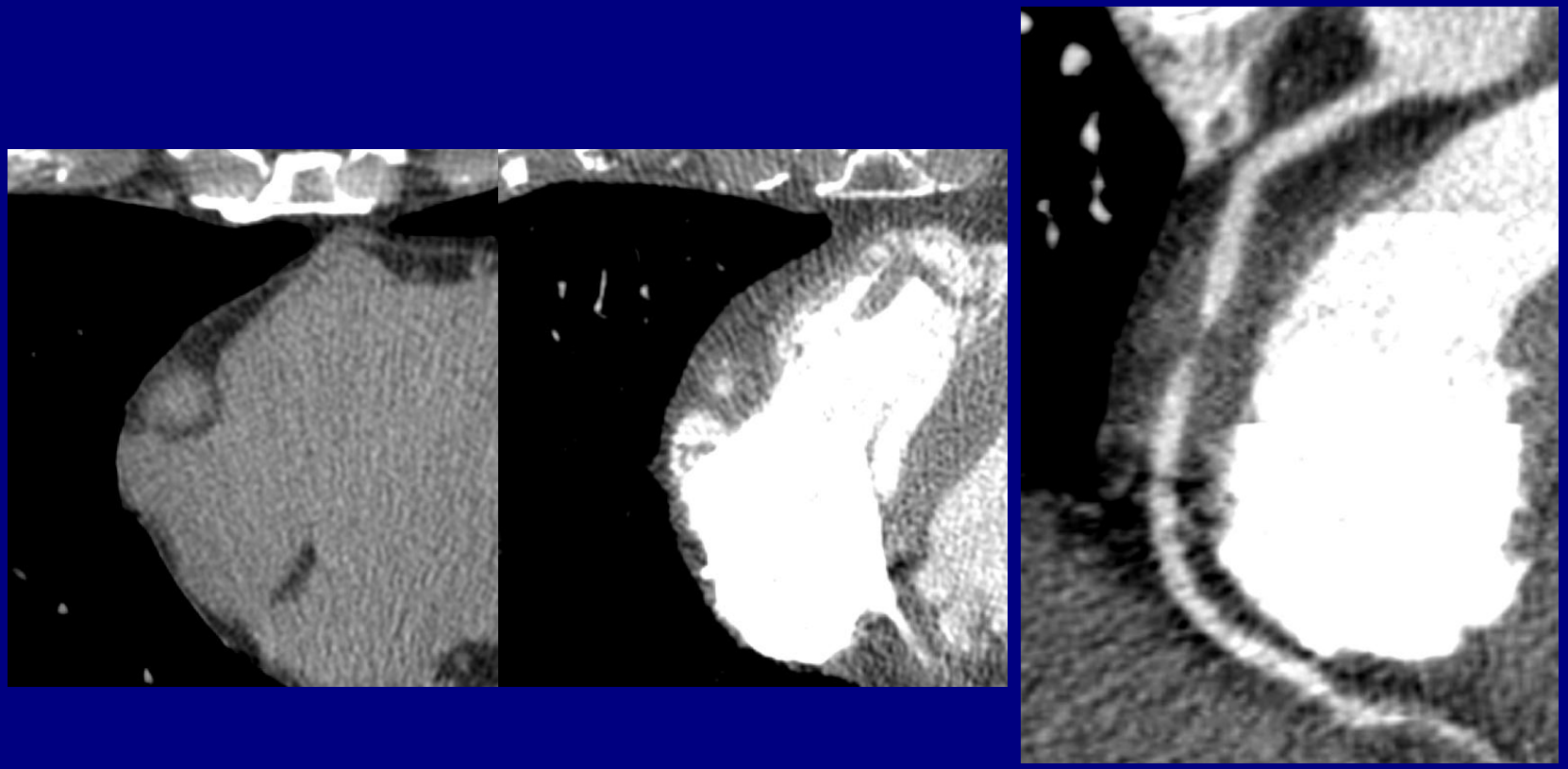
Detection of Intracoronary Thrombus by Magnetic Resonance Imaging in Patients With Acute Myocardial Infarction

C.H.P. Jansen, MD; D. Perera, MRCP, MD; M.R. Makowski, MD, PhD; A.J. Wiethoff, PhD; A. Phinikaridou, PhD; R.M. Razavi, MD; M.S. Marber, MD, PhD; G.F. Greil, MD; E. Nagel, MD, PhD; D. Maintz, MD; S. Redwood, MD; R.M. Botnar, PhD



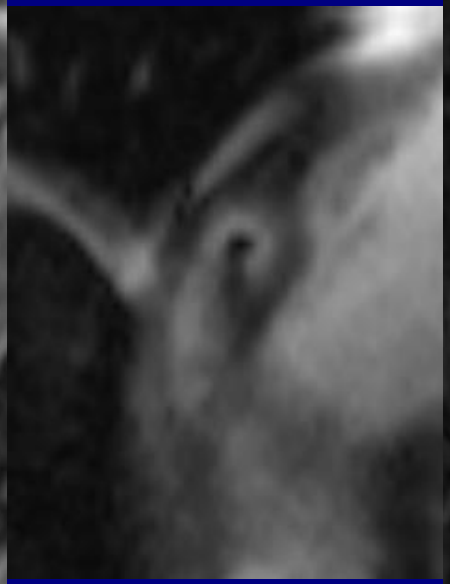
Circulation. 2011;124:416-424

Acute Intramural Hematoma of RCA, Coronary CTA



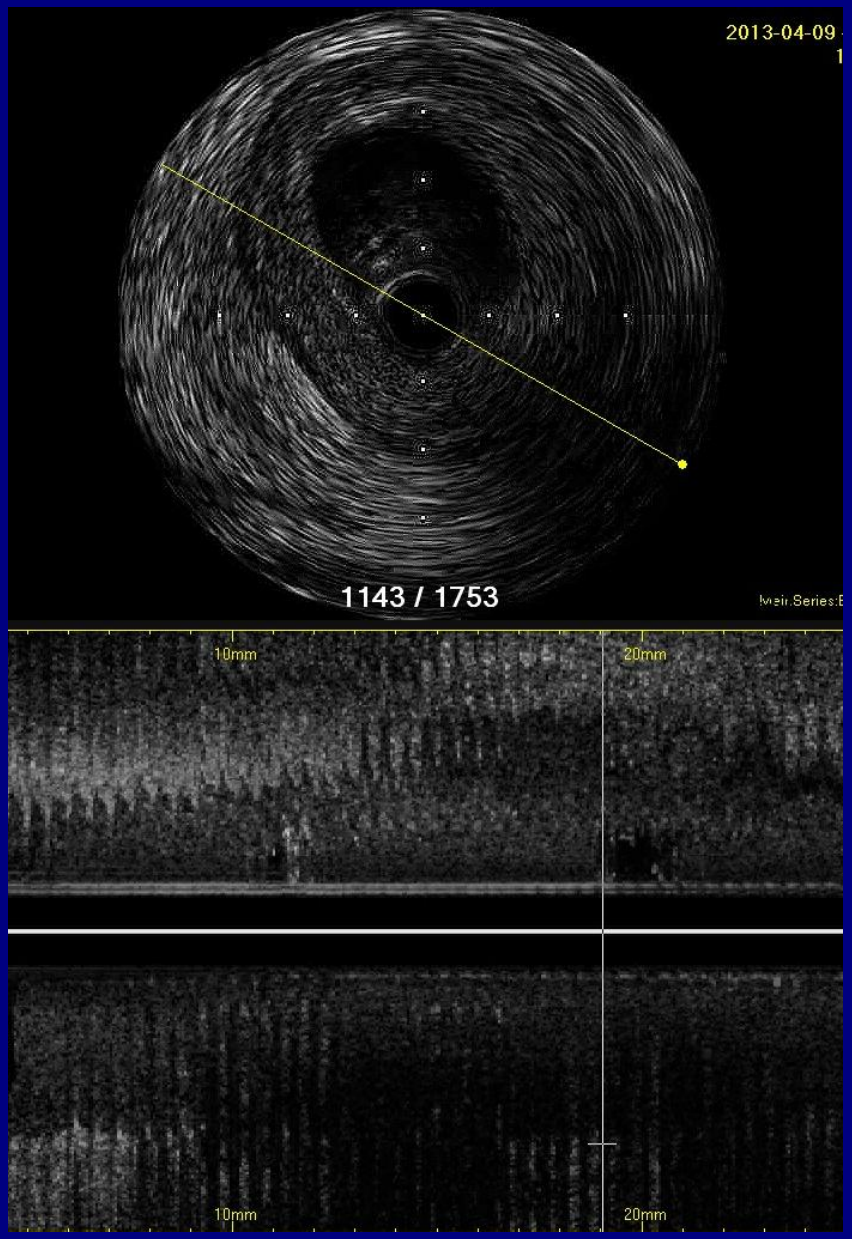
Acute IMH of RCA, MRI after stenting

T1WI

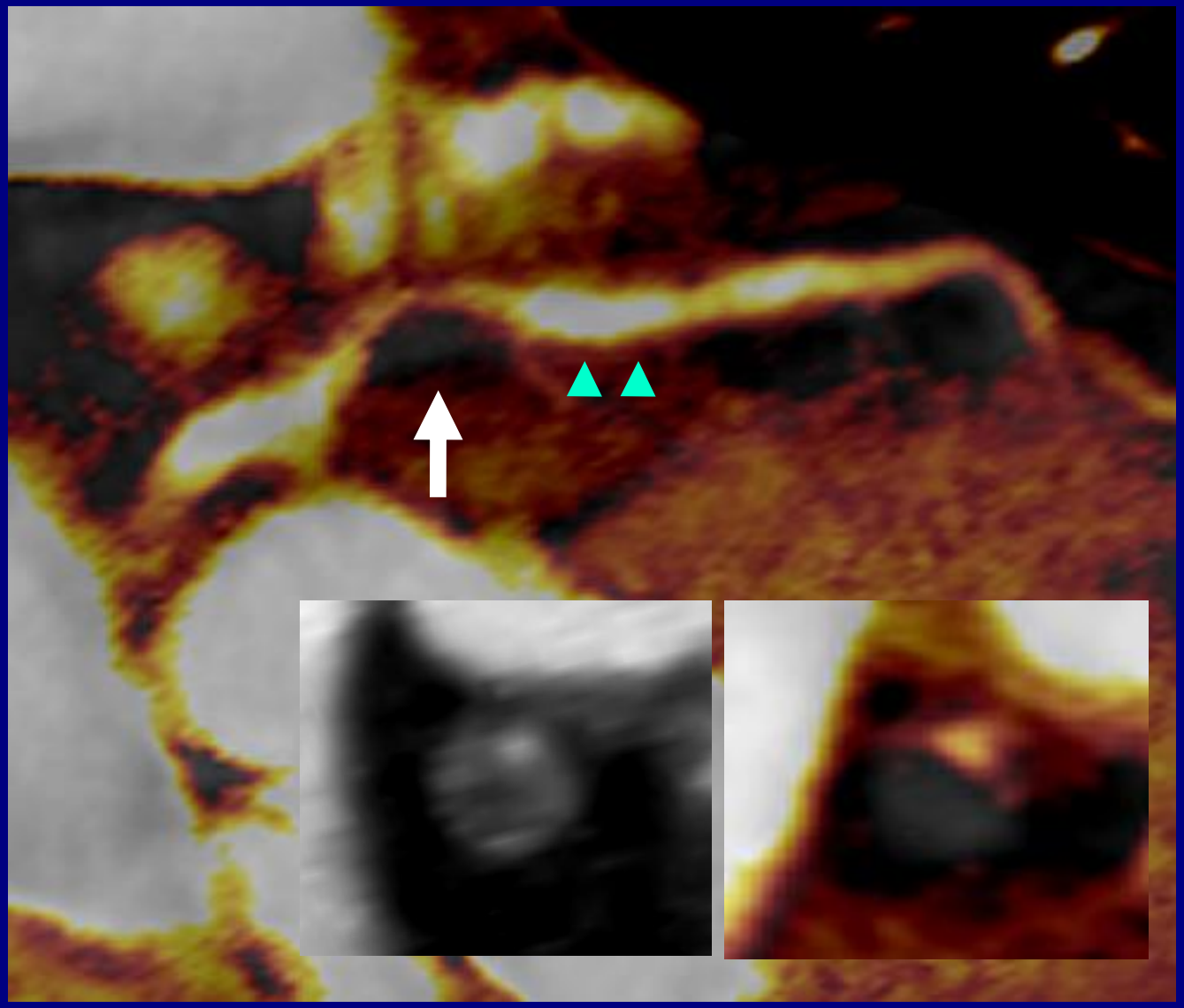


T2WI

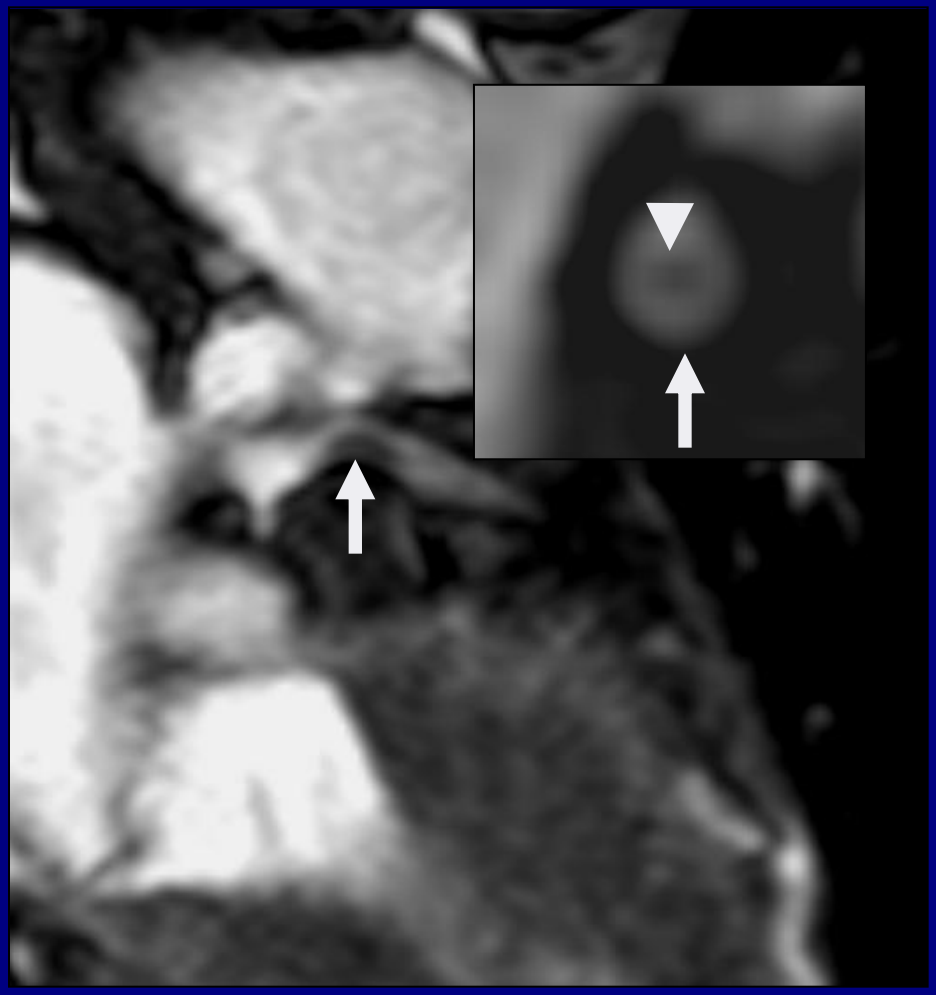
Coronary MRA, SSFP

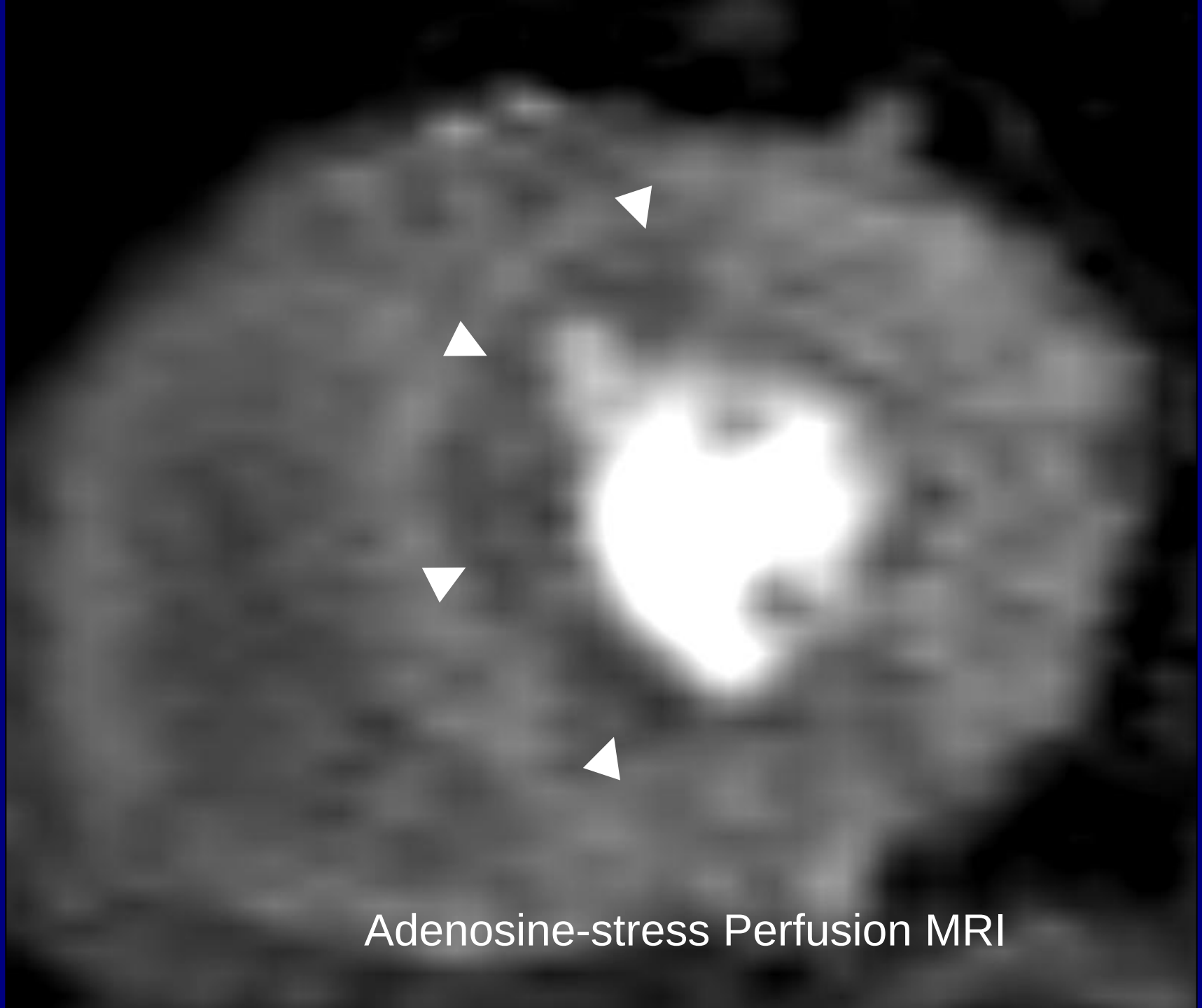

2013-04-09
1143 / 1753
10mm
20mm
10mm
20mm

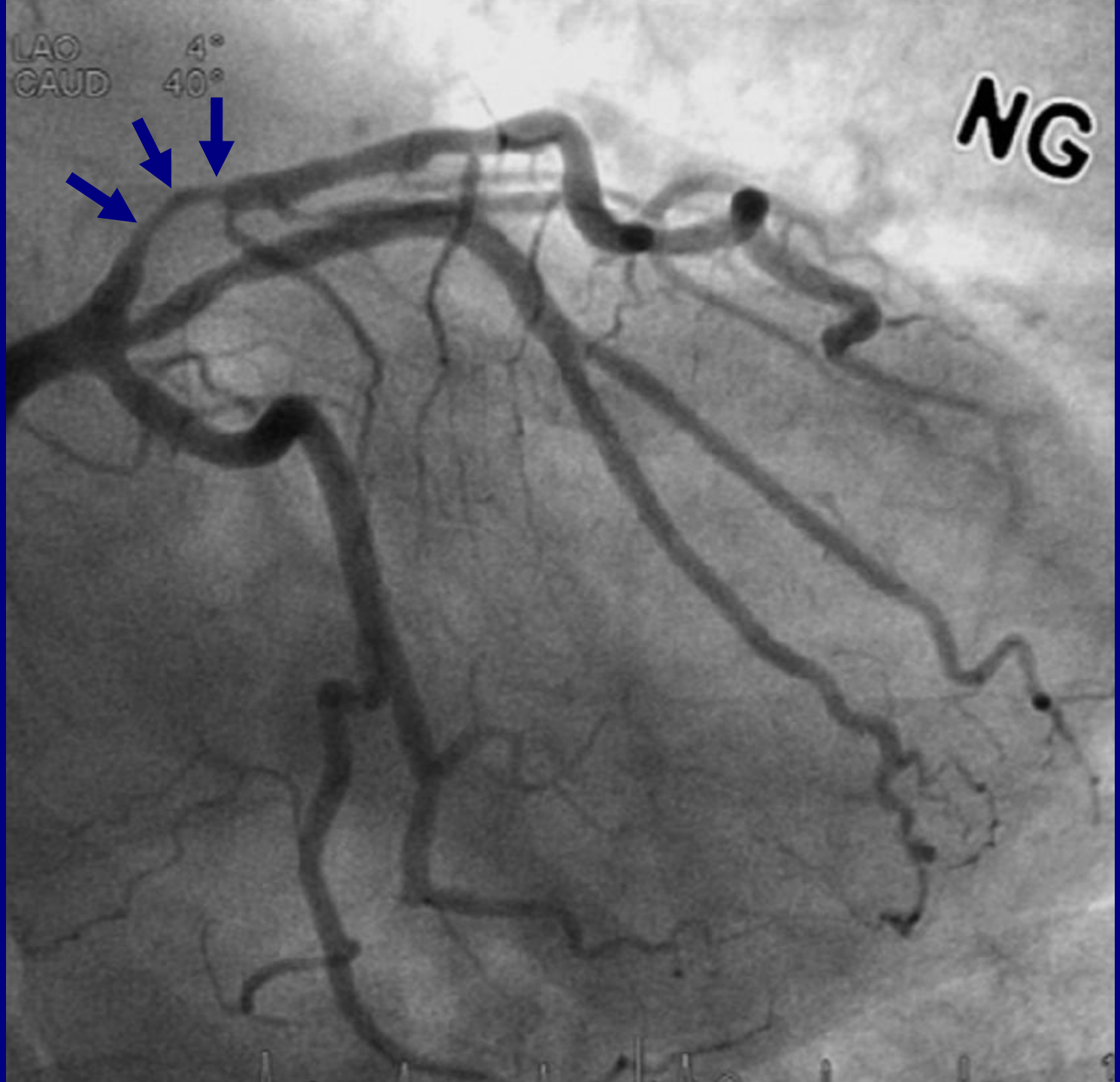
Dual-energy CT



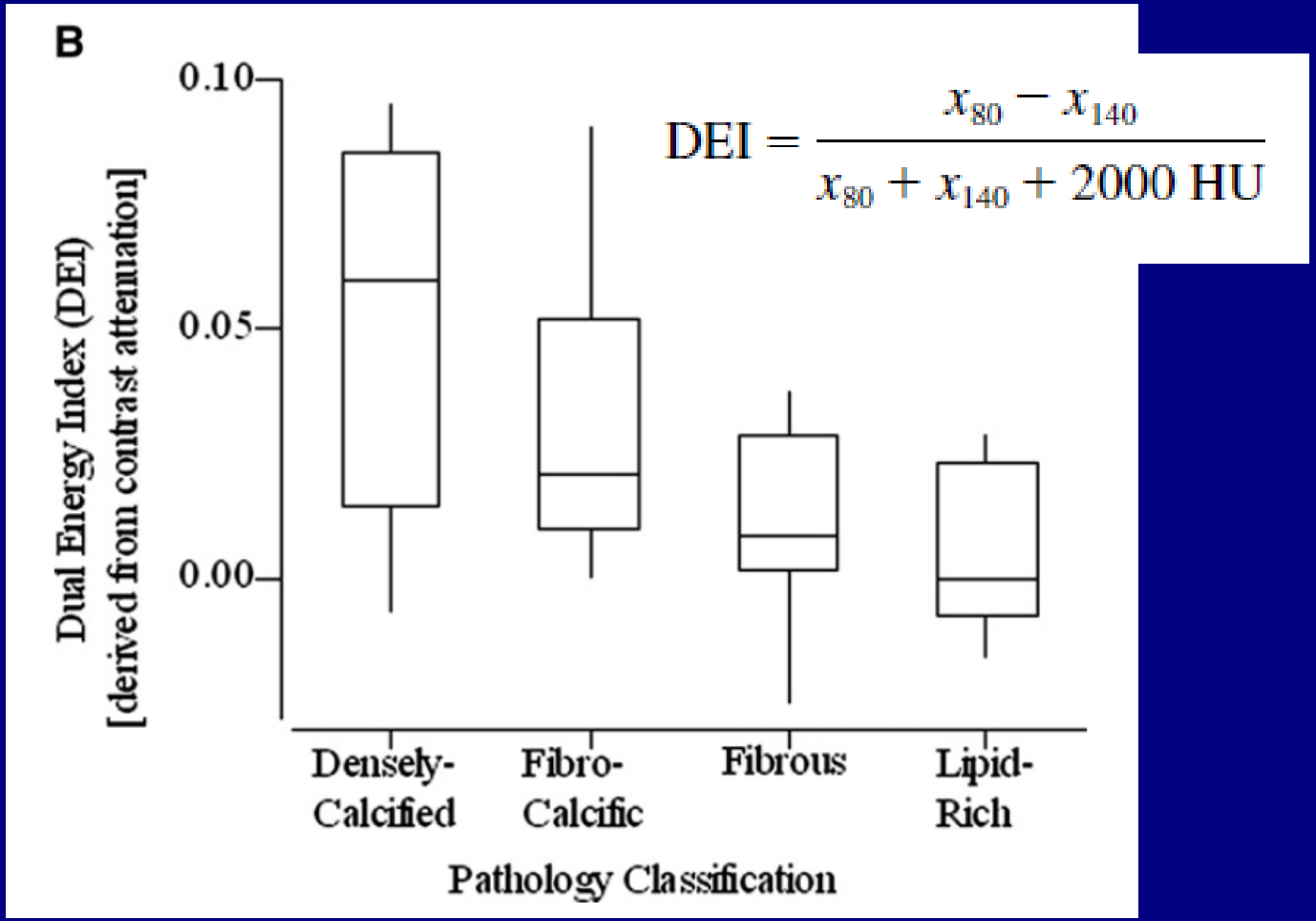
Coronary MRA




Adenosine-stress Perfusion MRI


LAO 4°
CAUD 40°
NG

Dual-energy index vs. pathology classification



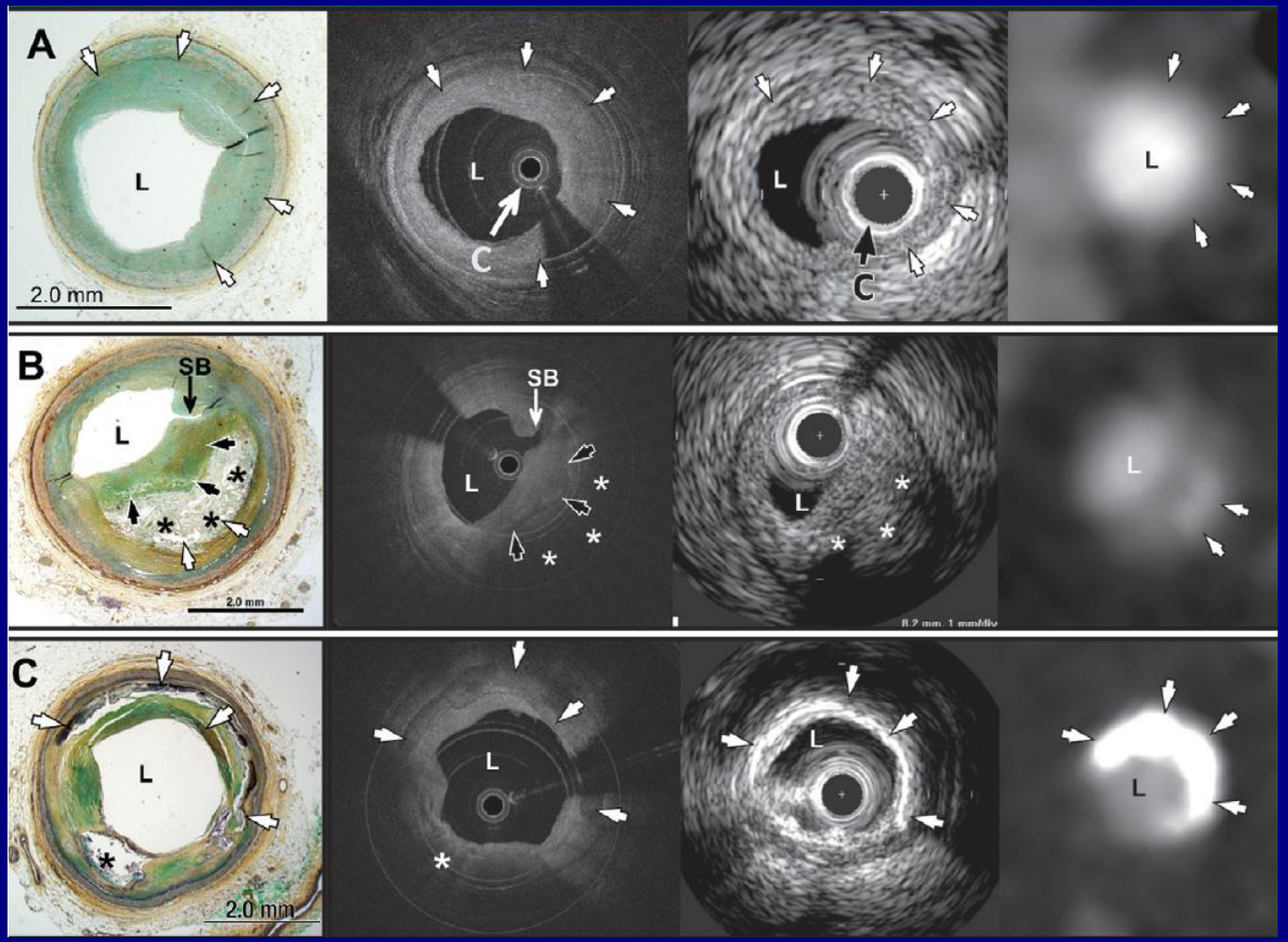
Barreto M, et al. JCCT 2008;2:234-242

Differentiating Early from Advanced Coronary Atherosclerotic Lesions with Imaging

Early

Mixed

Calcified



Maurovich-Horvat et al. Radiology 2012

Summary

- MRI has potential in atherosclerotic plaque characterization.
- However, current limitation in spatial resolution does not allow for clinical application of MRI in noninvasive coronary plaque characterization.