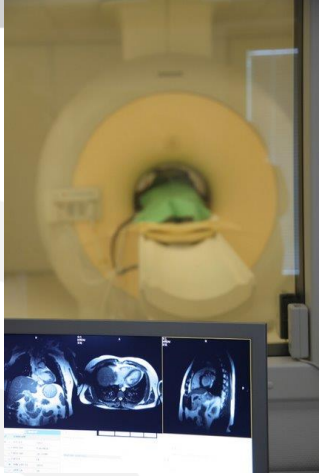
The Heart and Vascular Center
of Semmelweis University

Cardiac Magnetic Resonance Imaging Laboratory

Contraindications of CMR

- Claustrophobia
- Brain aneurysm clips
- Ear/ocular implants
- Pacemaker and implantable cardioverter defibrillator (ICD)
- Mechanical heart valves (implantations before1985)
- High-magnetic metal prostheses (prostheses implanted after 1995 are already MR conditional)
- Certain skin tattos

MR environment, MR safety



MR Safe - an item that poses no known hazards in all MRI environments, “MR safe” items include non-conducting, non-metallic, non-magnetic items.

MR Conditional - an item that has been demonstrated to pose no known hazards in a specified MRI environment **with specified conditions of use**. Additional conditions, including specific configurations of the item (e.g., the routing of leads used for a neurostimulation system), may be required.

- There are hundreds of serious injuries (burns),

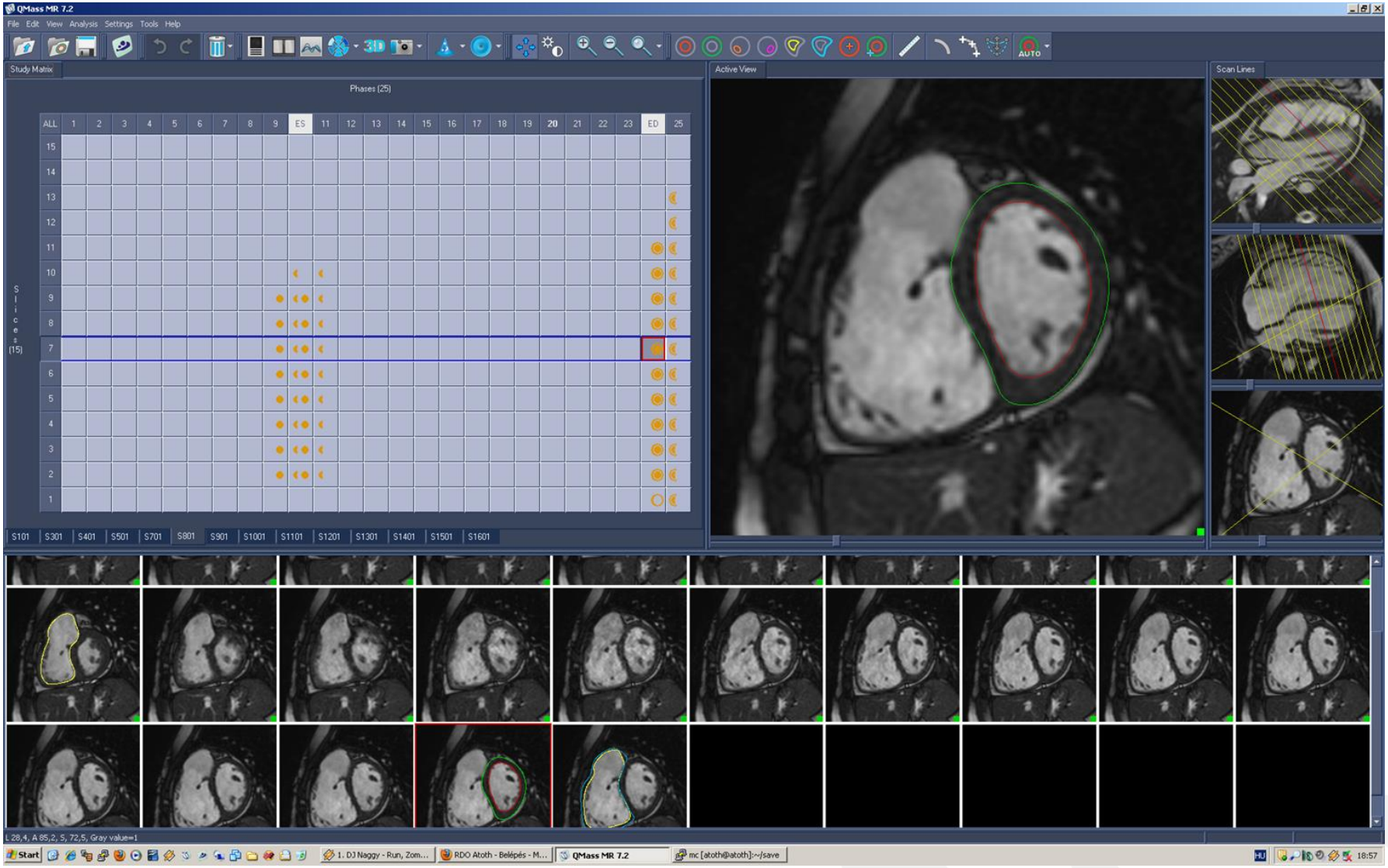
  published death
- **Nephrogenic systemic fibrosis** due to MR contrast agents

Bullet impact, flying objects

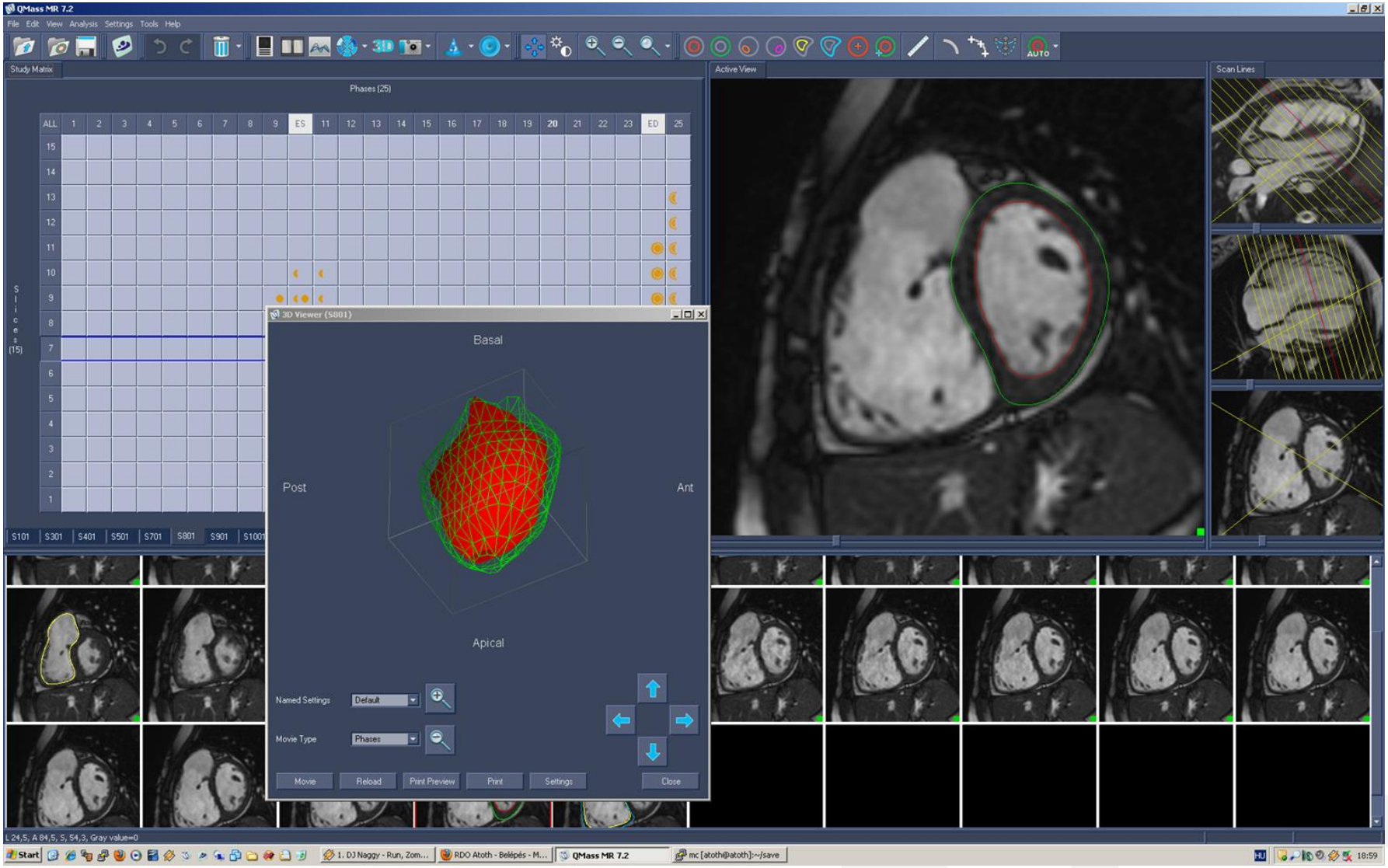
High magnetic field strength (permanent!)

Velocity of 50 km/h!

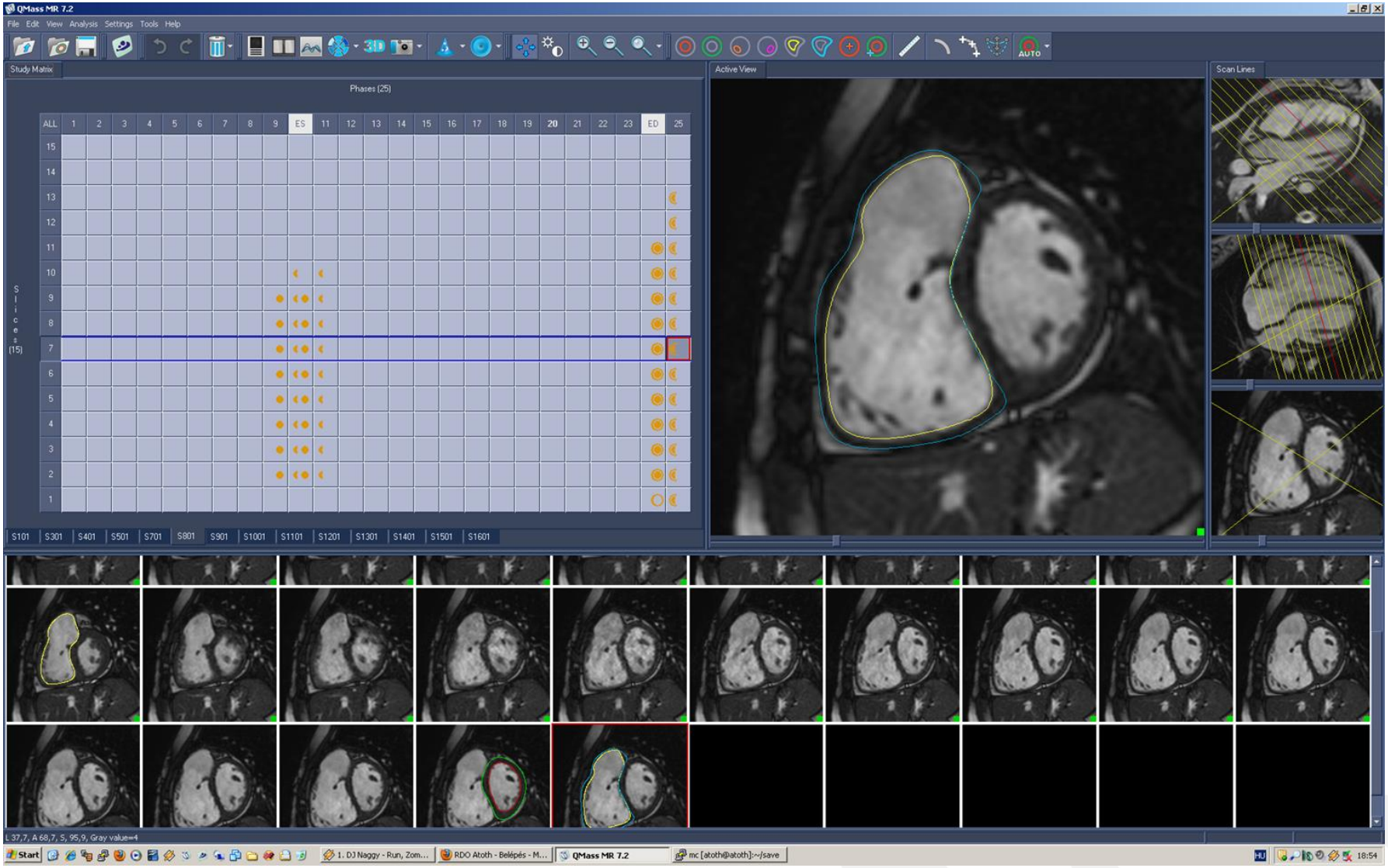
Volumes, function



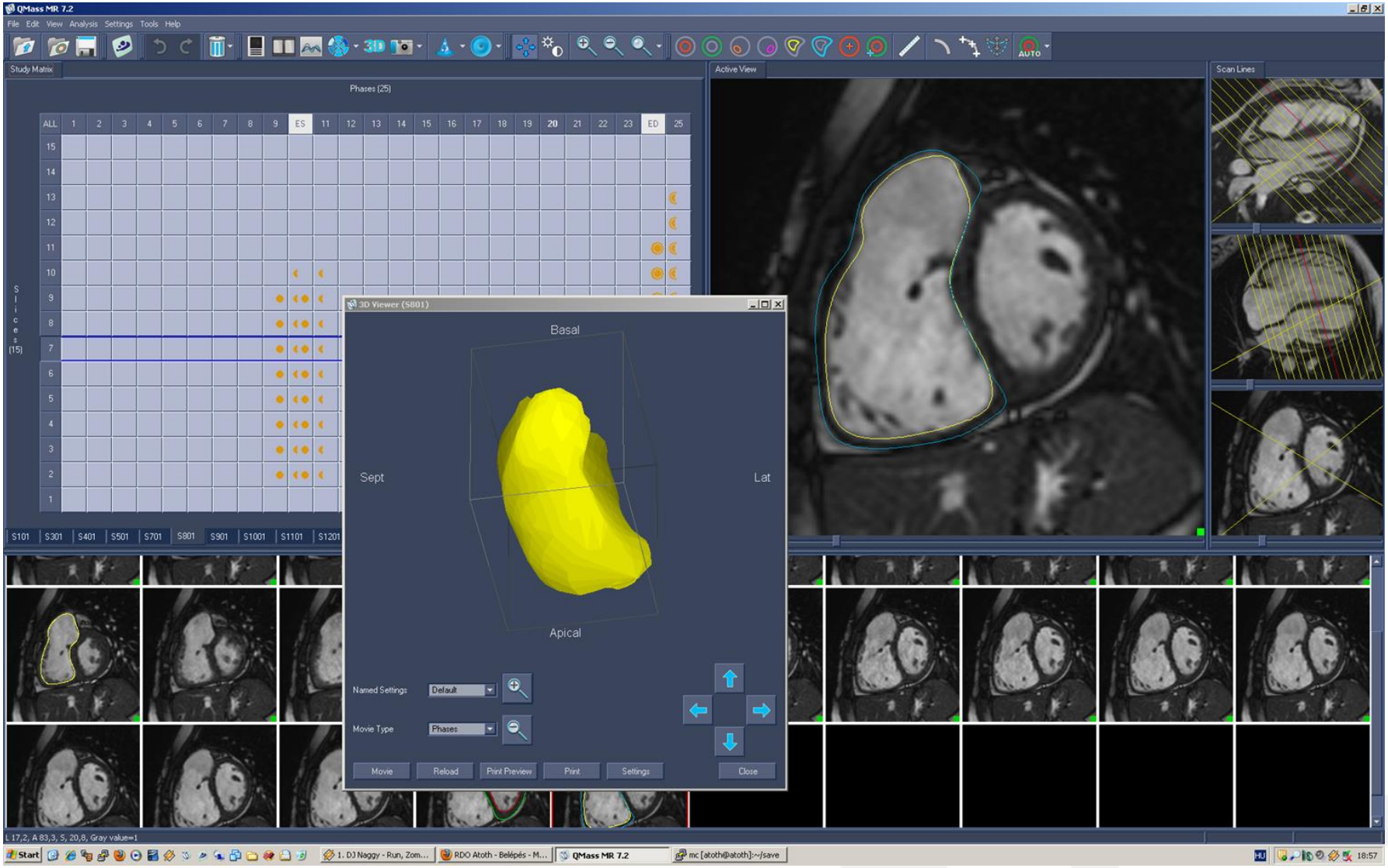
Left ventricular volumes and mass



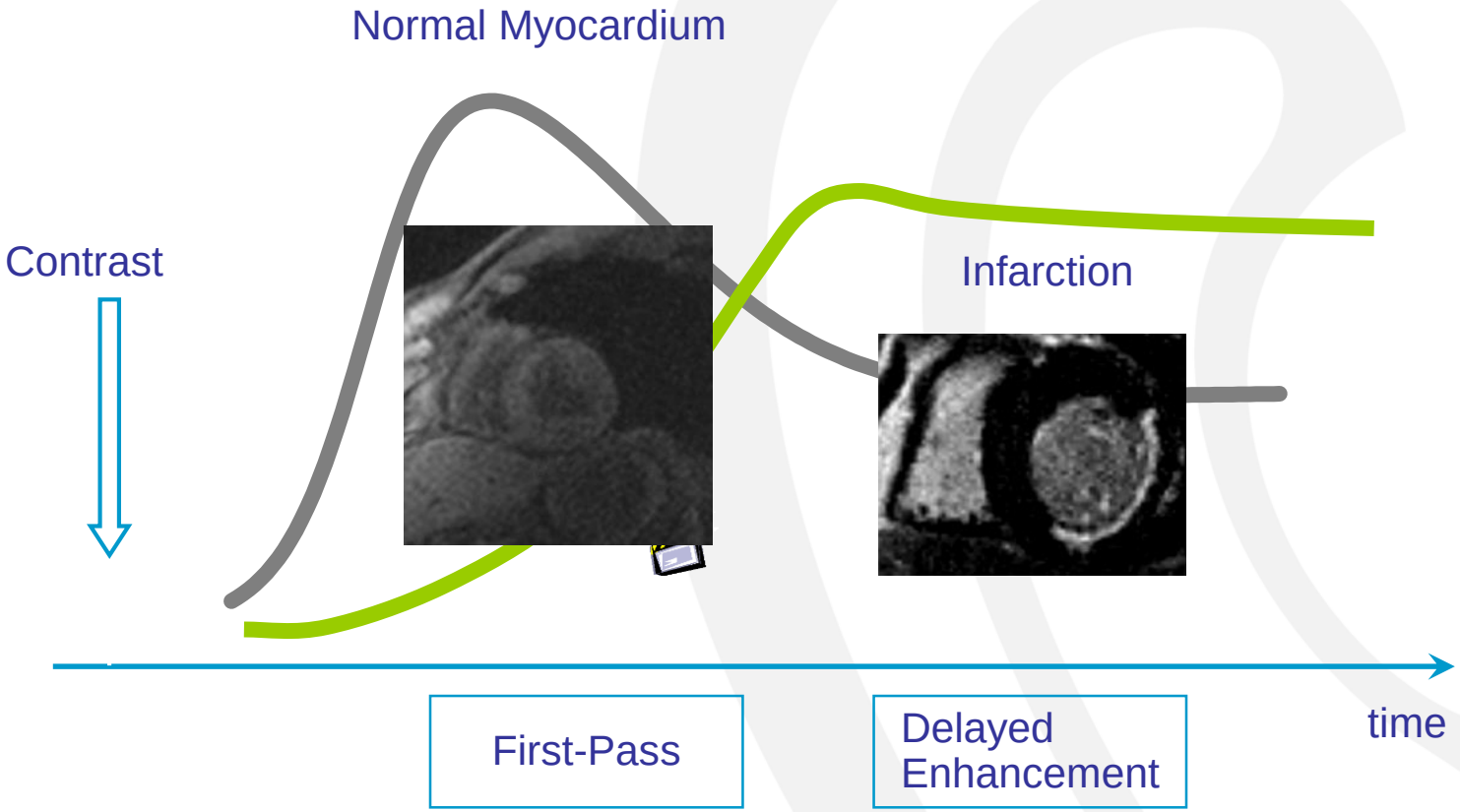
Right ventricular volumes and mass



Right ventricular volumes and mass



Perfusion MRI and delayed contrast enhancement



Contrast enhancement

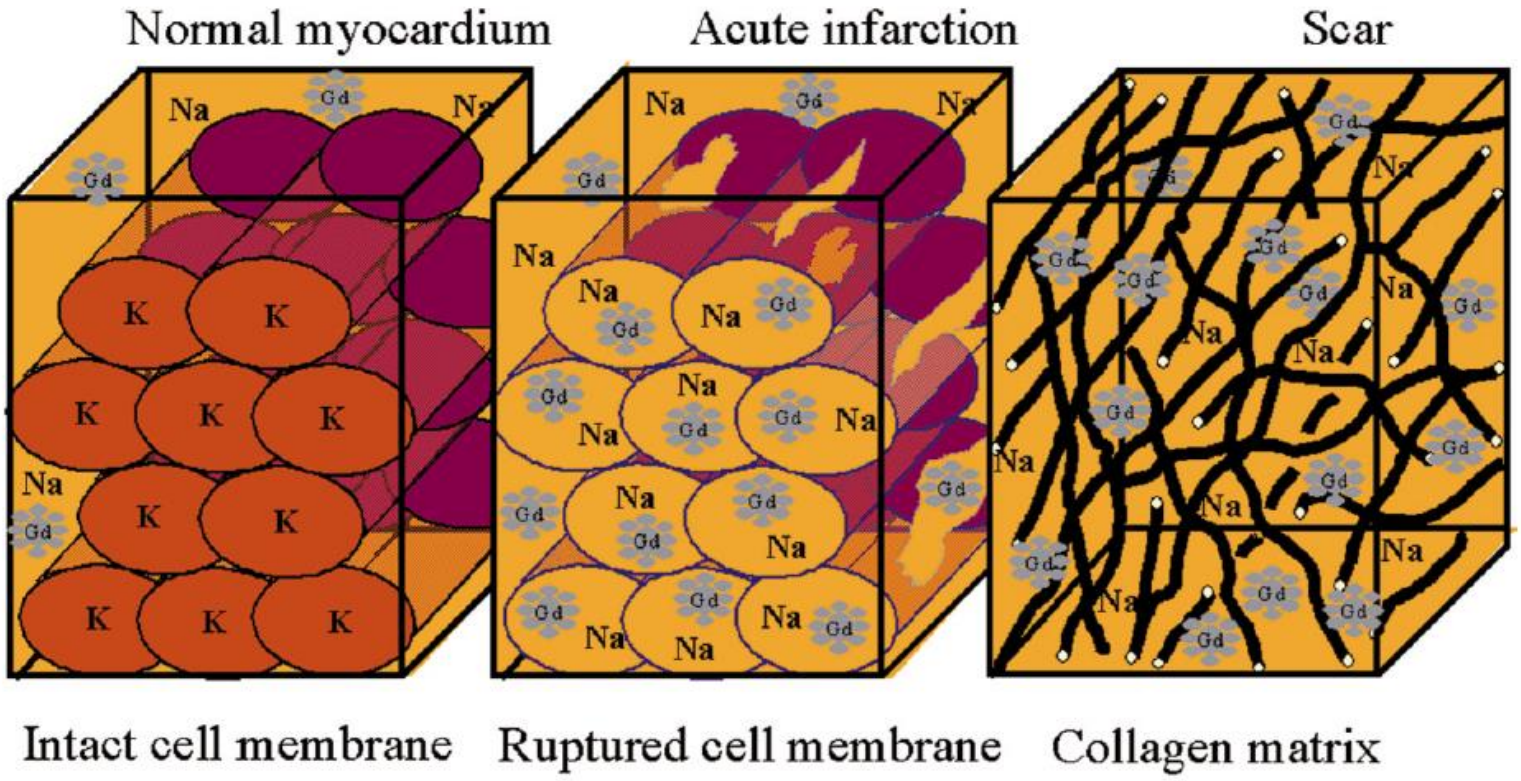
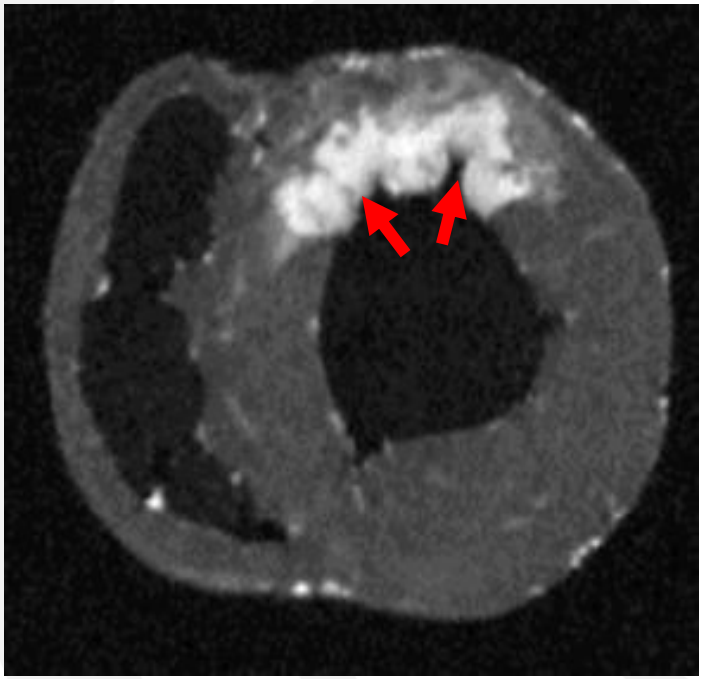


Figure 8. Potential mechanisms of hyperenhancement in acute and chronic MI. See text for details. (Reprinted with permission from Cardiovascular MRI and MRA. Charles B. Higgins, editor. Lippincott Williams & Wilkins, 2002.)

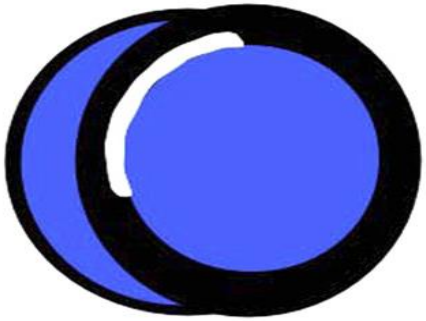
Delayed contrast enhancement



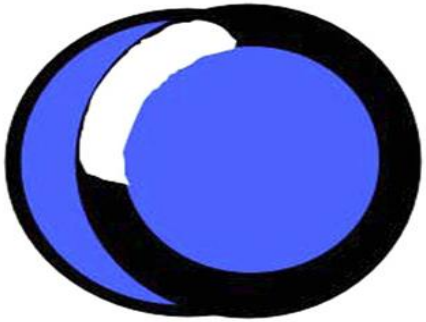
Courtesy of Dr. R. Judd, Northwestern University, Chicago

Ischemic

A **Subendocardial Infarct**

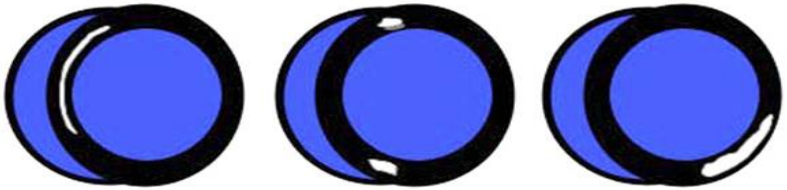


B **Transmural Infarct**



Nonischemic

A **Mid-wall HE**

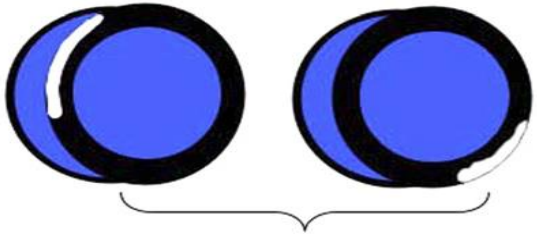


- Idiopathic Dilated Cardiomyopathy
- Myocarditis

- Hypertrophic Cardiomyopathy
- Right ventricular pressure overload (e.g. congenital heart disease, pulmonary HTN)

- Sarcoidosis
- Myocarditis
- Anderson-Fabry
- Chagas Disease

B **Epicardial HE**



- Sarcoidosis, Myocarditis, Anderson-Fabry, Chagas Disease

C **Global Endocardial HE**

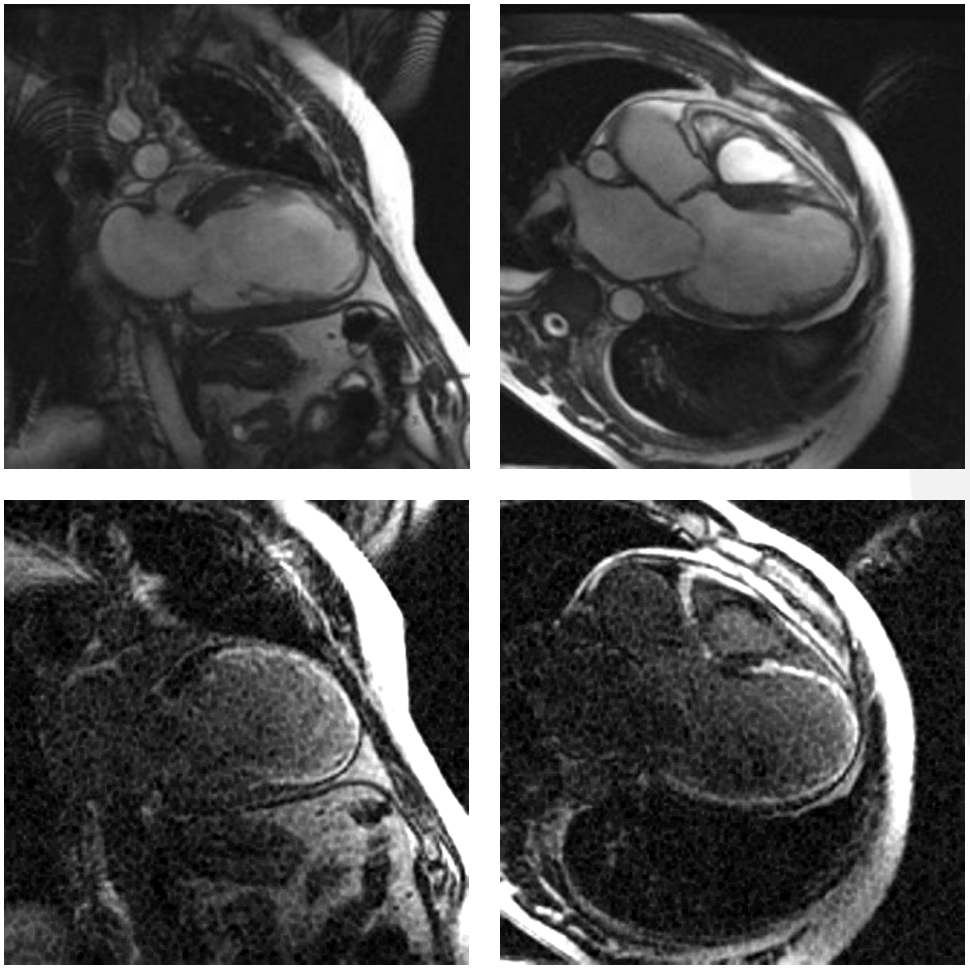
- Amyloidosis, Systemic Sclerosis, Post cardiac transplantation

Karamitsos J Am Coll Cradiol 2009

Top 6 indications

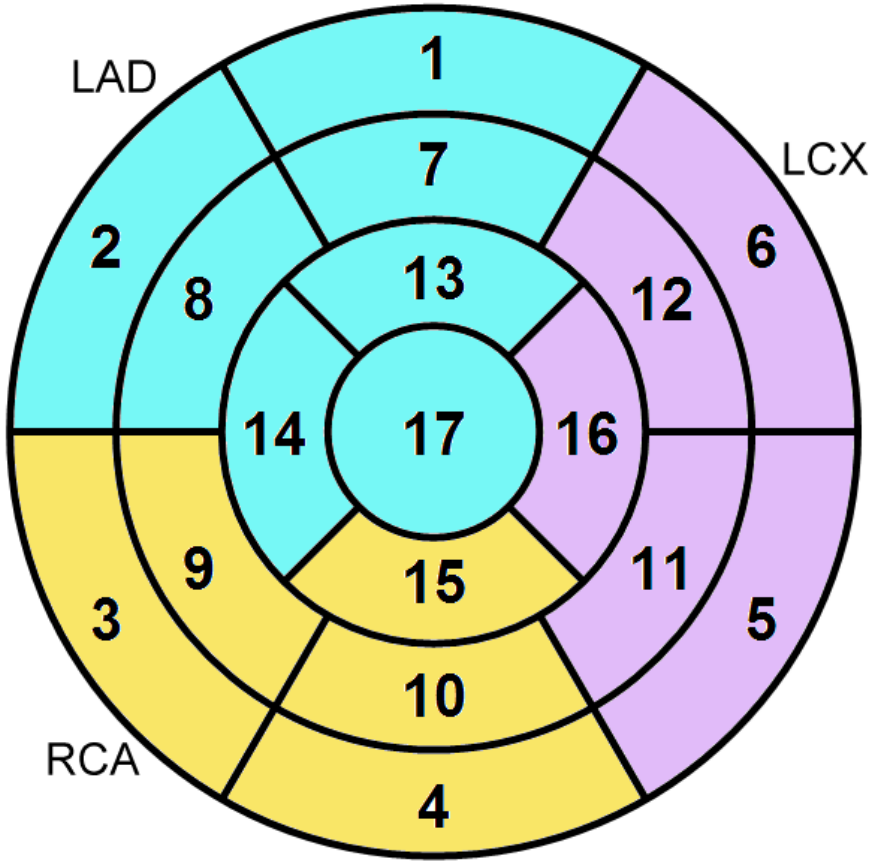
- Ischaemic heart disease
- Cardiomyopathies
- Myocarditis
- Congenital heart disease
- Tumours
- Pericardial diseases

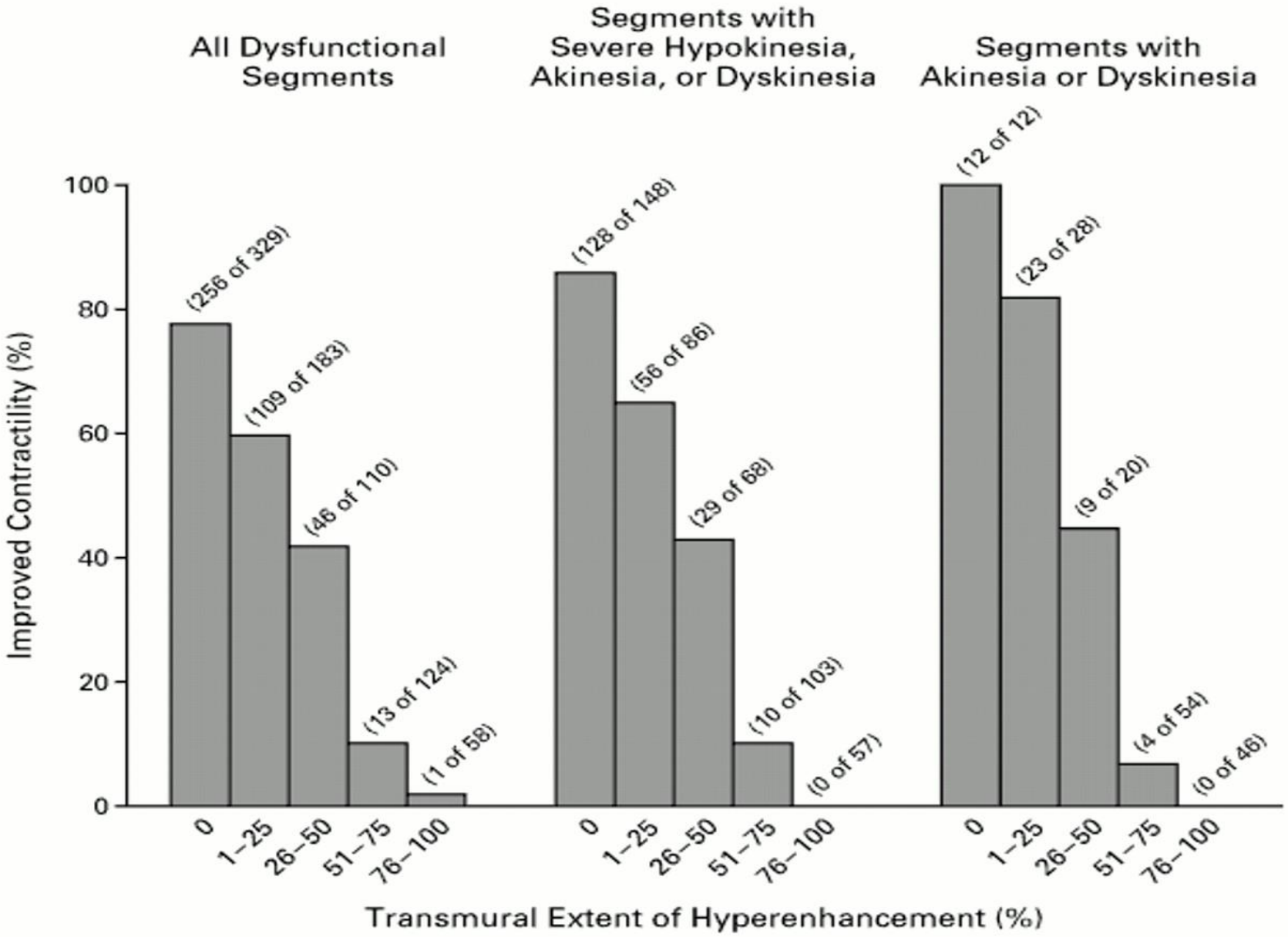
Ischaemic heart disease



- Global and regional left ventricular function
- Viability „the bright is dead”

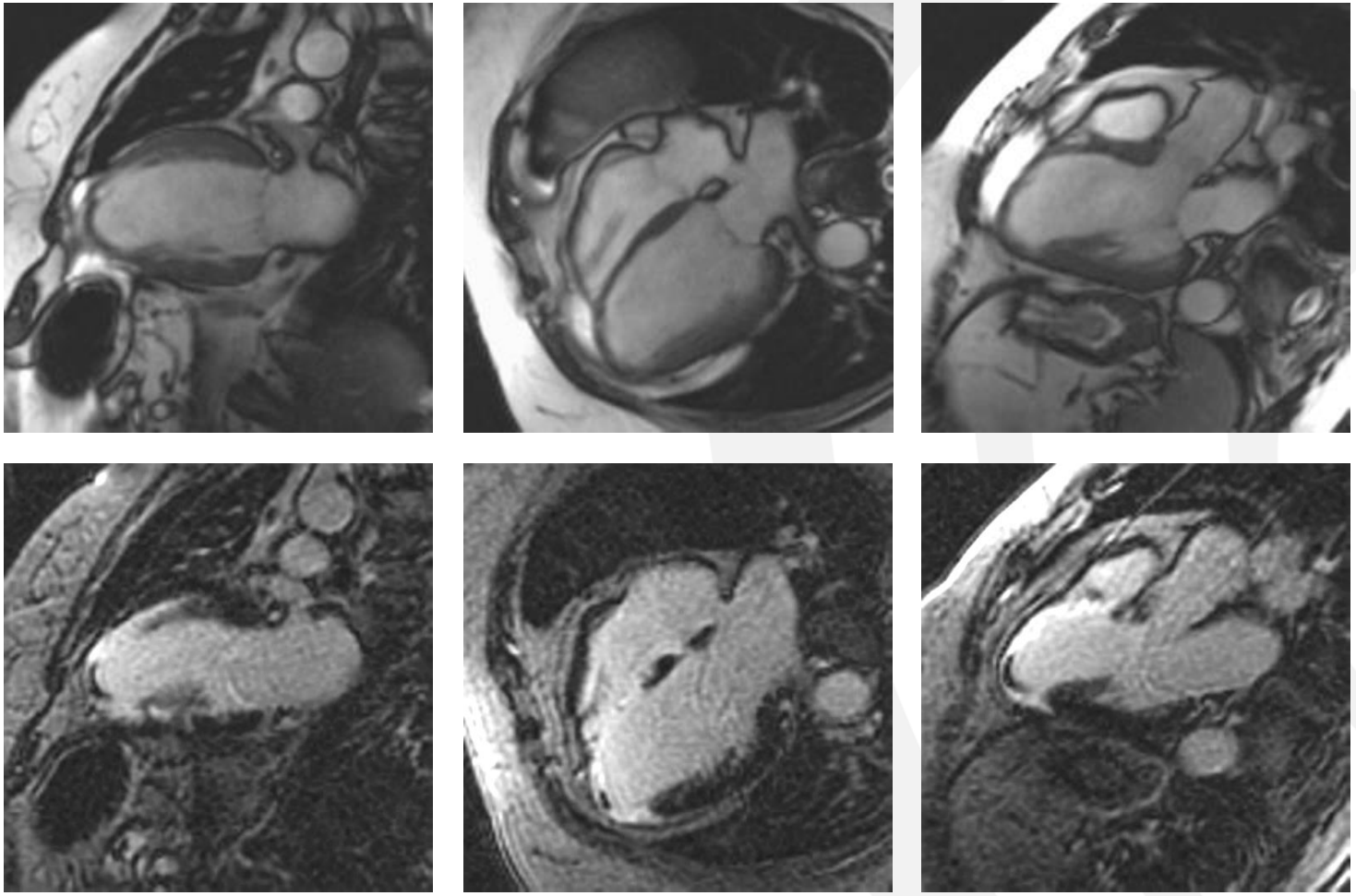
17-segment model of the heart




All Dysfunctional Segments
Segments with Severe Hypokinesia, Akinesia, or Dyskinesia
Segments with Akinesia or Dyskinesia
Improved Contractility (%)
100
80
60
40
20
0
(256 of 329)
(109 of 183)
(46 of 110)
(13 of 124)
(1 of 58)
(128 of 148)
(56 of 86)
(29 of 68)
(10 of 103)
(0 of 57)
(12 of 12)
(23 of 28)
(9 of 20)
(4 of 54)
(0 of 46)
0
1–25
26–50
51–75
76–100
Transmural Extent of Hyperenhancement (%)

Non viable myocardium

Viable myocardium is myocardium which due to ischaemia does not contract normally at rest **but has the potential to recover its function**, either by itself over time or after revascularisation.



Stress MR

- Adenosine stress perfusion

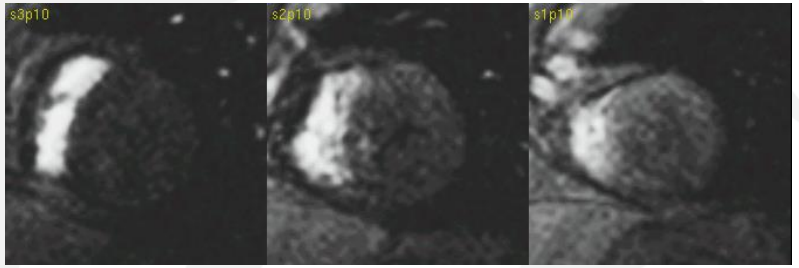
sensitivity ~91%, specificity ~81%

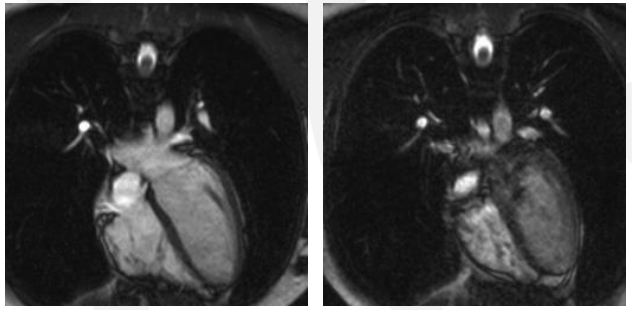
3 short axis slice: basal, mid., apical

- Dobutamin/atropin stress MR

sensitivity ~ 83%, specificity ~ 86%
3 short axis slice: basal, mid., apical
Long axis slices

- (Treadmill)

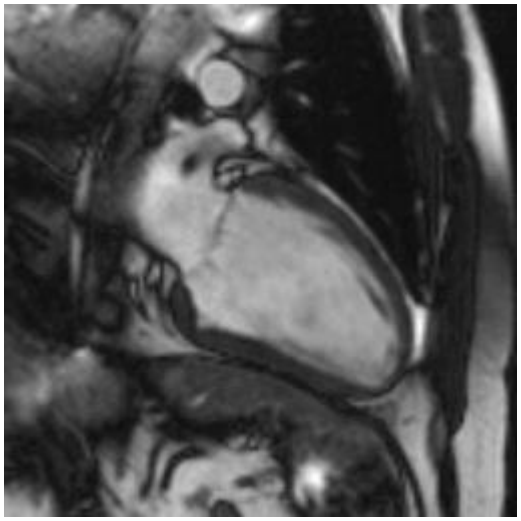
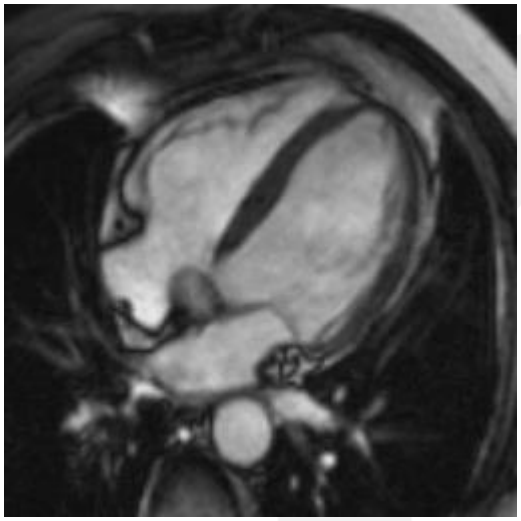
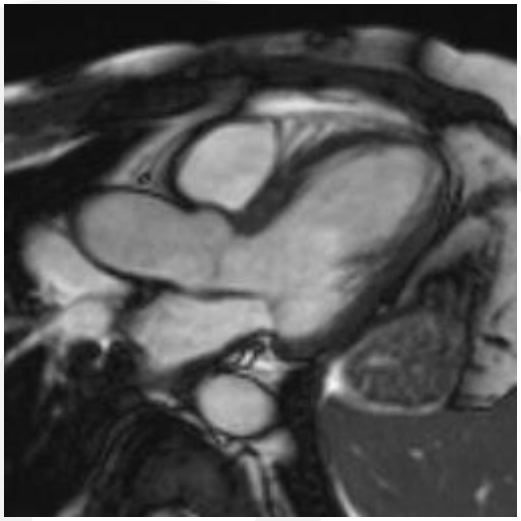
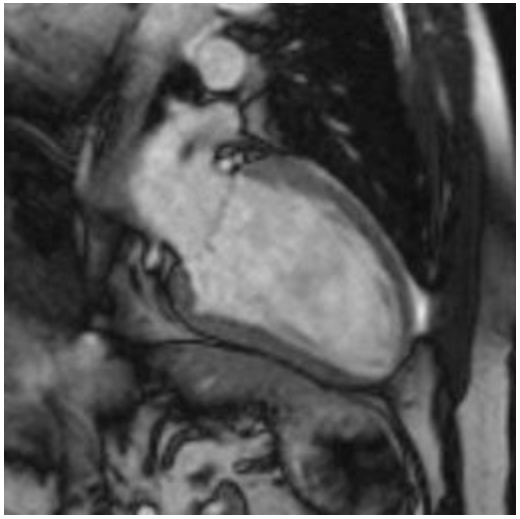


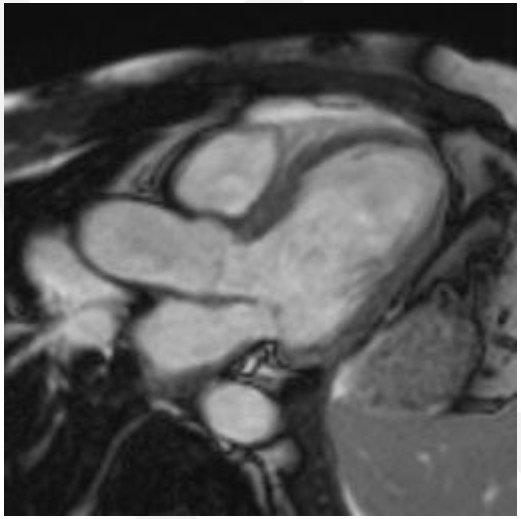


O.L. 61 yo male

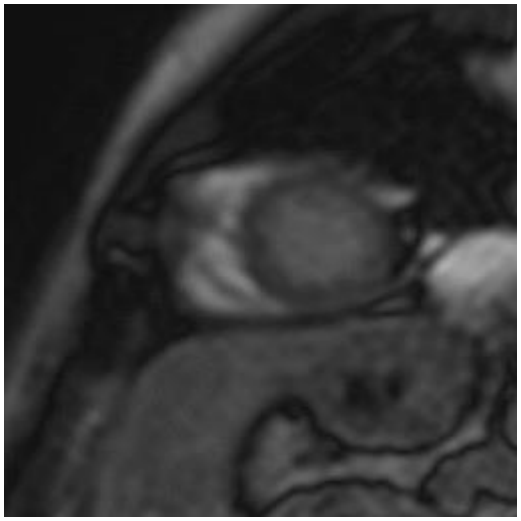
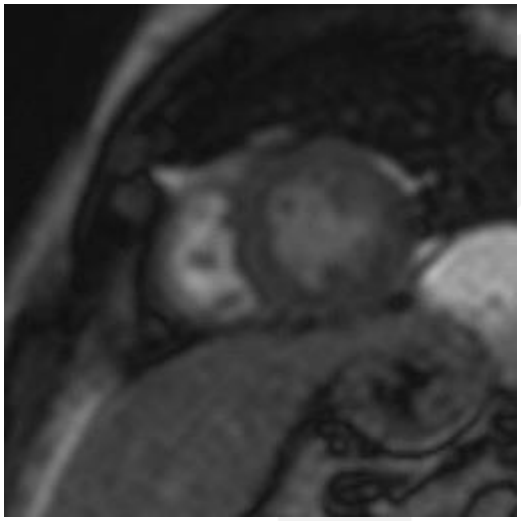
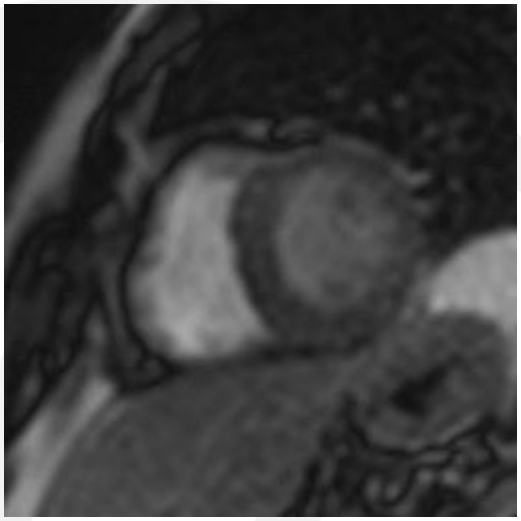
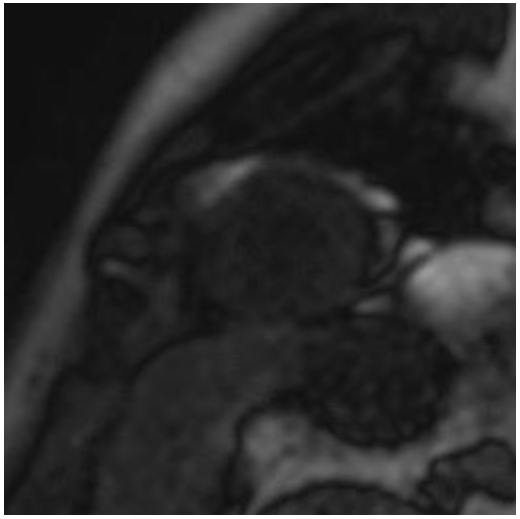
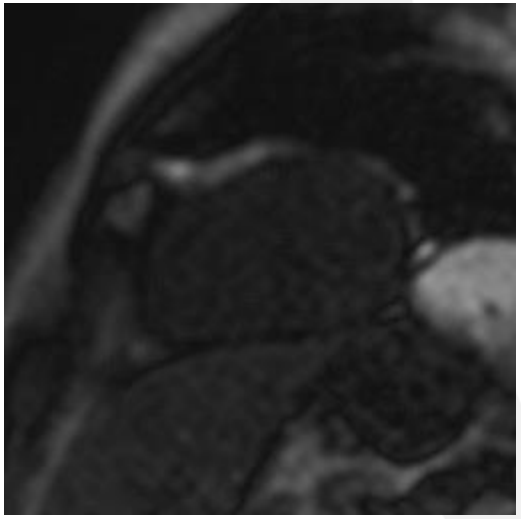
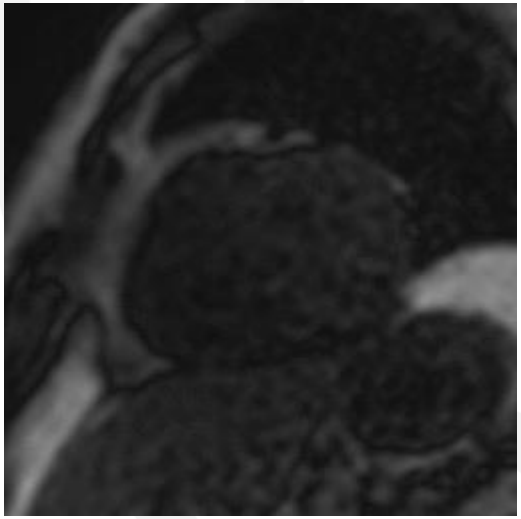
Typical effort angina, intermediate cardiovascular risk, treadmill ECG was inconclusive

Rest ans stress LA cine



Rest and stress perfusion

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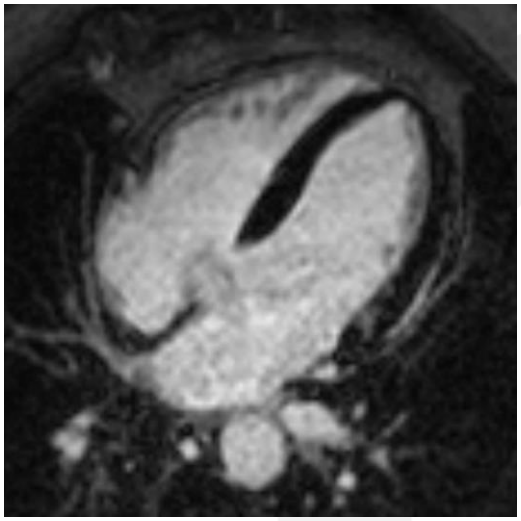
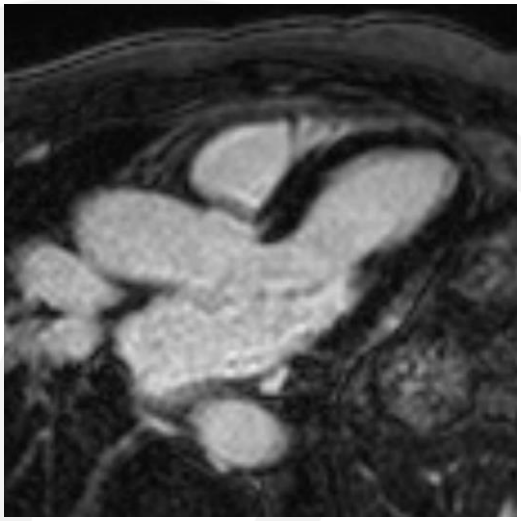
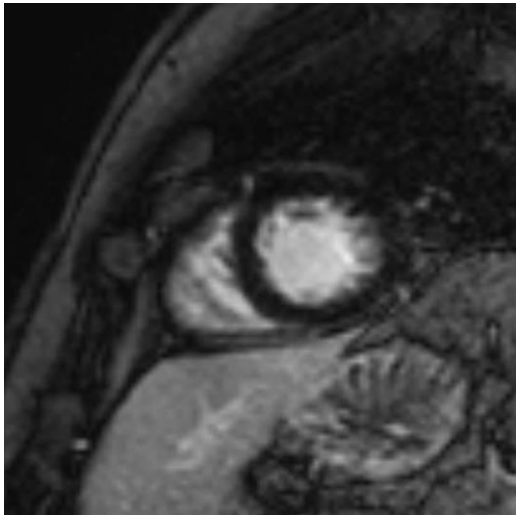
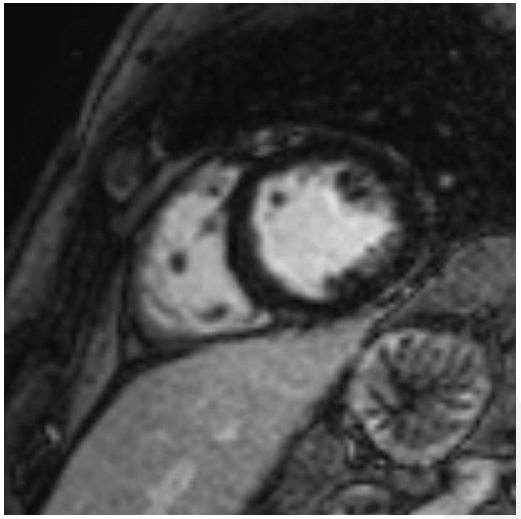
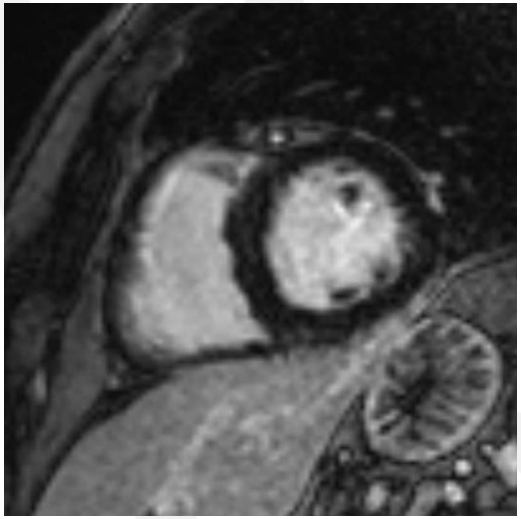
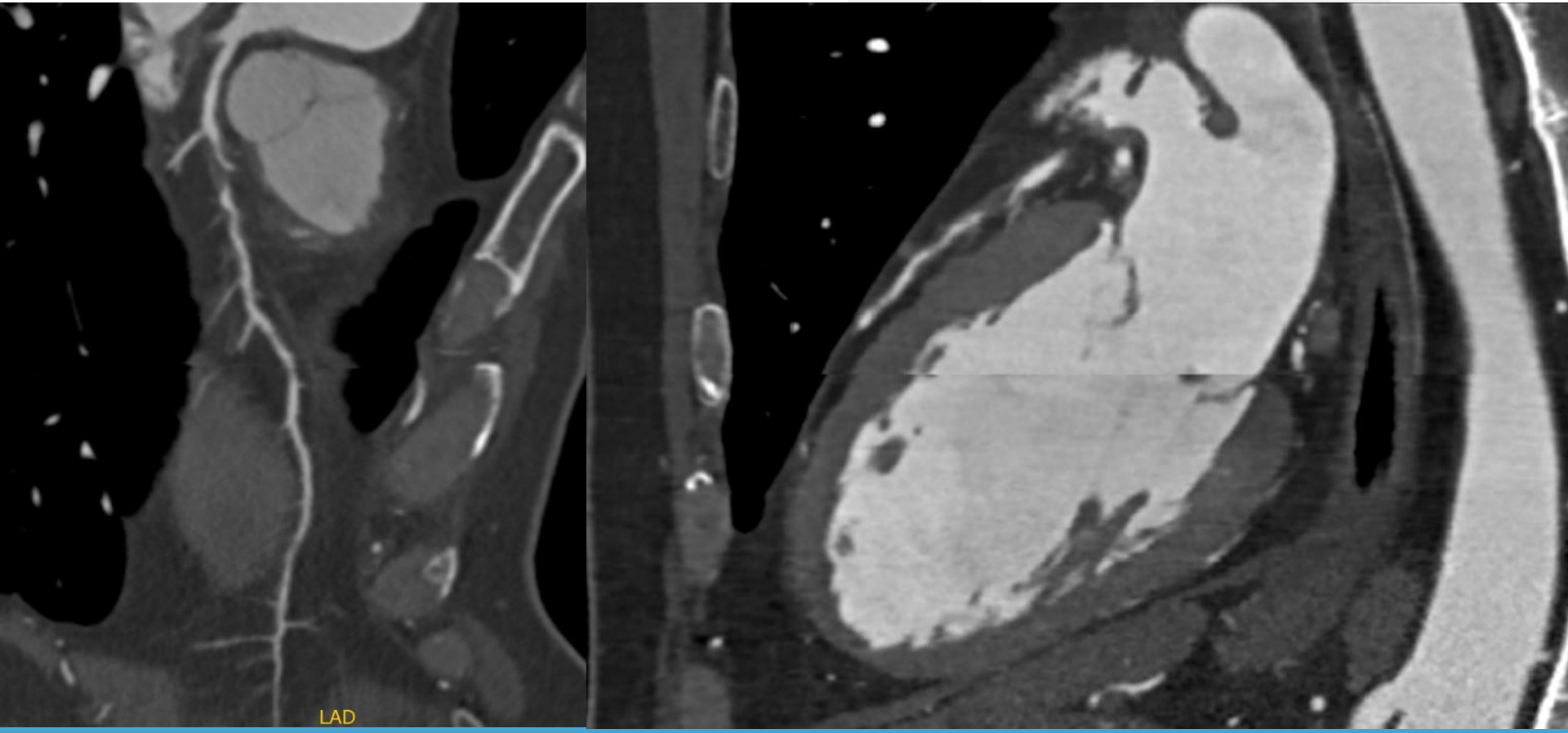
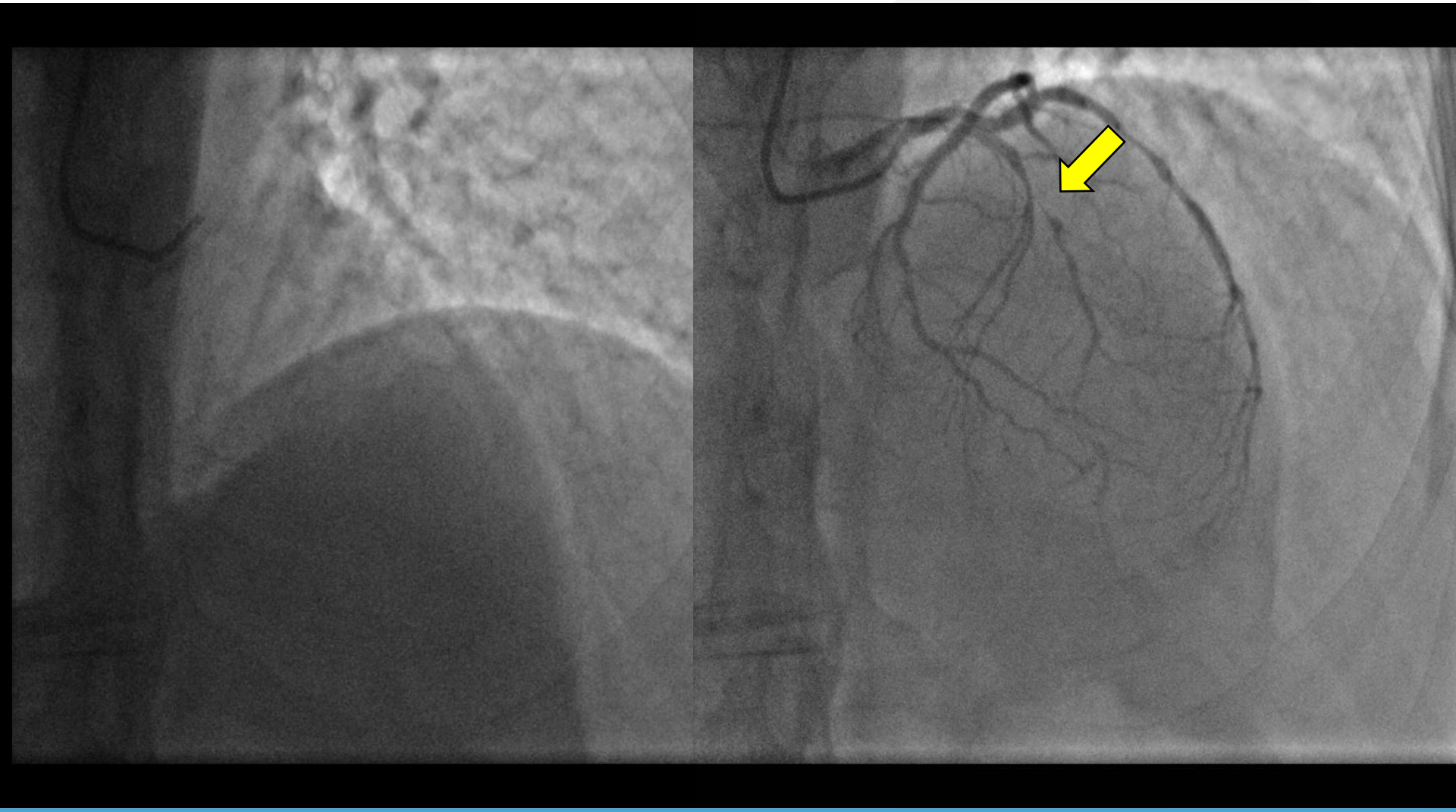






Coronary CTA: non calcified plaque on the proximal LAD



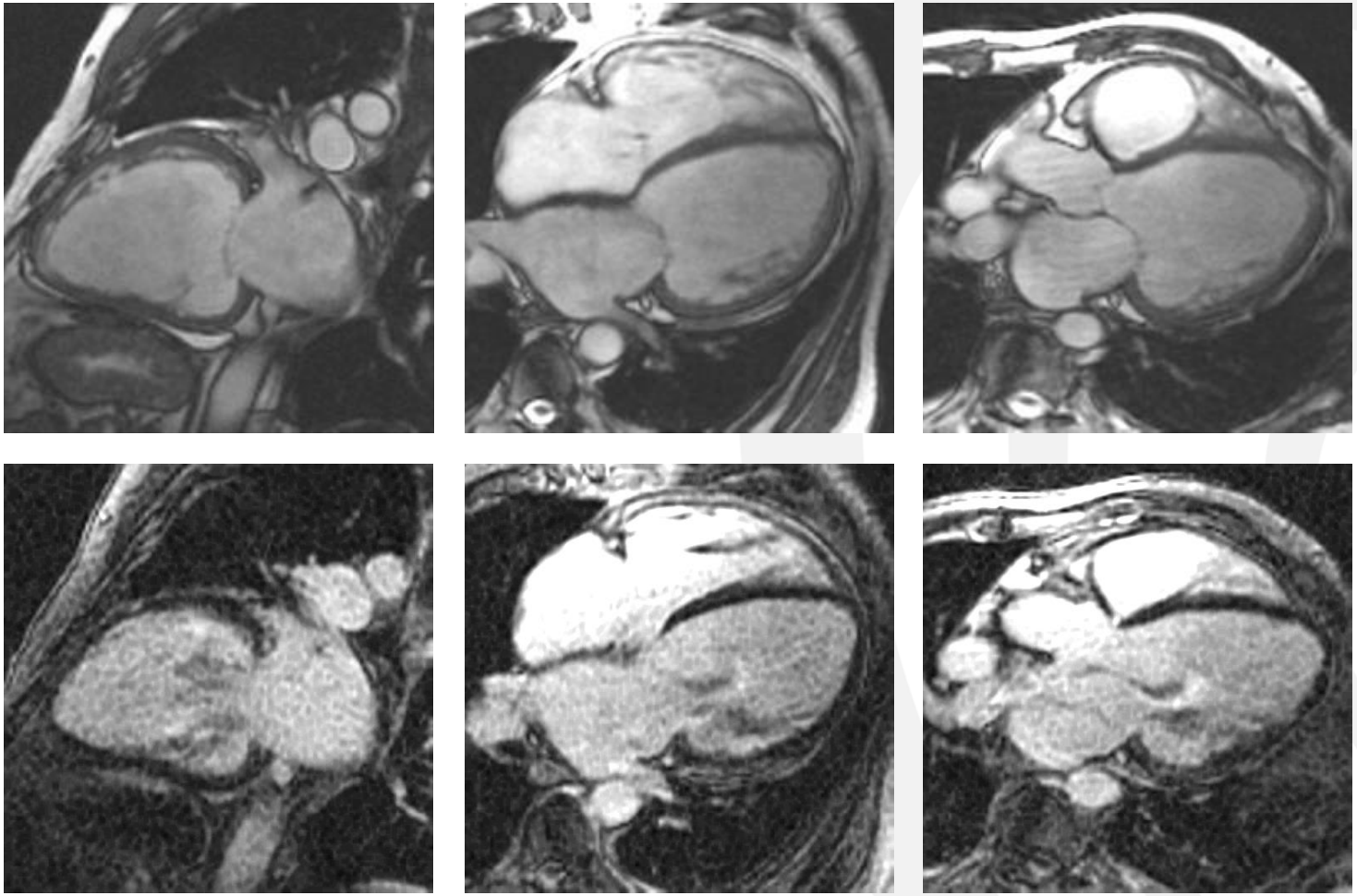
Coronary angiography



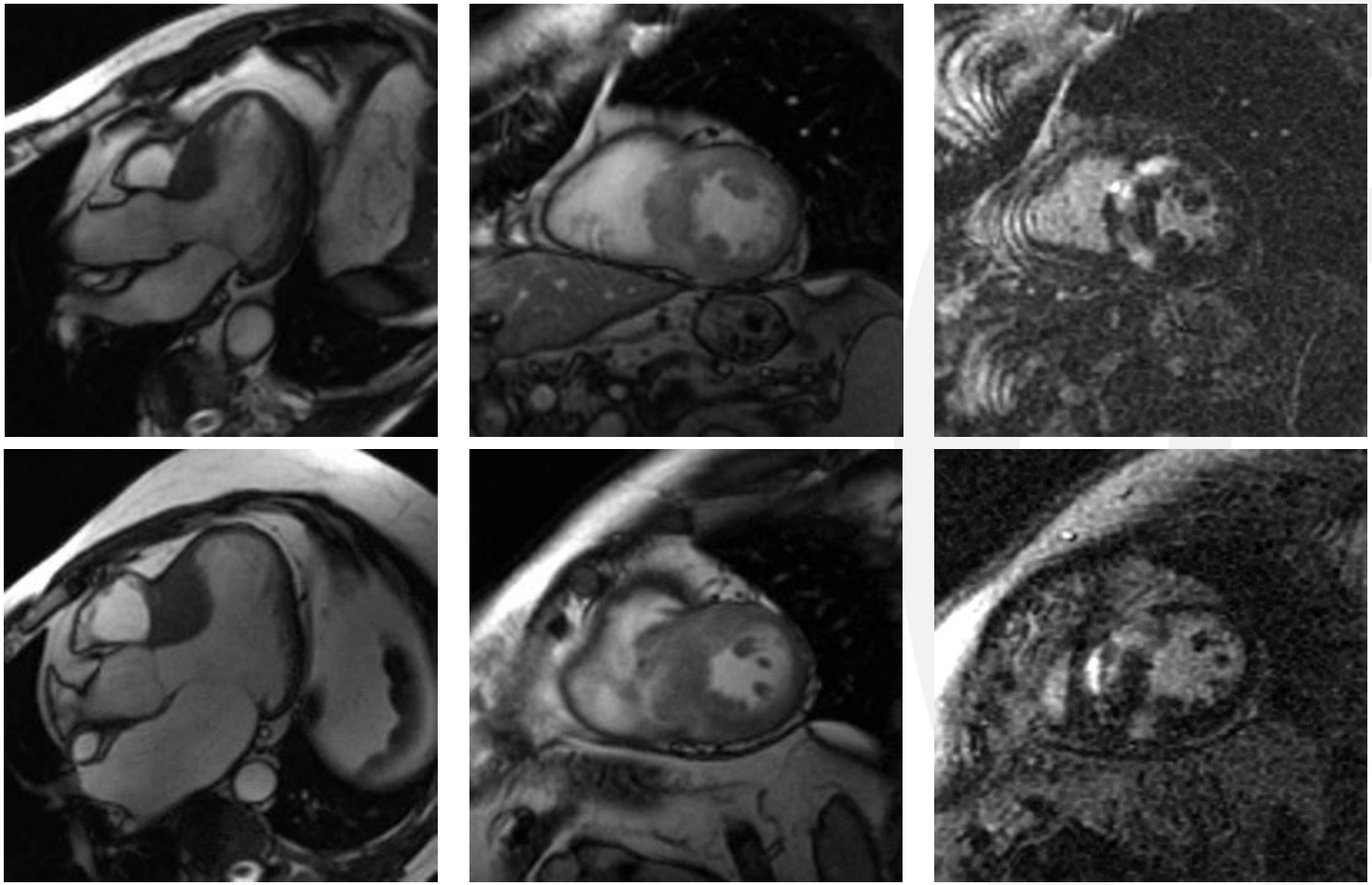
Top 6 indications

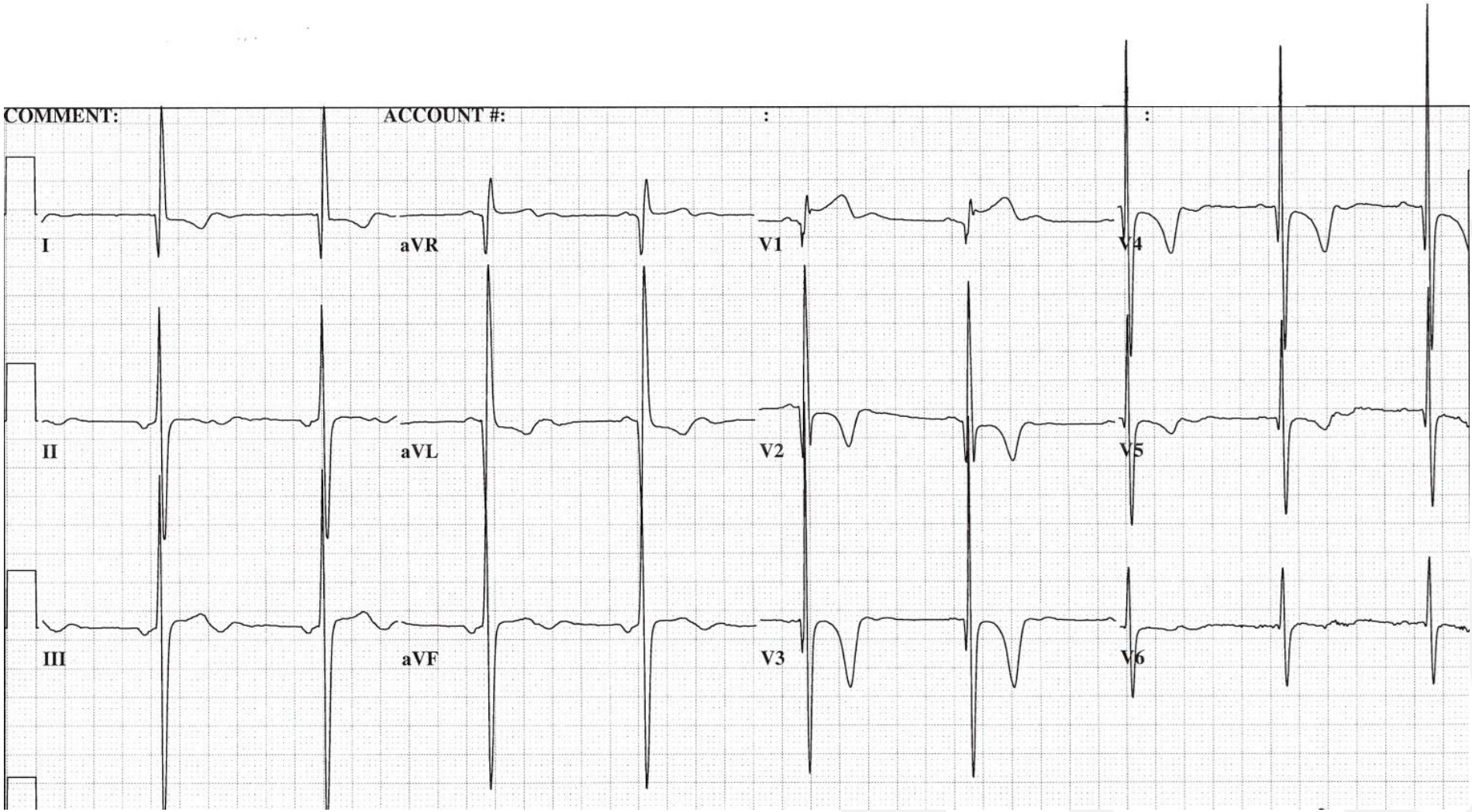
- Ischaemic heart disease
- Cardiomyopathies
- Myocarditis
- Congenital heart disease
- Tumours
- Pericardial diseases

Dilated cardiomyopathy

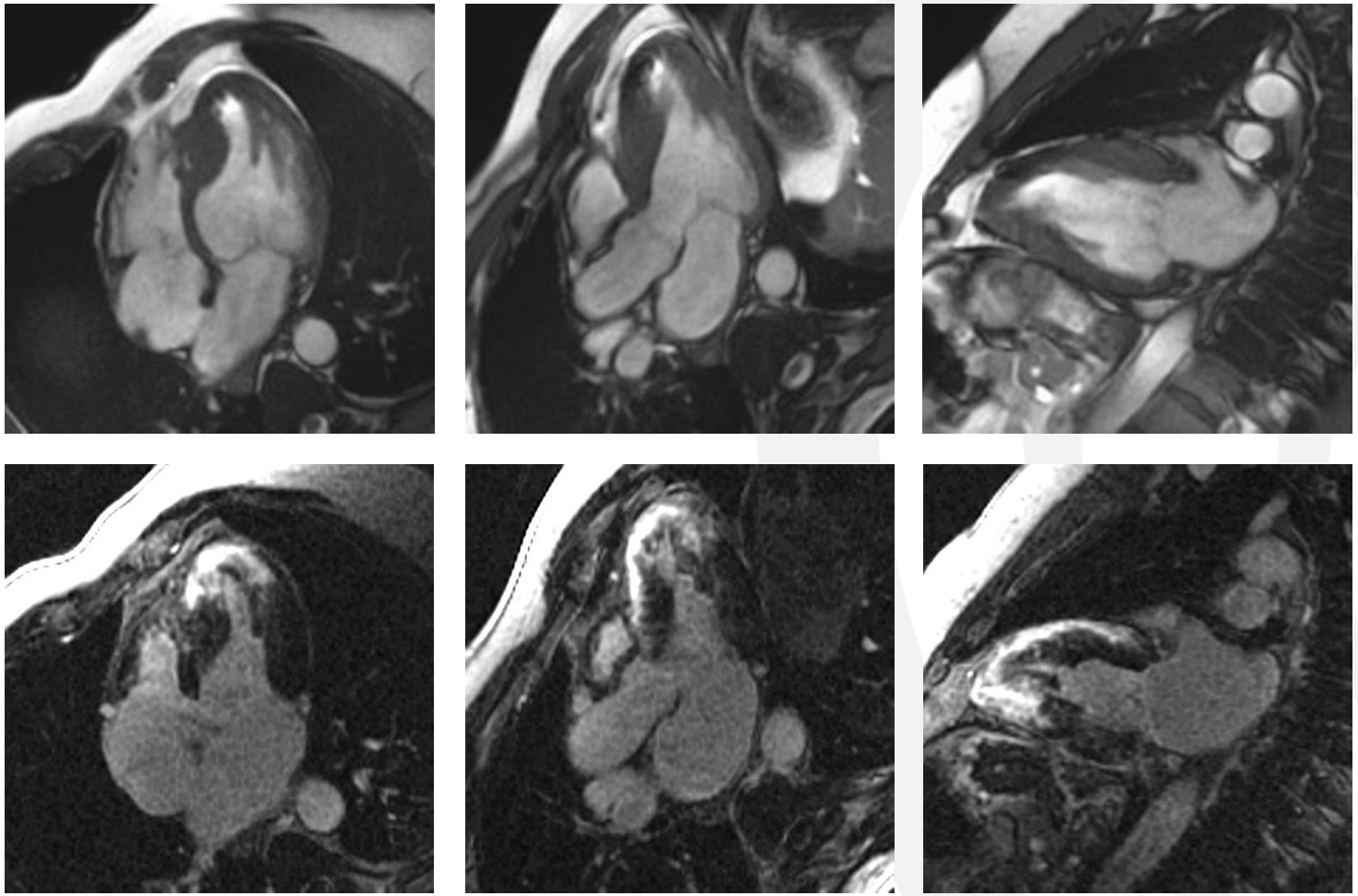


Hypertrophic cardiomyopathy

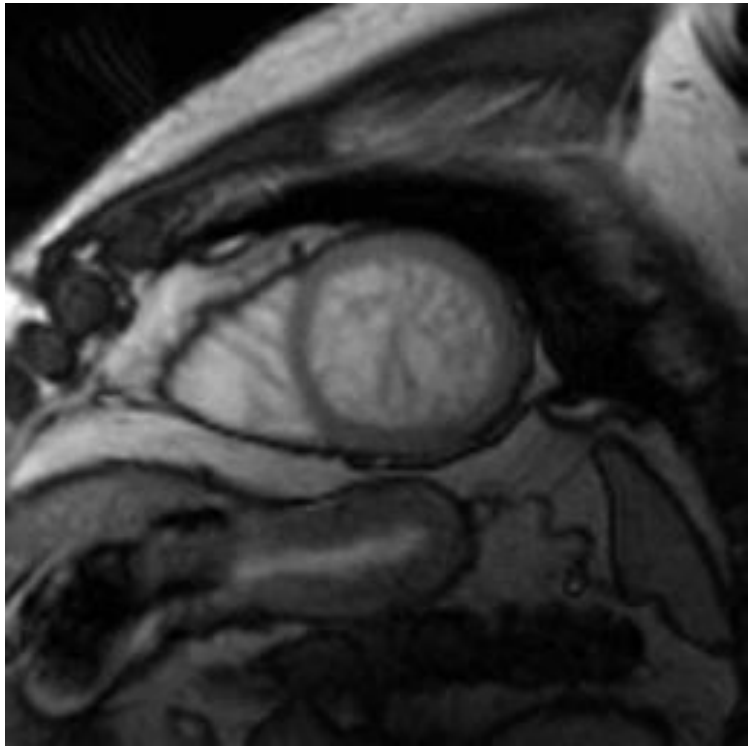


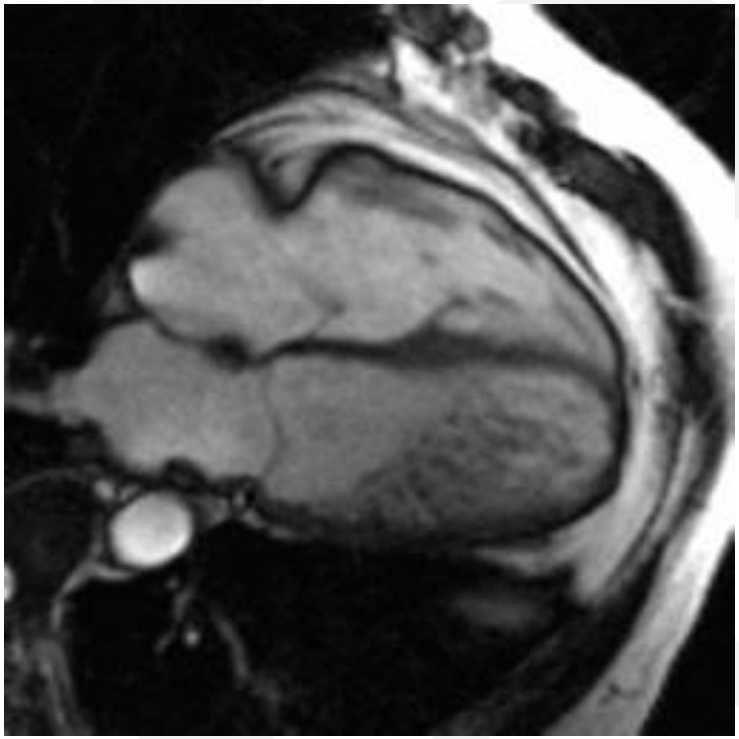

COMMENT:
ACCOUNT #:
:
:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

Hypertrophic cardiomyopathy

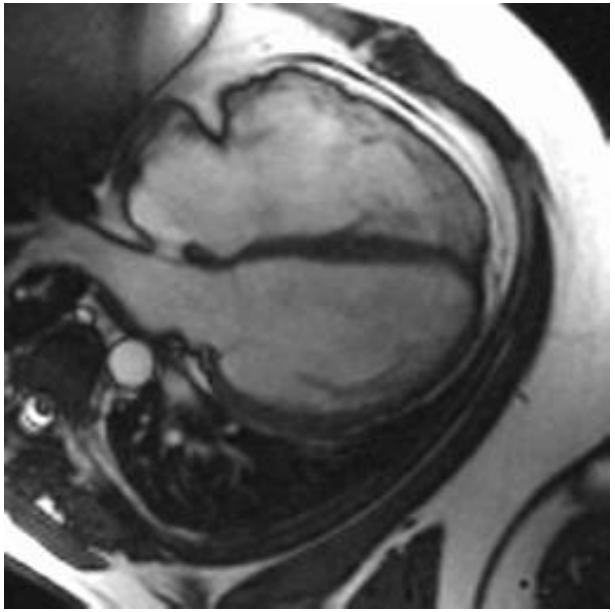


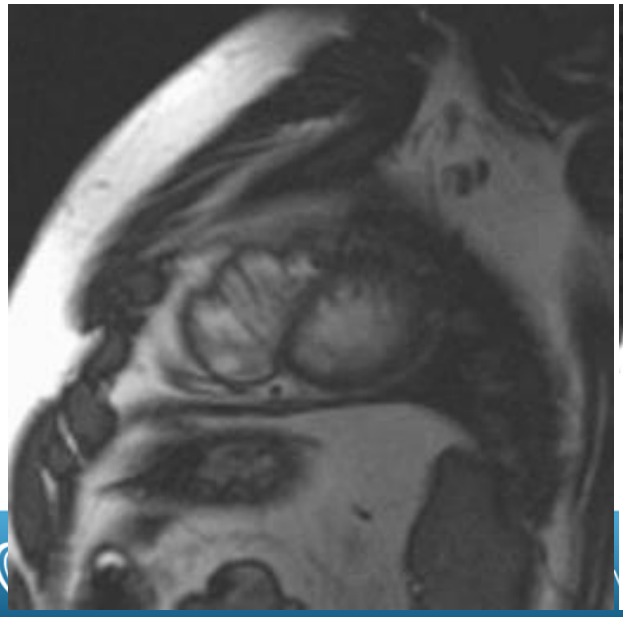
Left ventricular non-compaction

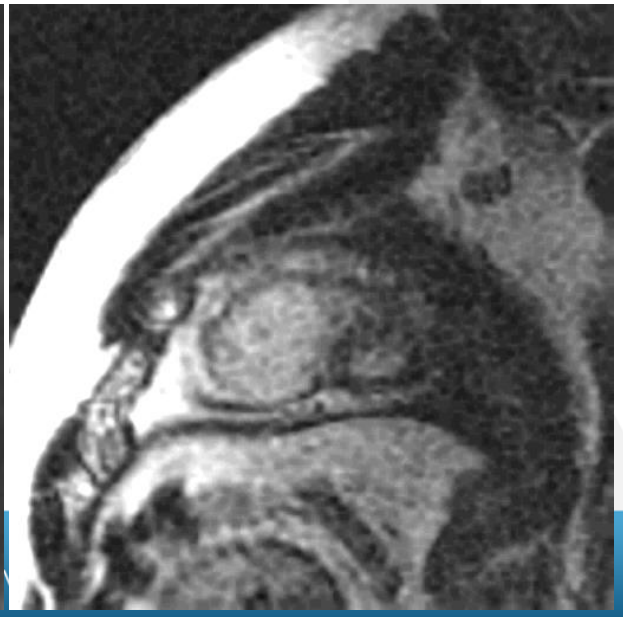




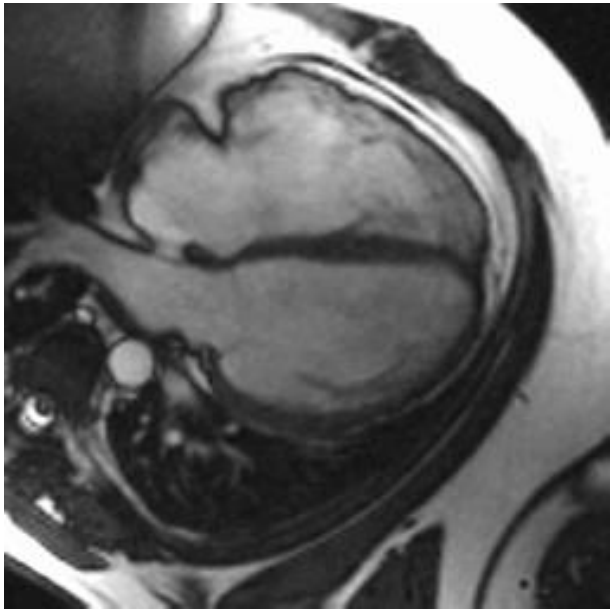
Arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVD)

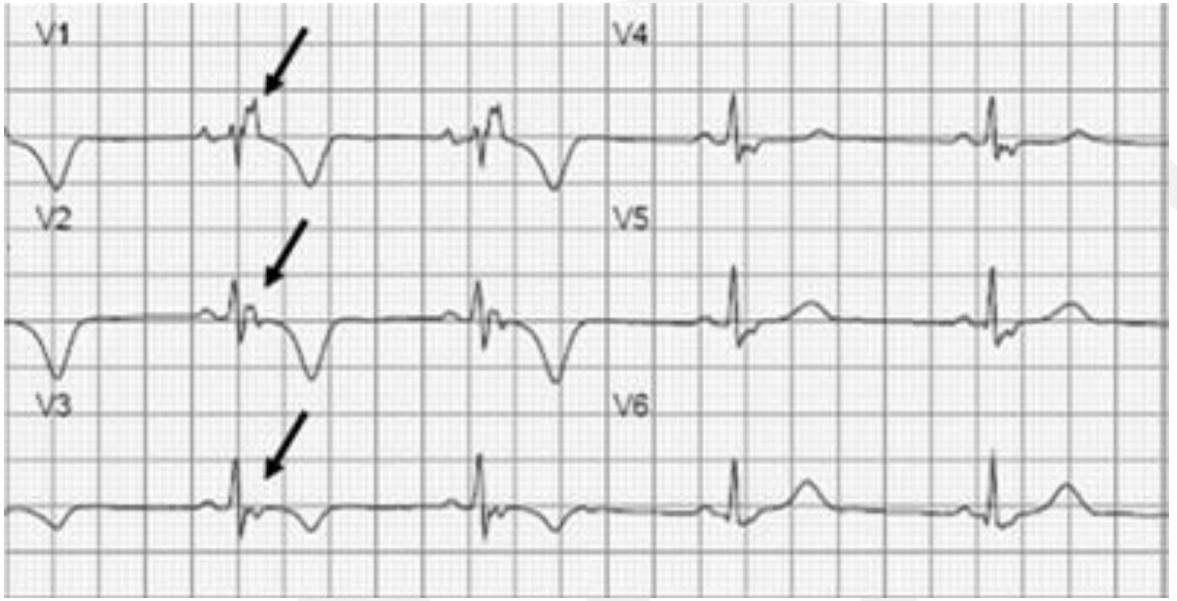


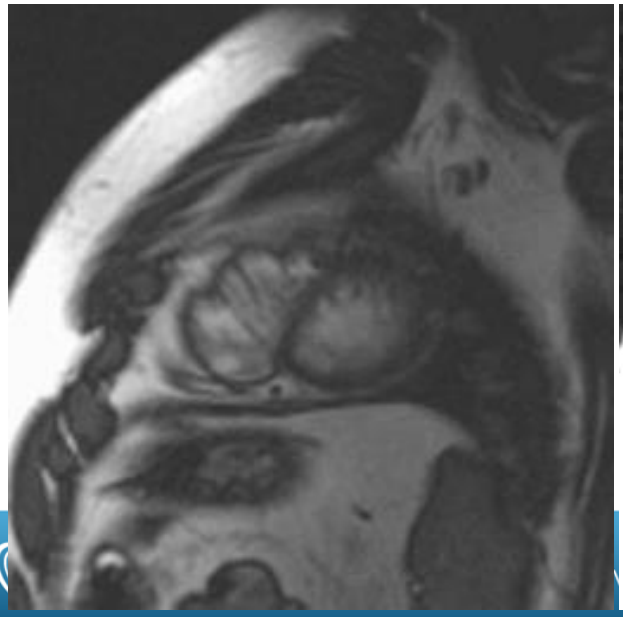


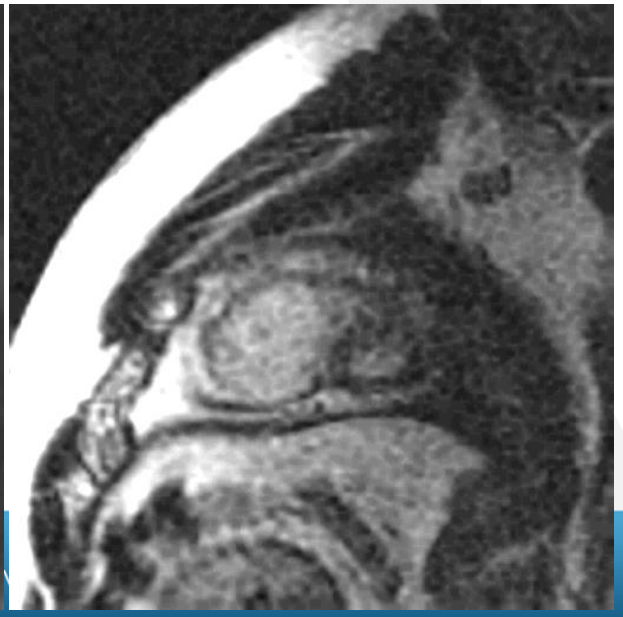


Arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVD)









Top 6 indications

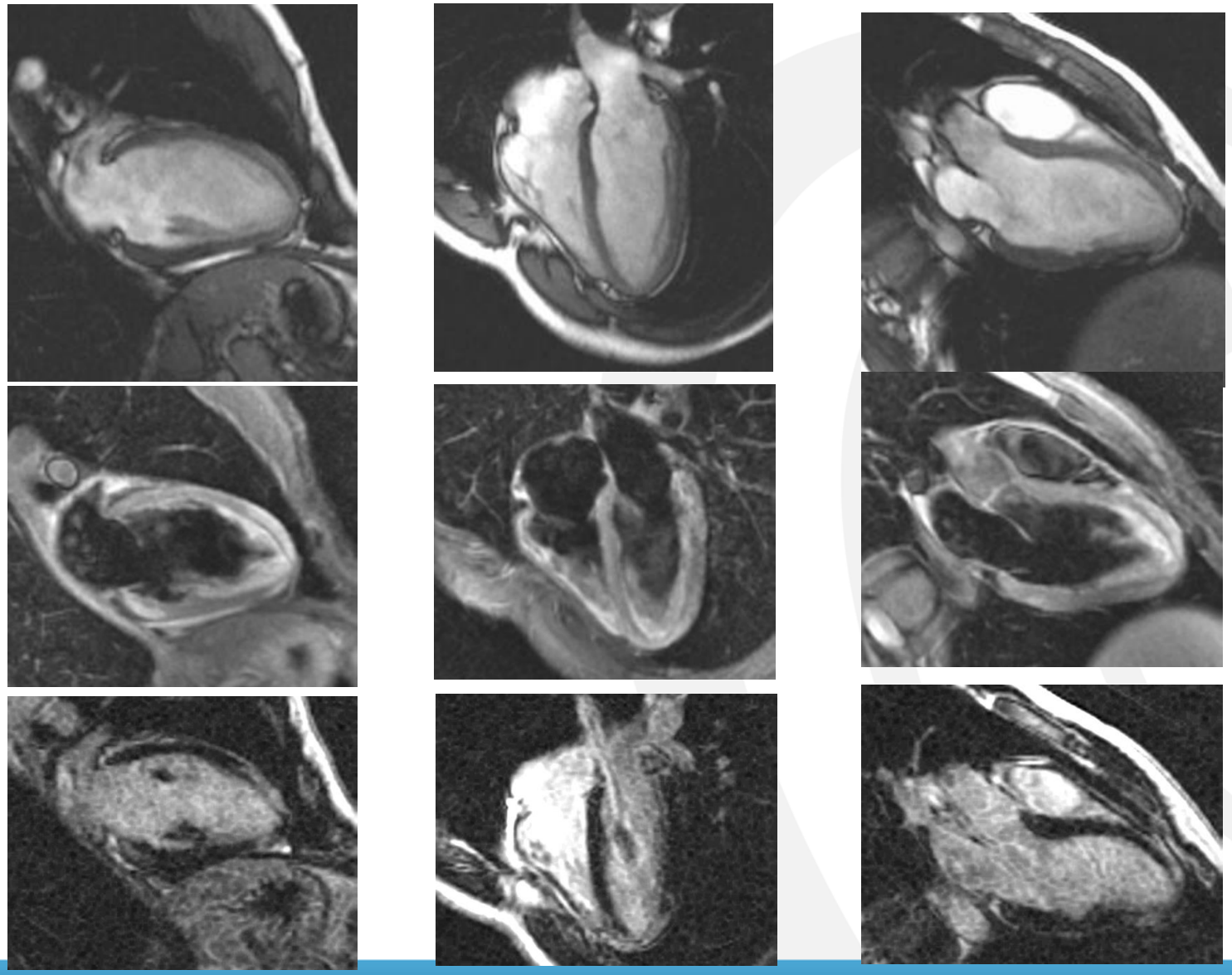
- Ischaemic heart disease
- Cardiomyopathies
- Myocarditis
- Congenital heart disease
- Tumours
- Pericardial diseases

Acute myocarditis

bSSFP

T2w

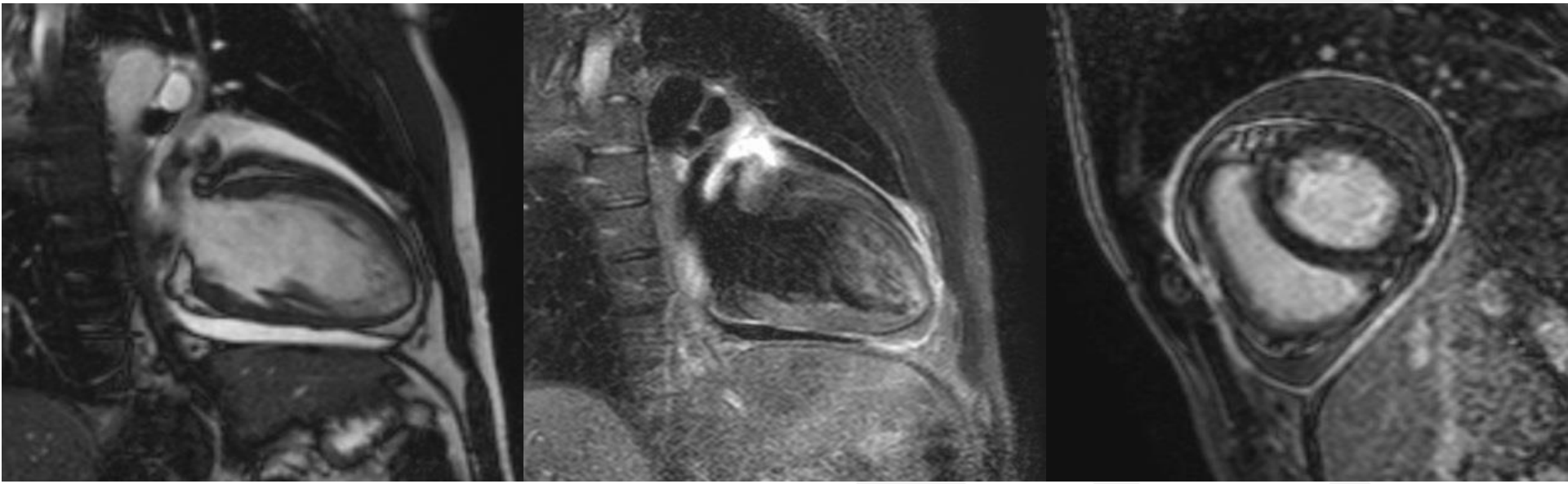
DE



Top 6 indications

- Ischaemic heart disease
- Cardiomyopathies
- Myocarditis
- Pericardial diseases
- Tumours
- Congenital heart disease

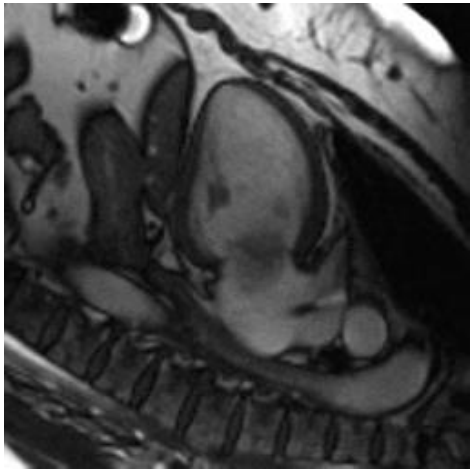
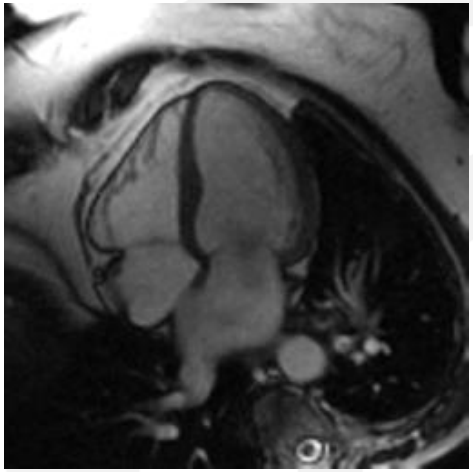
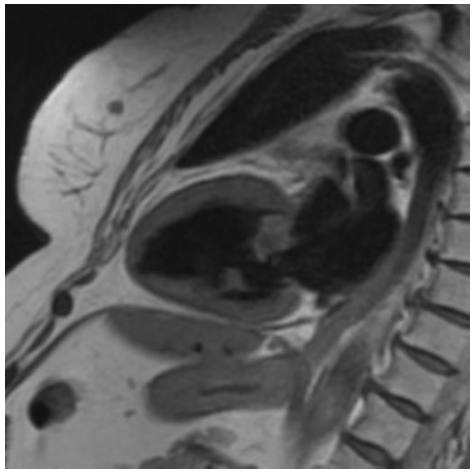
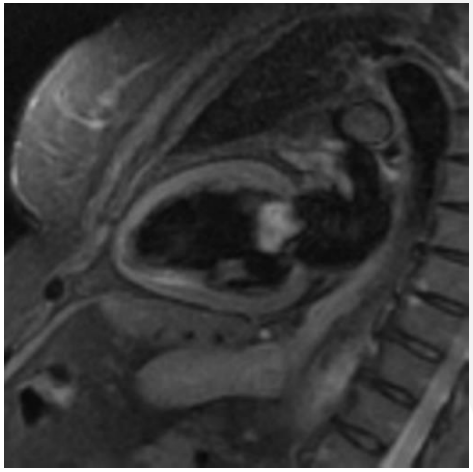
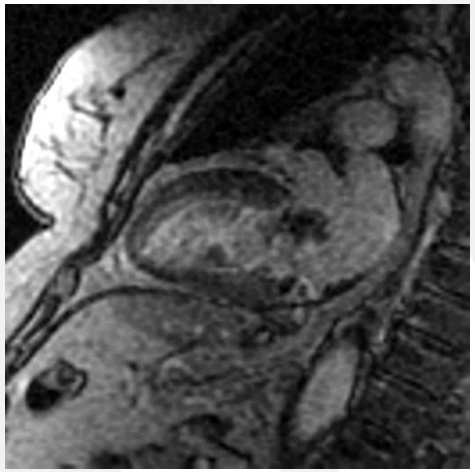
Acute pericarditis



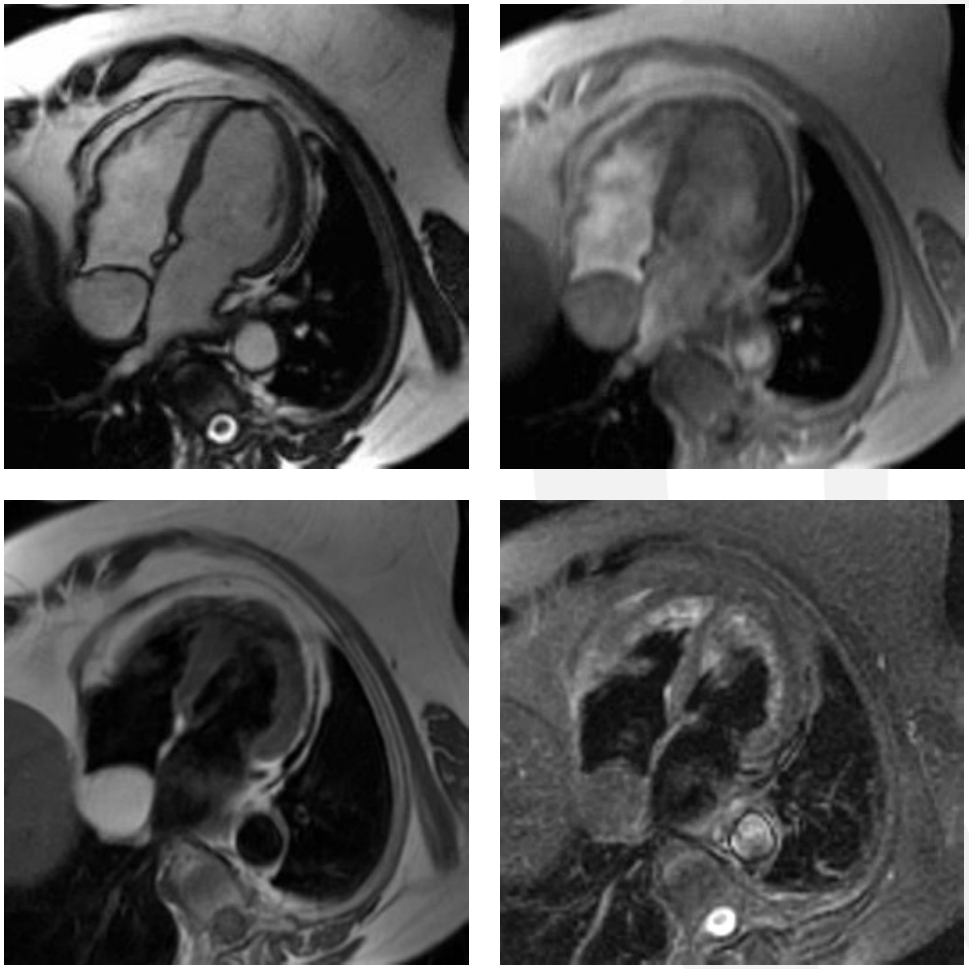
Top 6 indications

- Ischaemic heart disease
- Cardiomyopathies
- Myocarditis
- Pericardial diseases
- Tumours
- Congenital heart disease

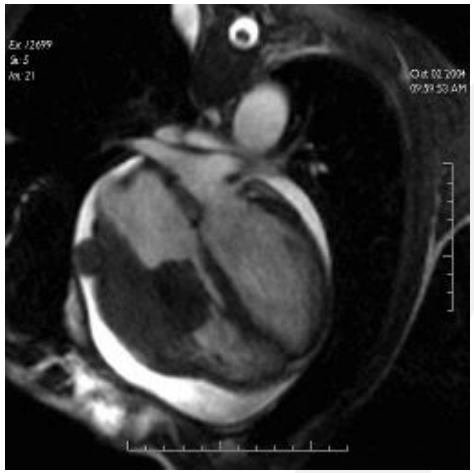
Left atrial myxoma

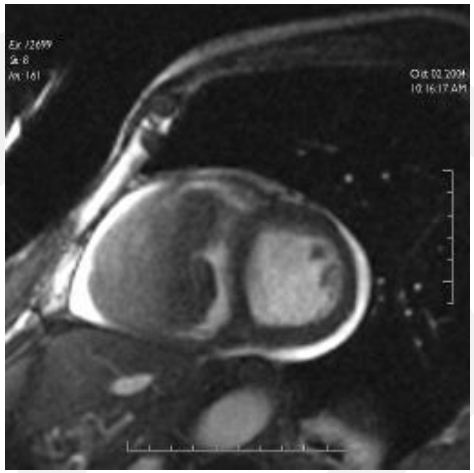






Right atrial lipoma

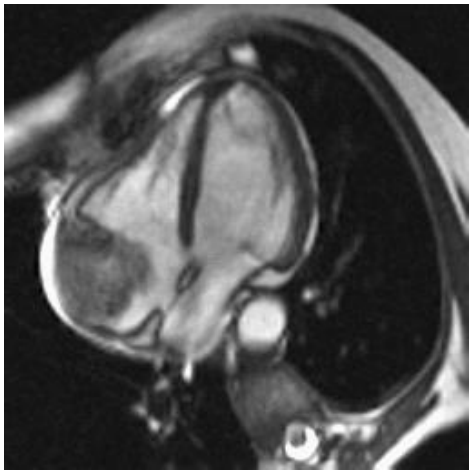


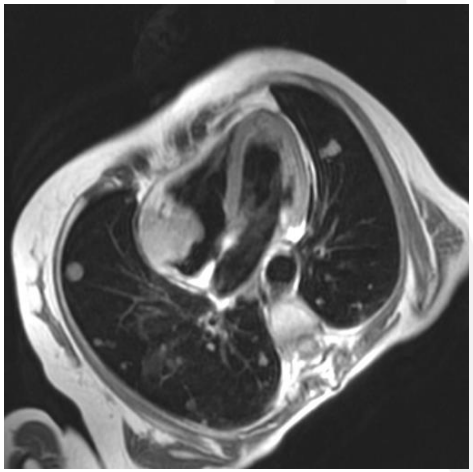
Rectal tumor metastasis

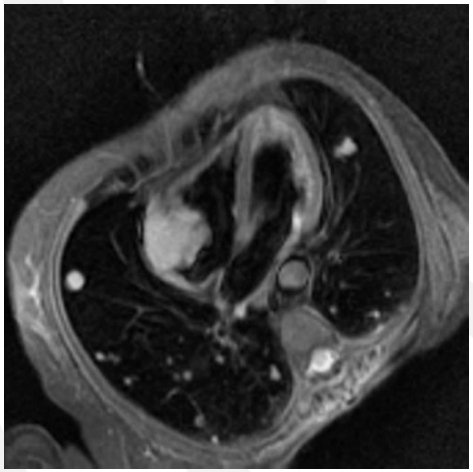




Breast cancer metastasis

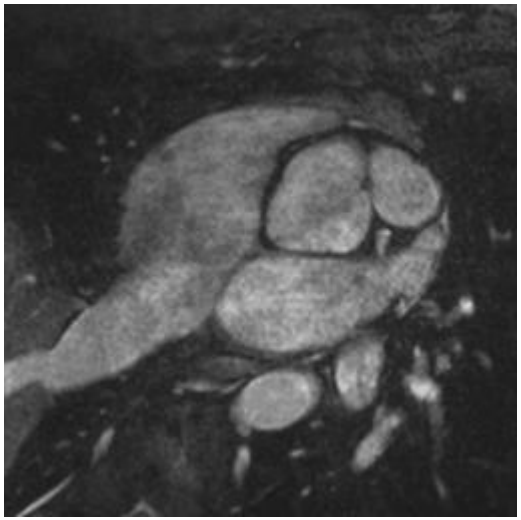
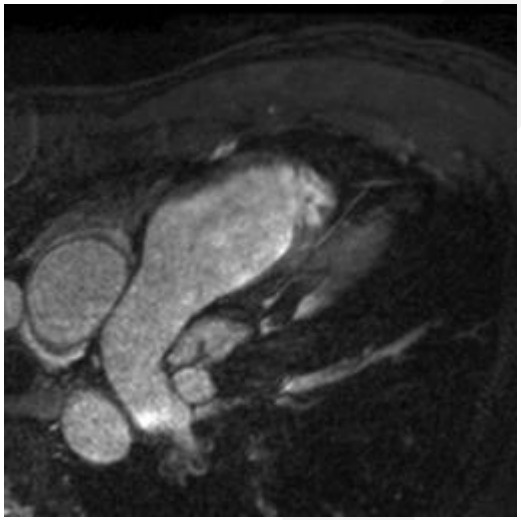
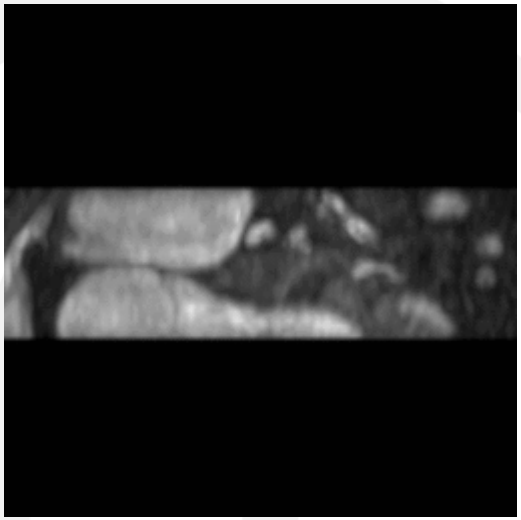
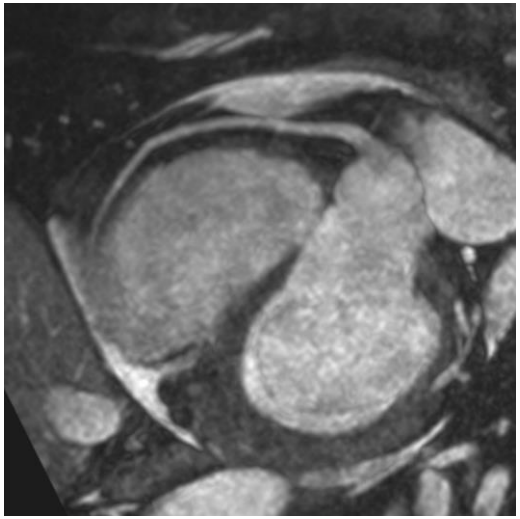
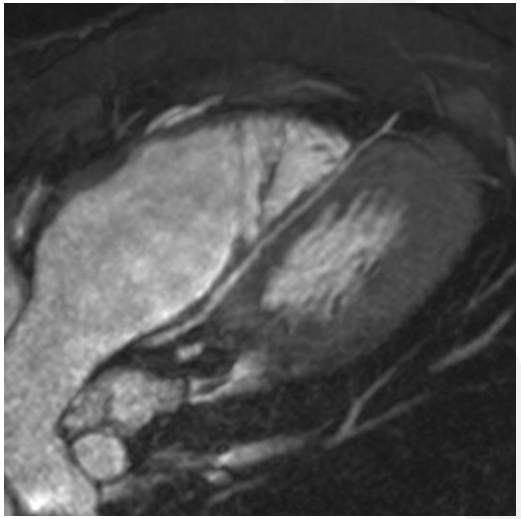
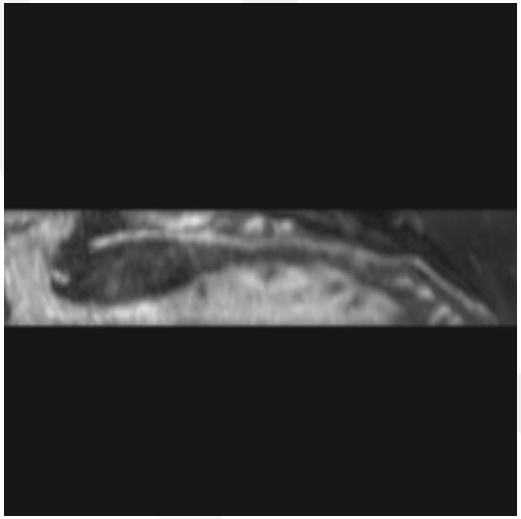




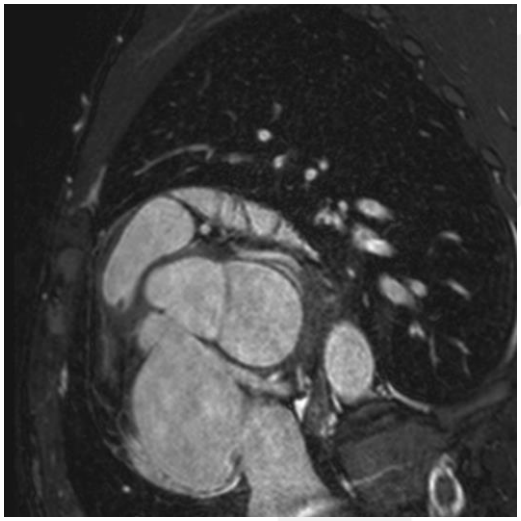
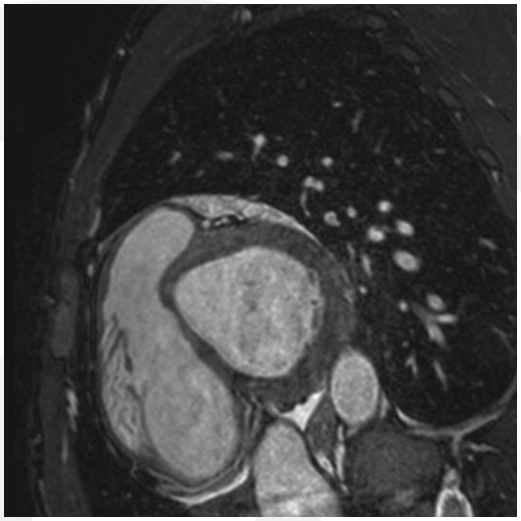
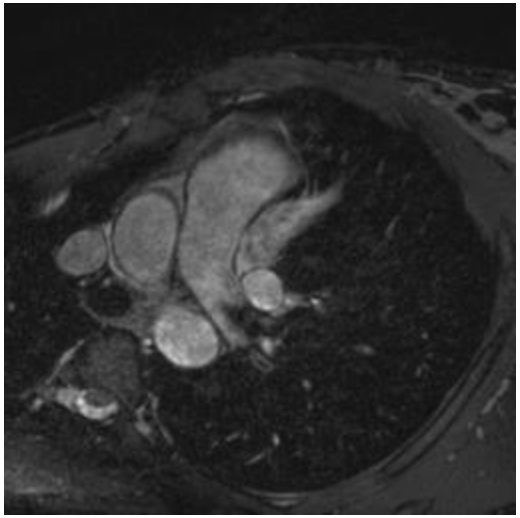
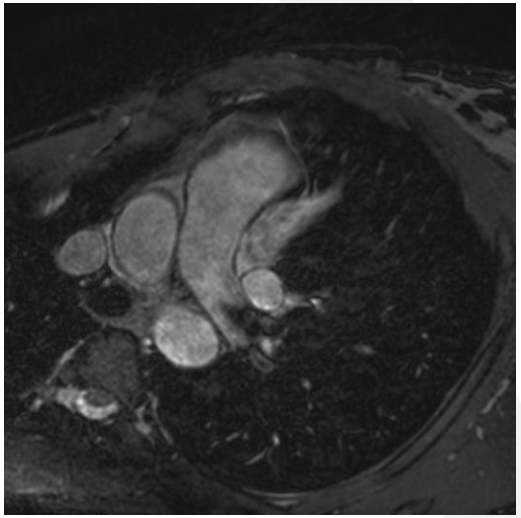
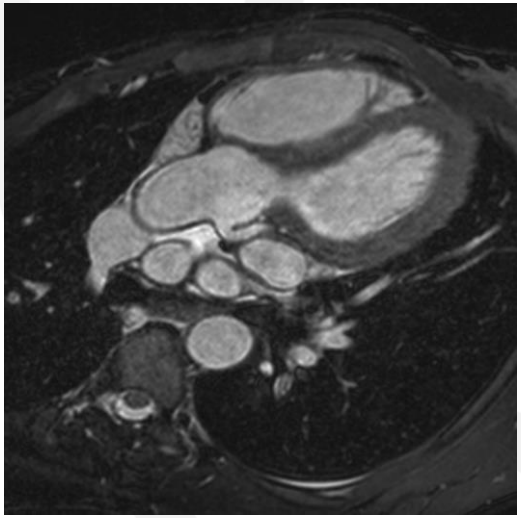


MRCA: LAD bridge

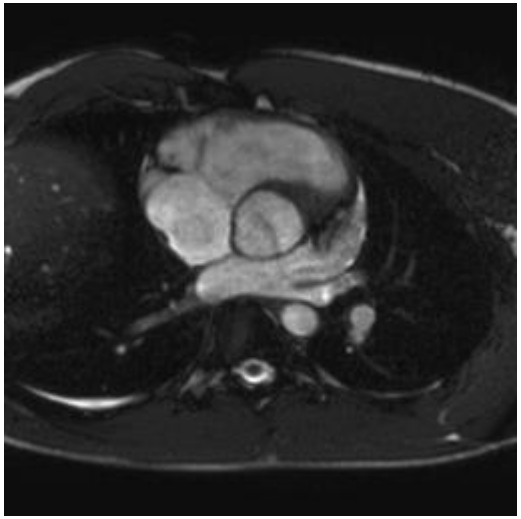
Myocardial bridge: segmental intramyocardial course of the epicardial coronary arteries

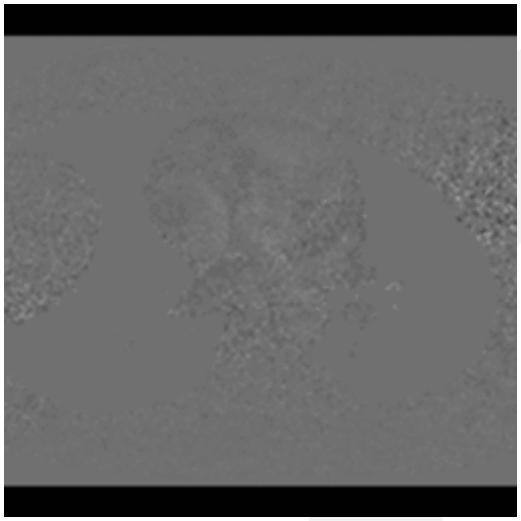







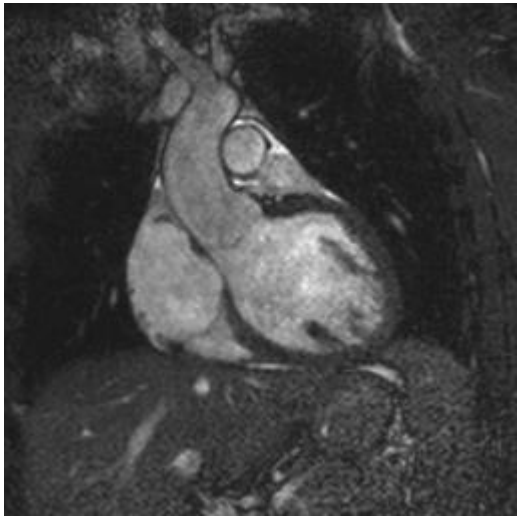
MR coronary angiography

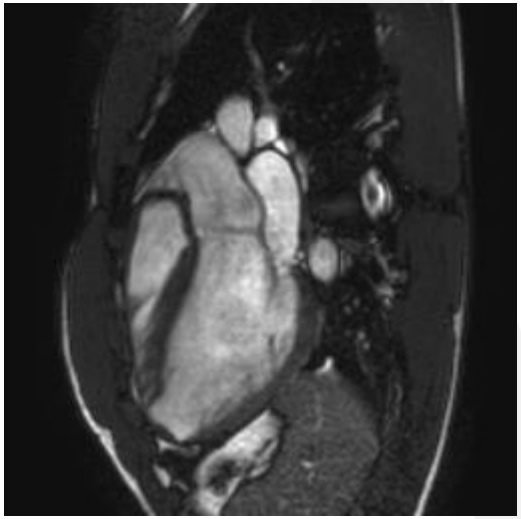







Bicuspid aortic valve









Left Ventricular Volume Results

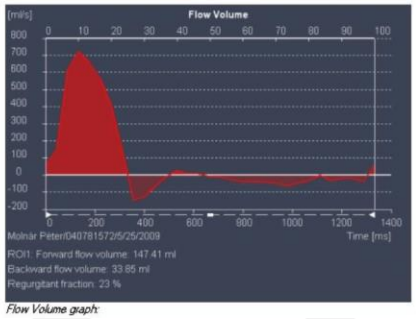
Mass:	261.39 g	85 - 181	Mass index:	121.83 g/m²	46 - 84
ED volume:	367.65 ml	101 - 236	ED volume index:	171.36 ml/m²	52 - 112
ES volume:	181.97 ml	28 - 93	ES volume index:	84.81 ml/m²	-
Stroke volume:	185.68 ml	66 - 150	Stroke volume index:	86.54 ml/m²	-
Ejection fraction:	50.50 %	55 - 74			

Volume Results Slice 1

ROI	Label	Flow / beat	Flow / minute
1		113.57 ml/beat	5.11 l/min
2		-	-
3		-	-
4		2.09 ml/beat	94.10 ml/min

Regurgitation Results Slice 1

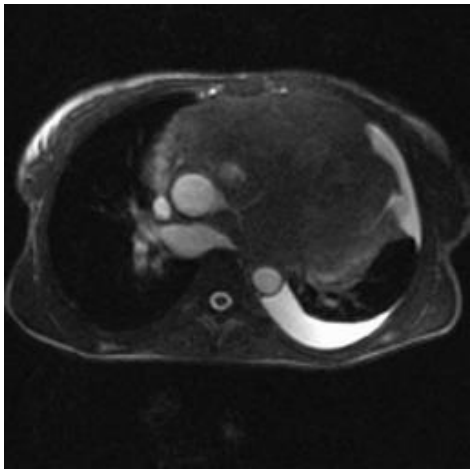
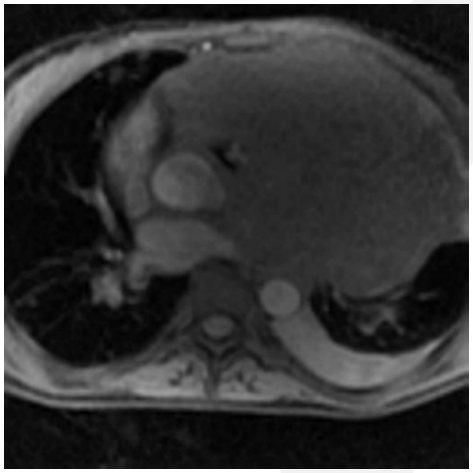
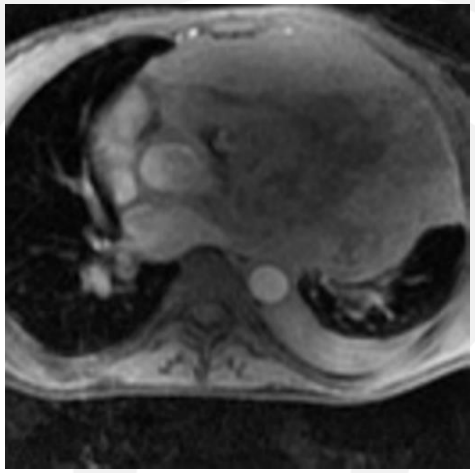
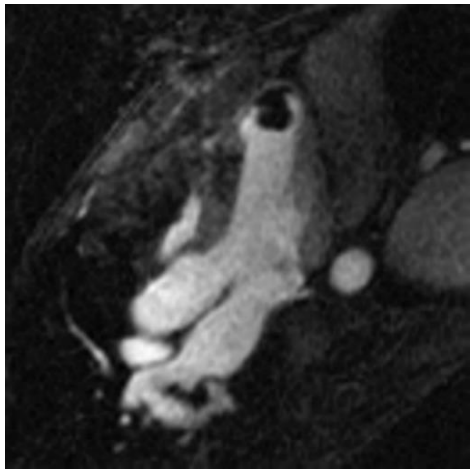
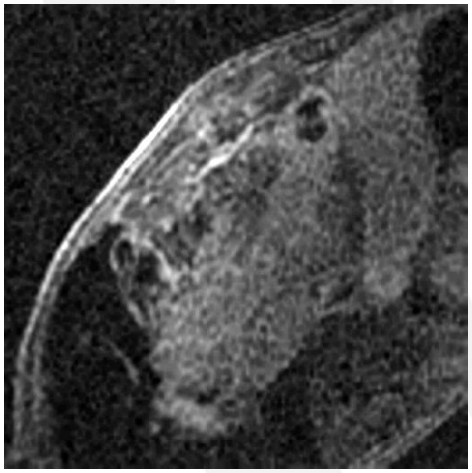
ROI	Label	Regurgitant fraction	Forward volume	Backward volume
1		22.96 %	147.41 ml/beat	33.85 ml/beat



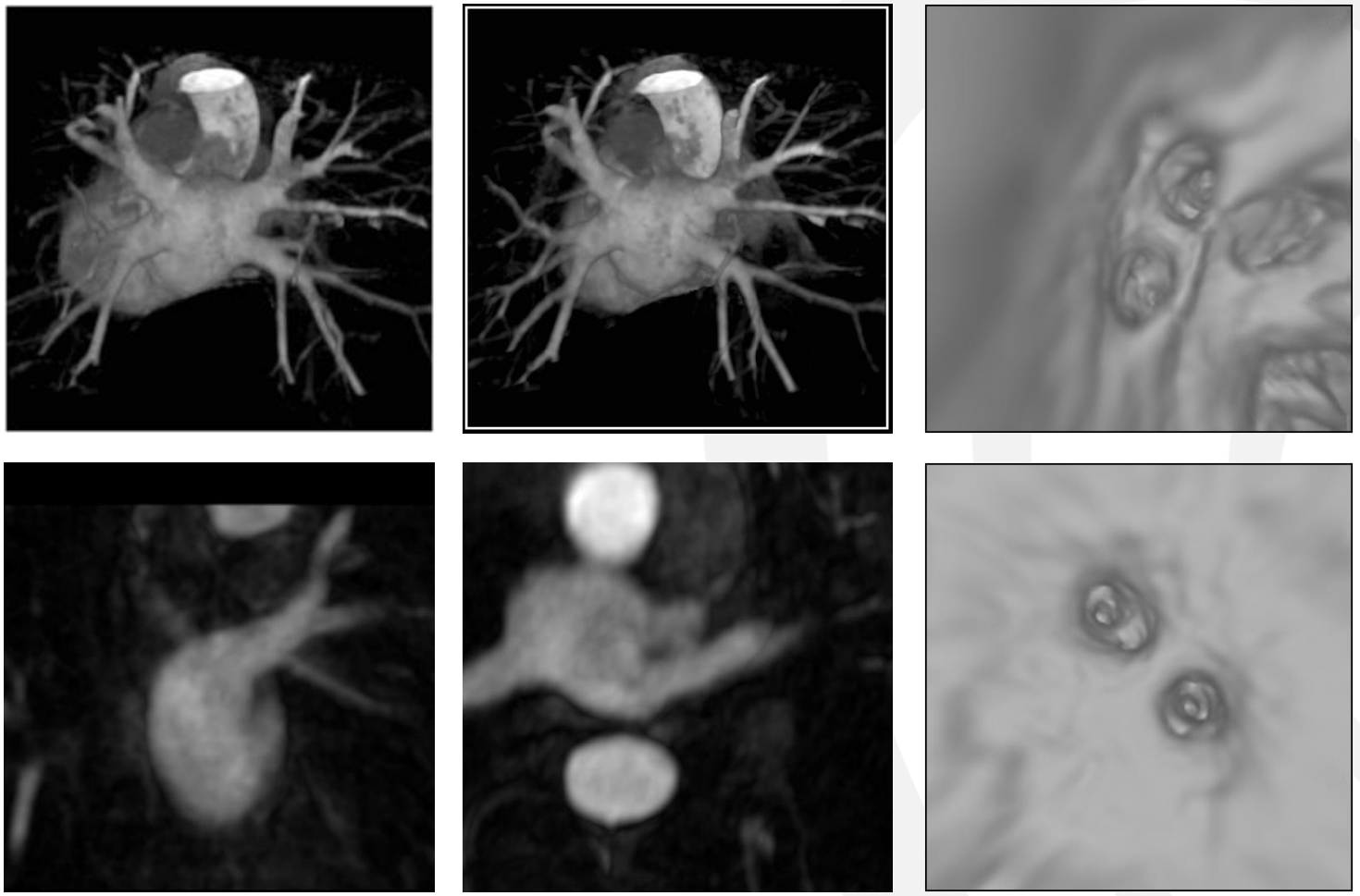
Flow Volume graph:

Phase contrast velocity measurement

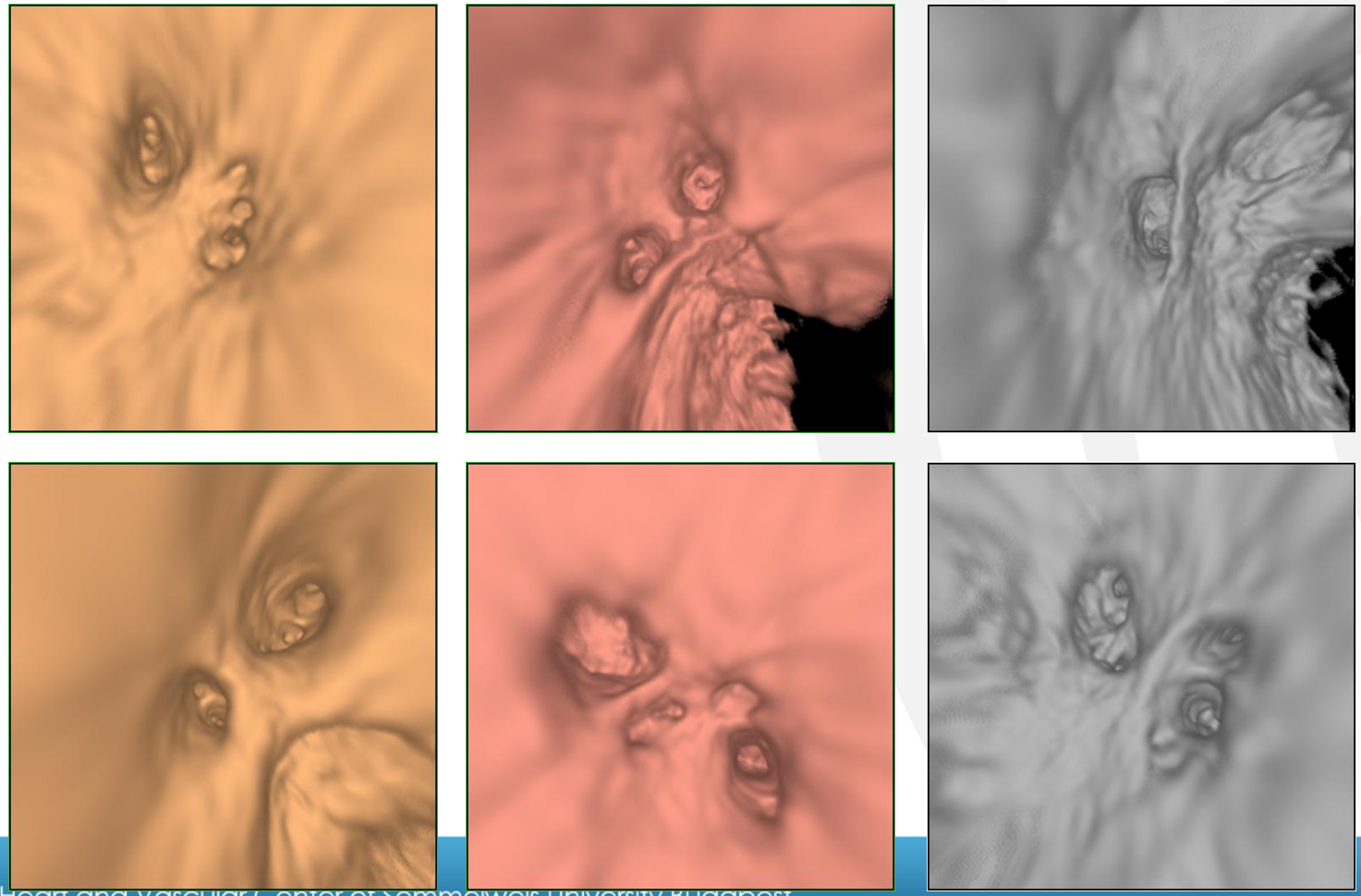
Non-Hodgkin lymphoma

Pulmonary vein isolation



Virtual endoscopic images



Thank you for your attention!