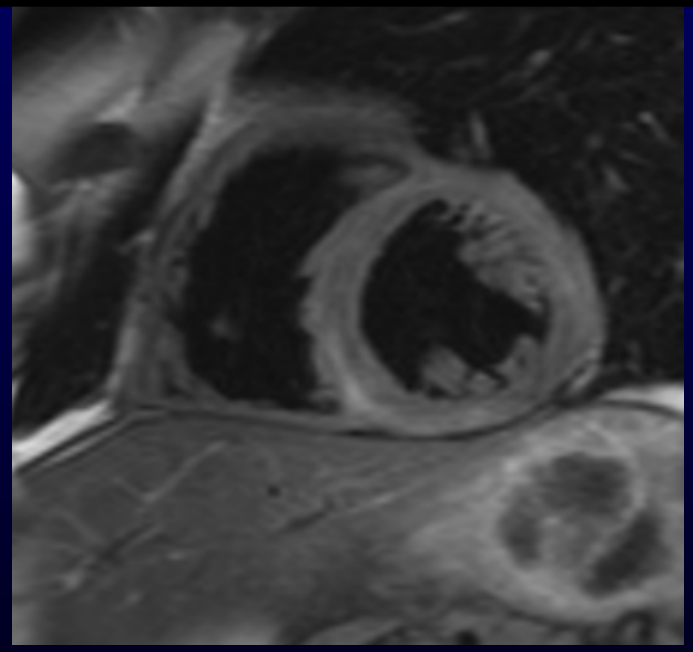
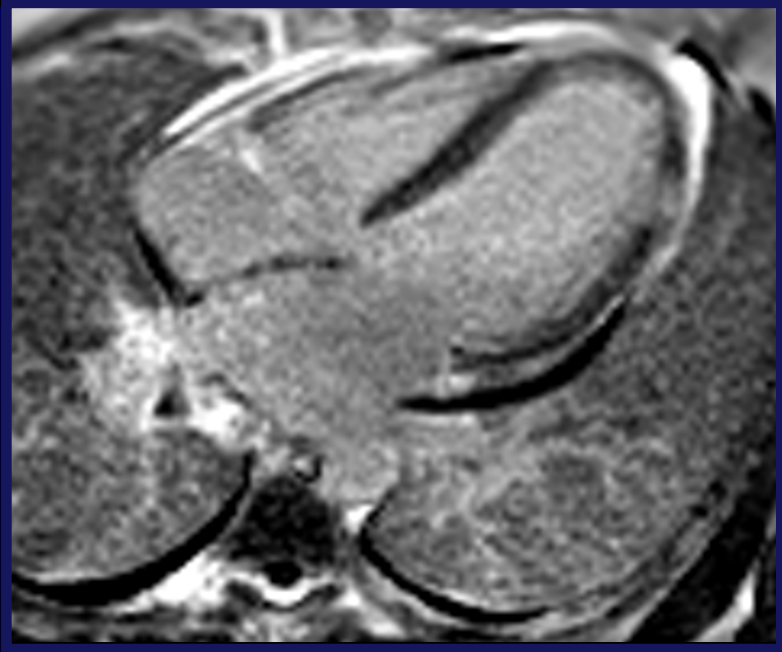
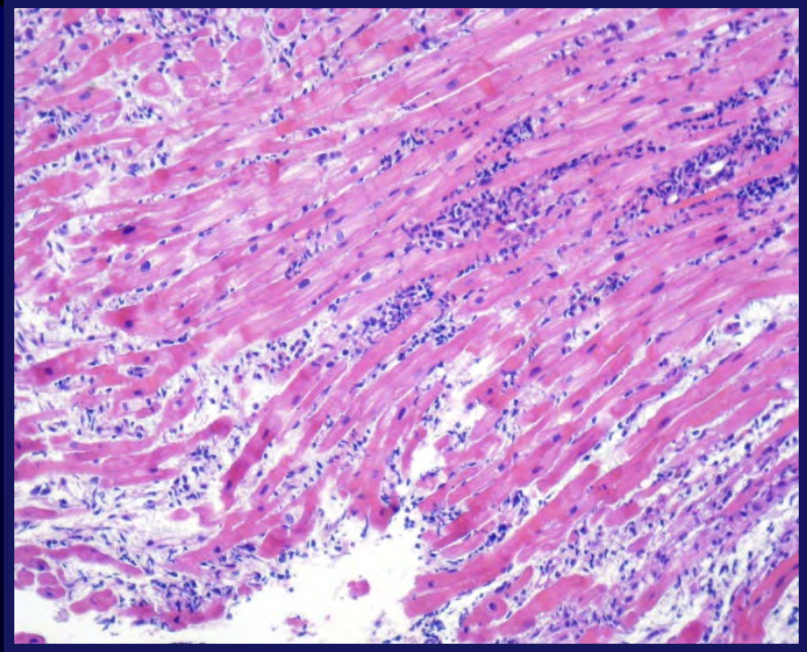
Prof. Ružica Maksimović

Dijagnostička vrednost magnetne rezonance srca kod miokarditisa

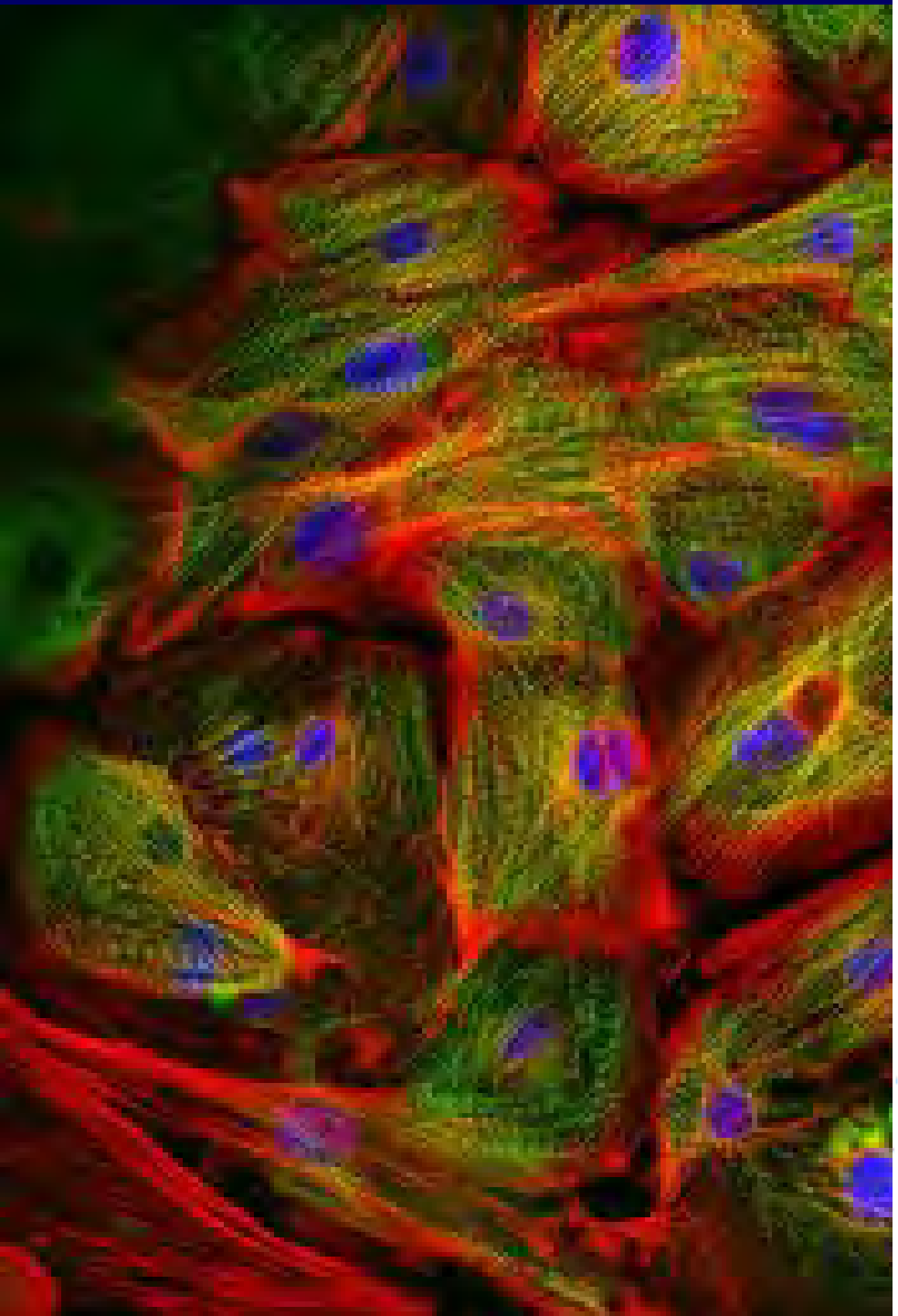


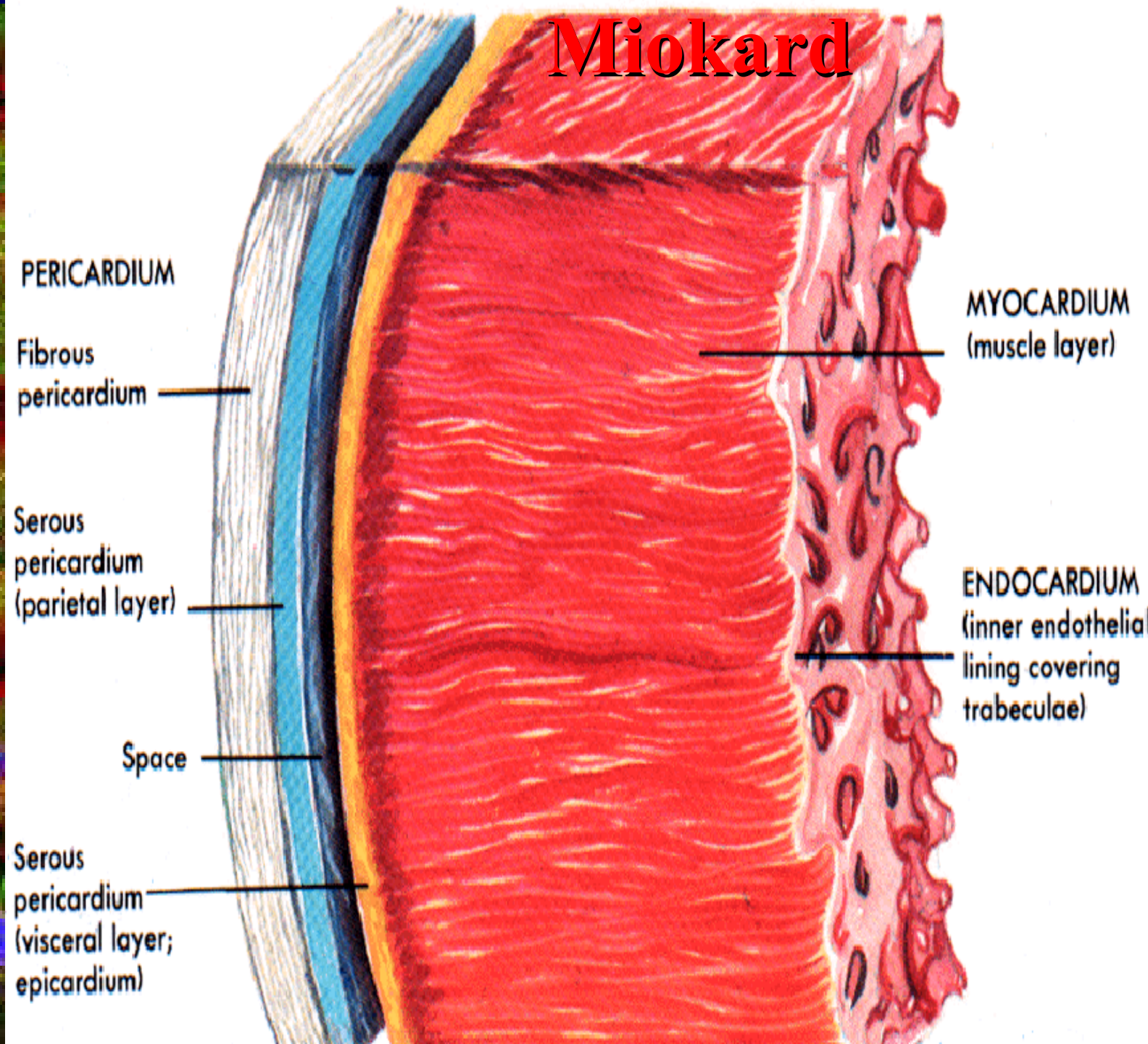




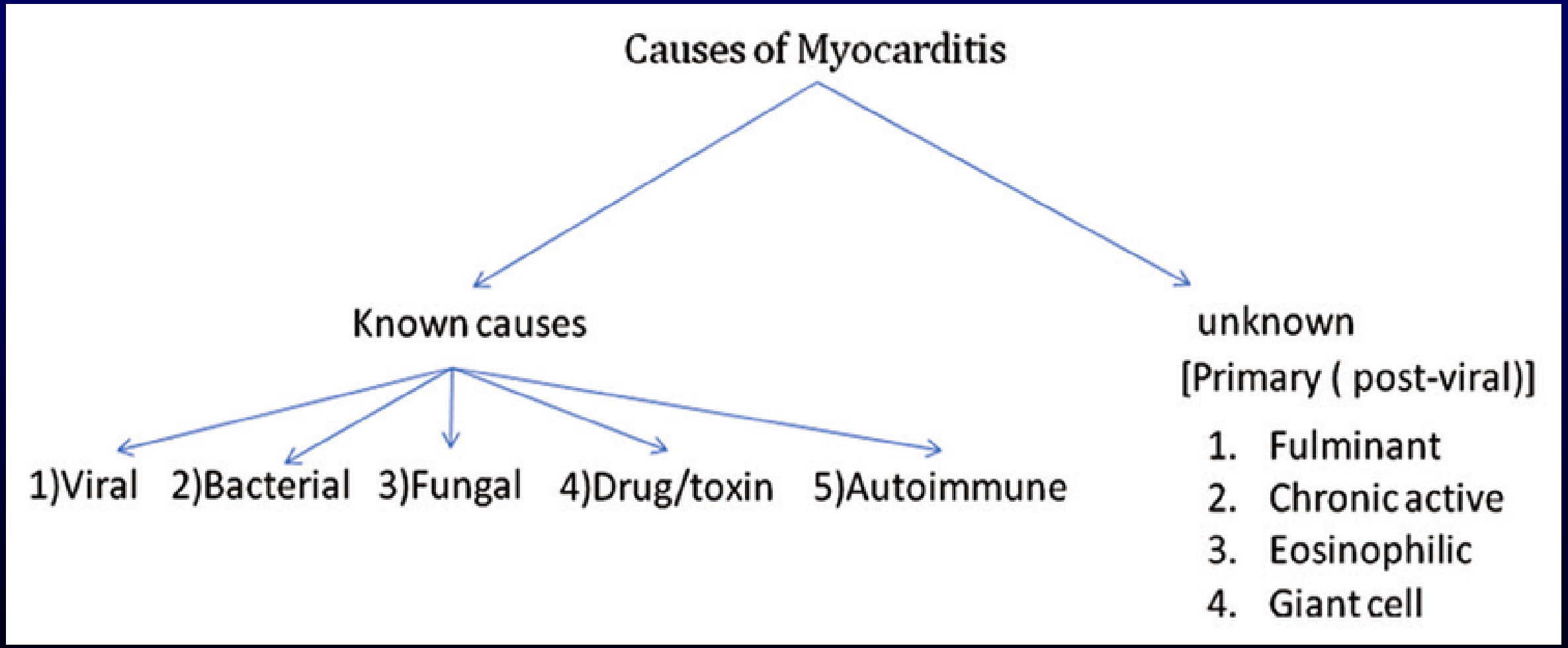
Medicinski fakultet, Univerzitet u Beogradu
Centar za radiologiju, Univerzitetski Klinički centar Srbije, Beograd

Miokard




PERICARDIUM
Fibrous pericardium
Serous pericardium (parietal layer)
Space
Serous pericardium (visceral layer; epicardium)
MYOCARDIUM (muscle layer)
ENDOCARDIUM (inner endothelial lining covering trabeculae)

Myocarditis

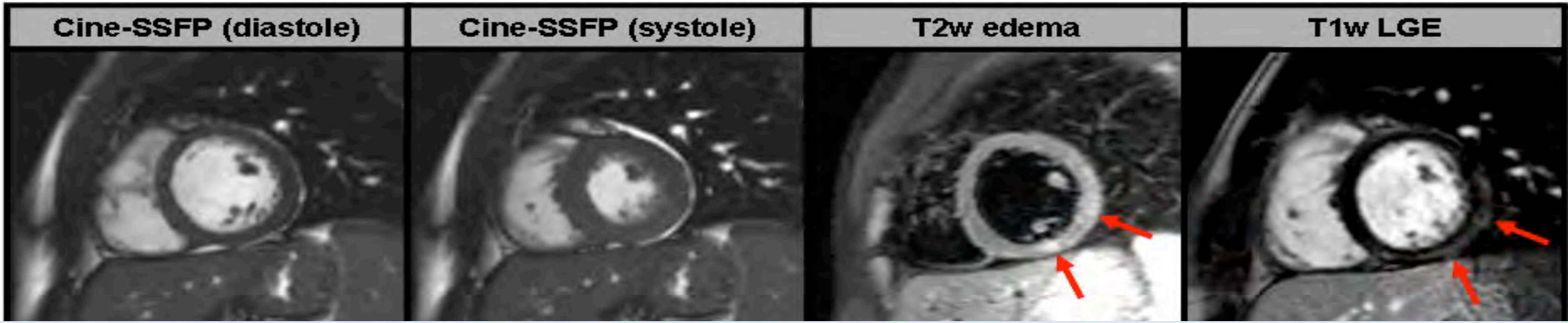


Arava S et al. J Practice of Cardiovascular Sciences, 2015:161.

Dg & Treatment of Myocarditis: ESC Consensus 2013

Diagnostic Criteria for Suspected Myocarditis

Caforio, Pankuweit et al. Eur Heart J 2013



In the setting of clinically suspected myocarditis (*Tables 3–4*), CMR findings are consistent with myocardial inflammation, if at least two of the following criteria are present:

≥2 criteria

(1) Regional or global myocardial signal intensity increase in T2-weighted oedema images[a]
(2) Increased global myocardial early gadolinium enhancement ratio between myocardium and skeletal muscle in gadolinium-enhanced T1-weighted images[b]
(3) There is at least one focal lesion with non-ischaemic regional distribution in inversion recovery-prepared gadolinium-enhanced T1-weighted images (late gadolinium enhancement)[c]

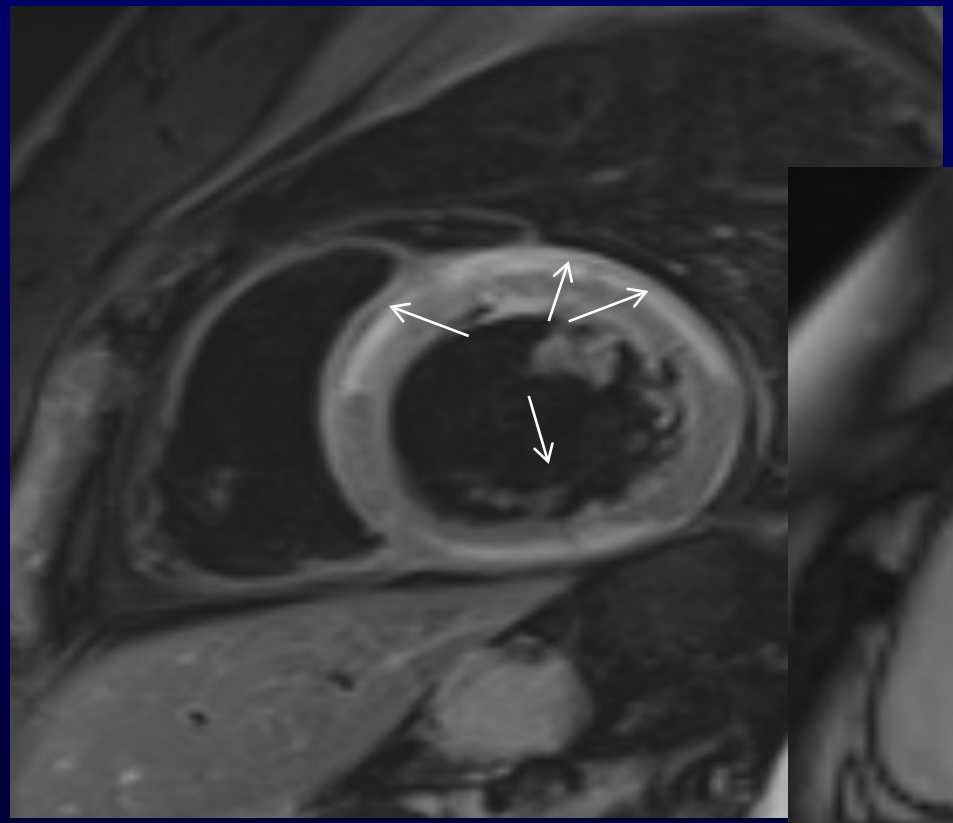
A CMR study is consistent with myocyte injury and/or scar caused by myocardial inflammation if Criterion 3 is present

A repeat CMR study between 1 and 2 weeks after the initial CMR study is recommended if

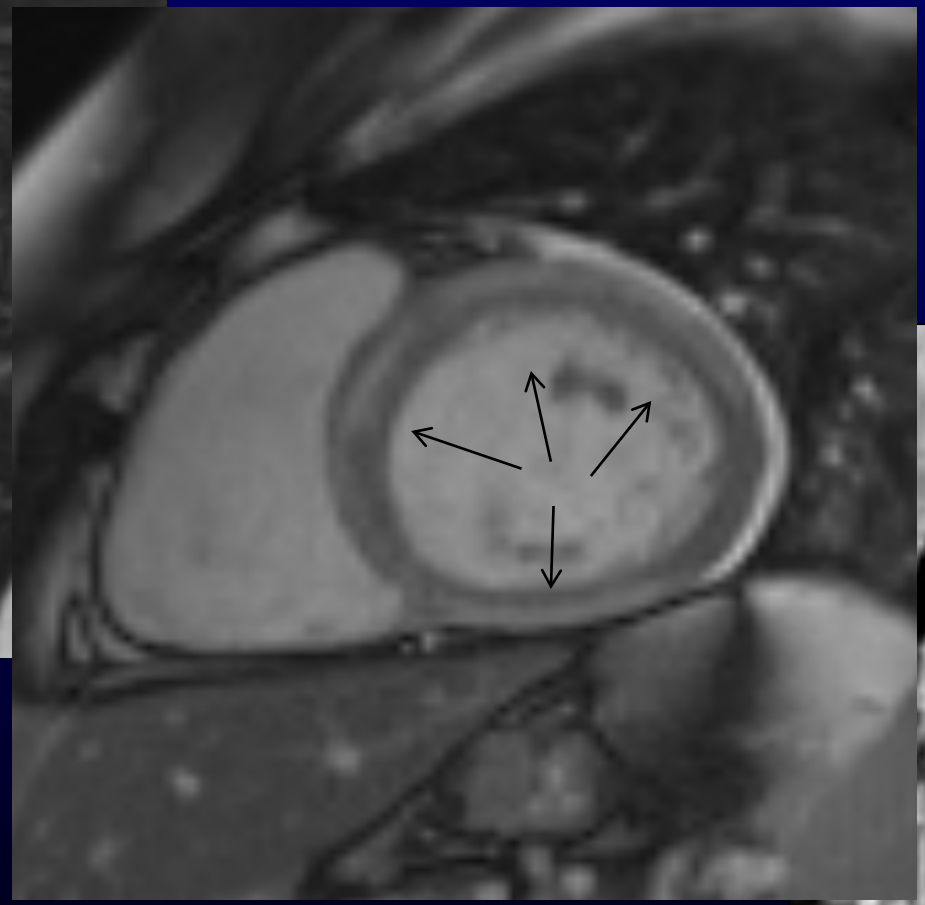
- None of the criteria are present, but the onset of symptoms has been very recent and there is strong clinical evidence for myocardial inflammation
- One of the criteria is present

The presence of LV dysfunction or pericardial effusion provides additional, supportive evidence for myocarditis

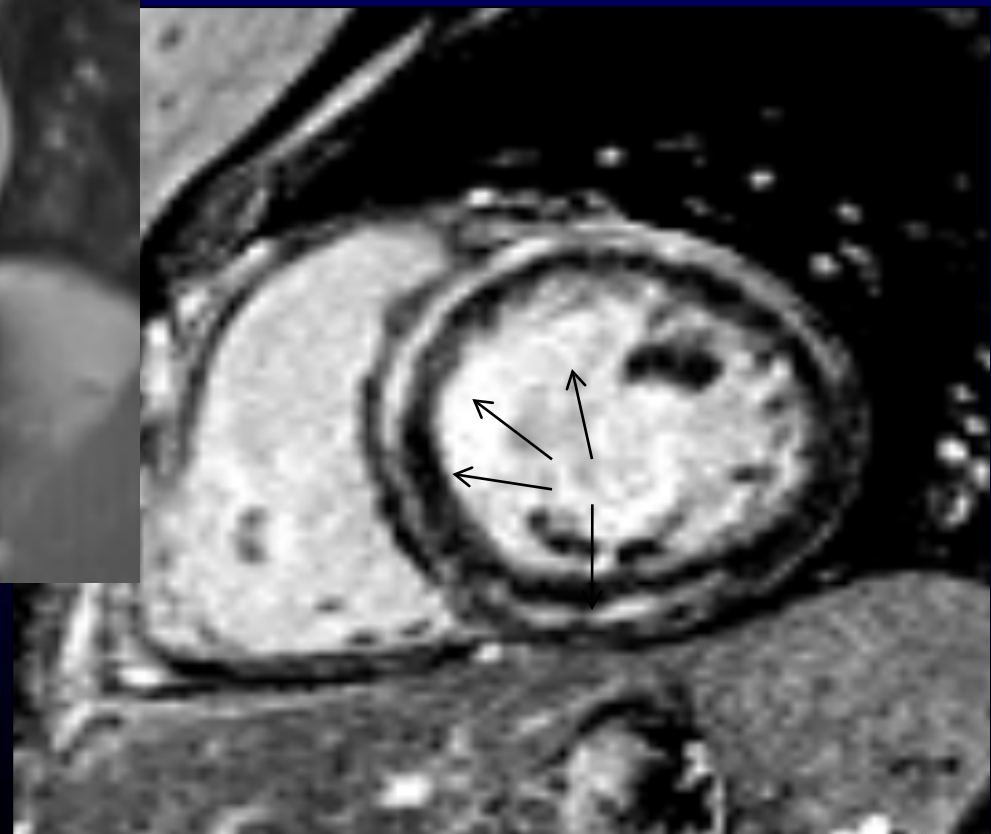
T2w FS (edem)



EGE (hiperemija)



LGE (fibroza)



Miokarditis – 2 od 3 kriterijuma su pozitivna

TABLE 1 Diagnostic Tests and Potential Findings in Patients With Acute Myocarditis*

ECG, Holter, or stress test
AV block I-III, bundle branch block, sinus arrest
Extrasystoles
Supraventricular tachycardia, atrial fibrillation
Ventricular tachycardia, ventricular fibrillation, asystole
ST-segment and T-wave changes (ST-segment elevation, T-wave inversion)
Intraventricular conduction delay
New Q waves
Low voltage
Seromarkers for myocardial necrosis
Troponin elevation
Creatine kinase elevation
Cardiac imaging
Echocardiography/angiography
Regional or global systolic or diastolic dysfunction, with or without LV dilatation
Increased wall thickness
Pericardial effusion
Intracavitary thrombi
CMR
Edema
Hyperemia or capillary leak (early gadolinium enhancement)
Irreversible injury (necrosis, scar; late gadolinium enhancement)
Regional or global systolic or diastolic dysfunction, with or without LV dilatation
Increased wall thickness
Pericardial effusion
Intracavitary thrombi

*Clinically suspected myocarditis if ≥1 clinical presentation and ≥1 diagnostic criteria from different categories, in the absence of: 1) angiographically detectable coronary artery disease (coronary stenosis ≥50%); 2) known pre-existing cardiovascular disease or extracardiac causes that could explain the syndrome (e.g., valve disease, congenital heart disease, hyperthyroidism). Suspicion is higher with higher number of fulfilled criteria. If the patient is asymptomatic, ≥2 diagnostic criteria should be met. Modified with permission from Caforio et al. (12).

AV = atrioventricular; CMR = cardiovascular magnetic resonance; ECG = electrocardiogram; LV = left ventricular.

Ferreira V et al. JACC 2018;72:24:3159.

VOL. 72, NO. 24, 2018

esonance in

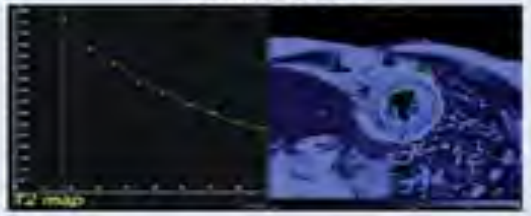
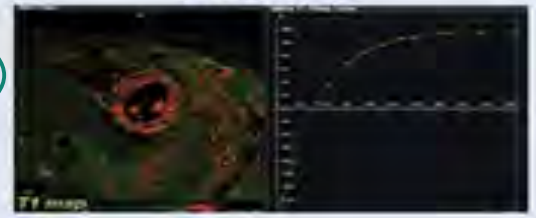
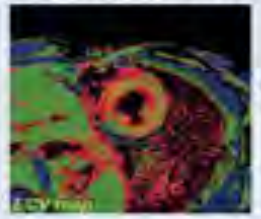
lammation

tfred Holmvang, MD,[c]

D,[f] Ingrid Kindermann, MD,[g]

hias G. Friedrich, MD[k,l,m]

Updated Lake Louise kriterijumi

2018 Lake Louise Criteria		CMR Image Examples			
Main Criteria	Myocardial Edema (T2-mapping or T2W images)	Regional or global increase of native T2		Regional or global increase of T2 signal intensity	
			or		
	Non-ischemic Myocardial Injury (Abnormal T1, ECV, or LGE)	Regional or global increase of native T1		Regional or global increase of ECV	Regional LGE signal increase
			or		or 
Supportive Criteria	Pericarditis (Effusion in cine images or abnormal LGE, T2, or T1)	Pericardial effusion		Regional or global hypokinesis	
					
	Systolic LV Dysfunction (Regional or global wall motion abnormality)				

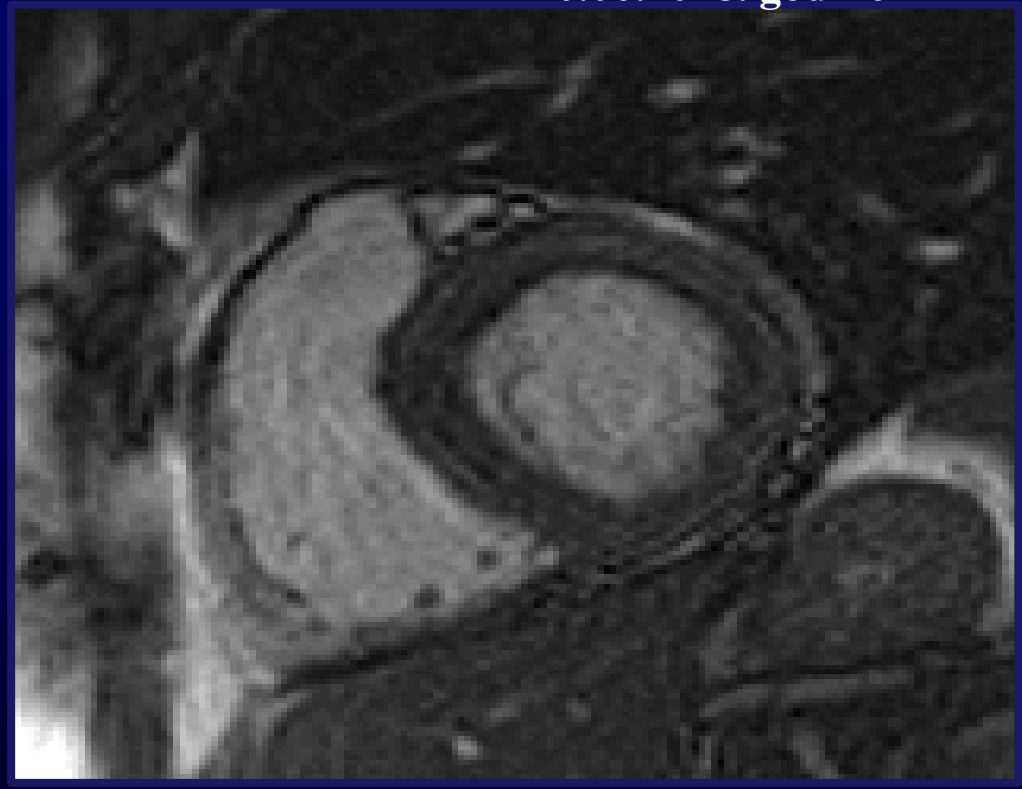
Dijagnostička tačnost 95%

Ferreira, V.M. et al. J Am Coll Cardiol. 2018;72(24):3158-76.

Case Presentation – Biopsy Positive Myocarditis

MRI

20.06.2018. godine

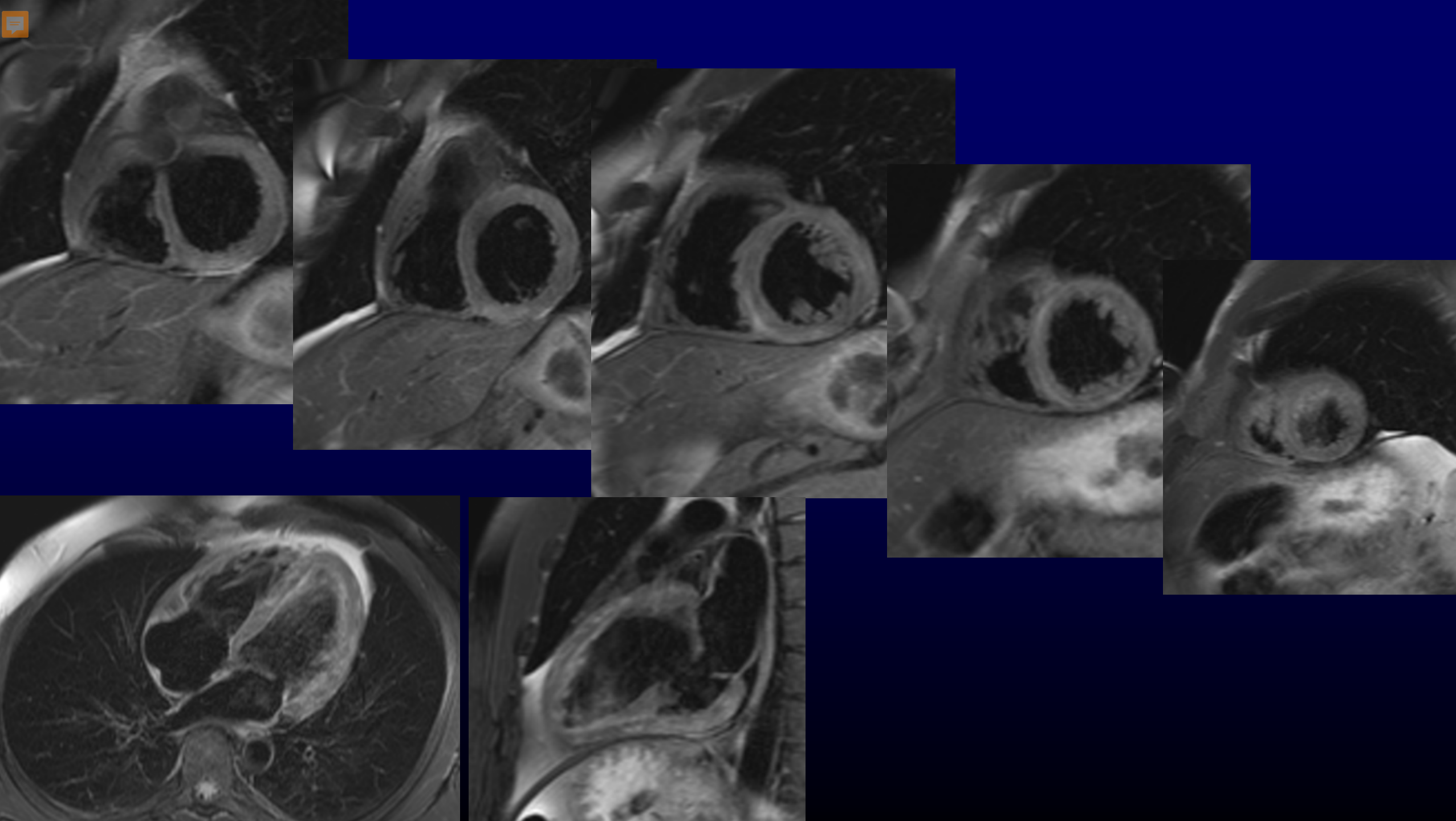


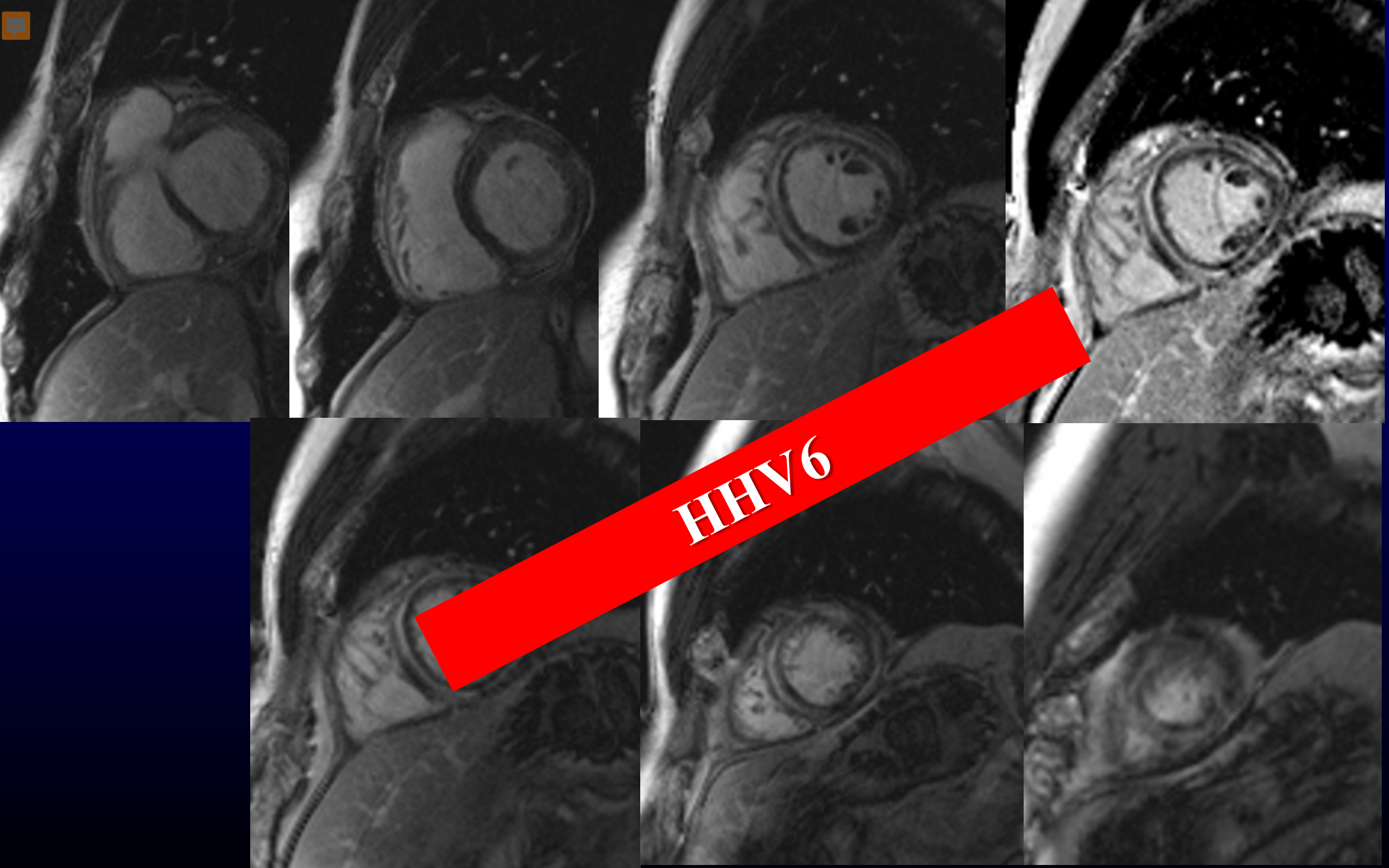
LV EDD	57 mm
LV ESD	36 mm
IVS	10 mm
PW	10 mm

EF 62%, EDV 159 mm, ESV 64 ml

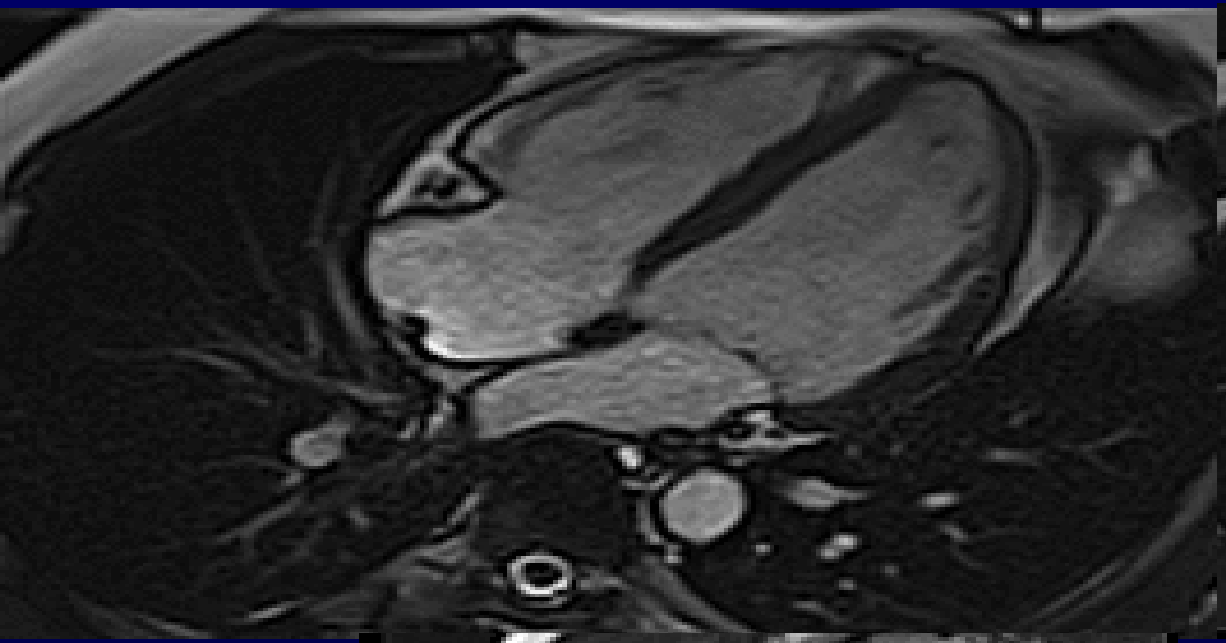
RV EDD 24 mm

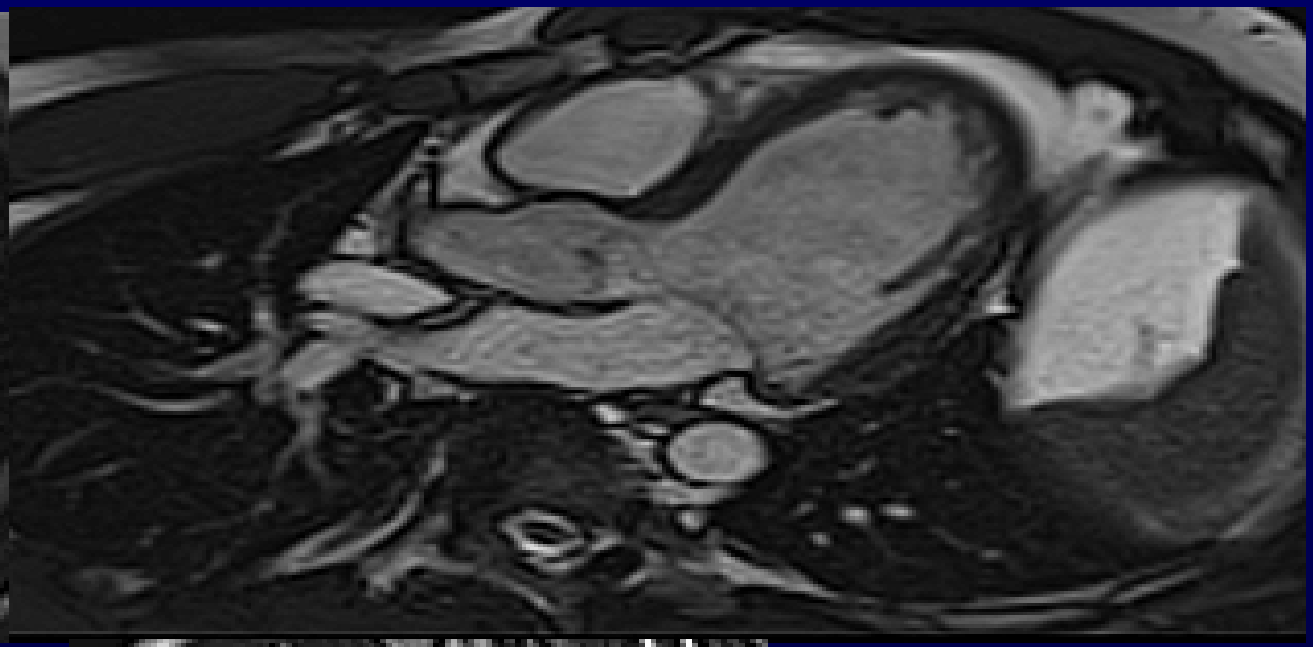
EF 58%, EDV 149 mm, ESV 63 ml

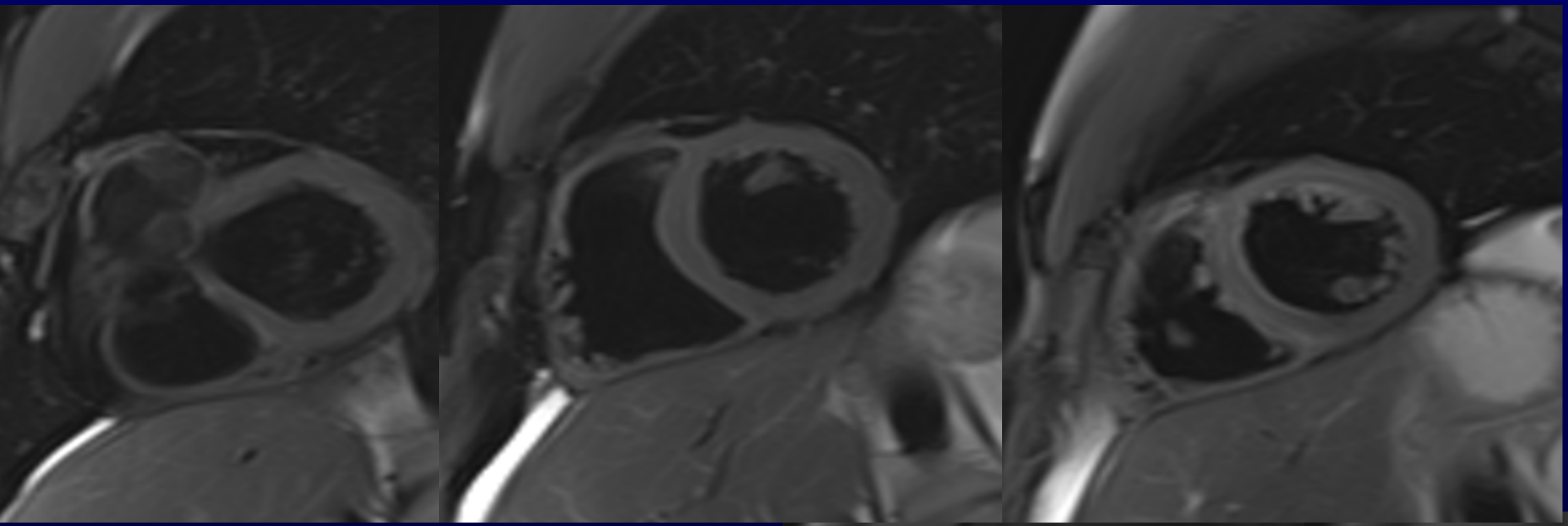


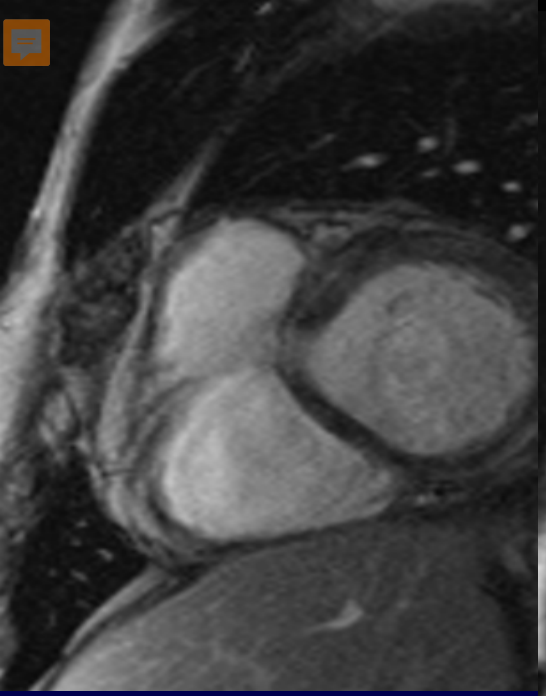
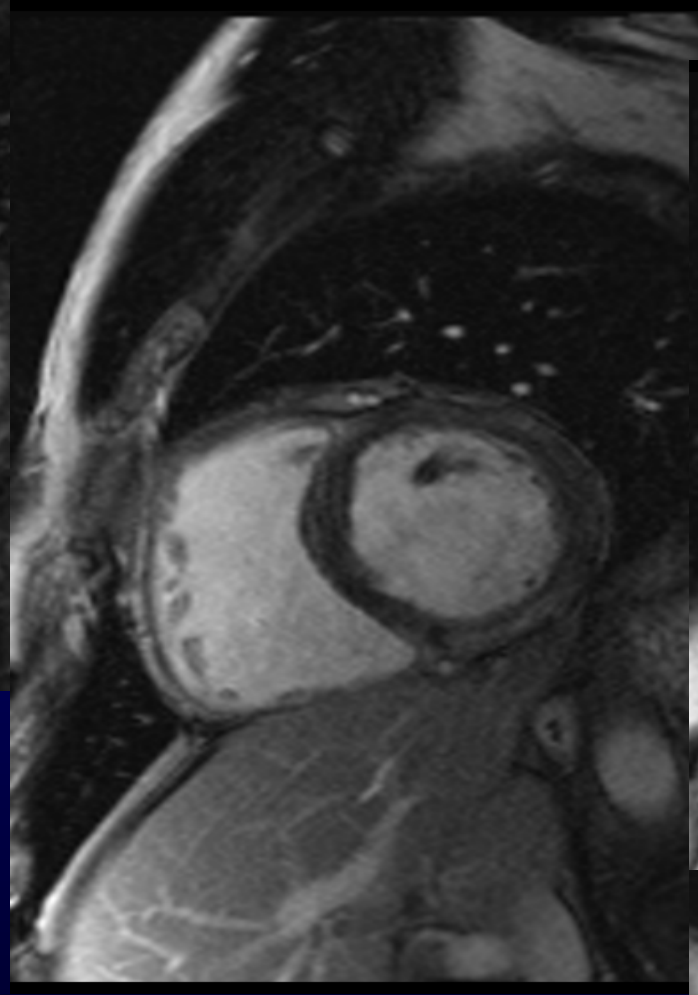
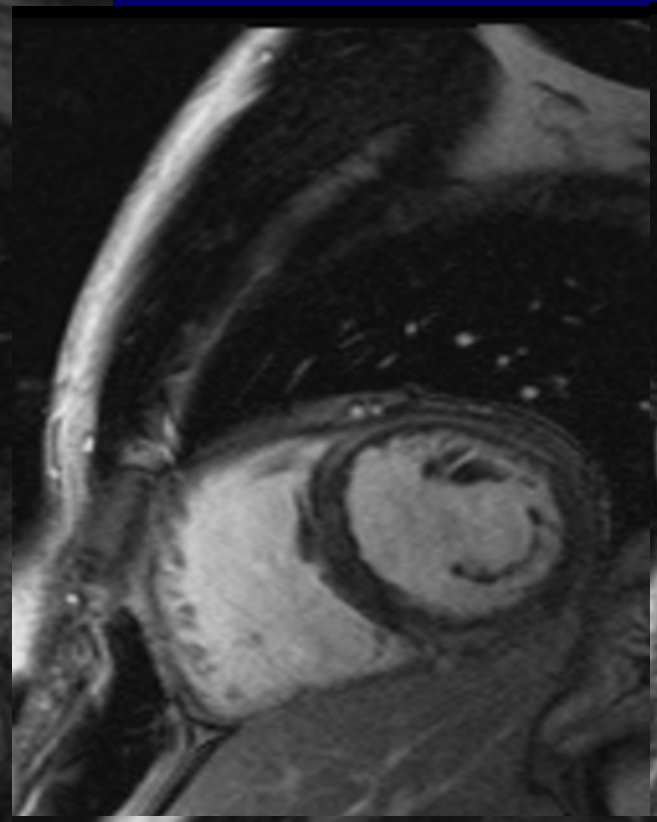
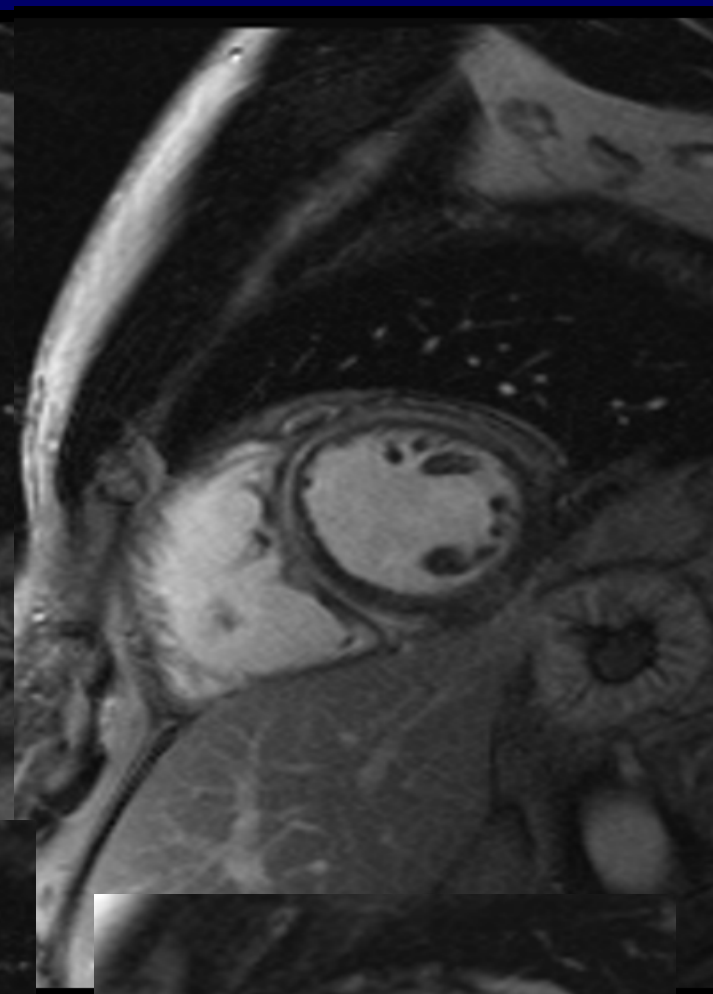
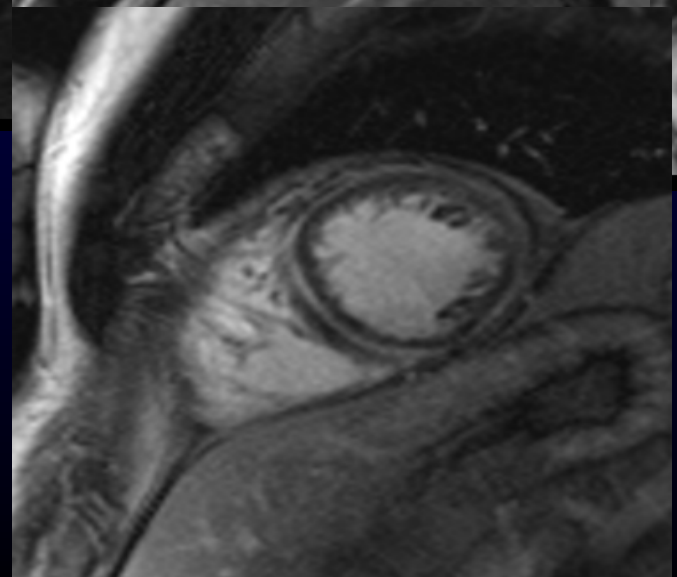
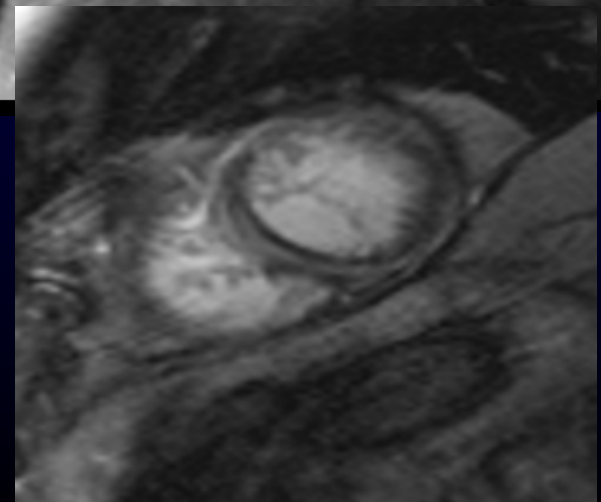

HHV6

19.09.2018. godine







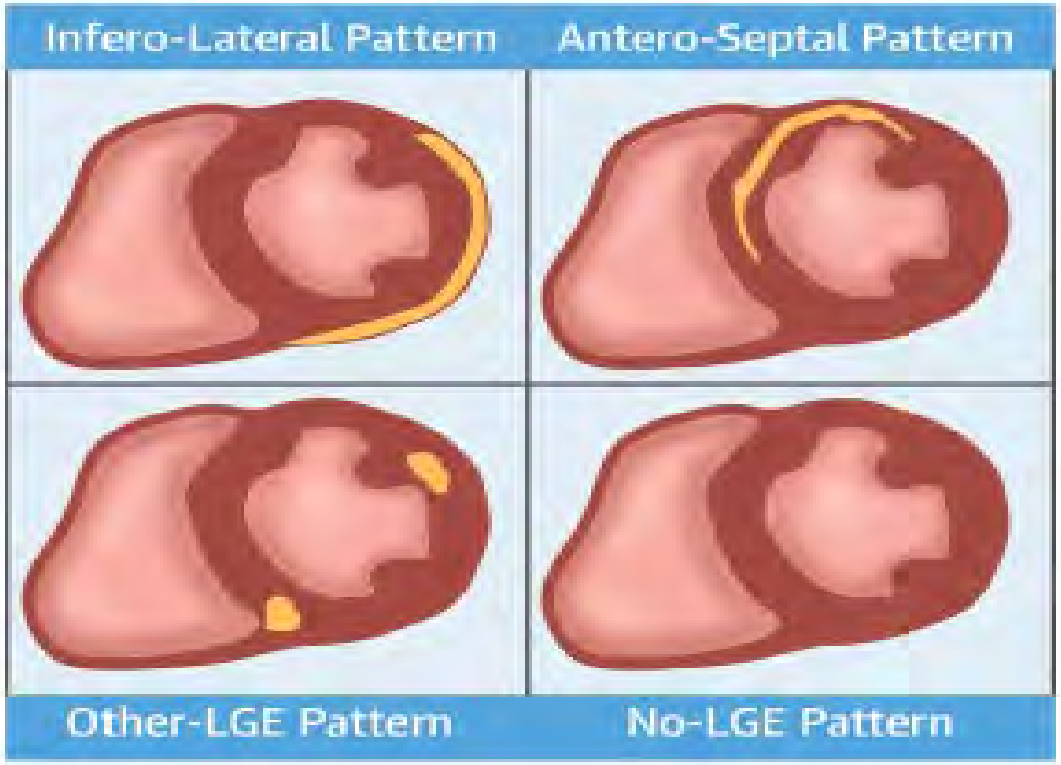








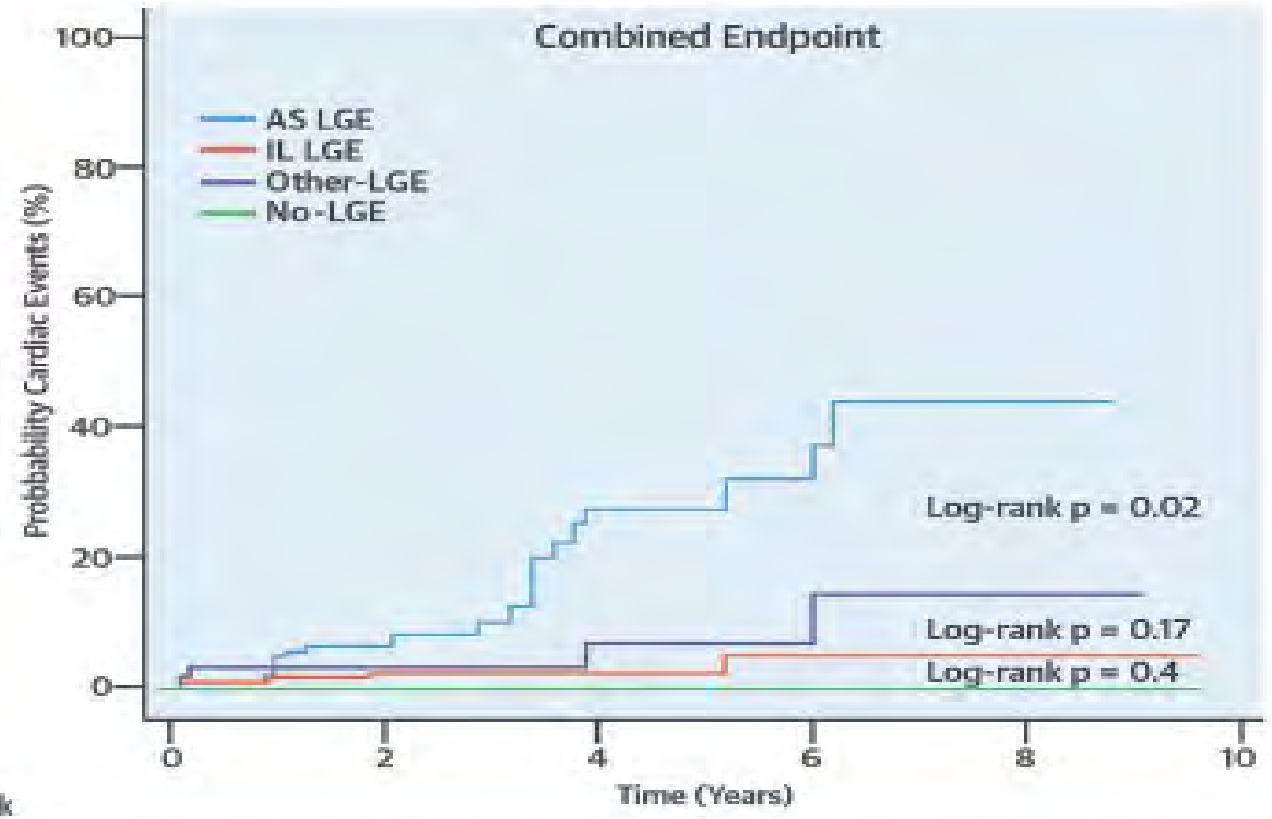
Prognostic Role of Different LGE Patterns in Patients with AM and Preserved EF

Aguaro GD, JACC 2017;70(16):1977.

ITAMY – Italian Multicenter Study on Acute Myocarditis

N – 386 pts

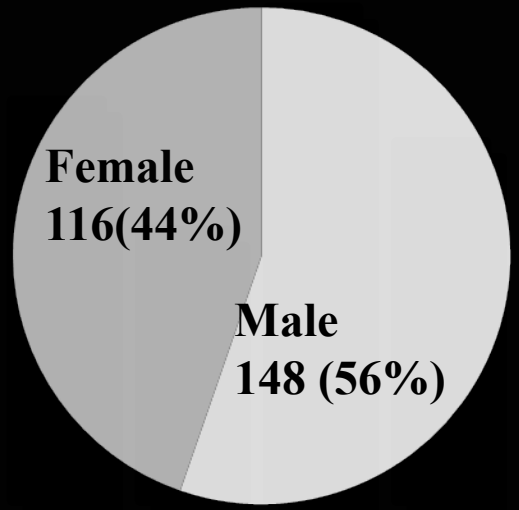




At Risk						
AS LGE	135	60	27	11	1	0
IL LGE	154	92	52	21	6	0
Other-LGE	59	44	24	11	6	0
No-LGE	26	19	7	1	1	0

Study Group

N=264 patients
Age= 42,5±15,5 (18-84 years)



Period from detection of COVID 19 to CMR	103,8±63,4 (15-303 days)
Period from cardiac symptoms to CMR	63,1±62,92 (0-296 days)

General Information

Smoking	(7,1%)
Diabetes Mellitus	(2,1%)
Hospitalisation	(35%)
Oxygen therapy	(29,6%)

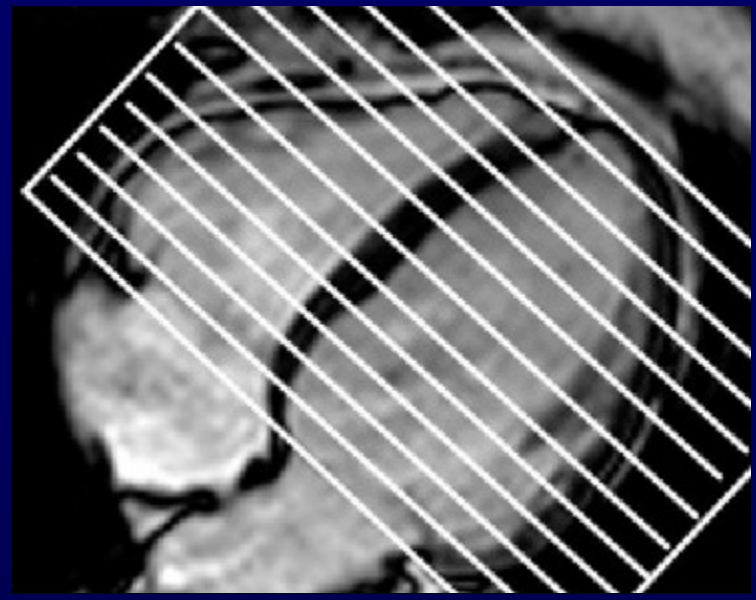
Symptoms

Headache	(33,8%)
Chest Pain	(26,7%)
Palpitation	(22,6%)
GIT symptoms	(45,1%)
Fatigue	(61,9%)
Shortness of breath	(50,7%)
Loss of taste and smell	(26,7%)
Pneumonia	(66,2%)

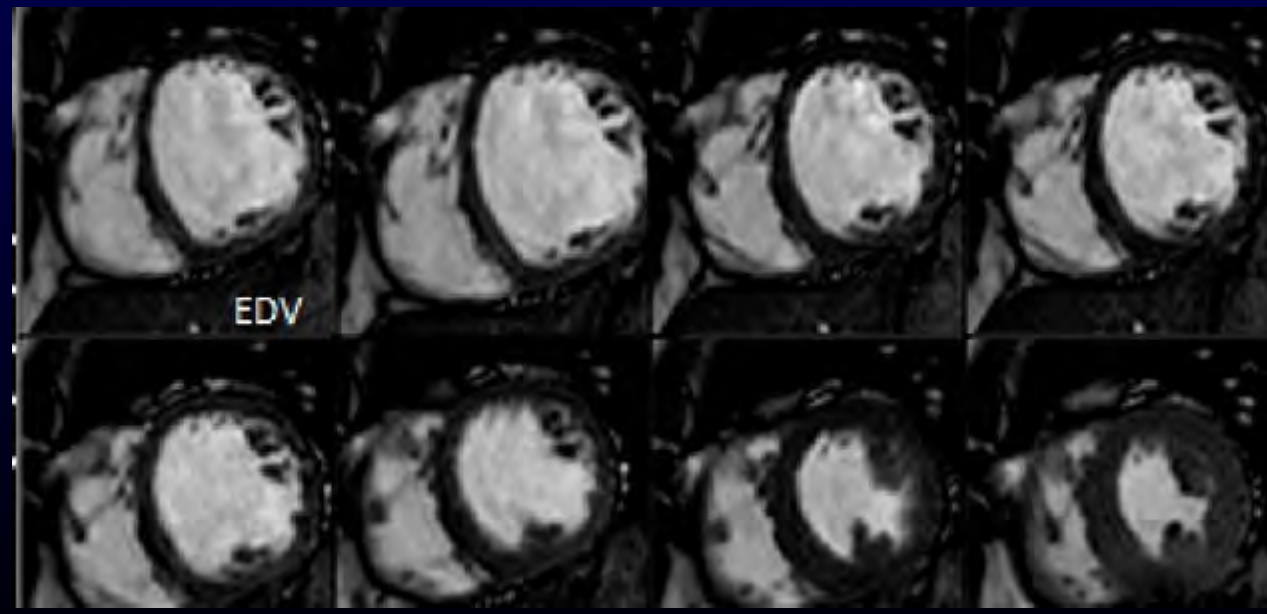
Cardiac Related Symptoms and Signs after COVID 19

Palpitation	(52,1%)
Fatigue	(64,8%)
Shortness of breath	(36,6%)
Chest pain	(38,1%)
Abnormal ECG	(66,2%)

Clinical Case



- JA, male, 1956
- COVID infection 09/ 2020
- Hospitalized
- Symptoms: tachycardia, paroxysmal atrial fibrillation, shortness of breath, cough, no high temperature
- Treatment: Concor, Farin
- No previous surgery, chronic diseases, allergy
- Ultrasound was normal



Patient ID	1210956710241		Examination Date	28.11.2021.
Patient Height	168 cm	Patient Weight 71 kg	Heart Rate	65 beats/min

Left Ventricle - Absolute

Cardiac Function			Normal Range(M) (MRI)	Unit
Ejection Fraction:	EF	55,17	56.00 – 78.00	%
End Diastolic Volume	EDV	155,86	77.00 - 195.00	ml
End Systolic Volume	ESV	69,88	19.00 - 72.00	ml
Stroke Volume	SV	85,98	51.00 - 133.00	ml
Cardiac Output:	CO	5,59	2.82 - 8.82	l/min
Myocardial Mass (at ED)		120,14	118.00 - 238.00	g
Myocardial Mass (Avg)		133,24	118.00 - 238.00	g

Patient ID	1210956710241		Examination Date	28.11.2021.
Patient Height	168 cm	Patient Weight 71 kg	Heart Rate	65 beats/min

Right Ventricle - Absolute

Cardiac Function			Normal Range(M) (MRI)	Unit
Ejection Fraction:	EF	62,71	47.00 - 74.00	%
End Diastolic Volume	EDV	132,53	88.00 - 227.00	ml
End Systolic Volume	ESV	49,42	23.00 - 103.00	ml
Stroke Volume	SV	83,11	52.00 - 138.00	ml
Cardiac Output:	CO	5,4	2.82 - 8.82	l/min
Myocardial Mass (at ED)		0	30.00 - 70.00	g
Myocardial Mass (Avg)		0	30.00 - 70.00	g

Filling and Ejection Data			
Peak Ejection Rate:	-306,15	n.a.	ml/s
Peak Ejection Time	58,58	n.a.	ms
Peak Filling Rate	258,96	n.a.	ml/s
Peak Filling Time:	827,46	n.a.	ms

Patient ID	1210956710241		Examination Date	28.11.2021.
Patient Height	168 cm	Patient Weight 71 kg	Heart Rate	65 beats/min

Left Ventricle - Normalized

Cardiac Function			Normal Range(M) (MRI)	Unit
End Diastolic Volume	EDV	86,35	47.00 - 92.00	ml/m2
End Systolic Volume	ESV	38,71	12.75 - 30.00	ml/m2
Stroke Volume	SV	47,63	32.00 - 62.00	ml/m2
Cardiac Index	CI	3,1	1.74 - 4.20	l/min/m2
Myocardial Mass (at ED)		66,56	70.00 - 113.00	g/m2
Myocardial Mass (Avg)		73,82	70.00 - 113.00	g/m2

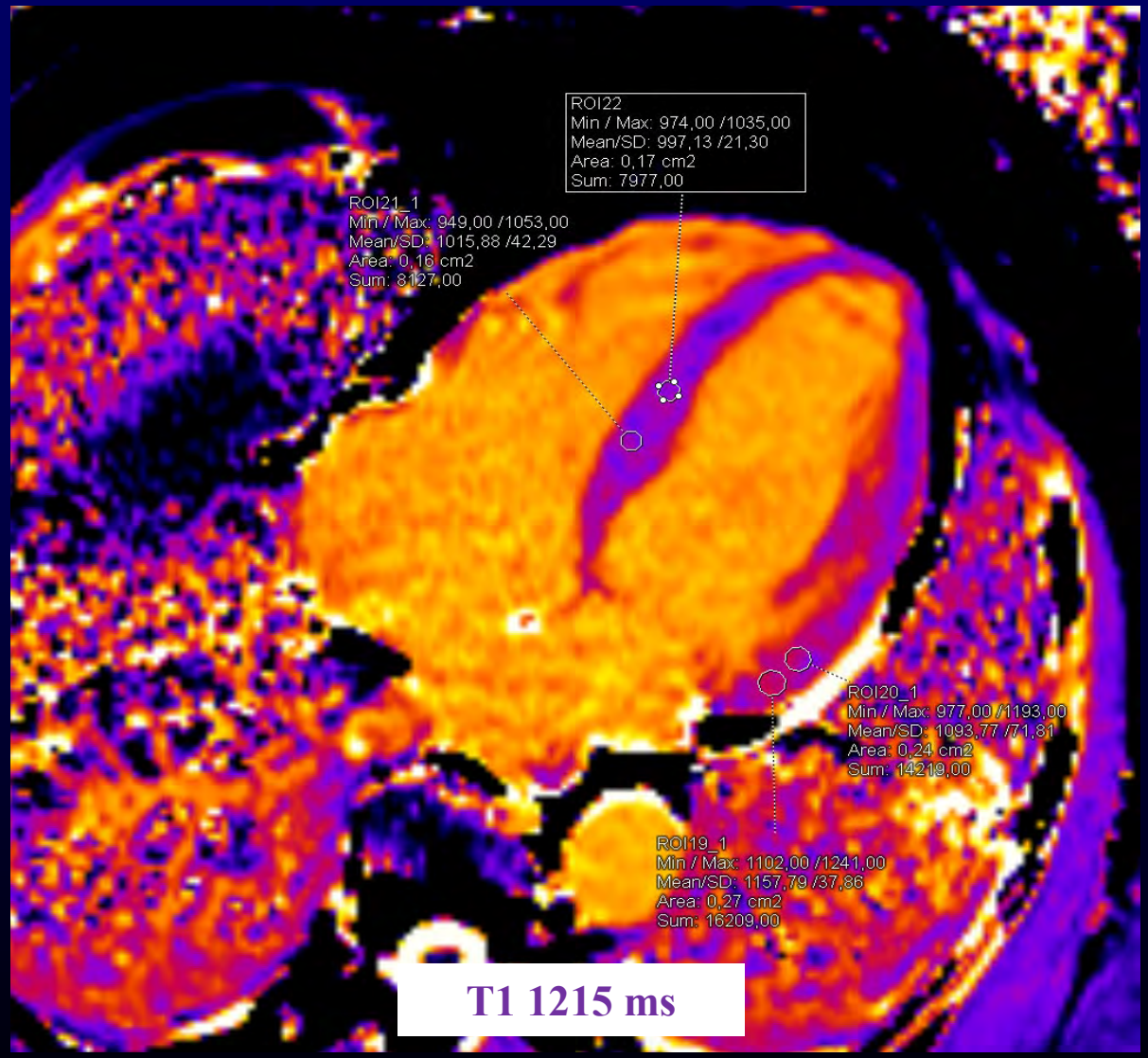
Patient ID	1210956710241		Examination Date	28.11.2021.
Patient Height	168 cm	Patient Weight 71 kg	Heart Rate	65 beats/min

Right Ventricle - Normalized

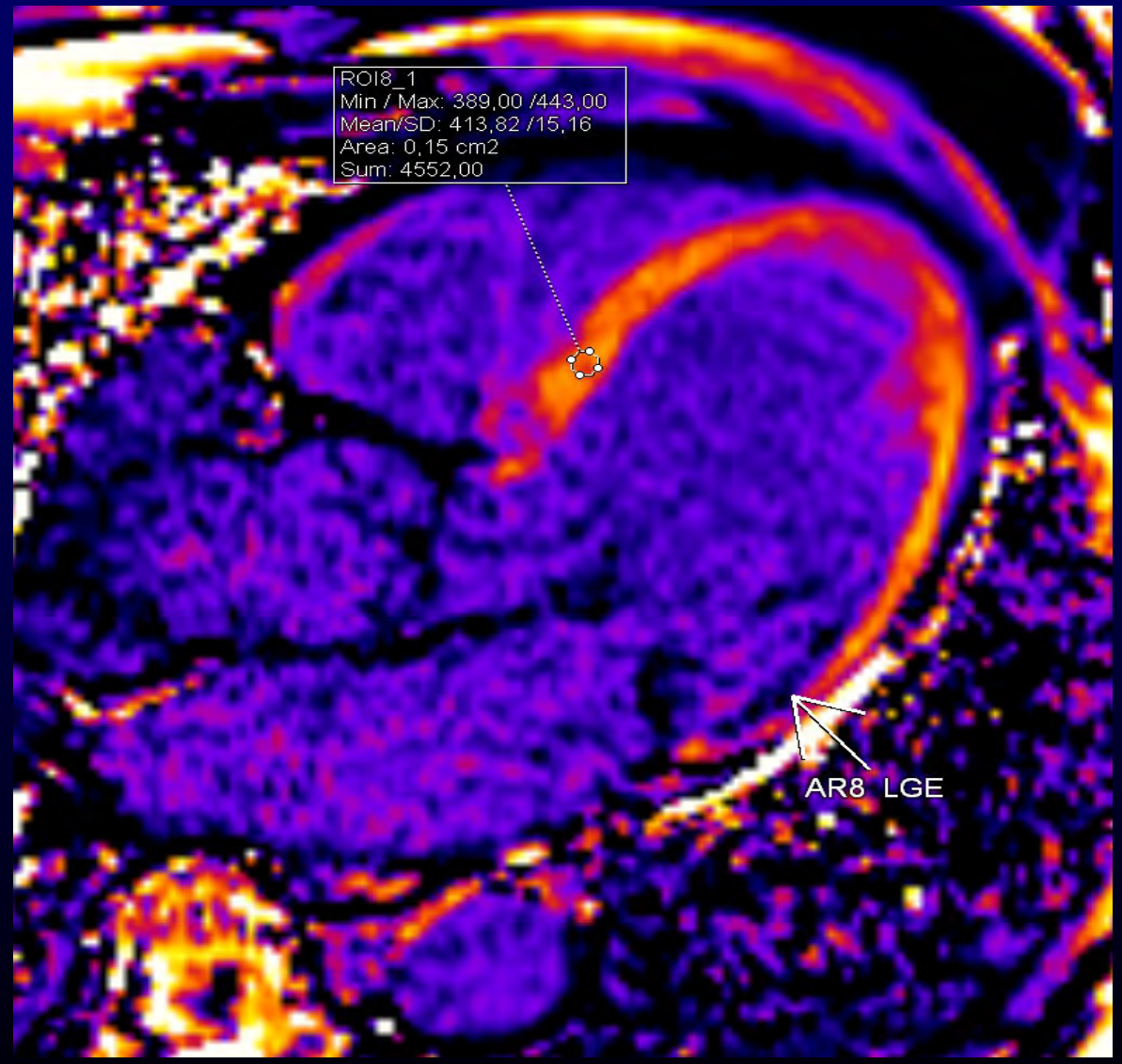
Cardiac Function			Normal Range(M) (MRI)	Unit
End Diastolic Volume	EDV	73,42	55.00 - 105.00	ml/m2
End Systolic Volume	ESV	27,38	15.43 - 42.91	ml/m2
Stroke Volume	SV	46,04	32.00 - 64.00	ml/m2
Cardiac Index	CI	2,99	1.74 - 4.20	l/min/m2
Myocardial Mass (at ED)		0	16.00 - 36.00	g/m2
Myocardial Mass (Avg)		0	16.00 - 36.00	g/m2

Filling and Ejection Data			
Peak Ejection Rate:	-169,61	n.a.	ml/s/m2
Peak Filling Rate	143,46	n.a.	ml/s/m2

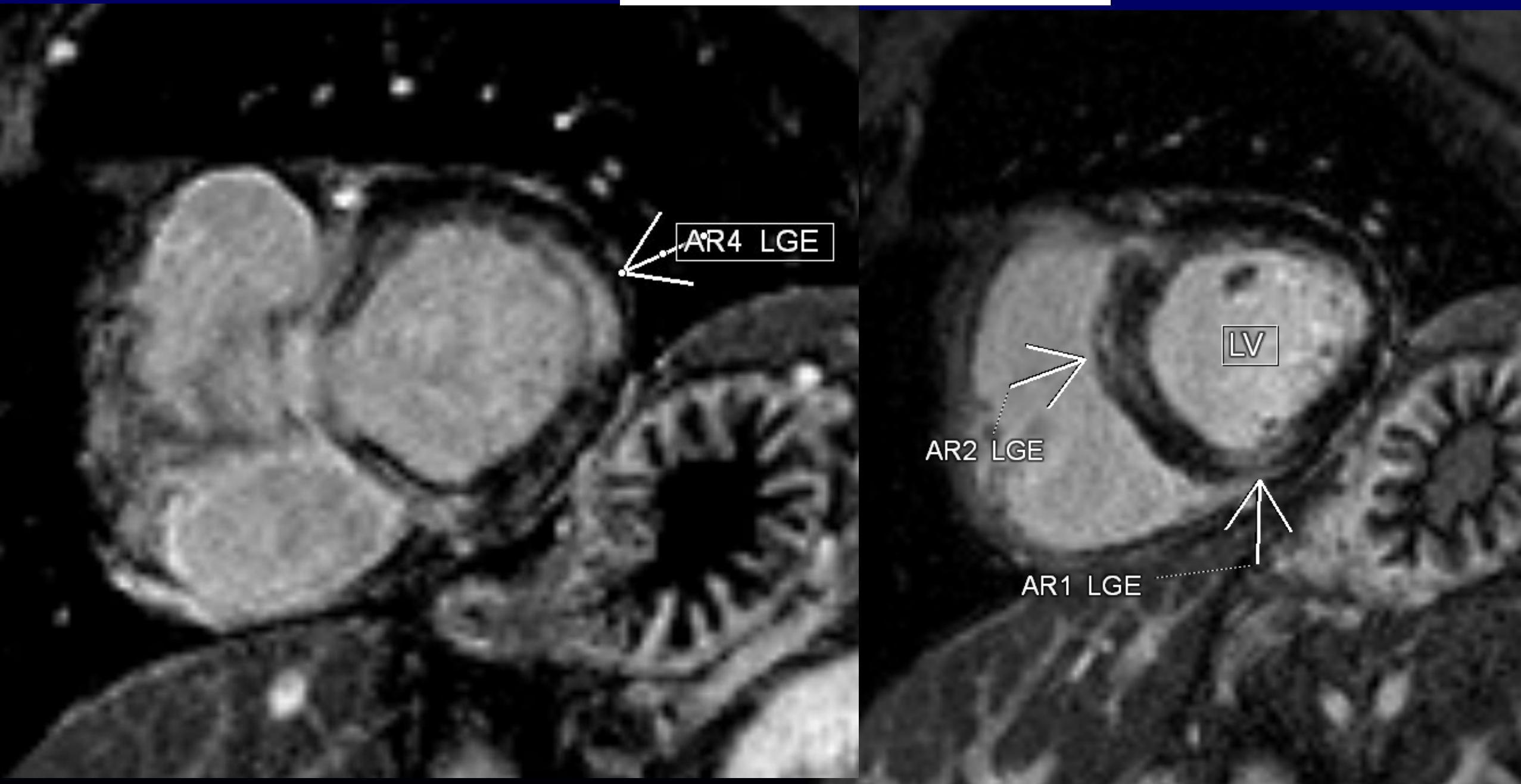
Native T1w



Postcontrast T1w



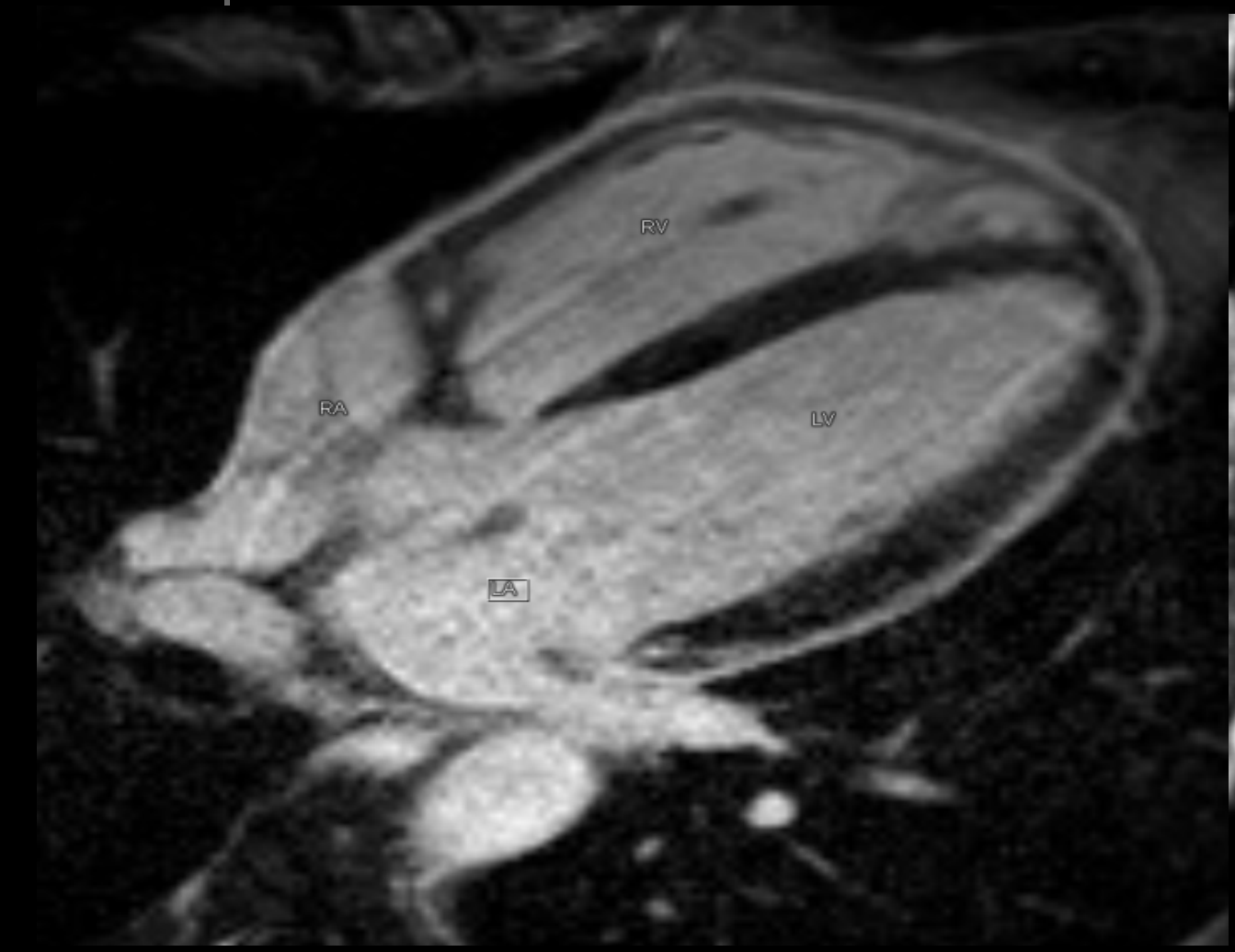
PSIR - LGE



PSIR - LGE

Perikard

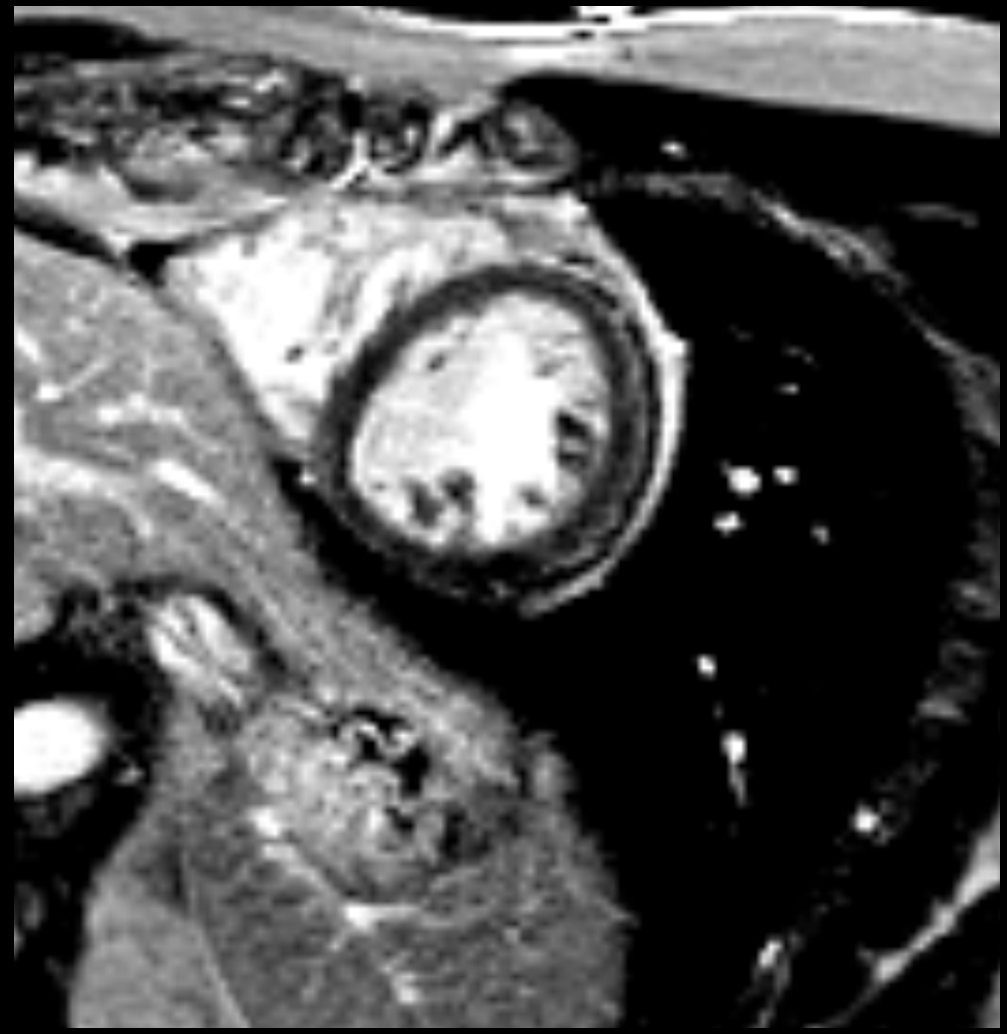
Grupa 1 – Nema perikarditis (N=129-49%)
Grupa 2 – Ima perikarditis (N=135-51%)



Poruke za poneti

- Dobra prostorna rezolucija
- Odlična reporducibilnost
- Nema štetnog zračenja

- Važna uloga u dijagnostici pacijenata sa suspektnim miokarditisom
- Uloga u izboru optimalnog terapijskog pristupa

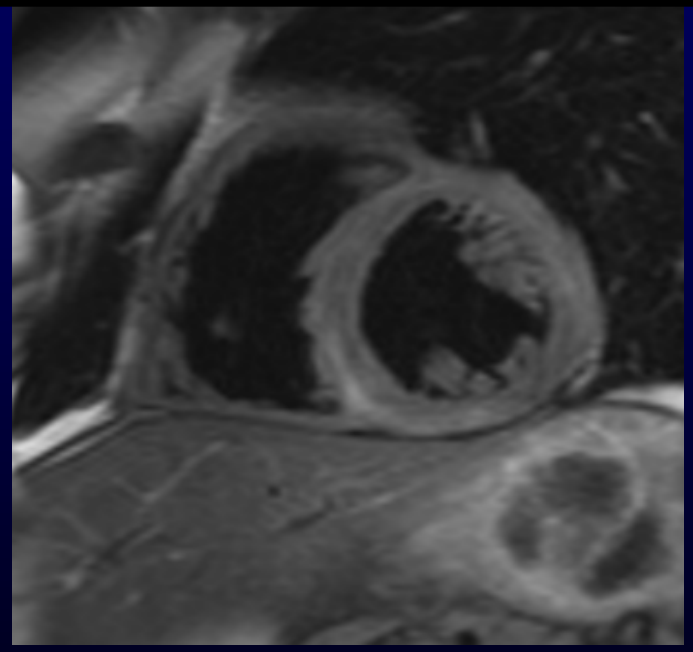


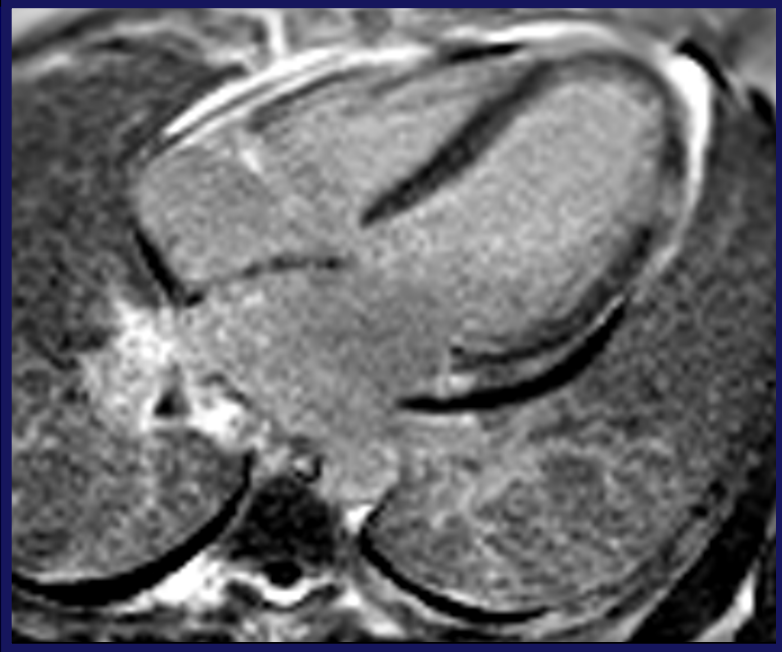
MR škola srca

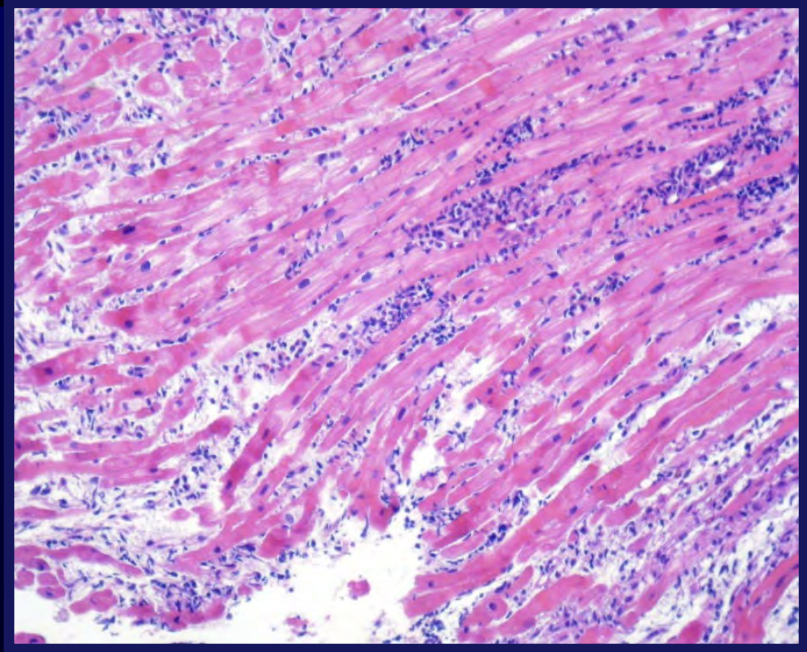
Beograd 2023

Prof. Ružica Maksimović

Dijagnostička vrednost magnetne rezonance srca kod miokarditisa







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Centar za radiologiju, Univerzitetski Klinički centar Srbije, Beograd