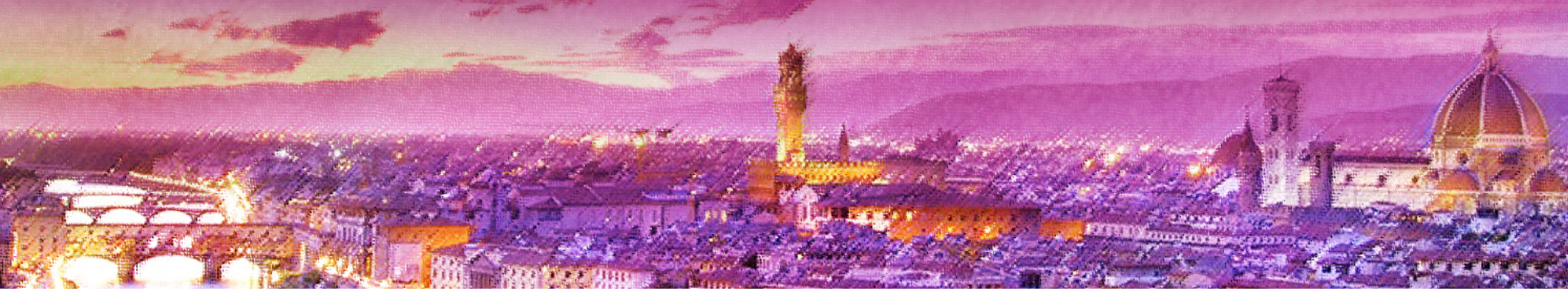
Conoscere e Curare il Cuore 2019

GIOVEDI' 28 FEBBRAIO

THE MRI AND THE HEART: USE IN DIFFERENT CLINICAL SCENARIOS

Chiara Bucciarelli-Ducci

Bristol Heart Institute
University of Bristol, Bristol (UK)



The MRI and the Heart: Use in Different Clinical Scenarios

Chiara Bucciarelli-Ducci MD, PhD, FESC, FRCP
Associate Professor of Cardiology
Bristol Heart Institute, University of Bristol, Bristol, UK

Secretary
European Association Cardiovascular Imaging (EACVI)
European Society of Cardiology (ESC)

University of BRISTOL

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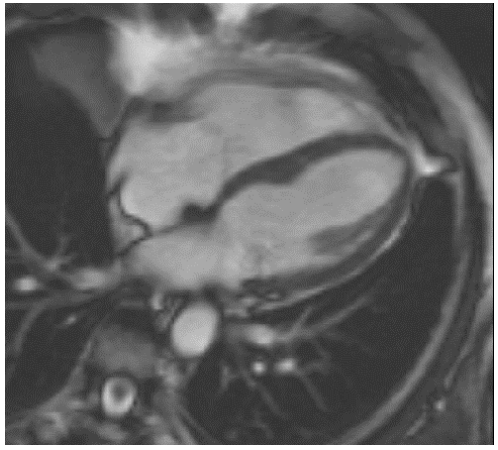
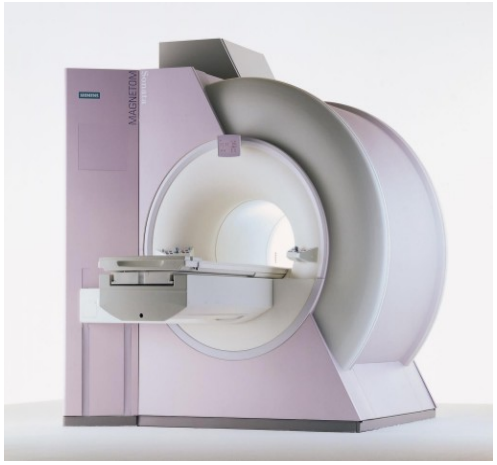
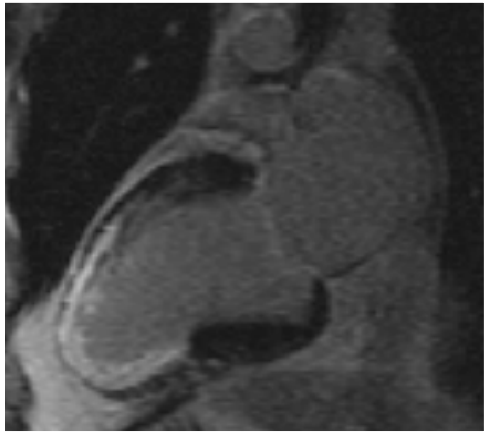
CMR Tissue Characterisation

Function



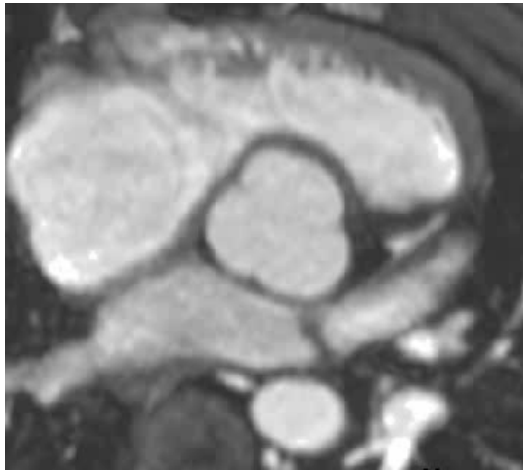


Replacement fibrosis

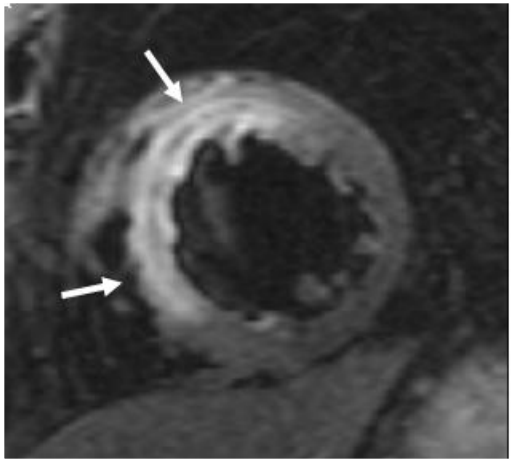


Inducible ischaemia

Origin coronaries



Myocardial oedema



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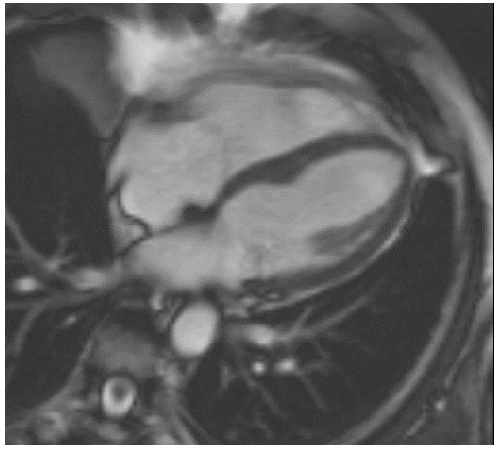
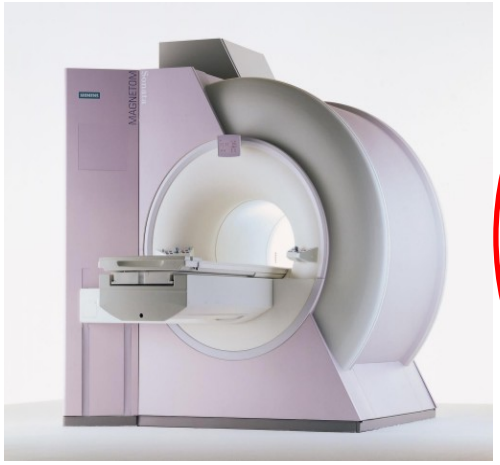
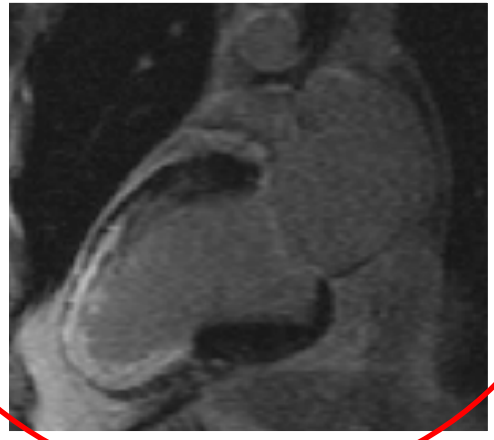
CMR Tissue Characterisation

Function





Replacement fibrosis



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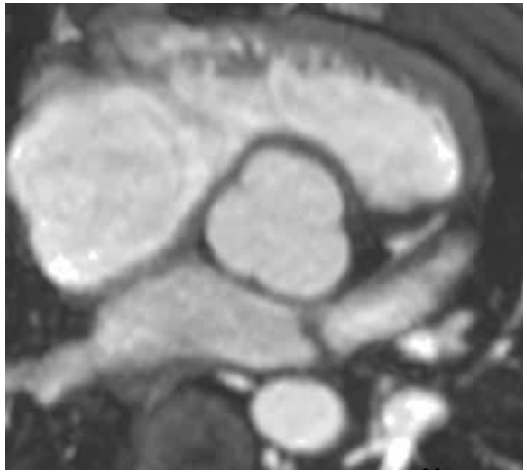
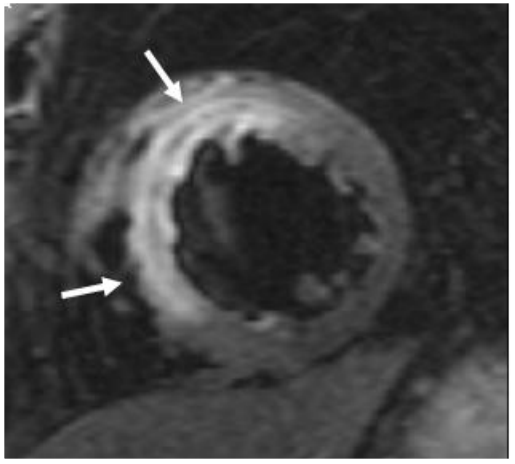


Myocardial oedema



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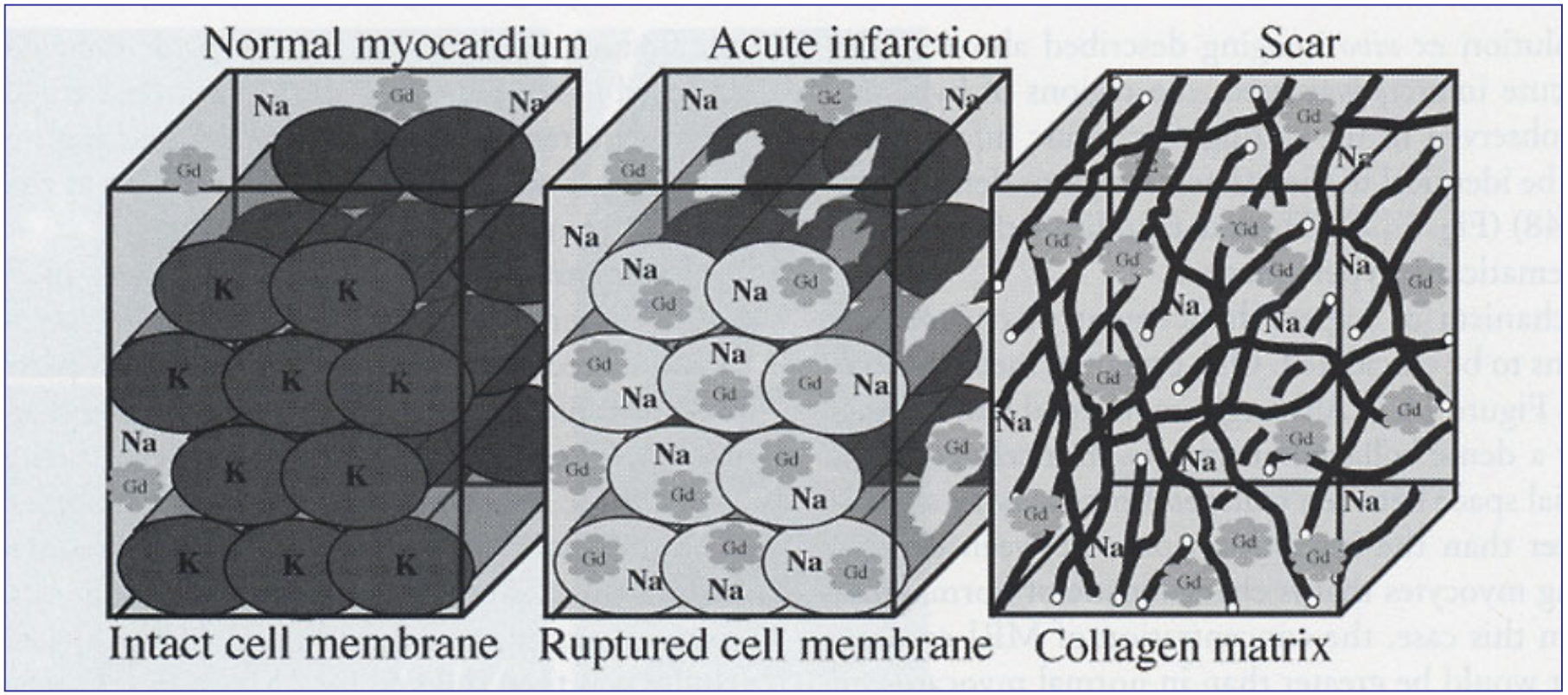
Gadolinium Contrast Agent



Kim RJ, Cardiovascular MRI and MRA, Higgins and de Roos ed. LWW 2003

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Contrast Enhancement

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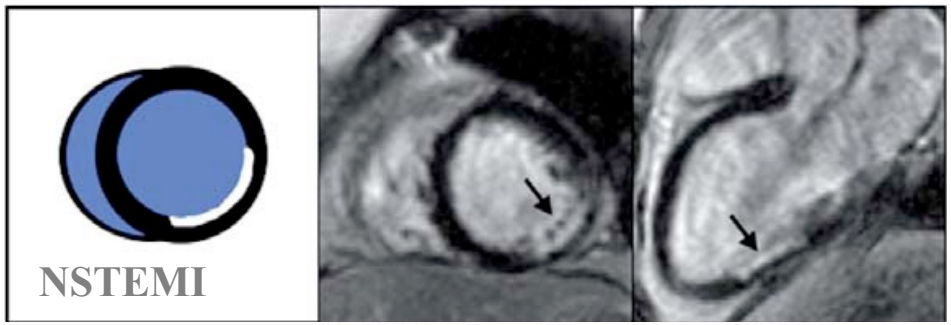
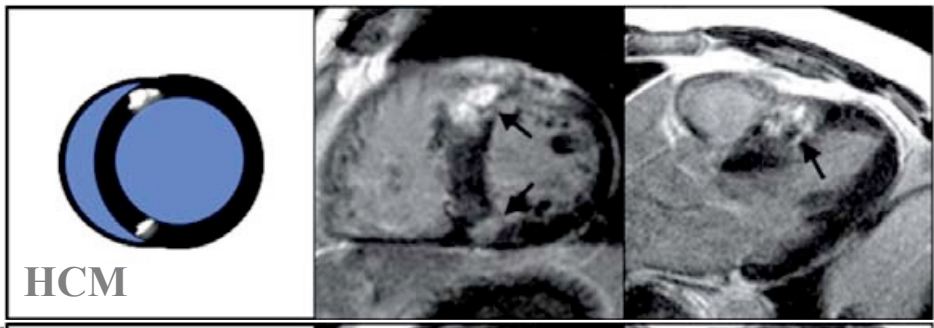
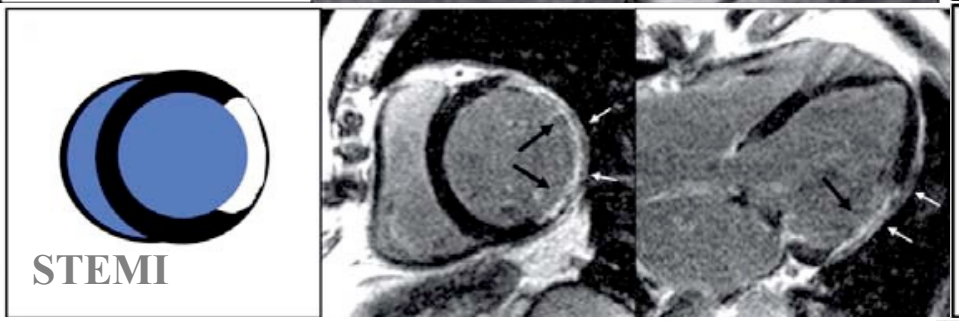
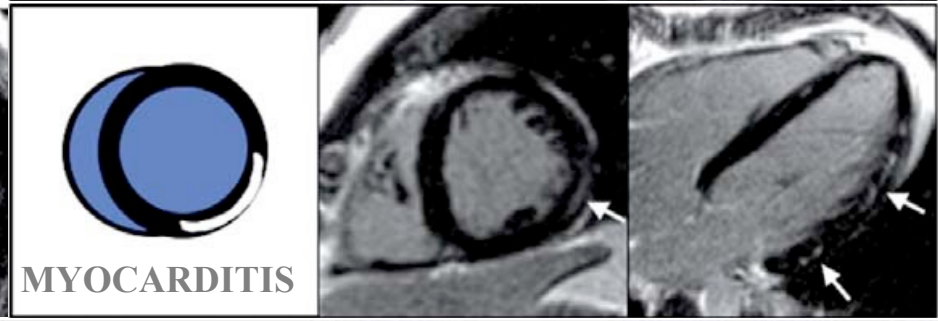
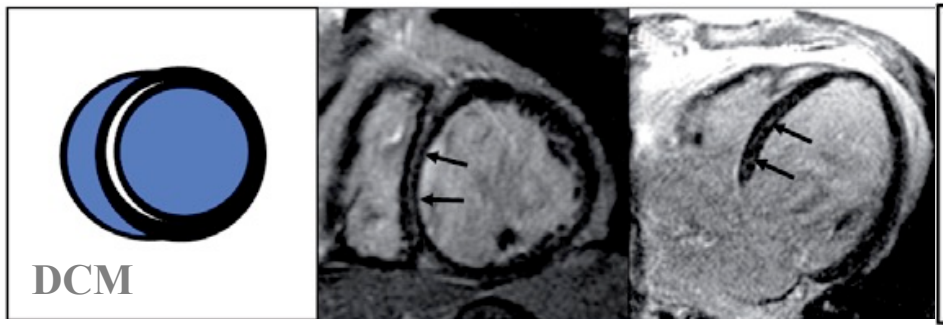
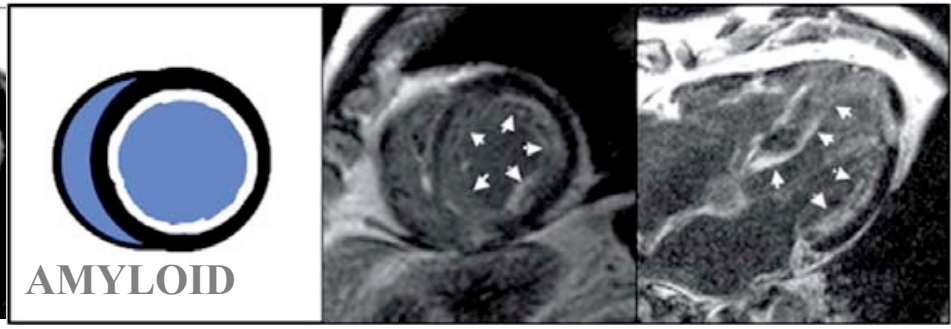




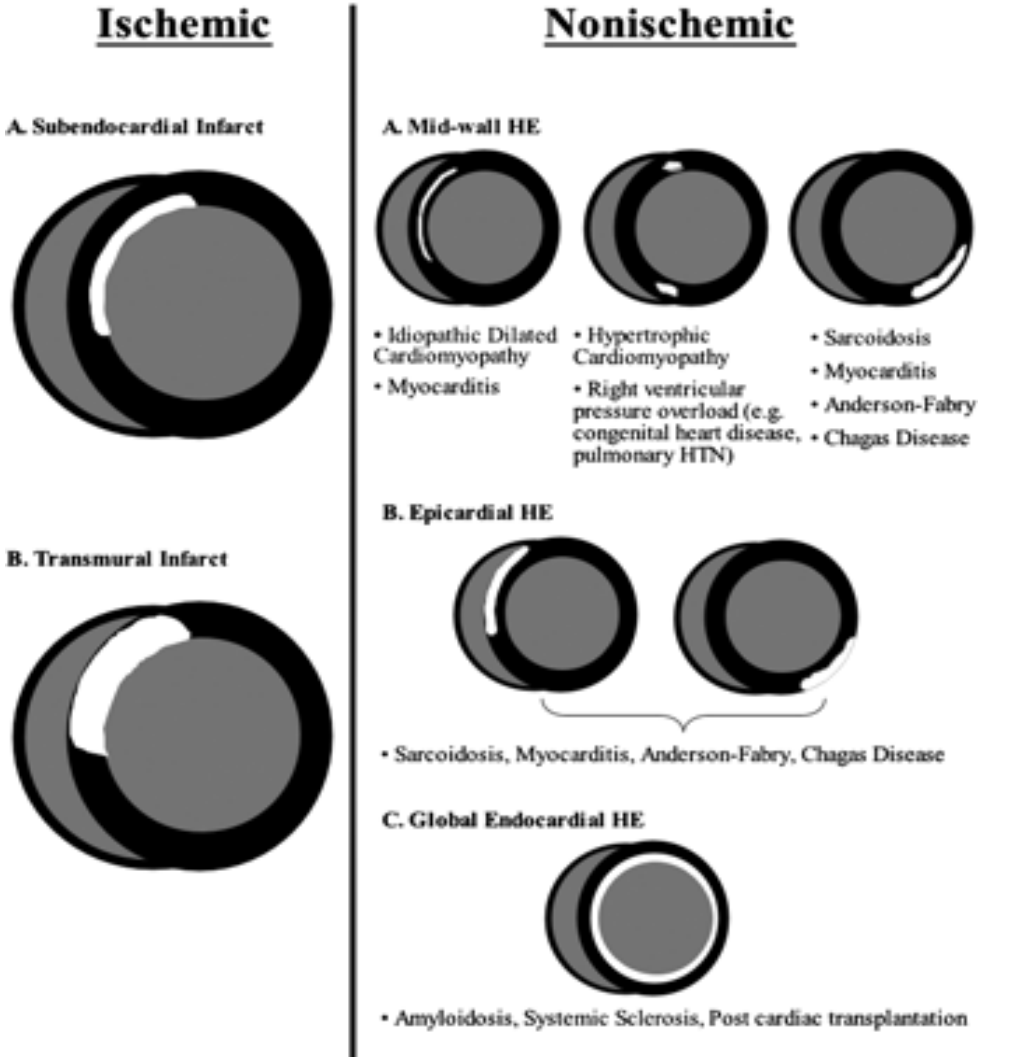








Gadolinium and differential diagnosis



Mahrholdt H et al , EHJ 2005; 26: 1461-74

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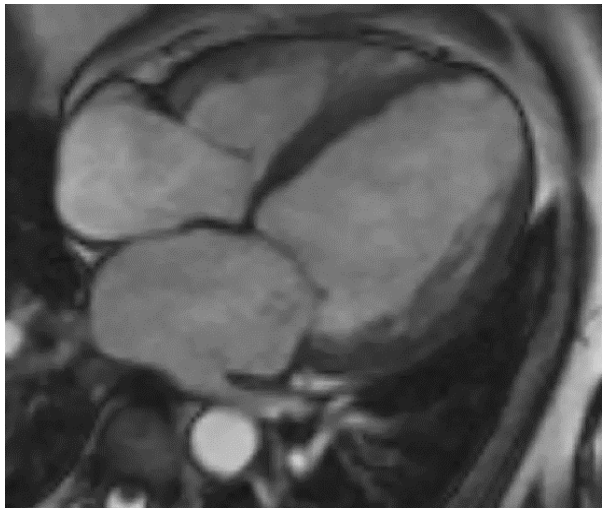
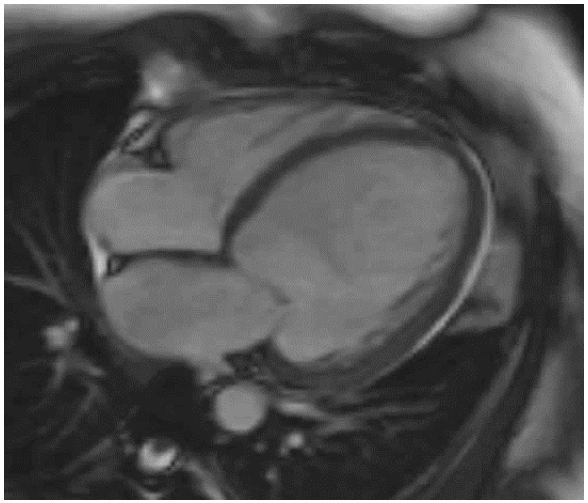
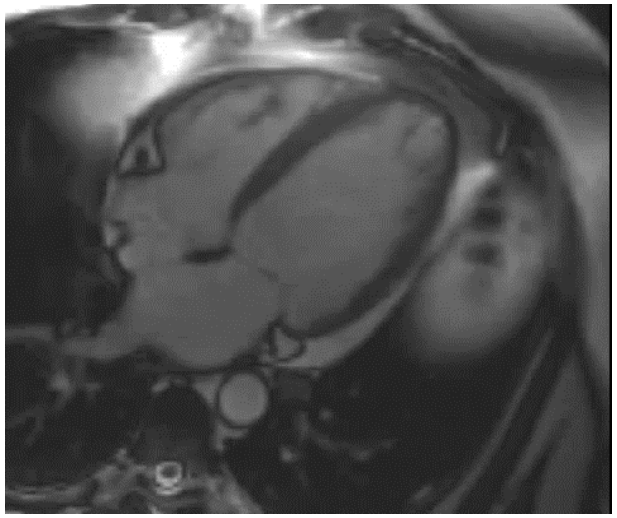
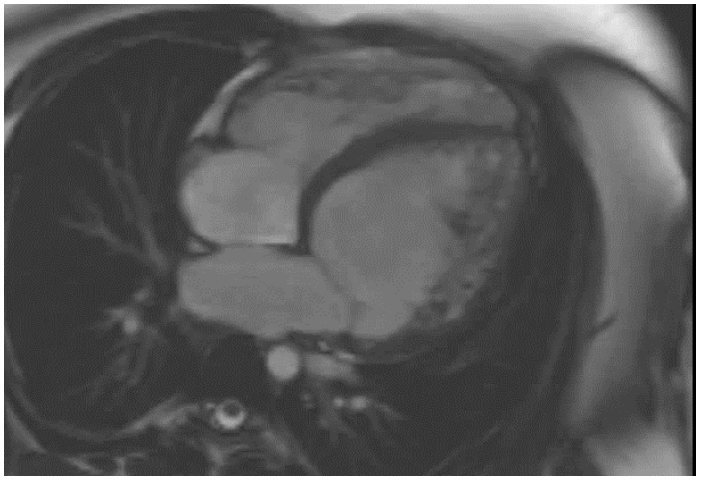
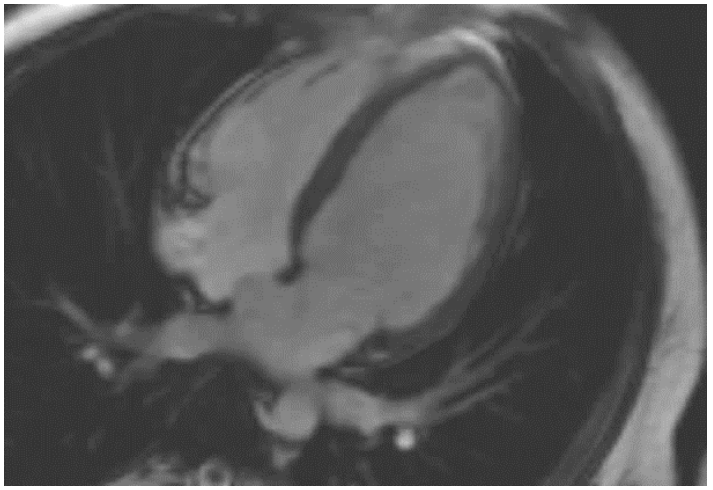
Dilated Hearts- Differentials











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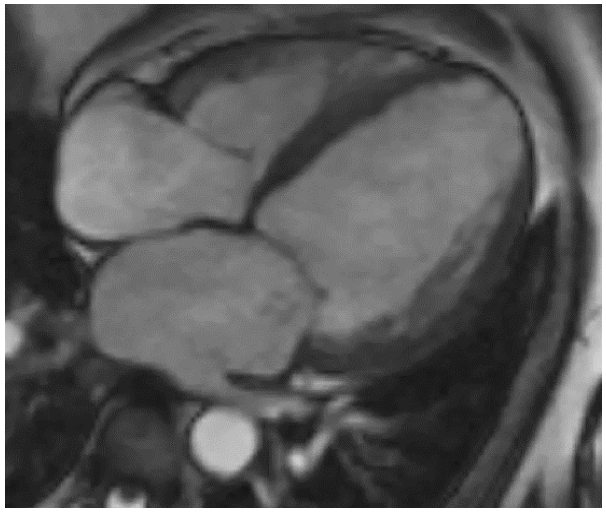
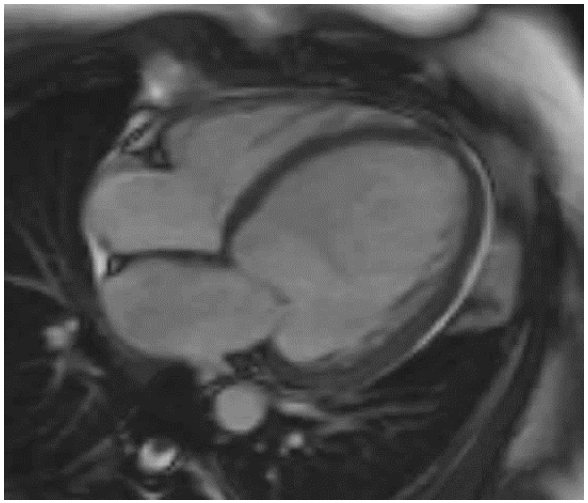
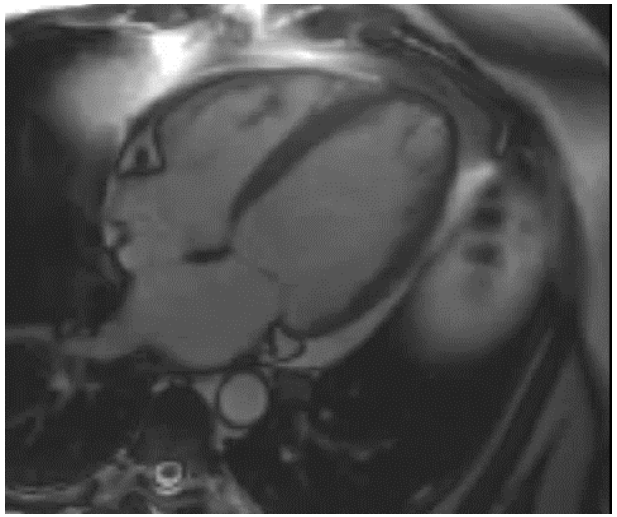
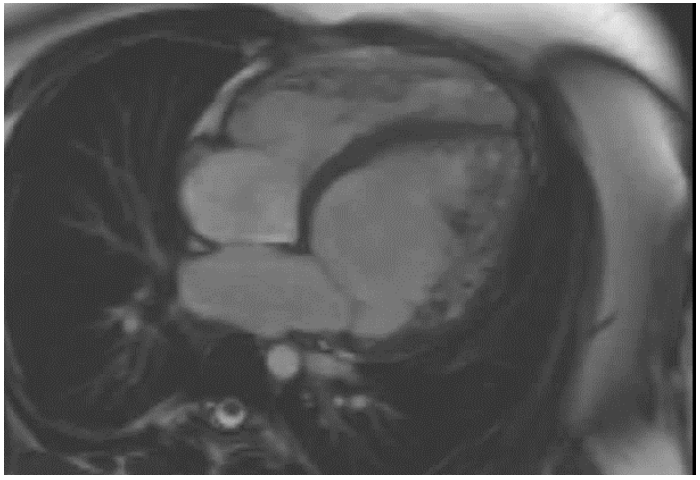
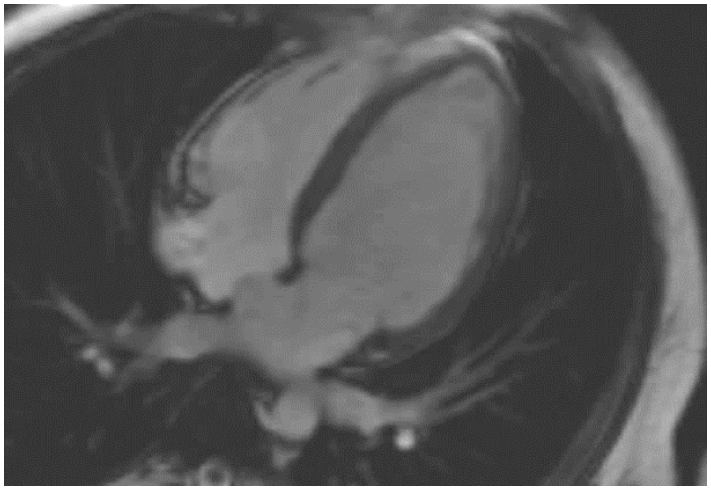
Dilated Hearts- Differentials











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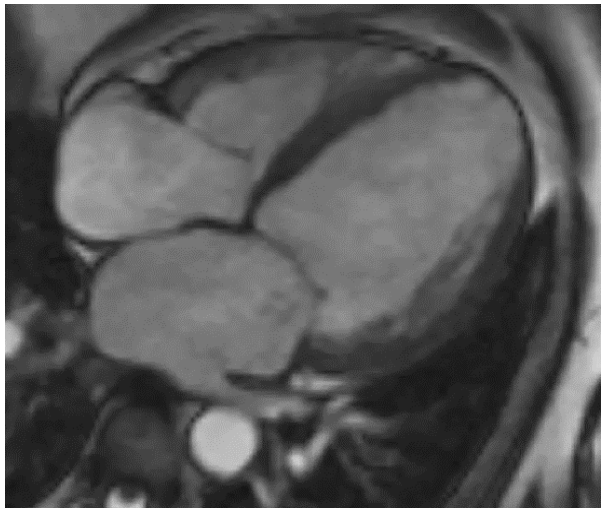
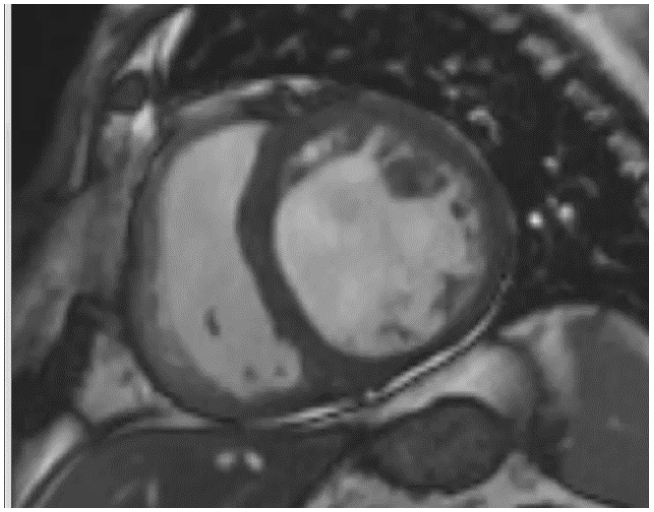
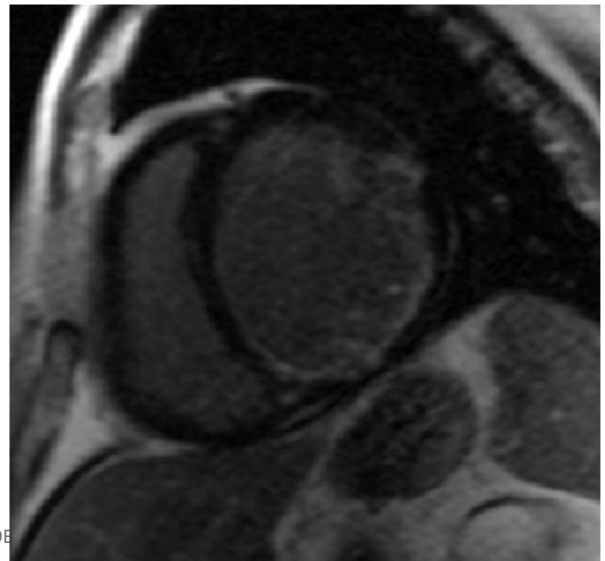
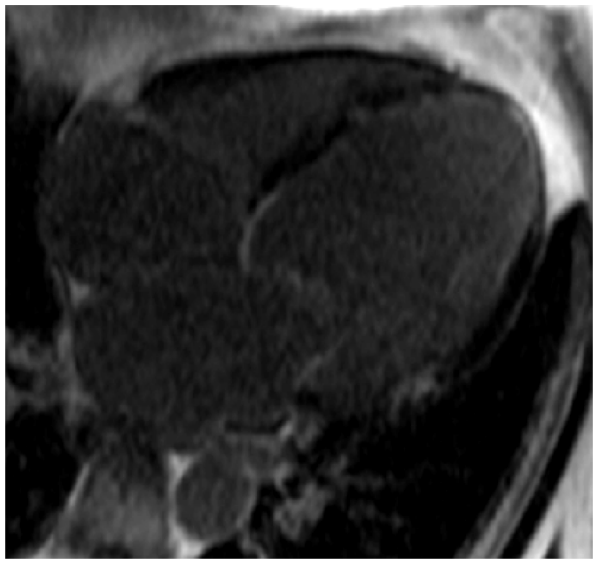
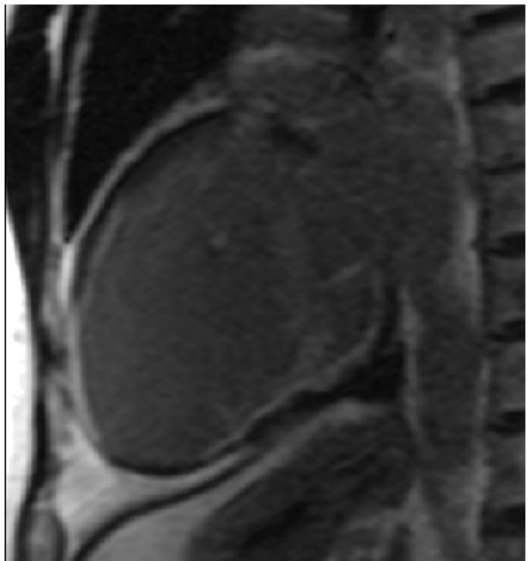
Case 1 Ischemic Cardiomyopathy











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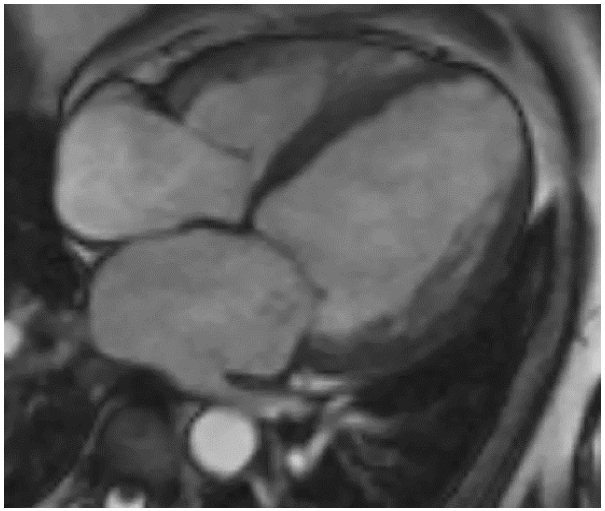
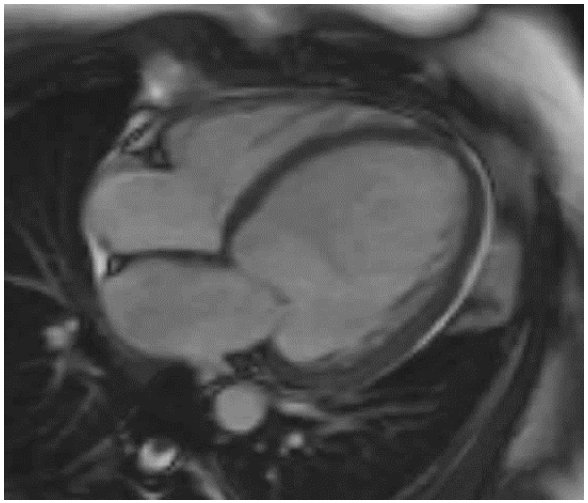
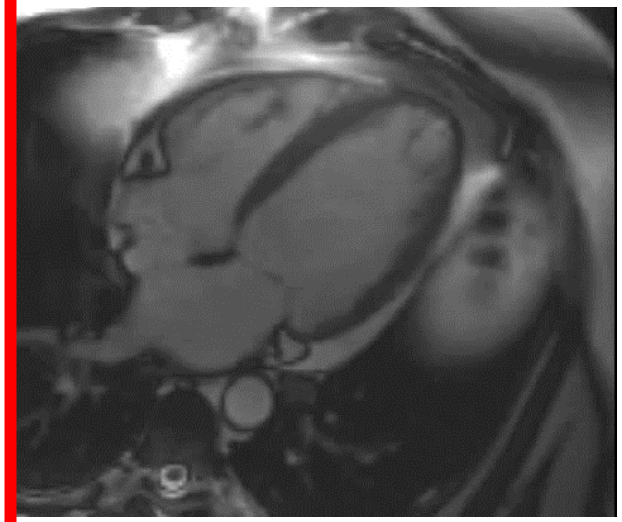
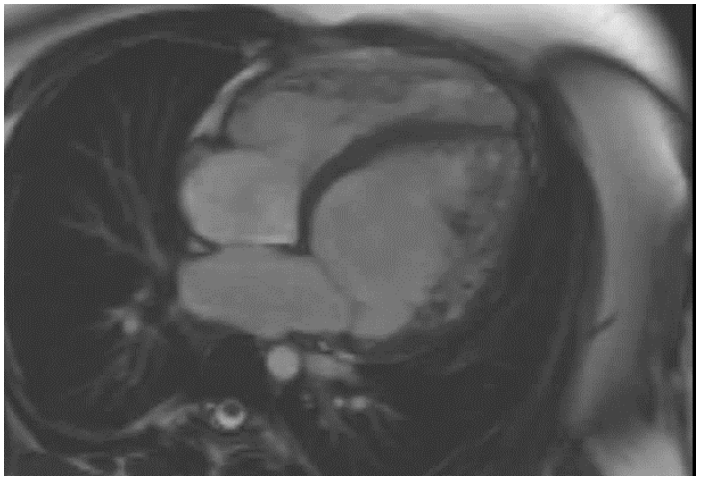
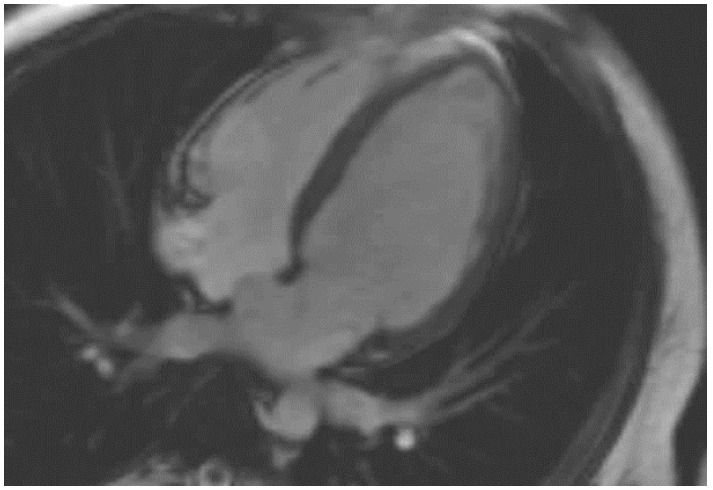
Dilated Hearts- Differentials











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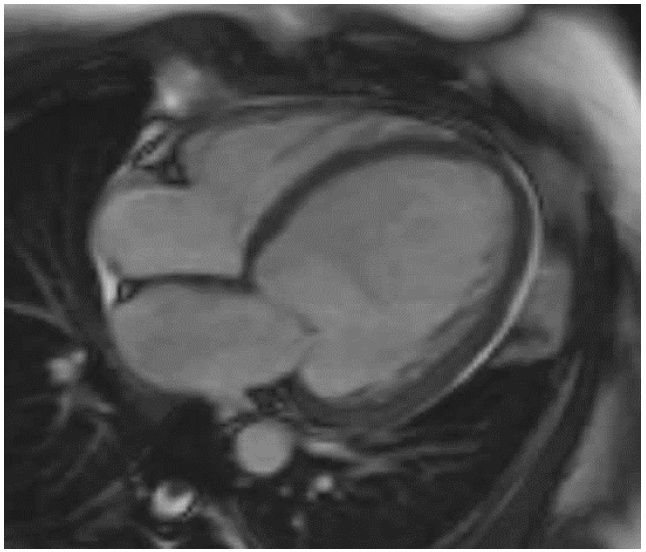
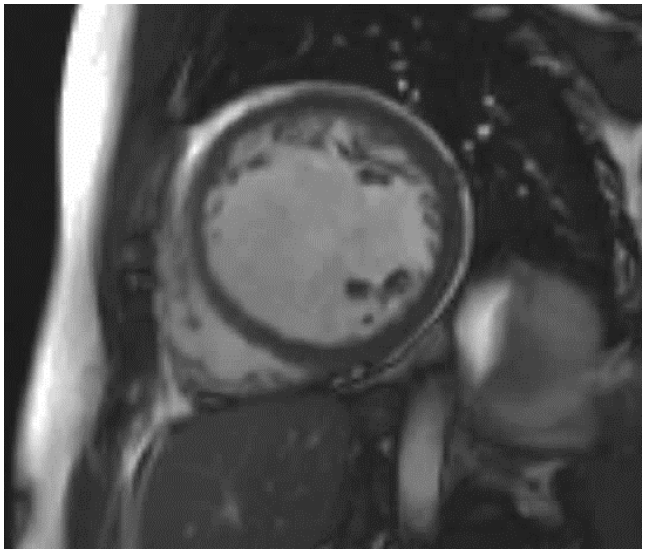
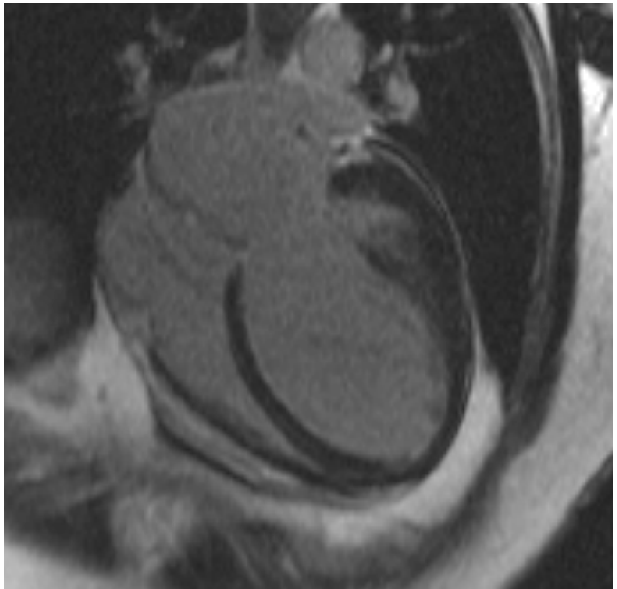
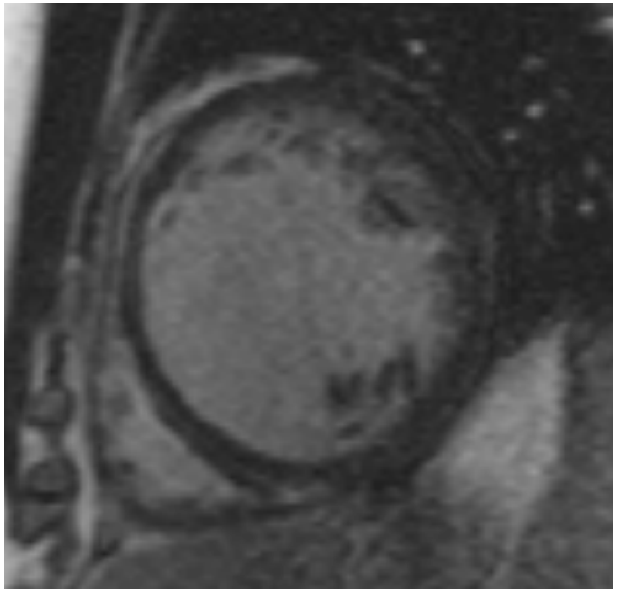
Case 2 Dilated Cardiomyopathy









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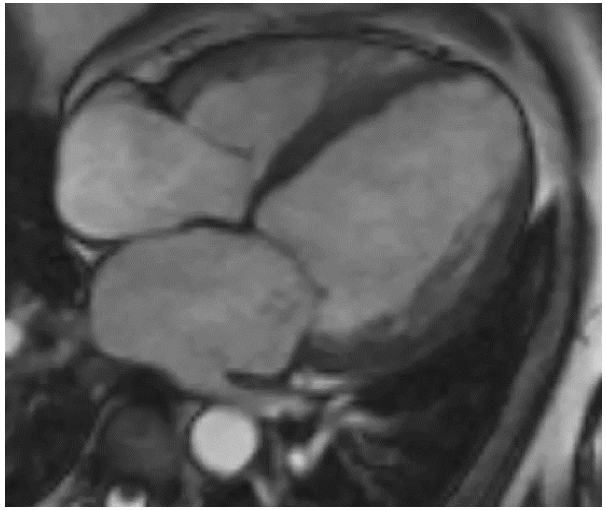
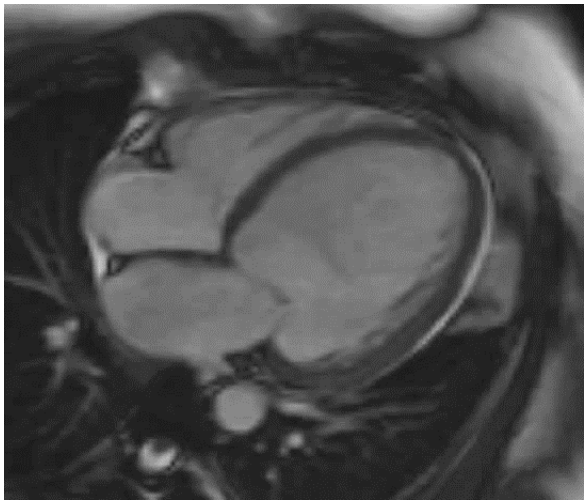
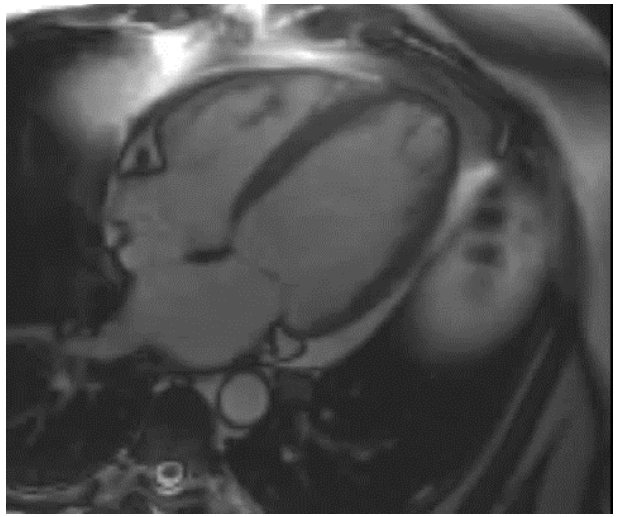
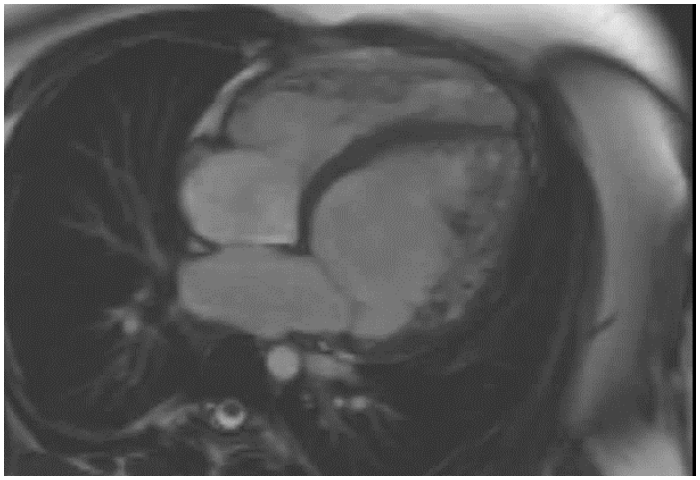
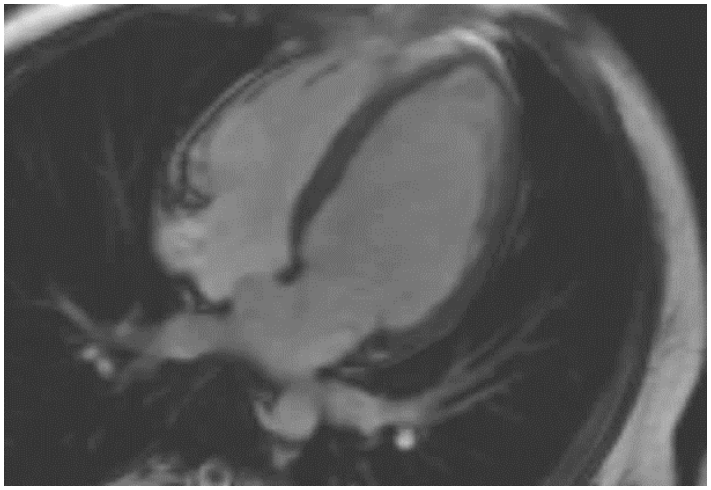
Dilated Hearts- Differentials











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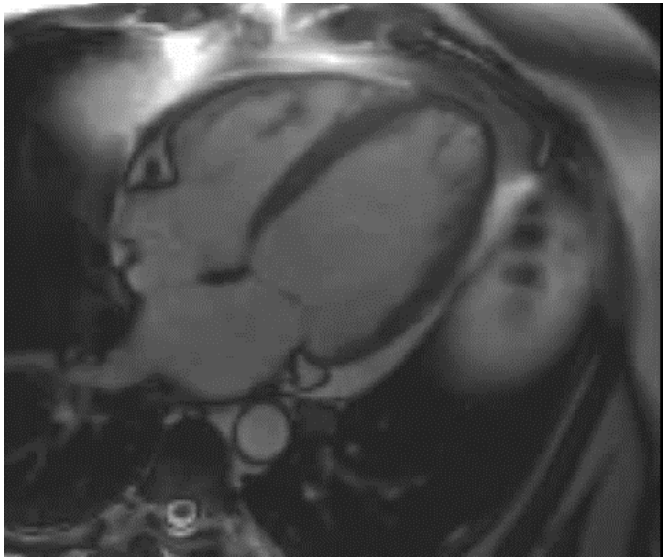
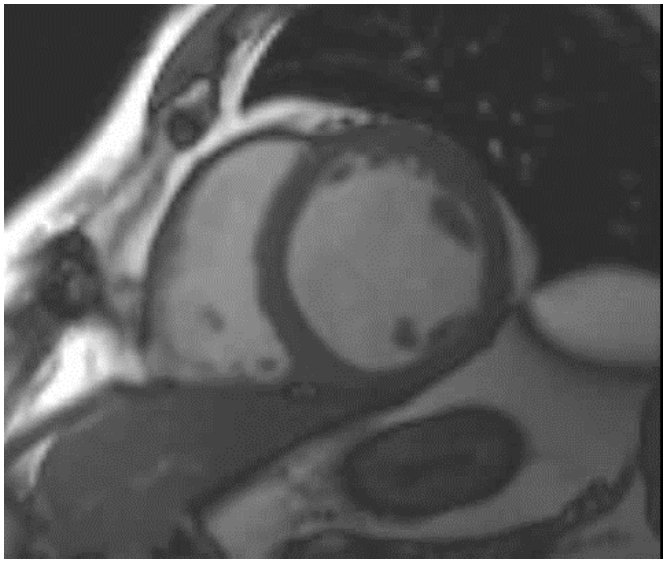
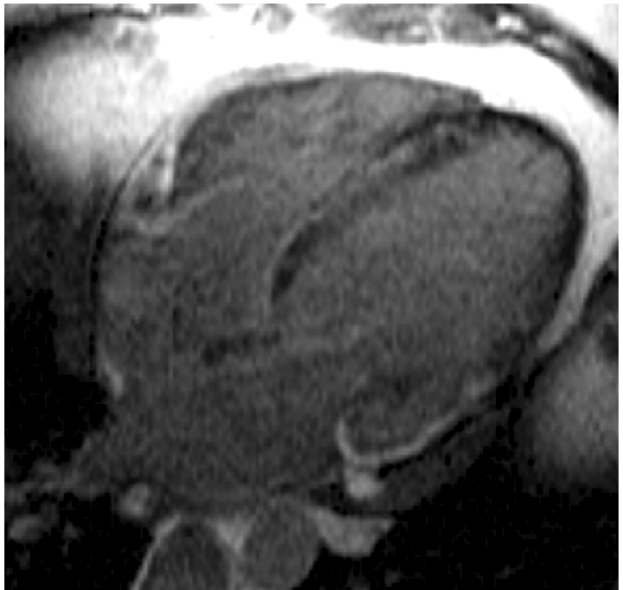
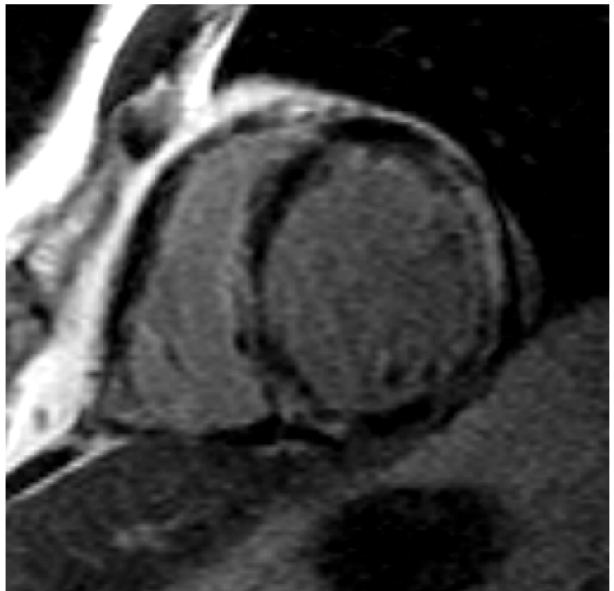
Case 3: Cardiac Sarcoidosis









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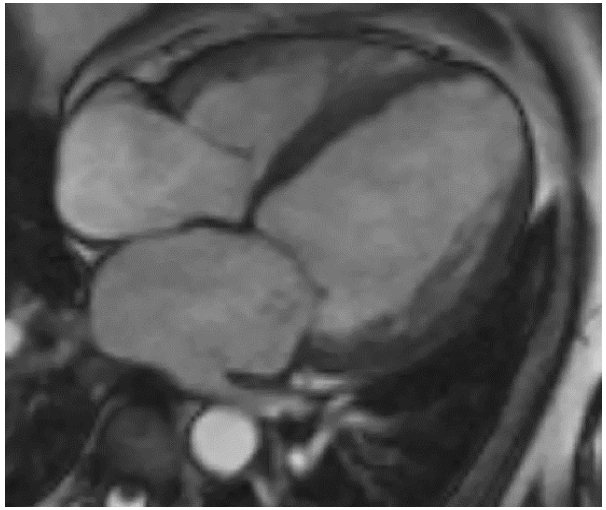
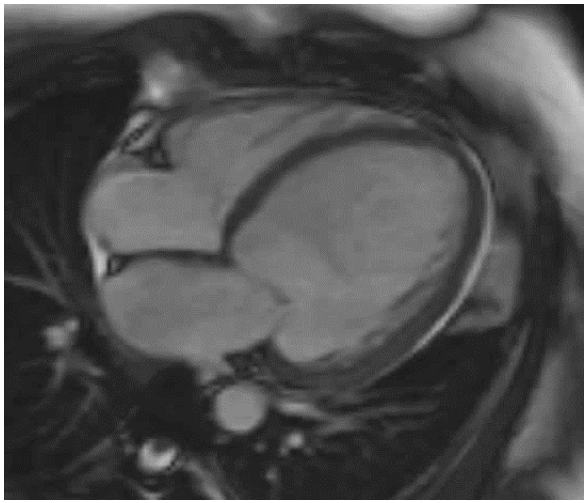
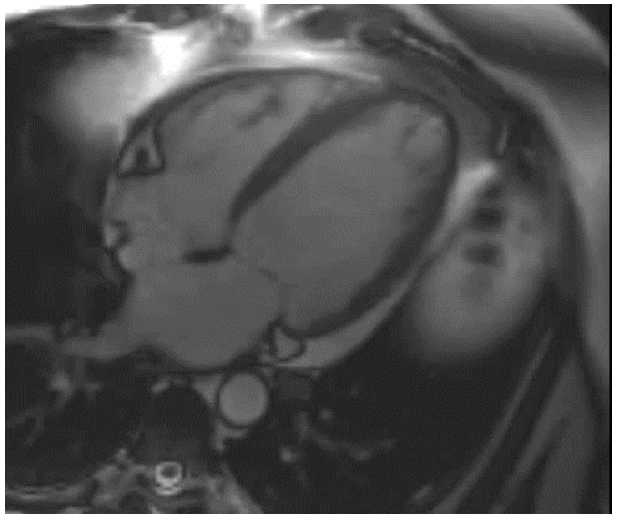
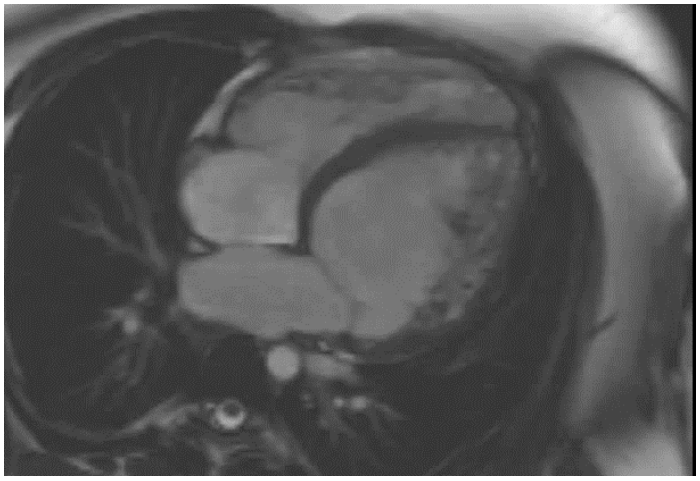
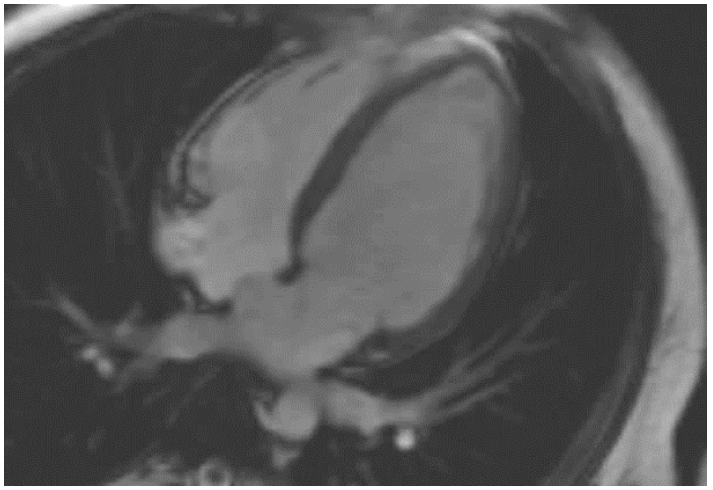
Dilated Hearts- Differentials











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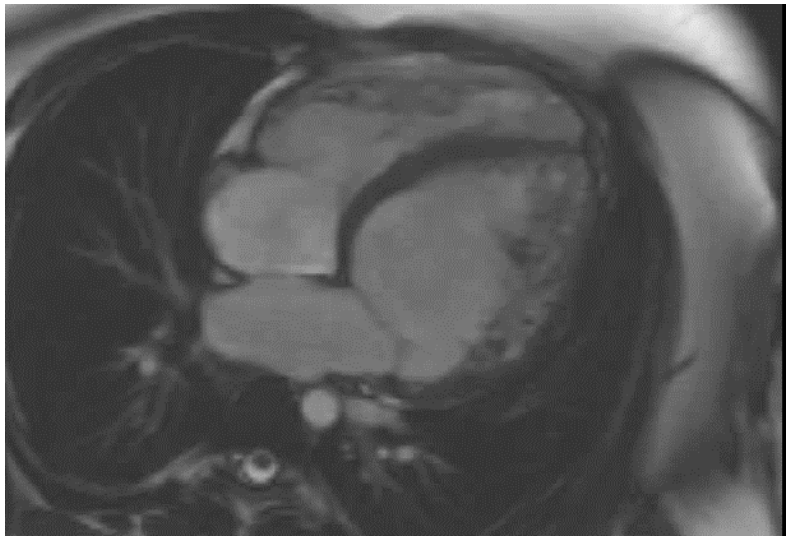
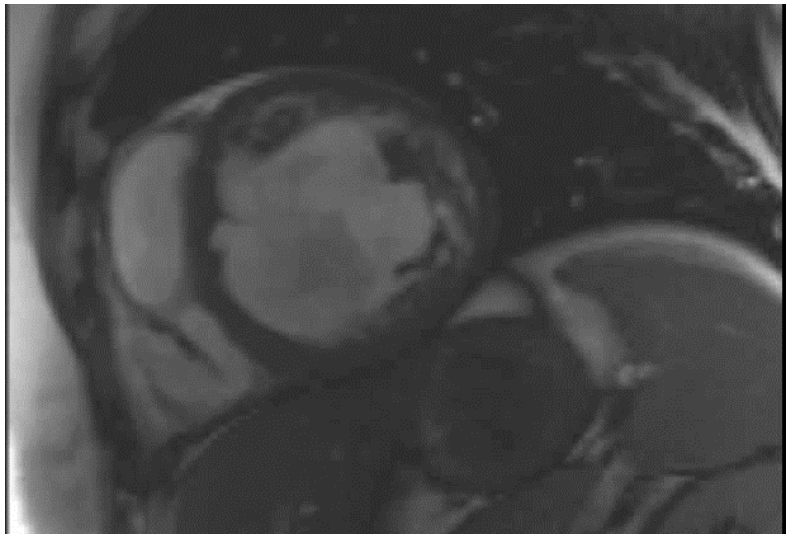
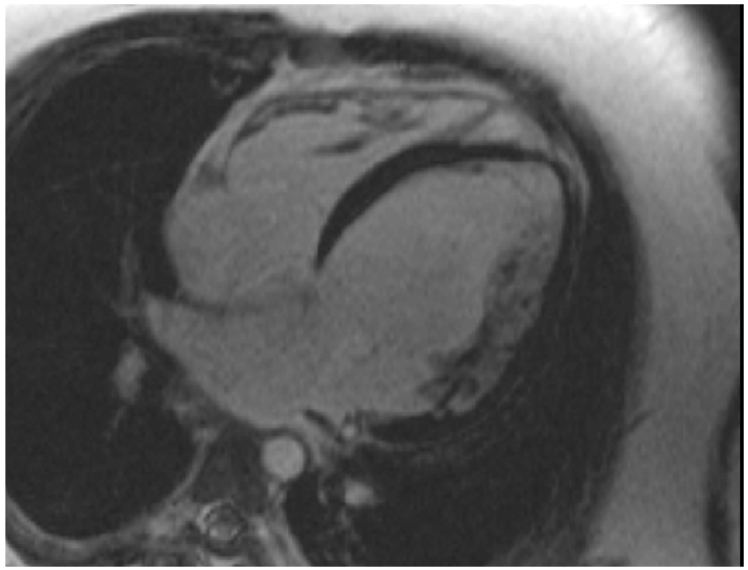
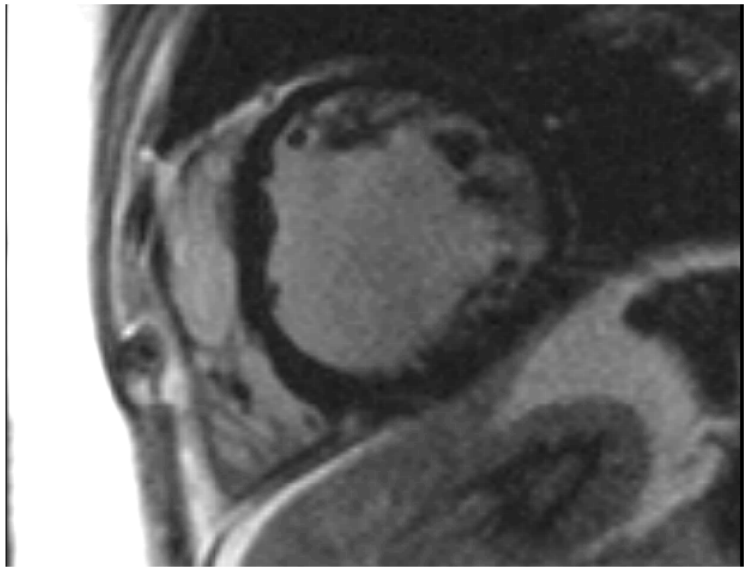
Left Ventricular Non Compaction









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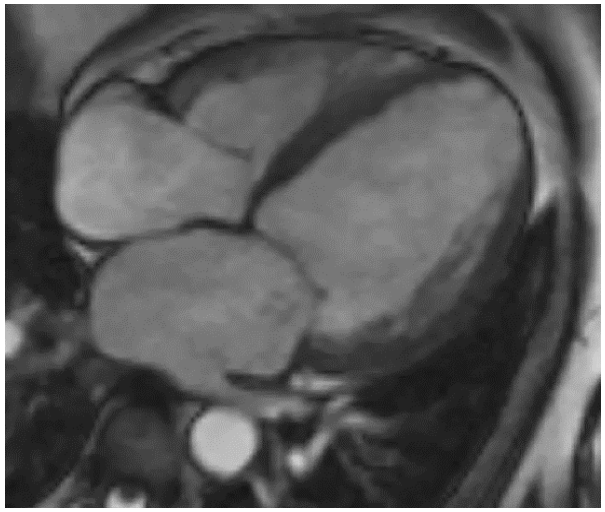
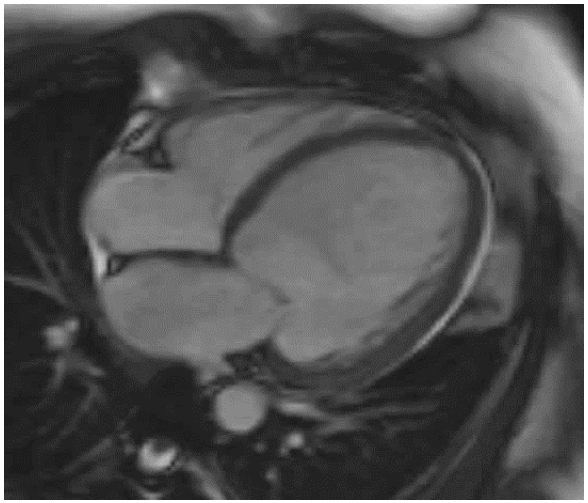
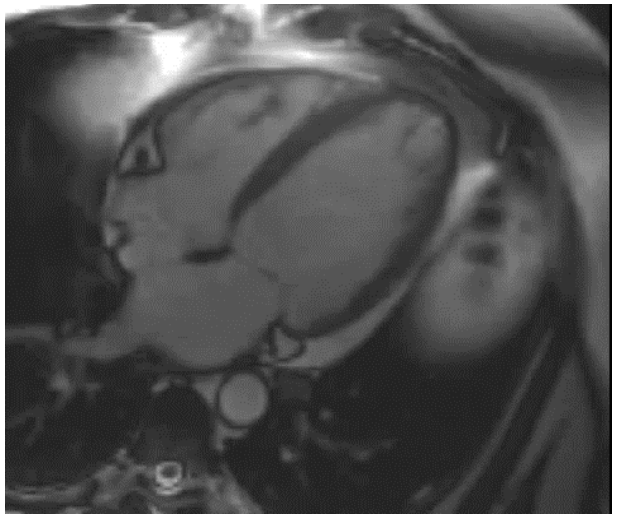
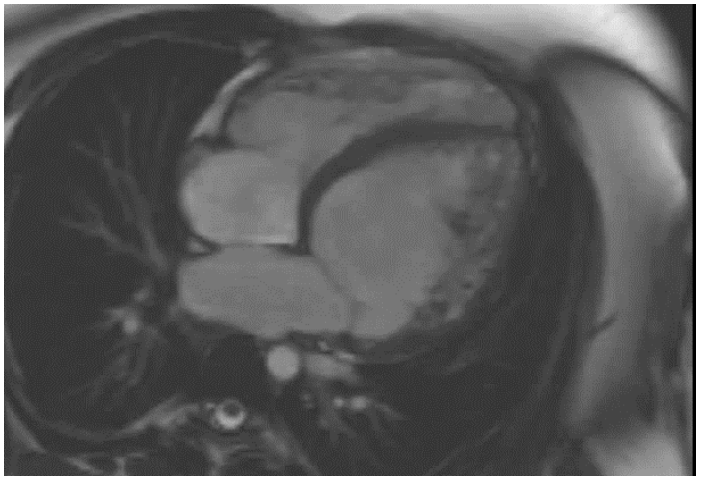
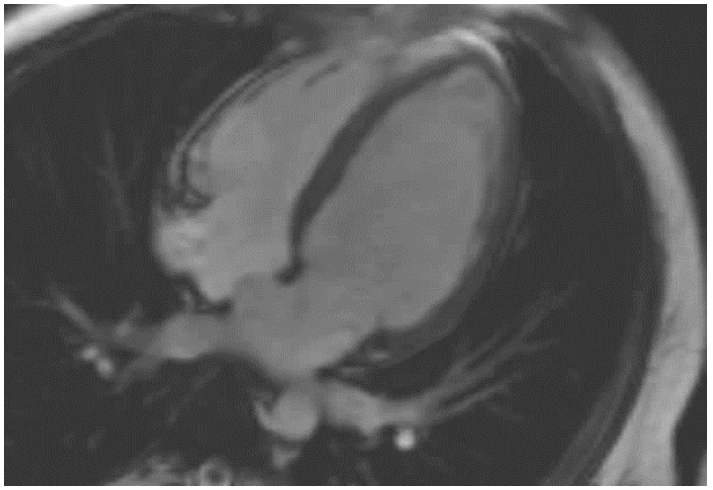
Dilated Hearts- Differentials











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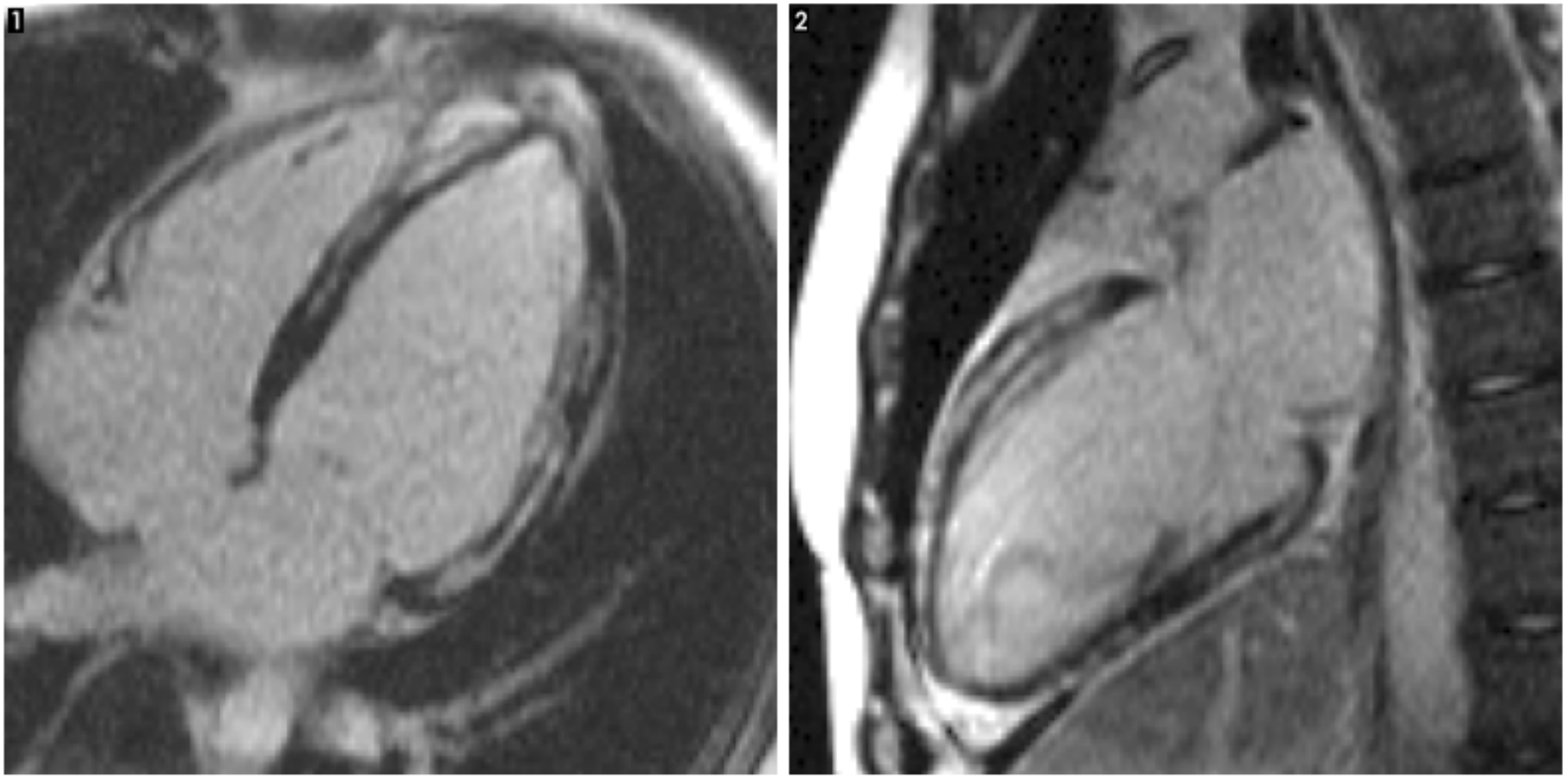
Images Post Gadolinium



DCM Post Myocarditis

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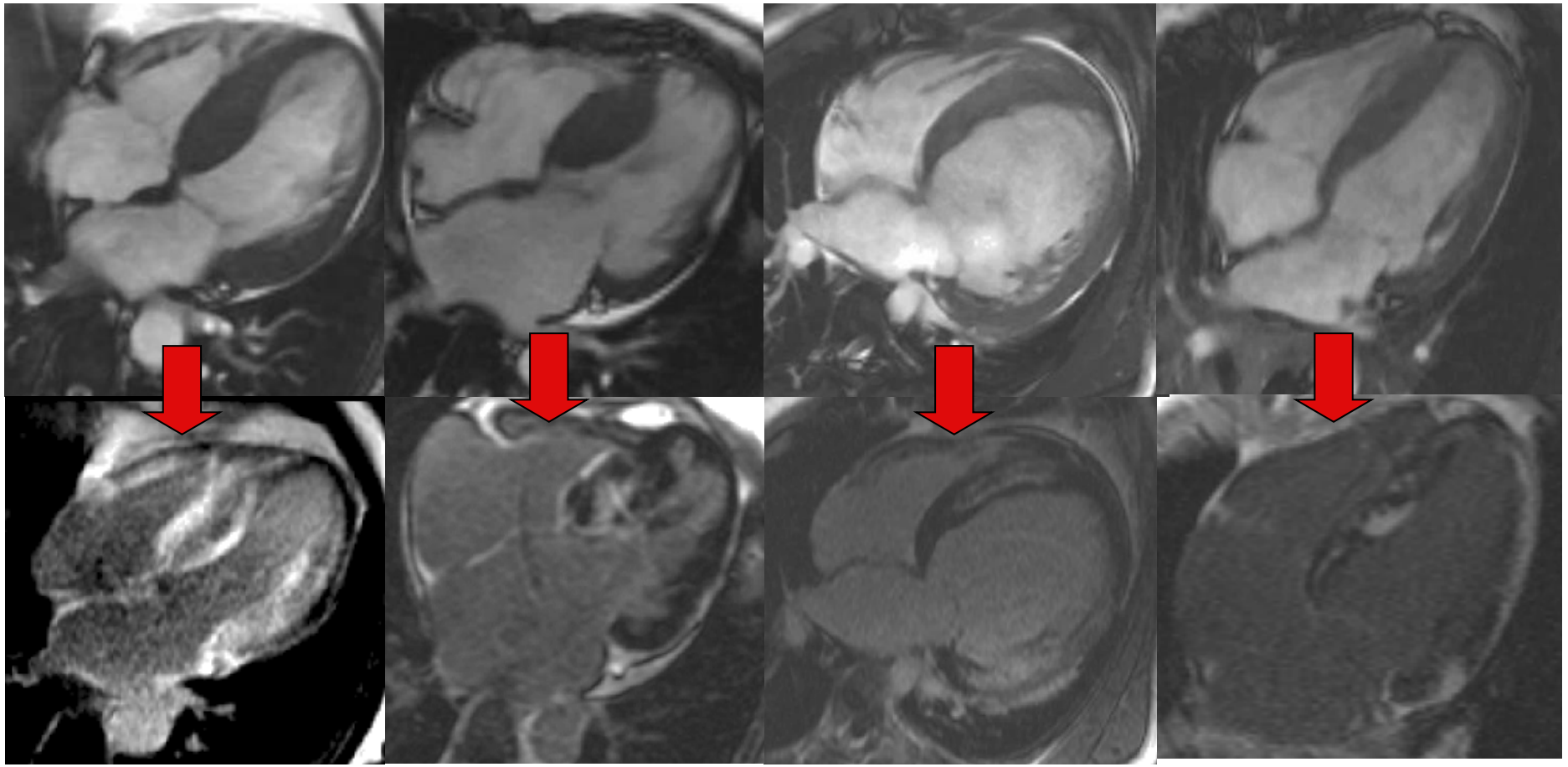
LVH Differential Diagnosis



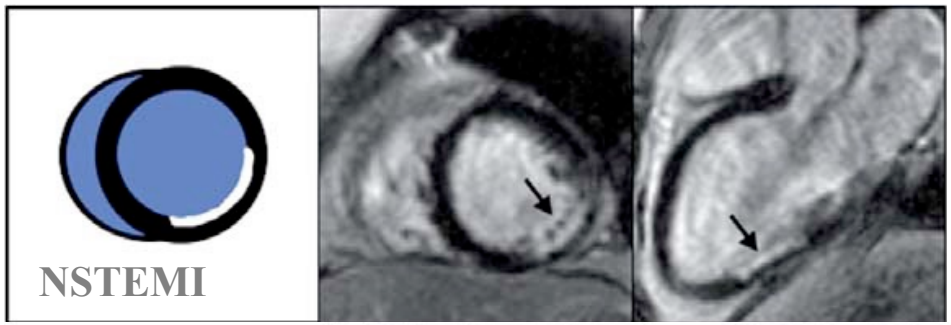
Amyloidosis | HCM | Fabry's | Sarcoidosis

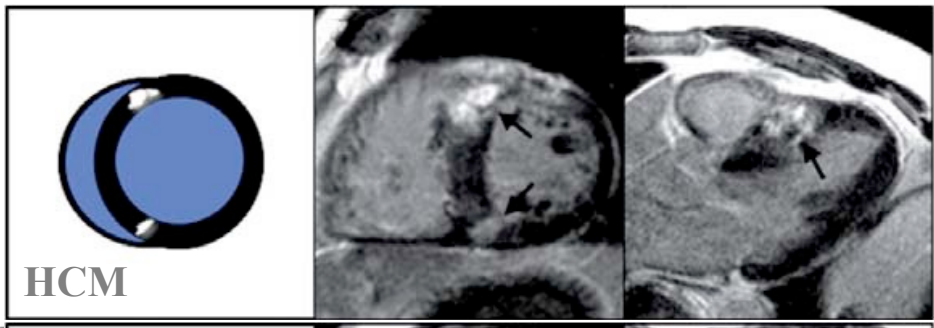
European Heart Journal (2016) **37**, 2129–2200
doi:10.1093/eurheartj/ehw128

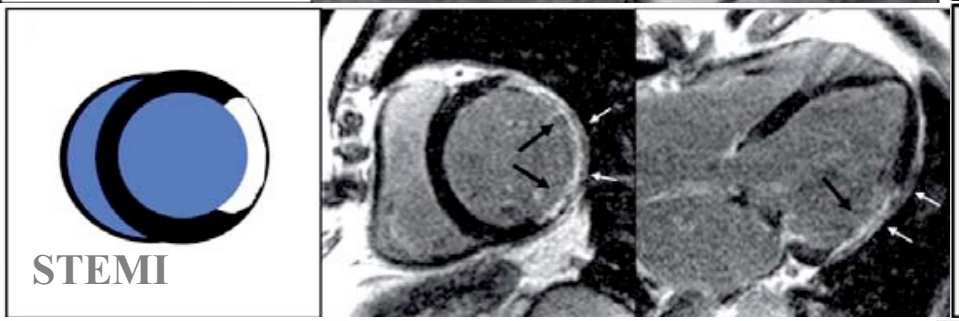
2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure

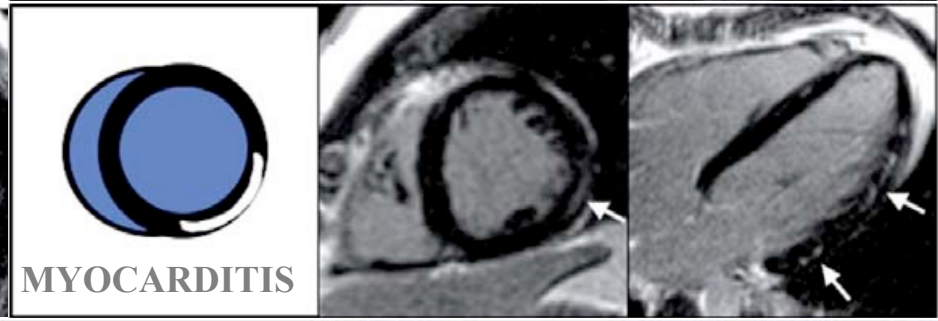
TTE is recommended to assess LVEF in order to identify patients with HF who would be suitable for evidence-based pharmacological and device (ICD, CRT) treatment recommended for HFrEF.	I	C	
TTE is recommended for the assessment of valve disease, right ventricular function and pulmonary arterial pressure in patients with an already established diagnosis of either HFrEF, HFmrEF or HFpEF in order to identify those suitable for correction of valve disease.	I	C	
TTE is recommended for the assessment of myocardial structure and function in subjects to be exposed to treatment which potentially can damage myocardium (e.g. chemotherapy).	I	C	
Other techniques (including systolic tissue Doppler velocities and deformation indices, i.e. strain and strain rate), should be considered in a TTE protocol in subjects at risk of developing HF in order to identify myocardial dysfunction at the preclinical stage.	IIa	C	
CMR is recommended for the assessment of myocardial structure and function (including right heart) in subjects with poor acoustic window and patients with complex congenital heart diseases (taking account of cautions/contra-indications to CMR).	I	C	
CMR with LGE should be considered in patients with dilated cardiomyopathy in order to distinguish between ischaemic and non-ischaemic myocardial damage in case of equivocal clinical and other imaging data (taking account of cautions/contra-indications to CMR).	IIa	C	
CMR is recommended for the characterization of myocardial tissue in case of suspected myocarditis, amyloidosis, sarcoidosis, Chagas disease, Fabry disease non-compaction cardiomyopathy, and haemochromatosis (taking account of cautions/contra-indications to CMR).	I	C	
Non-invasive stress imaging (CMR, stress echocardiography, SPECT, PET) may be considered for the assessment of myocardial ischaemia and viability in patients with HF and CAD (considered suitable for coronary revascularization) before the decision on revascularization.	IIb	B	116–118
Invasive coronary angiography is recommended in patients with HF and angina pectoris recalcitrant to pharmacological therapy or symptomatic ventricular arrhythmias or aborted cardiac arrest (who are considered suitable for potential coronary revascularization) in order to establish the diagnosis of CAD and its severity.	I	C	
Invasive coronary angiography should be considered in patients with HF and intermediate to high pre-test probability of CAD and the presence of ischaemia in non-invasive stress tests (who are considered suitable for potential coronary revascularization) in order to establish the diagnosis of CAD and its severity.	IIa	C	

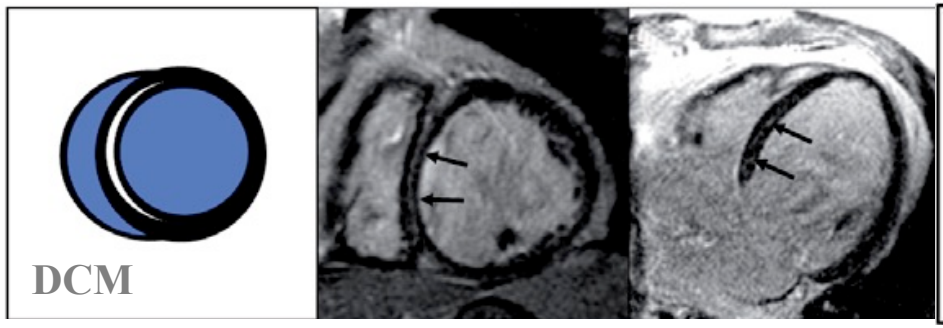
Contrast Enhancement

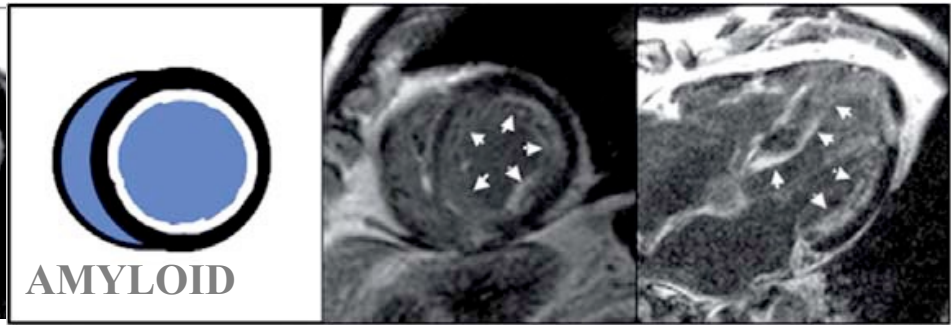












From Bright is Dead to…… Bright is BAD

Bucciarelli-Ducci C, JACC 2012

Case 4

51 yo caucasian female

Hypertension, hypercholesterolemia

Episode of chest discomfort

European Heart Journal
doi:10.1093/eurheartj/ehu278

2014 ESC/EACTS Guidelines on myocardial revascularization

The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Developed with the special contribution of the European Association of Percutaneous Cardiovascular Interventions (EAPCI)

Indications for diagnostic testing in patients with suspected CAD and stable symptoms

	Asymptomatic[a]		Symptomatic						
			Probability of significant disease[b]						
			Low (<15%)		Intermediate (15–85%)		High (>85%)		
	Class[c]	Level[d]	Class[c]	Level[d]	Class[c]	Level[d]	Class[c]	Level[d]	Ref[e]
Anatomical detection of CAD									
Invasive angiography	III	A	III	A	IIb	A	I	A	50–52,54
CT angiography[f,g]	III	B	III	C	IIa	A	III	B	57–62
Functional test									
Stress echo	III	A	III	A	I	A	III	A	63–65
Nuclear imaging	III	A	III	A	I	A	III	A	60,66–70
Stress MRI	III	B	III	C	I	A	III	B	71–75
PET perfusion	III	B	III	C	I	A	III	B	67,69,70,76,77
Combined or hybrid imaging test									
	III	C	III	C	IIa	B	III	B	78–83

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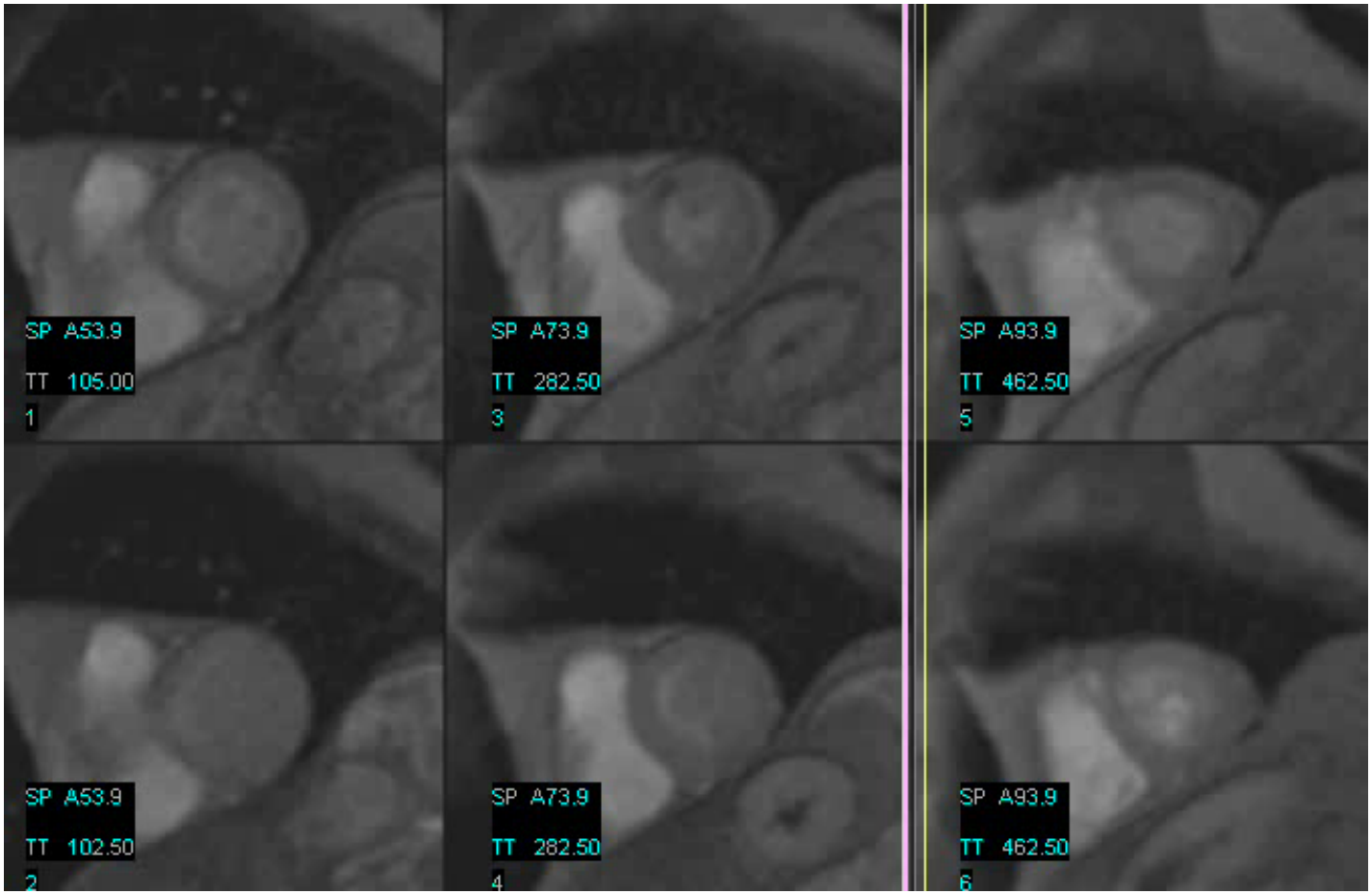
Stress Perfusion MRI

basal | mid-cavity | apical

STRESS

REST



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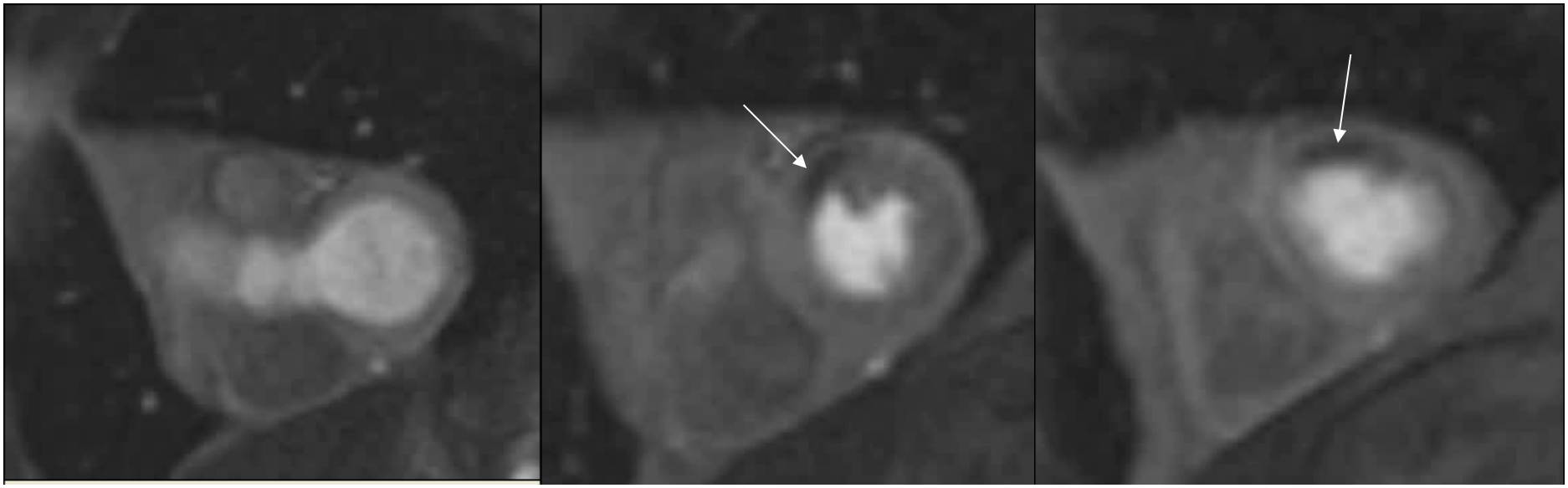
Stress Perfusion MRI

basal mid-cavity apical



STRESS

discrete inducible perfusion defect in the mid-cavity and apical anterior wall (white arrows) (corresponding to a large D1 territory)

Angio

- Severe stenosis ostional diagonal branch
- Moderate LAD disease but pressure wire was within normal limits

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ACS with unobstructed coronaries

- 7-15% ACS patients have unobstructed coronaries[1,2]
- Overall all-cause mortality - 4.7% at 12 months [3]
- CMR is an emerging investigation that may identify an underlying diagnosis and help in risk stratification[4]
- Discrepancies in literature

[1] Hochman JS, N Engl J Med 1999
[2] Glaser R, JAMA 2002
[3] Pasupathy, Circulation 2015
[4] Dastidar Current CV Imag reports 2015

Case 5

- 48 year old lady
- Chest pain
- No cardiac risk factors

- Troponin T 536 ng/L (normal <14 ng/L), CRP 10 mg/L (normal <10 mg/L)

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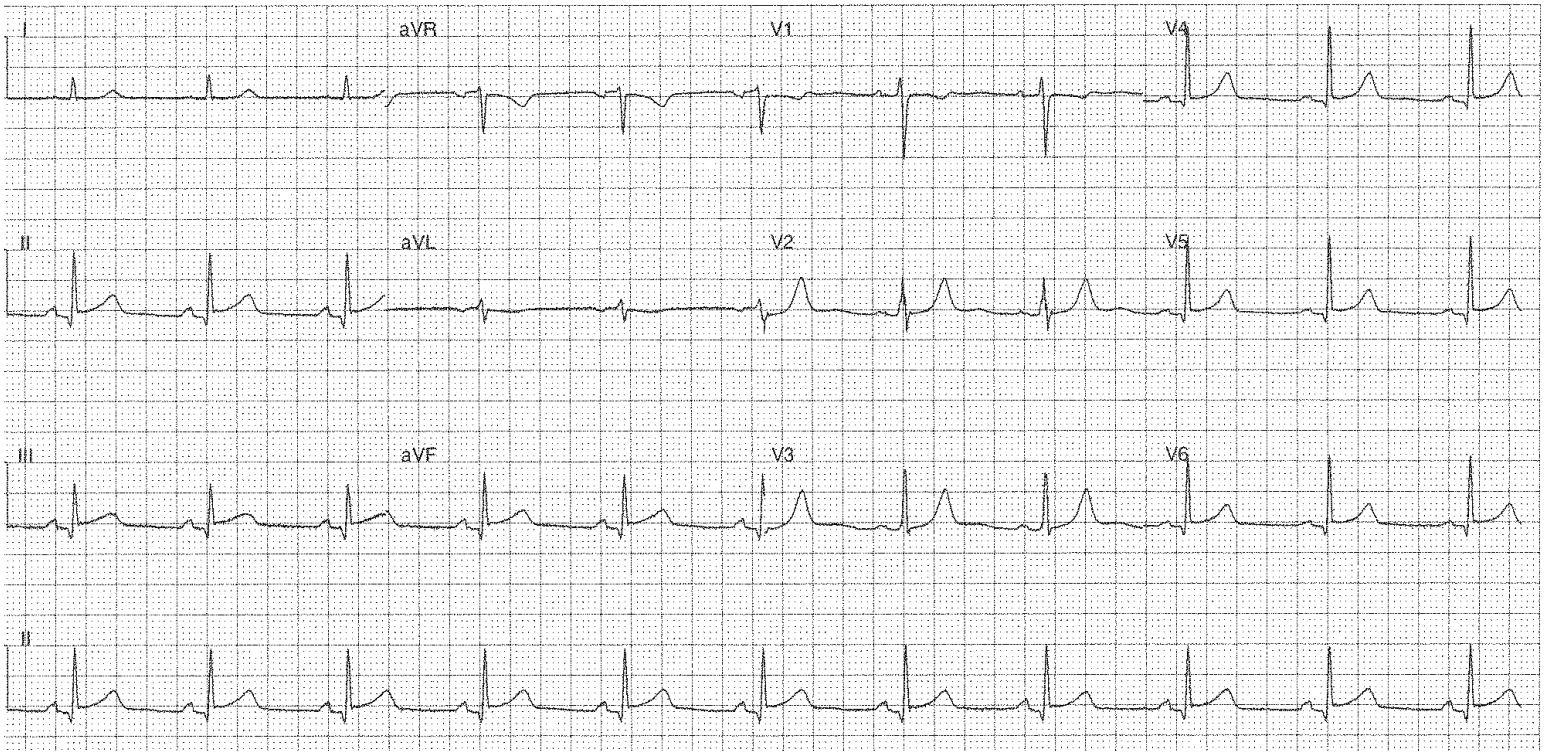
ECG



Transthoracic echocardiogram normal

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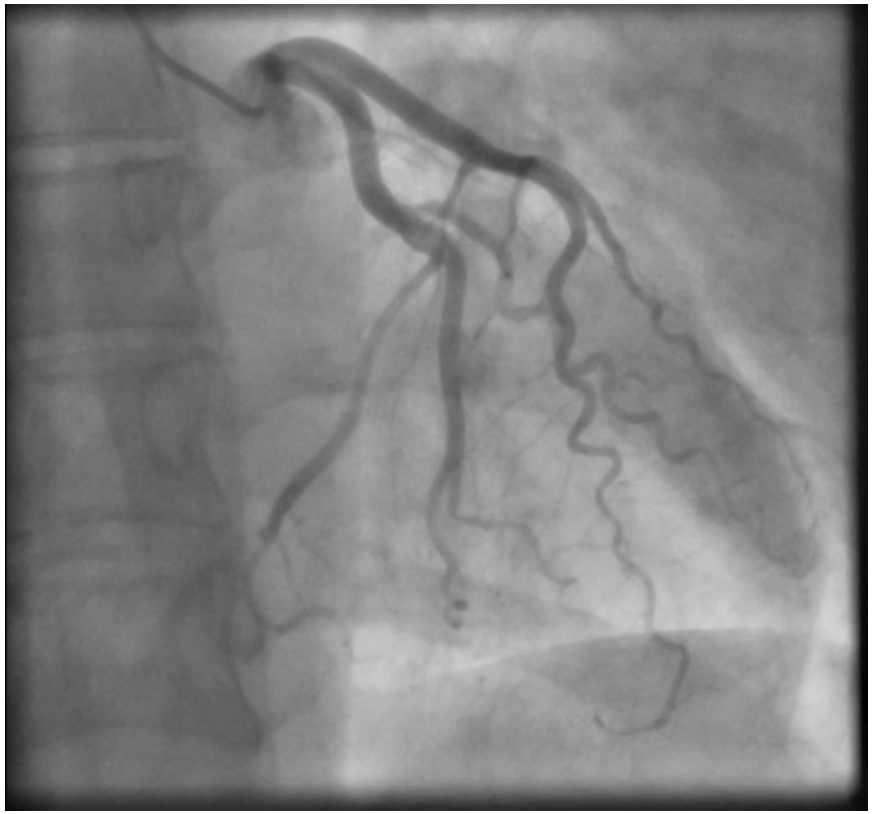
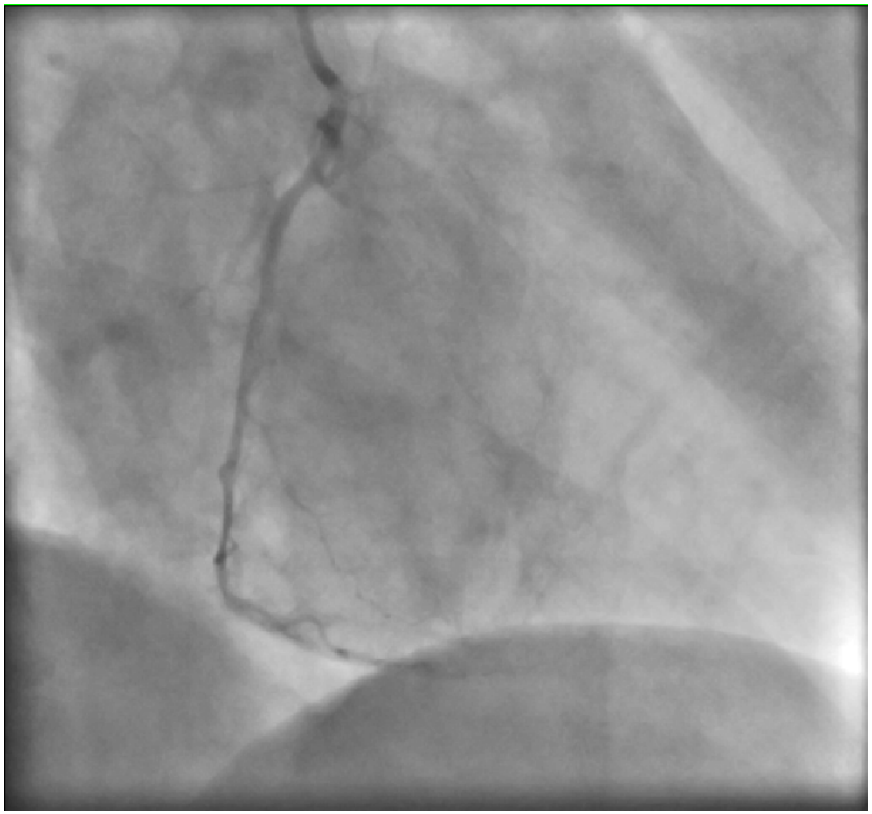
Angiogram





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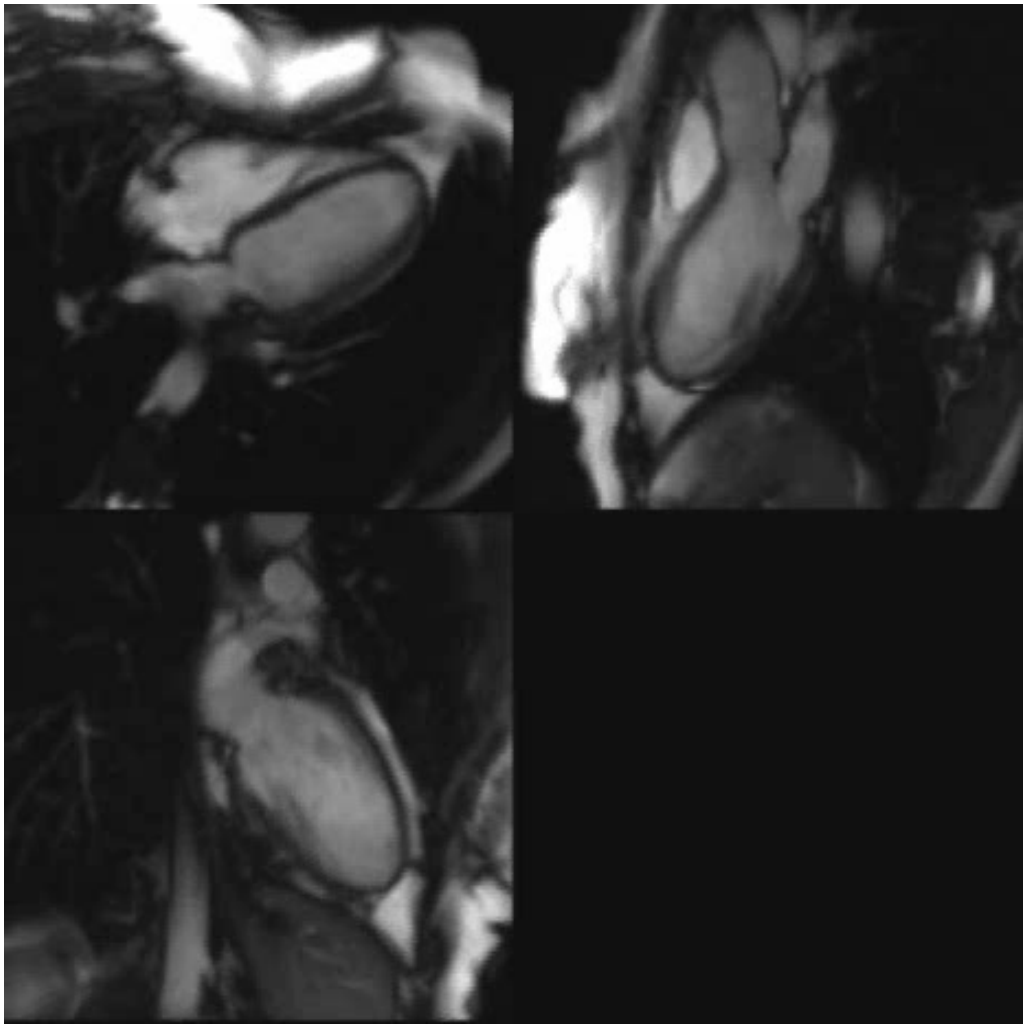
Long Axis Cines



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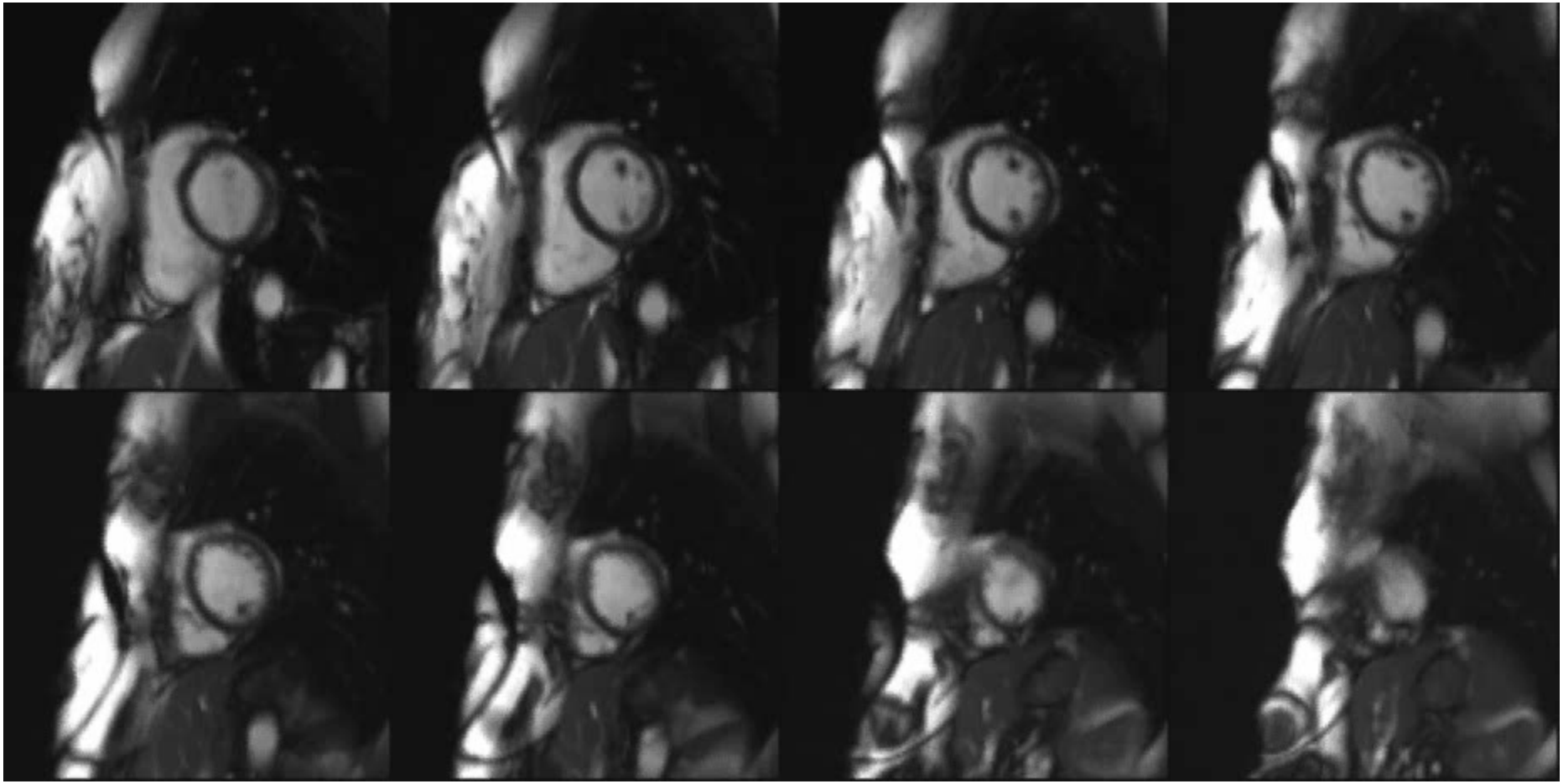
Short Axis Cines



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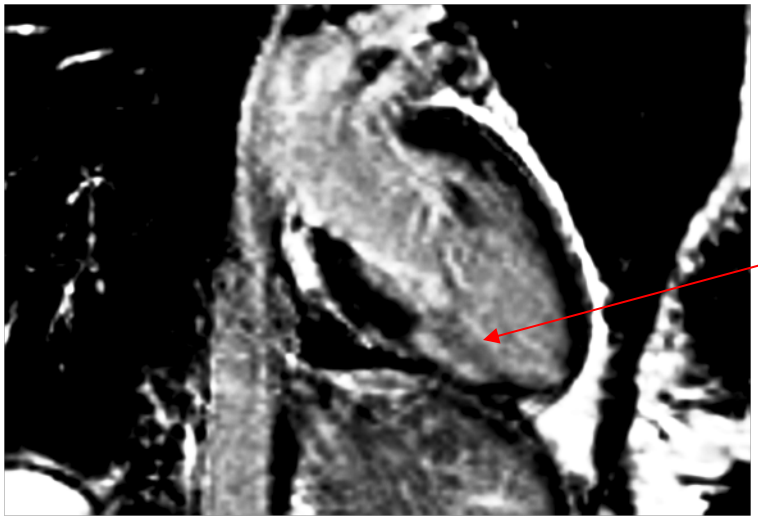
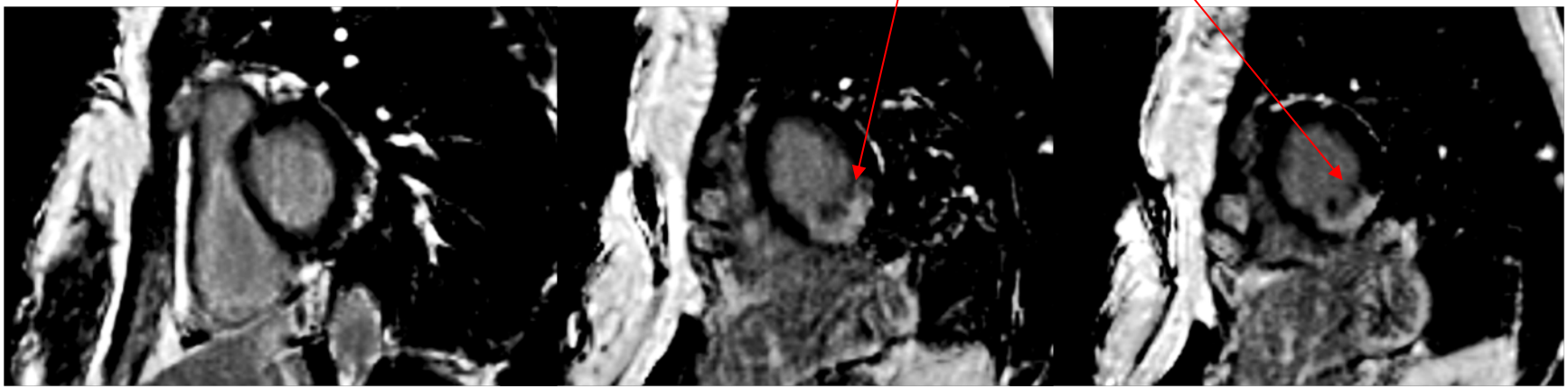
LGE Images



LGE in mid-cavity & apical inferior wall

MYOCARDIAL INFARCTION



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Case 6

- 52 year old male
- 2 hours of chest pain
- No cardiac risk factors

- Troponin T 1,438 ng/L (normal <14 ng/L), CRP 36 mg/L (normal <10 mg/L)

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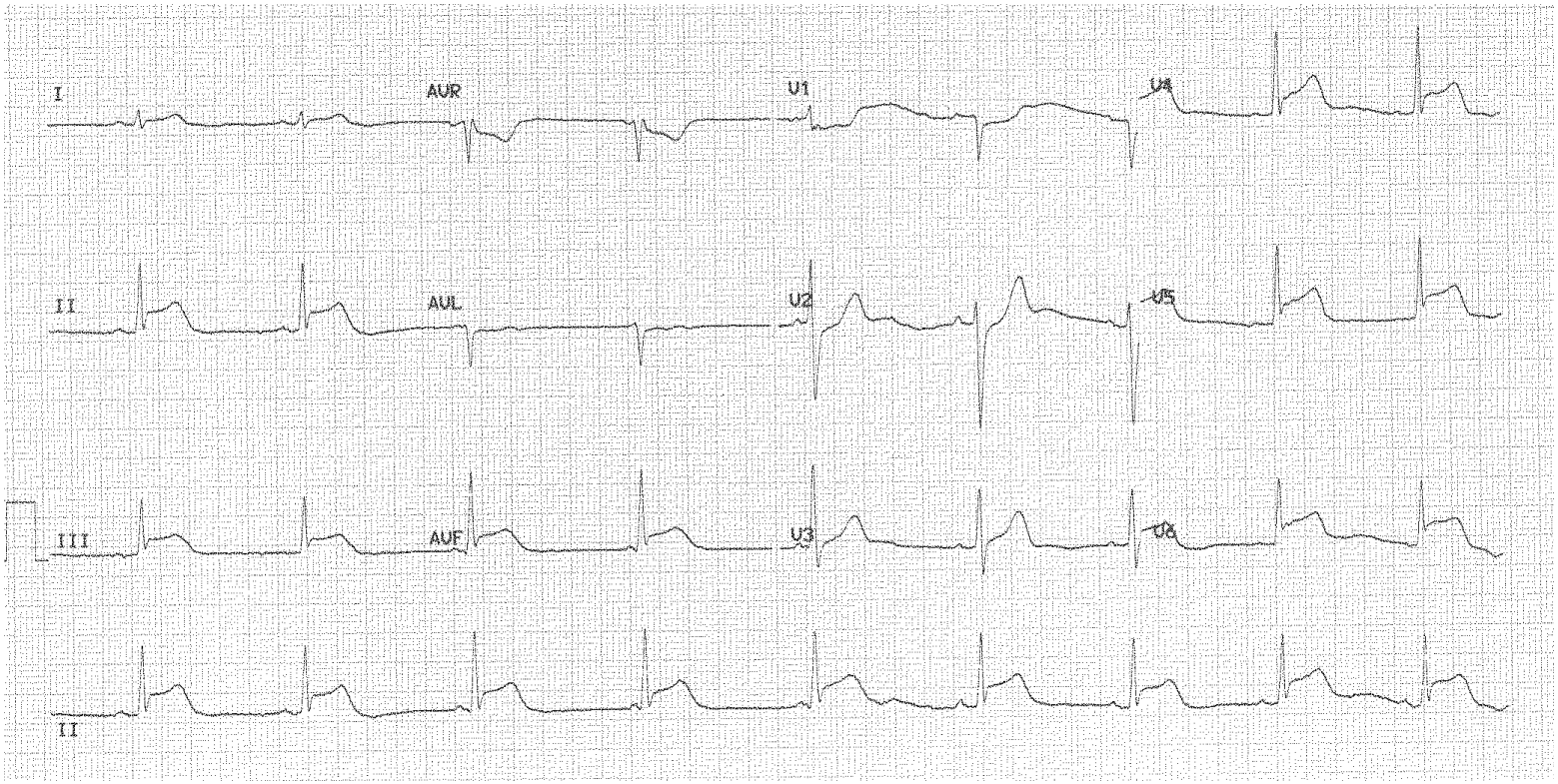
Bristol Heart Institute

ECG

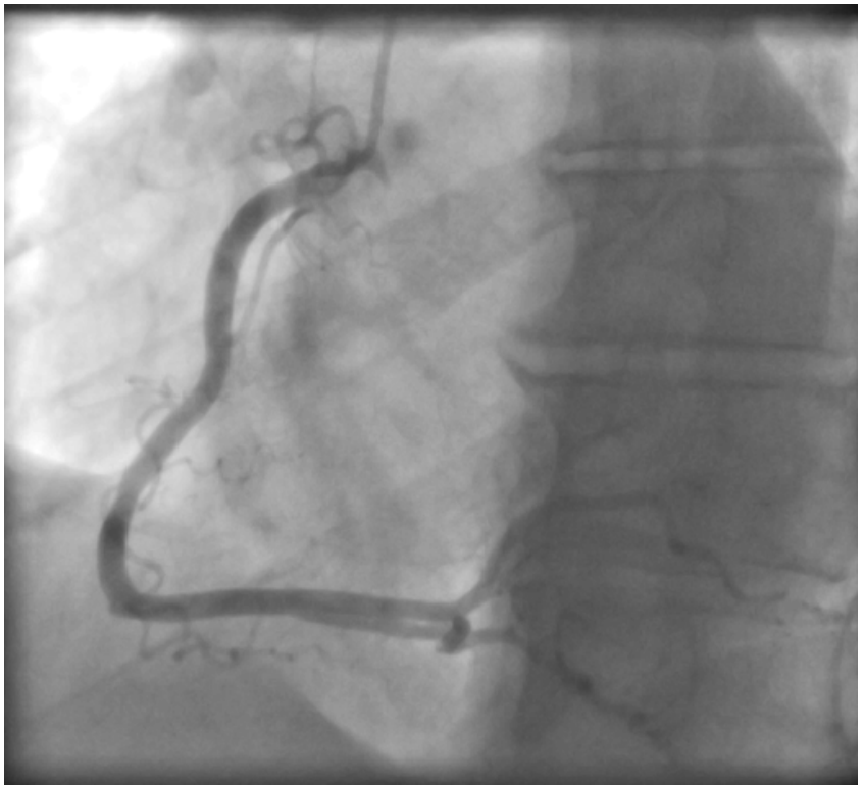


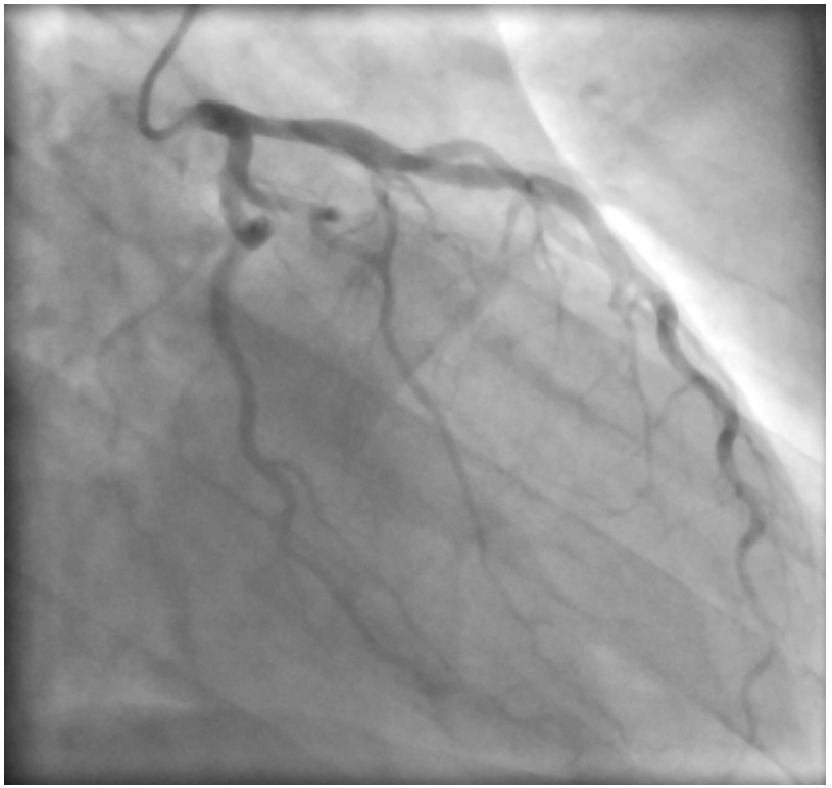
Transthoracic echocardiogram: normal

University of BRISTOL

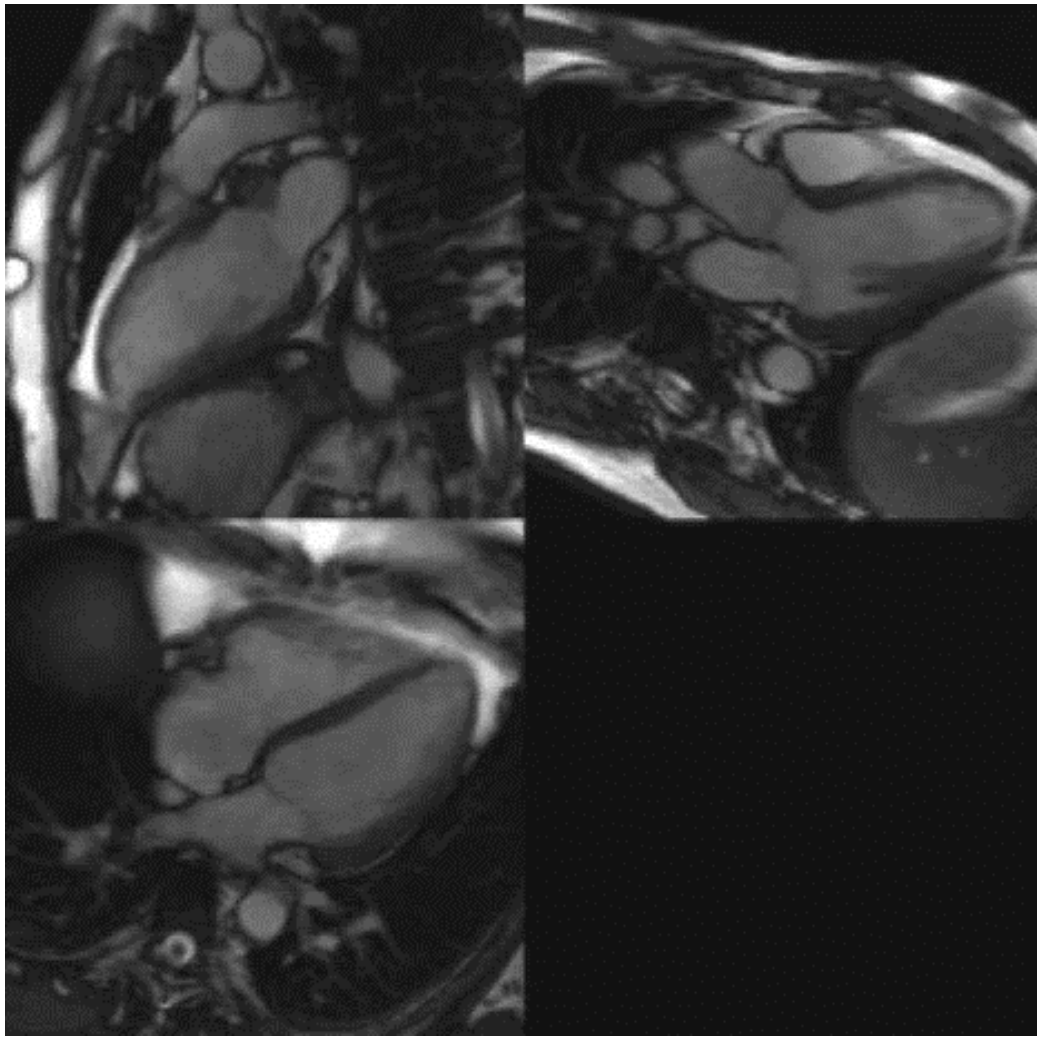
Bristol Heart Institute

Angiogram





Long Axis Cines



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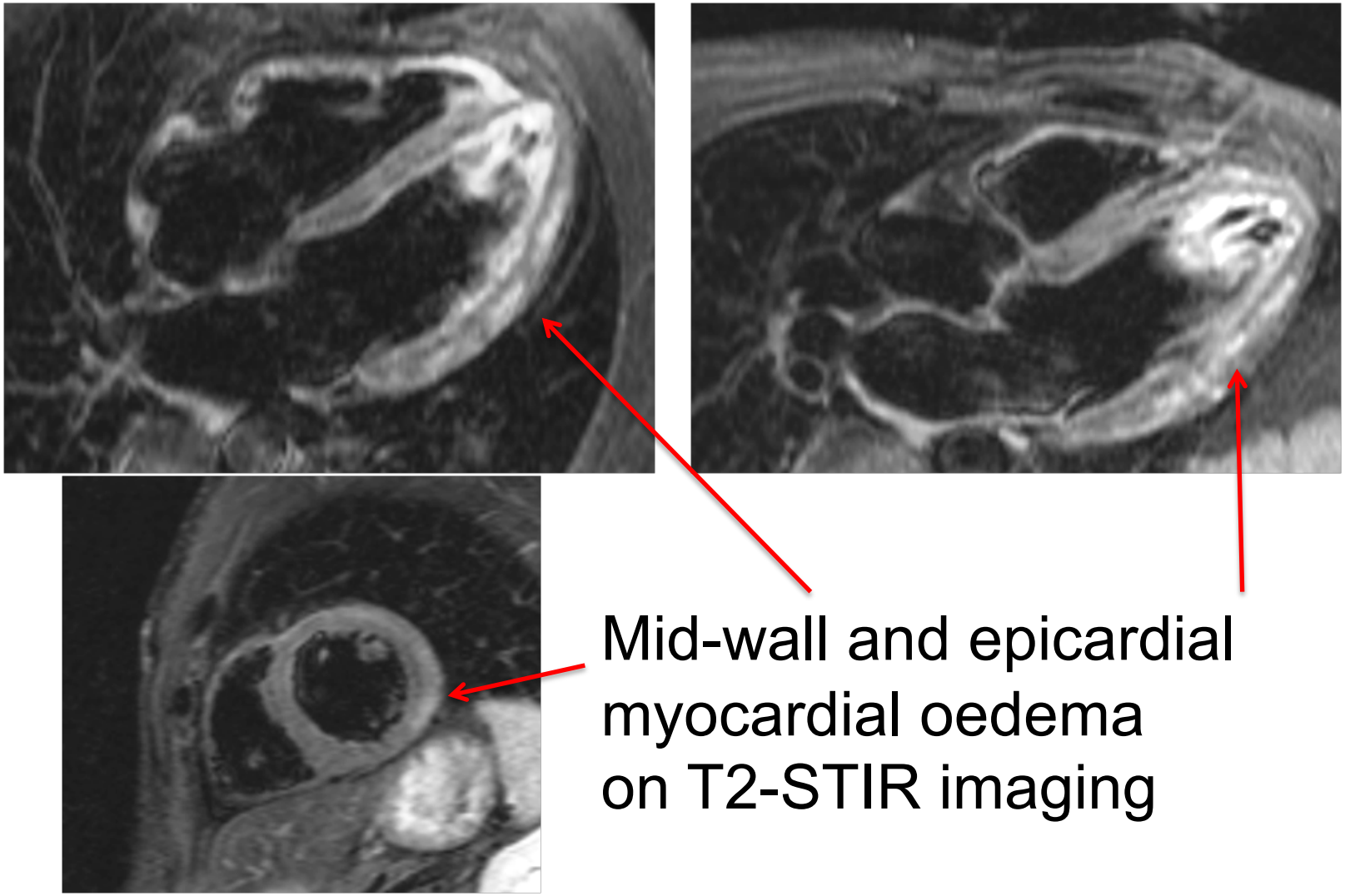
Myocardial Oedema



Mid-wall and epicardial myocardial oedema on T2-STIR imaging

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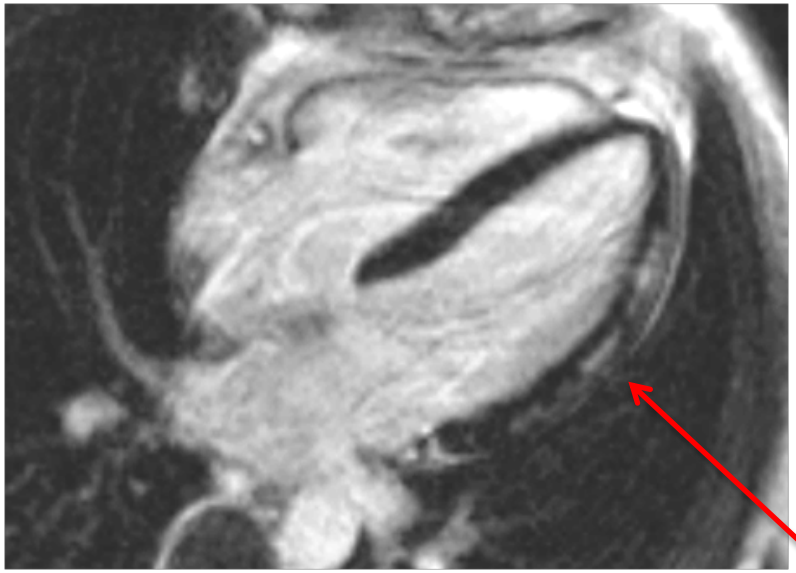
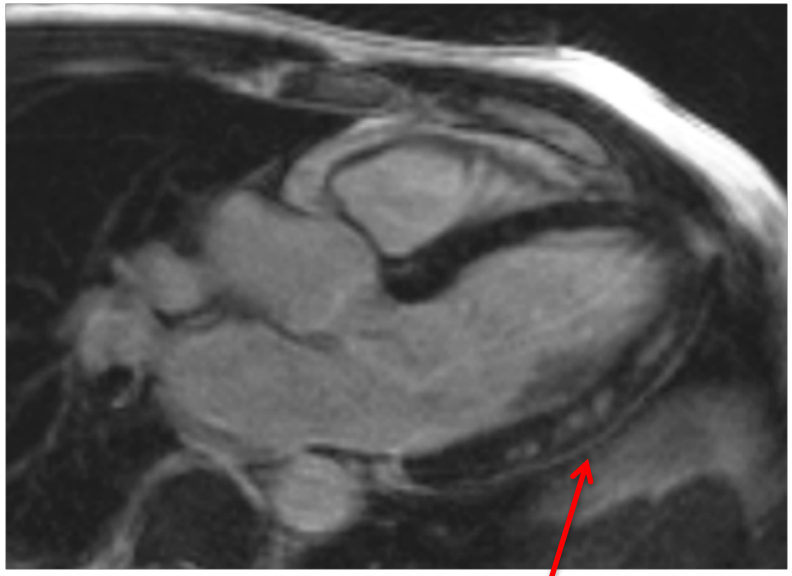
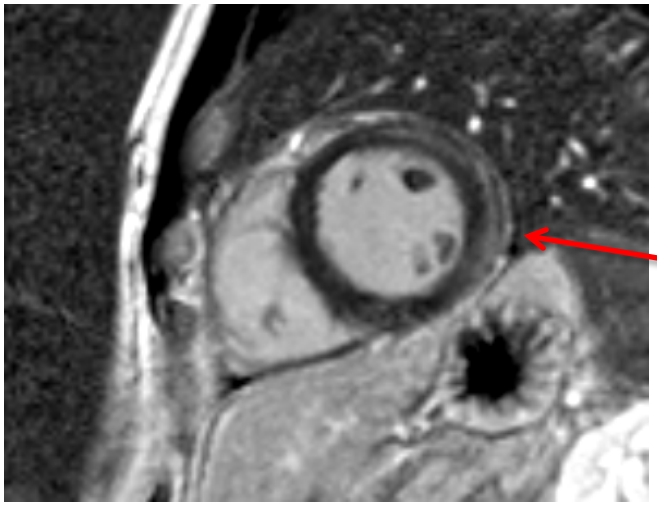
LGE







Mid wall and epicardial LGE

(following gadolinium administration)

ACUTE MYOCARDITIS

Myocardial Infarction with Non-Obstructed Coronary Arteries (MINOCA): Impact of CMR Early after Presentation

- 204 consecutive patients (mean age 55yrs & 51% males)
- "Early" (<2wks) CMR in 96 patients "Late" (>2weeks) in 108
- Overall diagnosis in 70% of patients with CMR
- Diagnostic value improved significantly when carried out early (within 2wks) – 82% vs 54% (p<0.001)

Pre-CMR diagnosis	Post-CMR diagnosis: Total sample n=204	Myocarditis	MI	TakoTsubo	Other CM	Normal CMR
	Myocarditis	34	23	5	4	7
	MI	10	6	8	6	1
	TakoTsubo	1	5	3	0	2
	Other CM	1	0	1	0	0
	Uncertain	8	19	2	8	50

Fig 1a: Chart showing a comparison of pre-CMR with post-CMR diagnosis. Black denotes change in diagnosis, white an agreement between pre- and post -CMR and gray if the CMR showed structurally normal heart. Uncertain defined as when the referring clinician had ≥2 differential "pre-CMR diagnosis". MI – myocardial infarction, CM – cardiomyopathy.

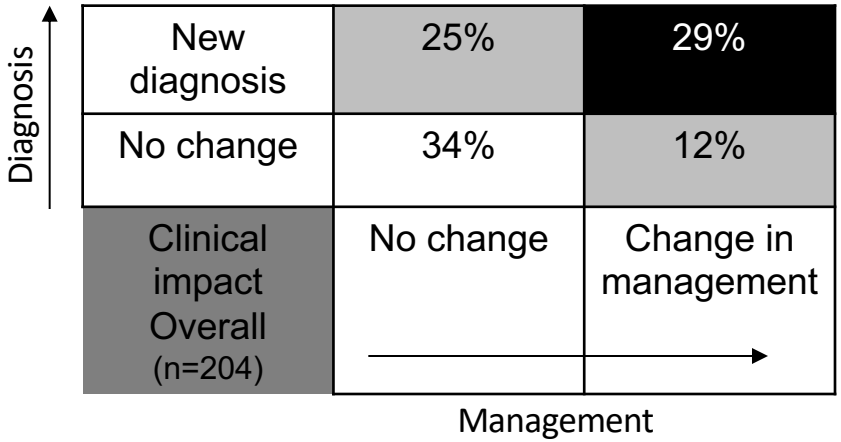
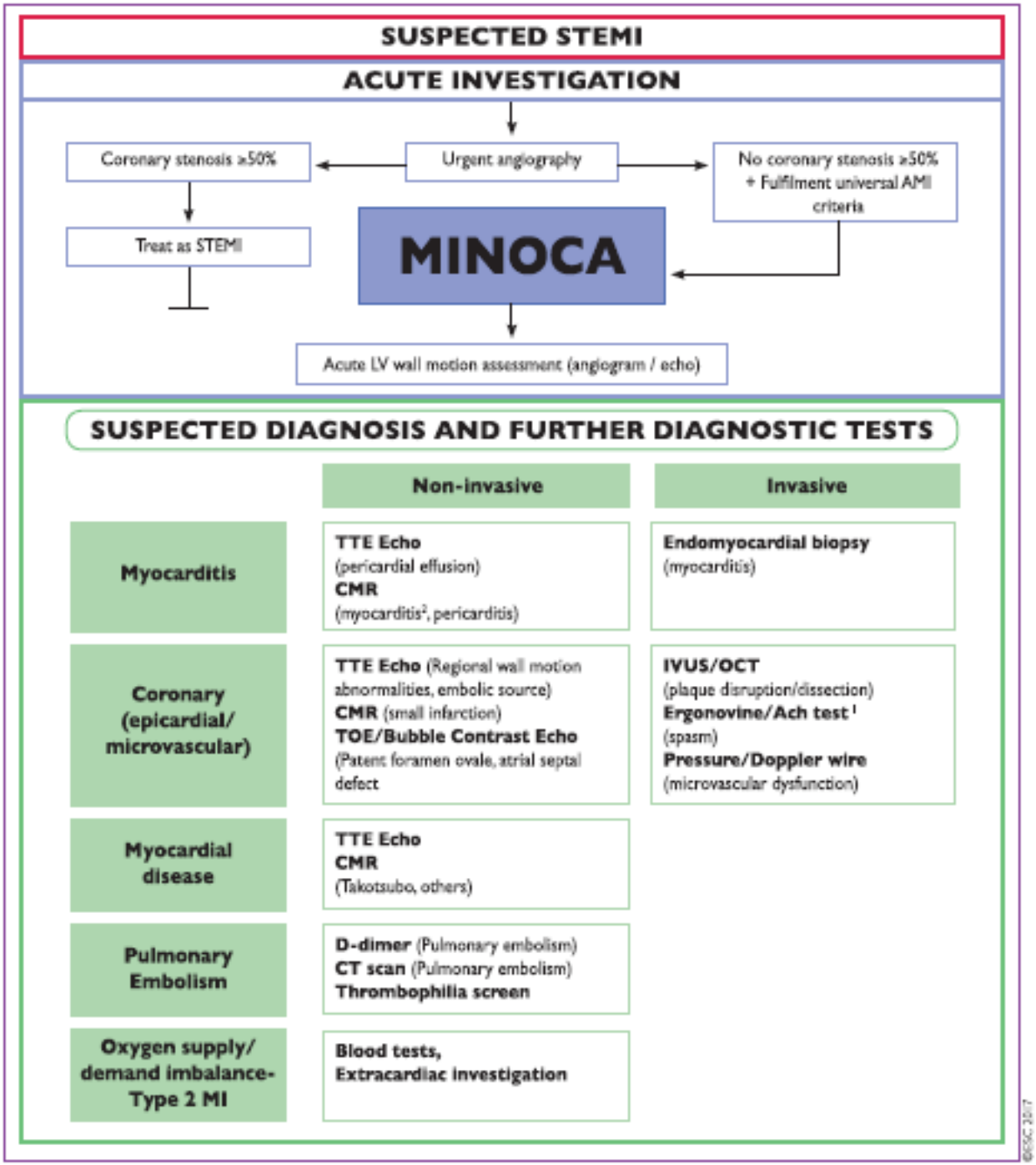


Fig 1b: Chart showing overall clinical impact (n=204). White denotes no change, gray if there is a new diagnosis or a change in management, black if both.

Dastidar AG … Bucciarelli-Ducci C, JACC Imaging 2017

ESC European Society of Cardiology
European Heart Journal (2017) 00, 1–66
doi:10.1093/eurheartj/ehx393

2017 ESC Guidelines for the acute myocardial infarction i presenting with ST-segment



ESC European Society of Cardiology
European Heart Journal (2018) 00, 1–33
doi:10.1093/eurheartj/ehy462

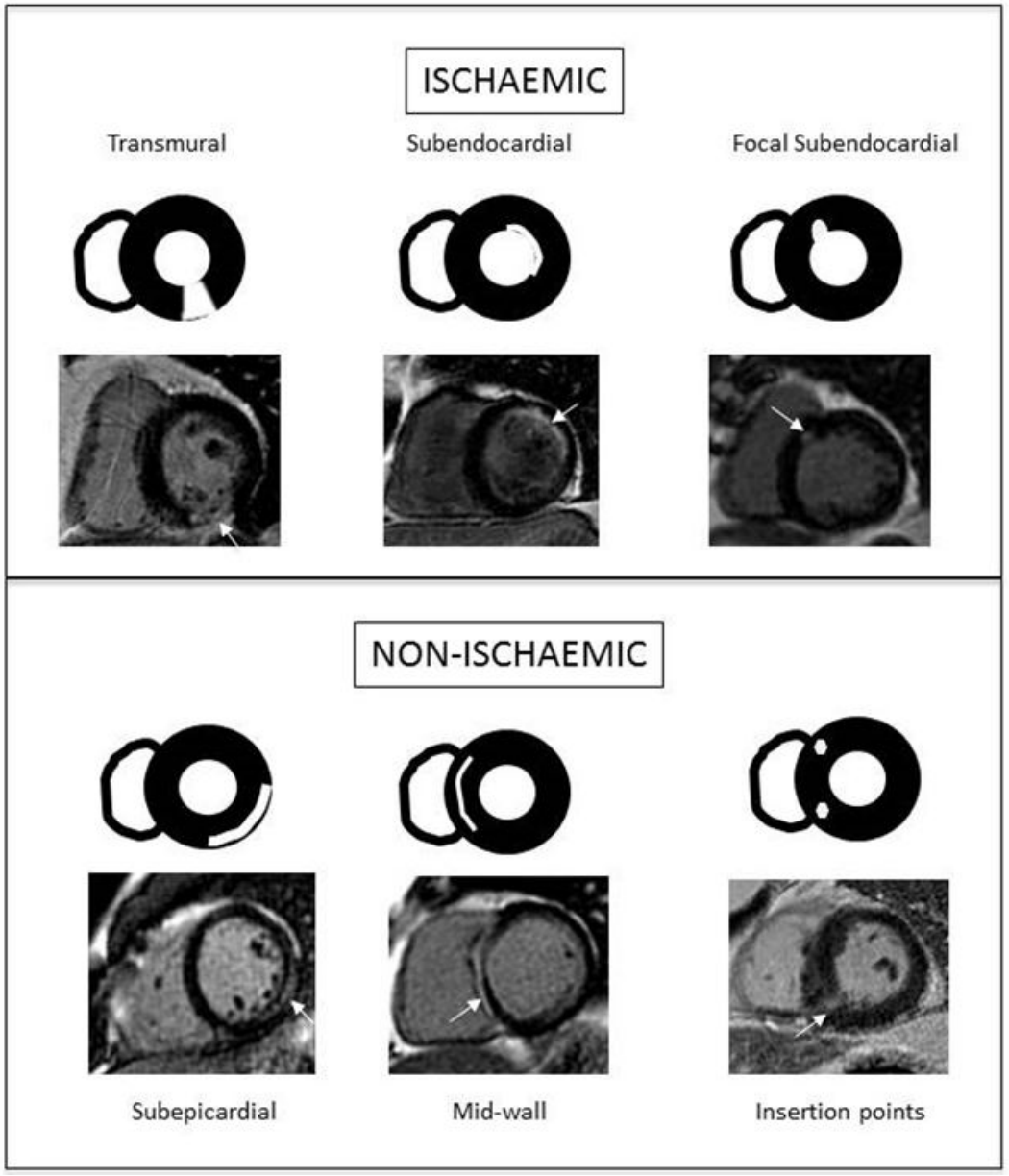
EXPERT CONSENSUS DOCUMENT

Fourth universal definition of myocardial infarction (2018)

Kristian Thygesen* (Denmark), Joseph S. Alpert* (USA), Allan S. Jaffe (USA), Bernard R. Chaitman (USA), Jeroen J. Bax (The Netherlands), David A. Morrow (USA), Harvey D. White* (New Zealand): the Executive Group on behalf of the Joint European Society of Cardiology (ESC)/American College of Cardiology (ACC)/ American Heart Association (AHA)/World Heart Federation (WHF) Task Force for the Universal Definition of Myocardial Infarction

Authors/Task Force Members/Chairpersons: Kristian Thygesen* (Denmark), Joseph S. Alpert* (USA), Allan S. Jaffe (USA), Bernard R. Chaitman (USA), Jeroen J. Bax (The Netherlands), David A. Morrow (USA), Harvey D. White* (New Zealand), Hans Mickley (Denmark), Filippo Crea (Italy), Frans Van de Werf (Belgium), Chiara Bucciarelli-Ducci (UK), Hugo A. Katus (Germany), Fausto J. Pinto (Portugal), Elliott M. Antman (USA), Christian W. Hamm (Germany), Raffaele De Caterina (Italy), James L. Januzzi Jr (USA), Fred S. Apple (USA), Maria Angeles Alonso Garcia (Spain), S. Richard Underwood (UK), John M. Canty Jr (USA), Alexander R. Lyon (UK), P. J. Devereaux (Canada), Jose Luis Zamorano (Spain), Bertil Lindahl (Sweden), William S. Weintraub (USA), L. Kristin Newby (USA), Renu Virmani (USA), Pascal Vranckx (Belgium), Don Cutlip (USA), Raymond J. Gibbons (USA), Sidney C. Smith (USA), Dan Atar (Norway), Russell V. Luepker (USA), Rose Marie Robertson (USA), Robert O. Bonow (USA), P. Gabriel Steg (France), Patrick T. O'Gara (USA), Keith A. A. Fox (UK)

UOB Open



In Cardiac MRI
The pattern of Late Enhancement
(i.e. contrast accumulation)

Follows the pathophysiology of underlying disease

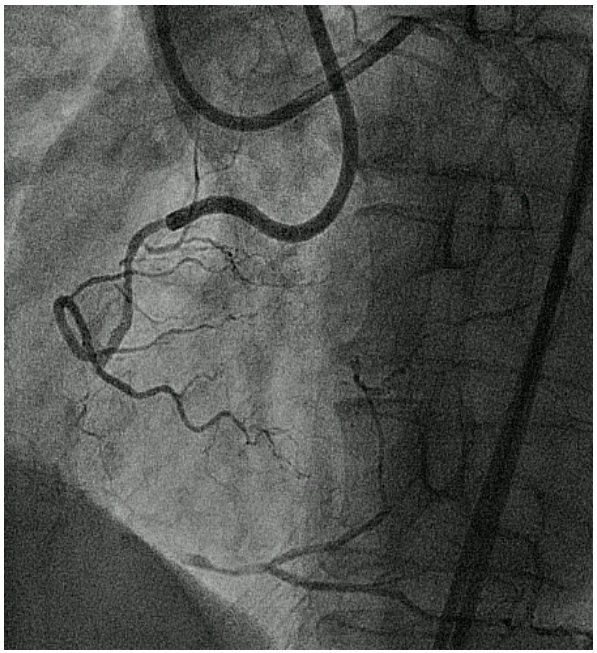
Criteria for PCI related Myocardial Infarction ≤48 h after the Index Procedure (Type 4a MI)

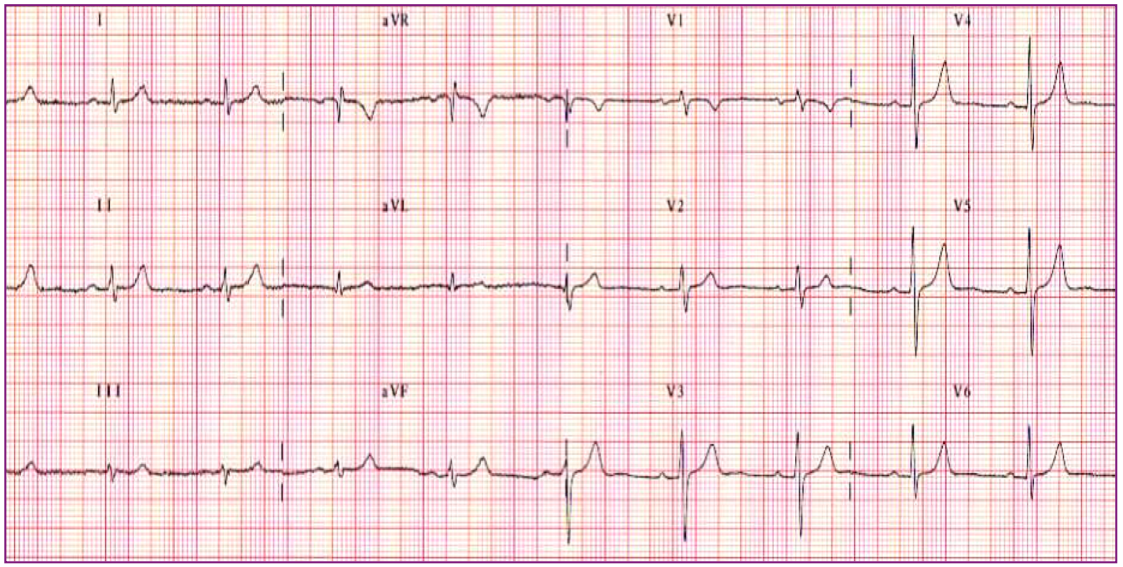
Coronary intervention related MI is arbitrarily defined by elevation of cTn values >5 times 99th percentile URL in patients with normal baseline values. In patients with elevated pre-procedure cTn in whom the cTn level are stable (≤20% variation) or falling, the post-procedure cTn must rise by >20%. However, the absolute post-procedural value still must be at least 5 times 99th percentile URL. In addition, one of the following elements is required:

- New ischaemic ECG changes;
- Development of new pathological Q waves;
- **Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality in a pattern consistent with an ischaemic aetiology;**
- Angiographic findings consistent with a procedural flow-limiting complication such as coronary dissection, occlusion of a major epicardial artery or a side-branch occlusion/ thrombus, disruption of collateral flow or distal embolization.

Case 7

56yo male, hypertension, ex-smoker
NSTEMI, 2 DES in LCx, CTO RCA
Residual angina, CCS2. Failed attempt to CTO RCA





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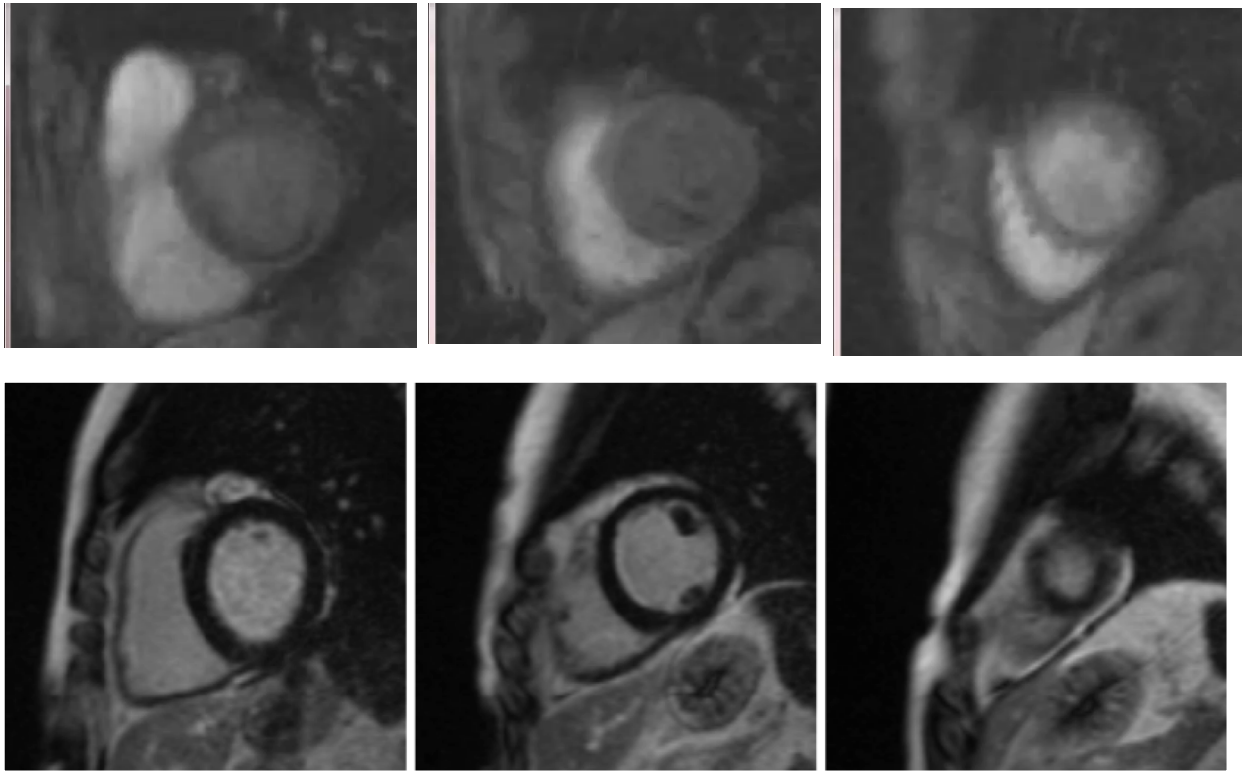
Ischemia and Viability



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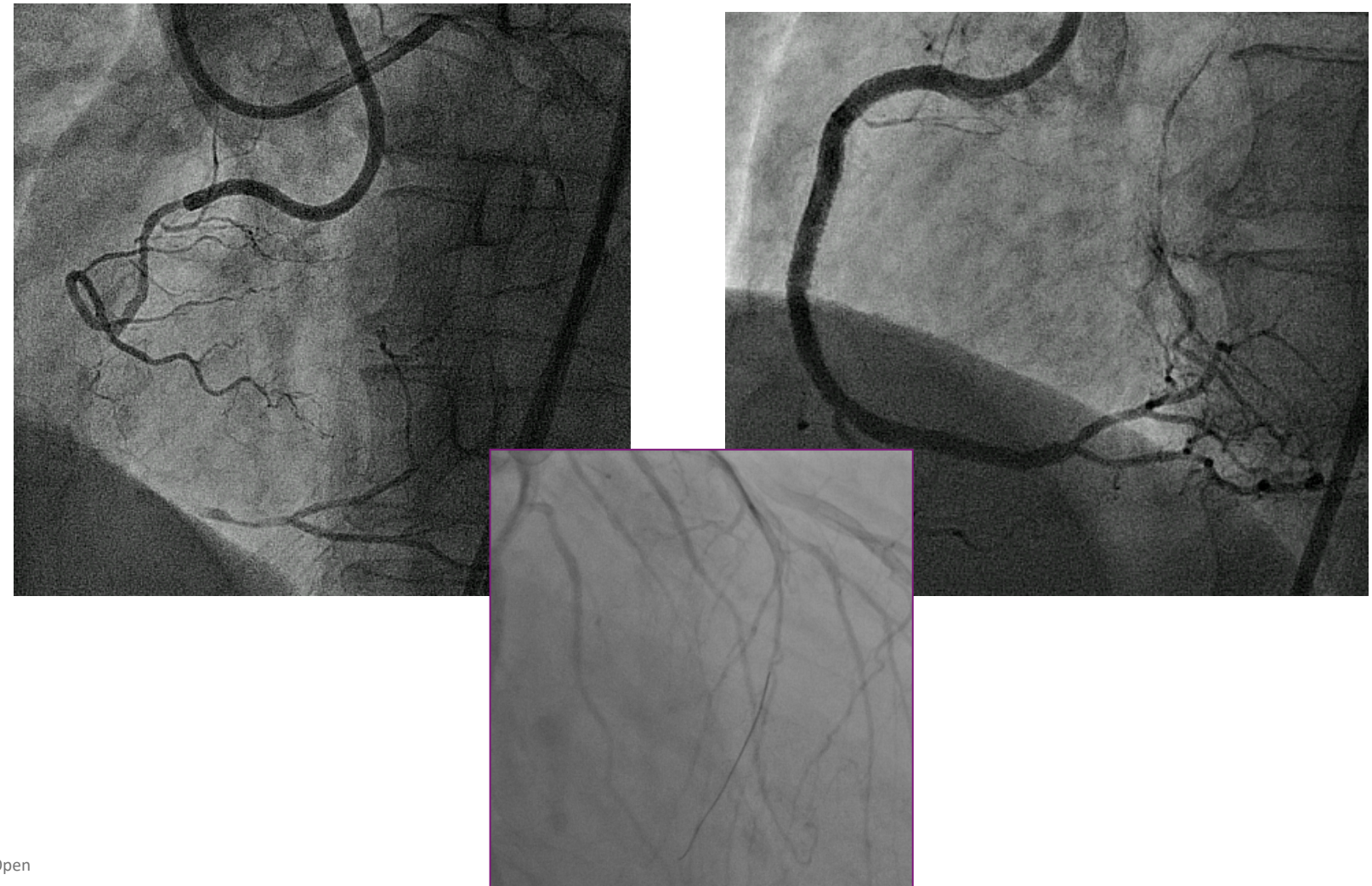
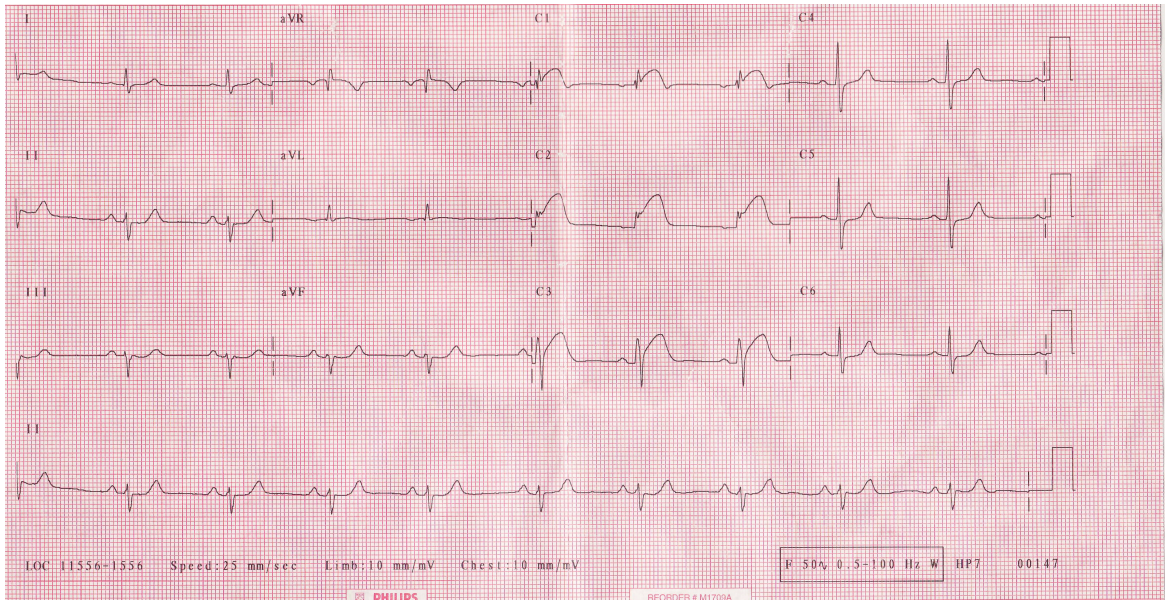
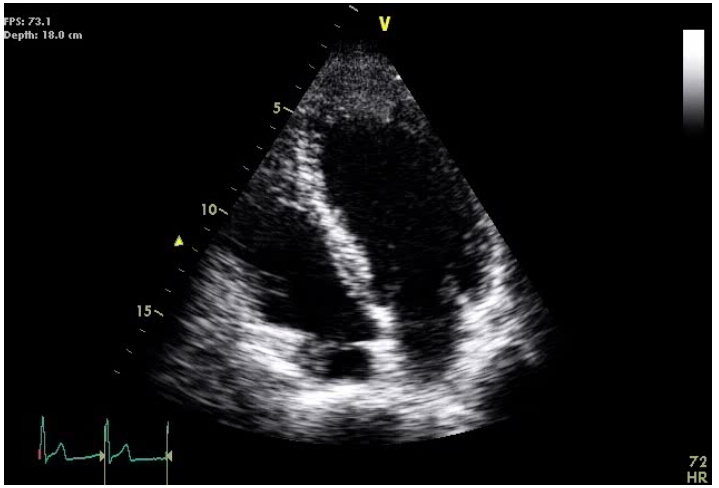
Recanalization of CTO RCA



Acute Symptom after PCI



ECG 1 hour after the procedure



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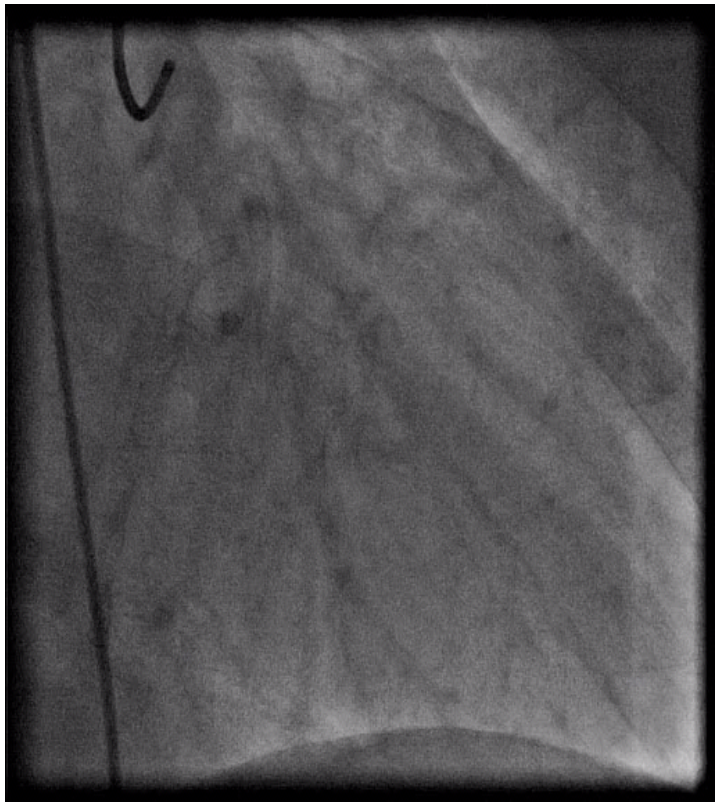
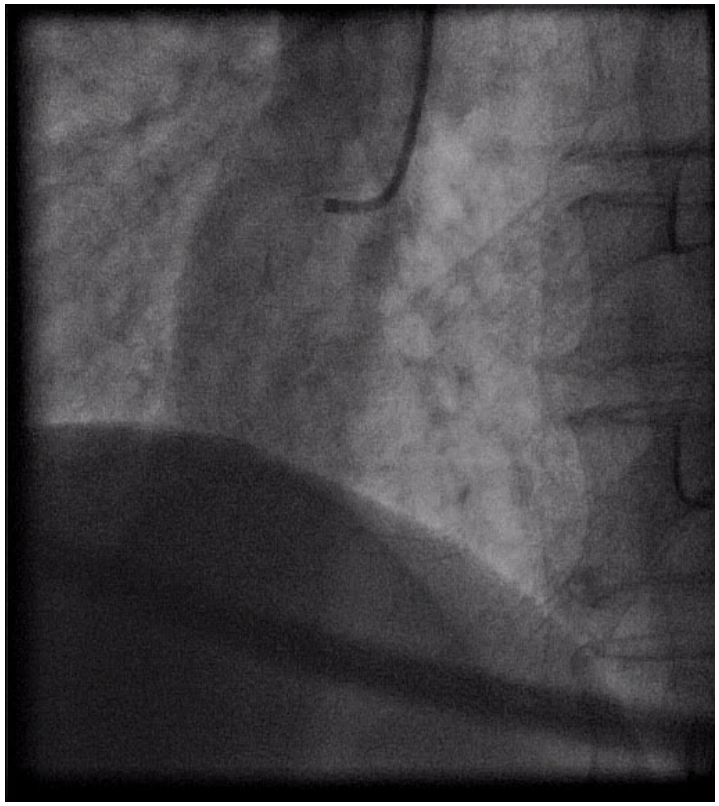
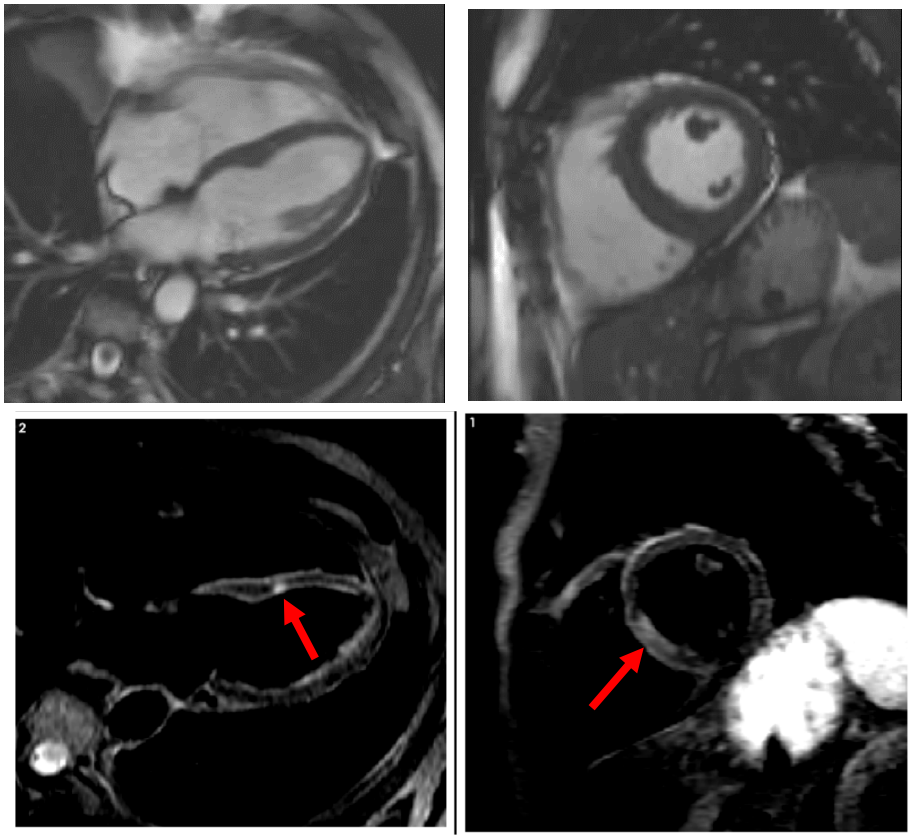
Repeat Angiography





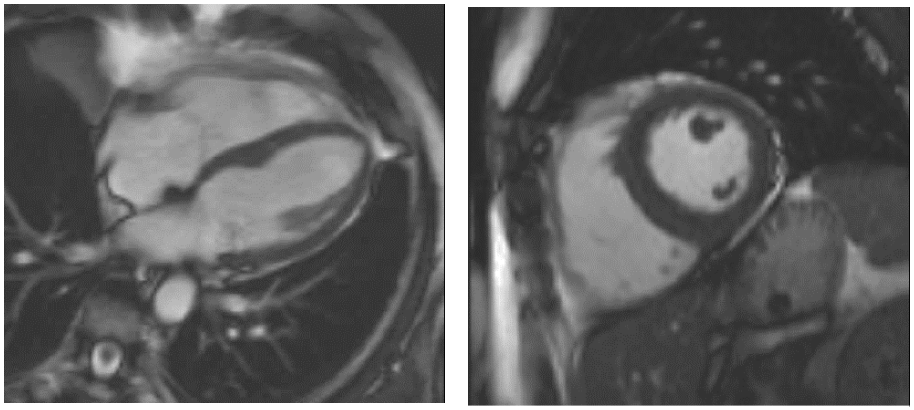
CMR the following day



No regional wall motion abnormalities
No pericardial effusion

Septal Oedema

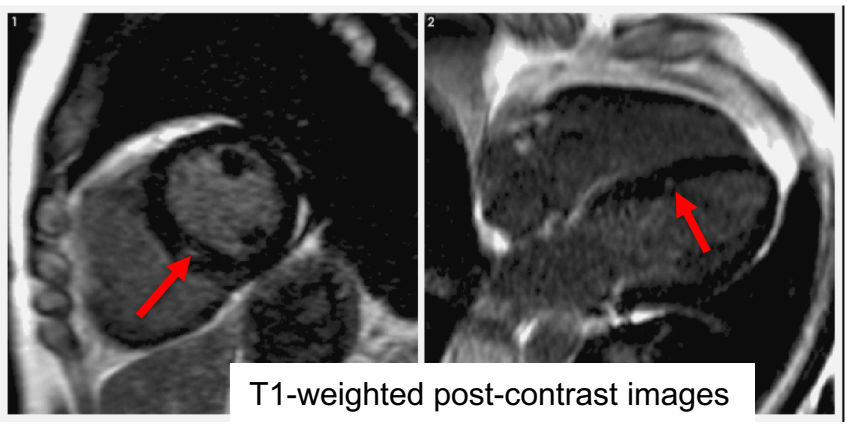
CMR the following day



No regional wall motion abnormalities
No pericardial effusion

T2-weighted oedema images

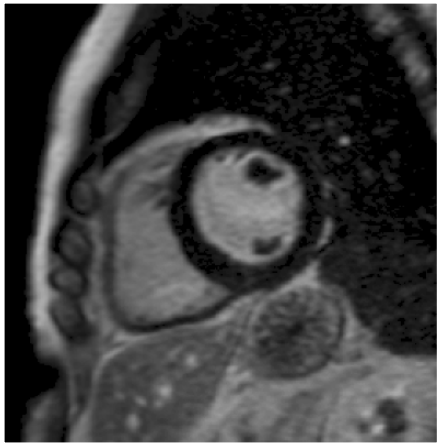
Micro septal infarction



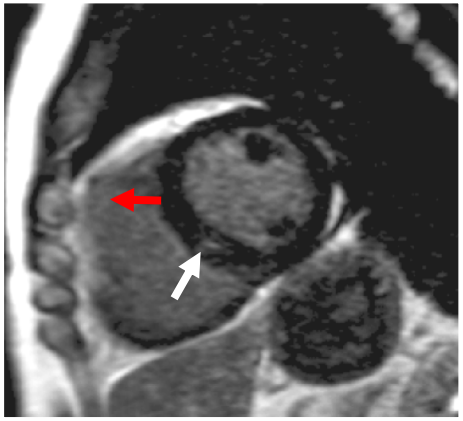
T1-weighted post-contrast images

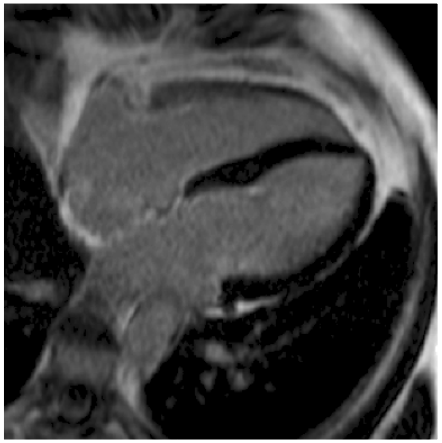
New Myocardial Damage(s)

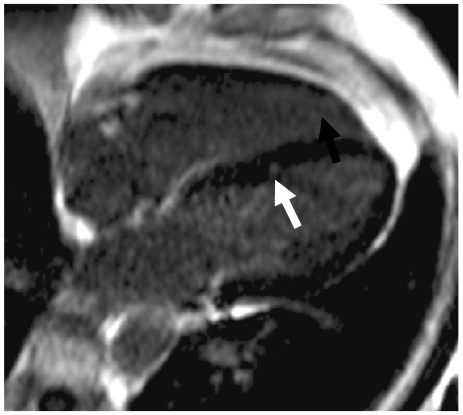
BEFORE PCI



AFTER PCI







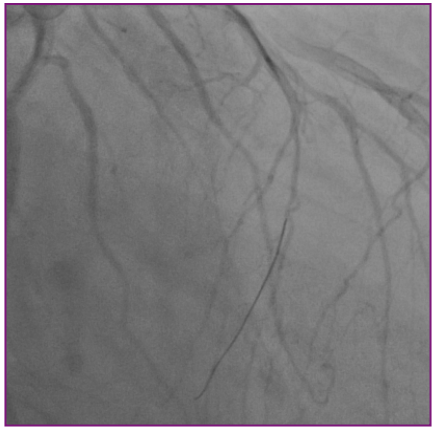
CK: 550 U/L (normal range 25-171 U/L)

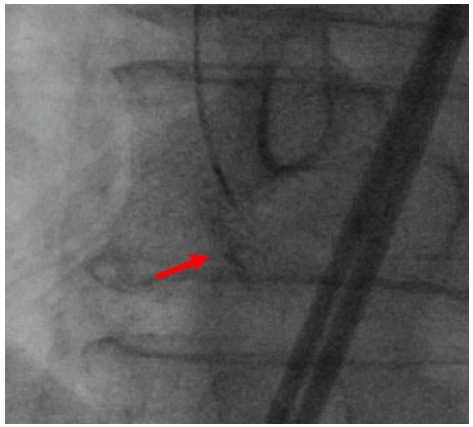
CK-MB: 52.2 ug/L (normal range 0-6 ug/L)

TnI: 4.15 ug/L (normal range 0-0.04 ug/L)

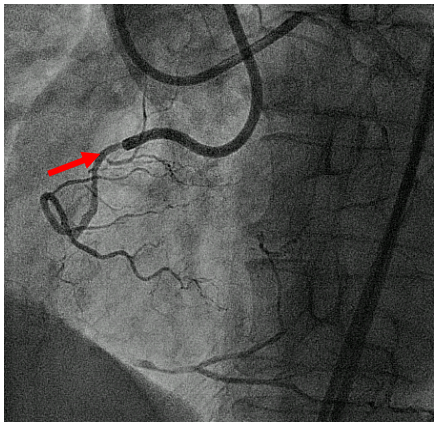
Microinfarction: 0.34 gr

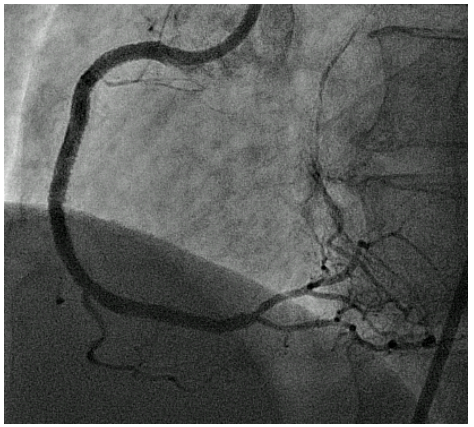
New Myocardial Damages





Septal infarction due to LAD Septal Branch





RCA branch occlusion

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EuroCMR 2019

Venice, Italy

2-4 May 2019

CMR Level 1 Track

(Level 1= basic level of knowledge of CMR for every European Cardiologist, according to the ESC)

- **For the young community**
- **For the grown up!**

No previous experience !

EACVI

EUROPEAN SOCIETY OF CARDIOLOGY

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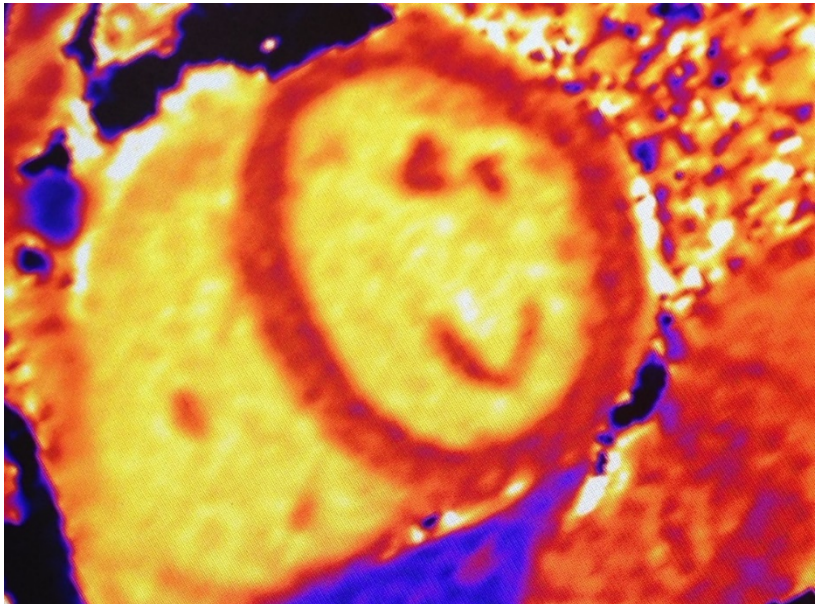
The Future is Bright (and Smiling)



(CMR T2 mapping, short-axis slice)

The papillary muscles are in a “pleasing” distribution mimicking A SMILING HEART :-)

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