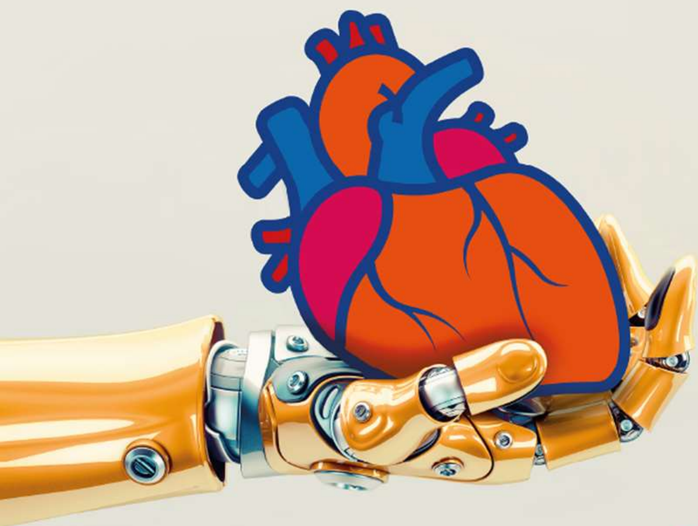

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Chrysanthos Grigoratos

Stato dell’arte della miocardite acuta

Fondazione Monasterio
la ricerca che cura

Infectious aetiologies

Viral agents
- Adenoviruses
- Enteroviruses (coxsackievirus)
- Herpesviruses (human herpesvirus 6, Epstein–Barr virus)
- Hepatitis C virus
- HIV
- Influenza A
- Parvovirus B19

Parasitic agents
- Larva migrans
- Schistosomiasis

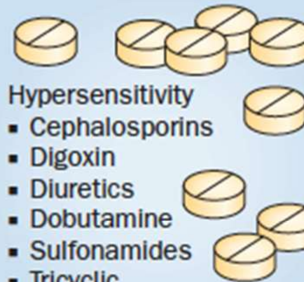
Bacterial agents
- *Borrelia* species
- *Mycobacterium* species
- *Mycoplasma pneumoniae*
- *Streptococcal* species
- *Treponema pallidum*

Fungal agents
- *Aspergillus* species
- *Candida* species
- *Coccidioides* species
- *Cryptococcus* species
- *Histoplasma* species

Protozoal agents
- *Trypanosoma cruzi* (Chagas disease)

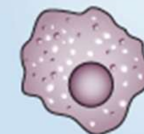
Noninfectious aetiologies

Toxins
- Anthracyclines
- Cocaine
- Interleukin-2



Hypersensitivity
- Cephalosporins
- Digoxin
- Diuretics
- Dobutamine
- Sulfonamides
- Tricyclic antidepressants

Immunological syndromes
- Churg–Strauss syndrome
- Diabetes mellitus
- Inflammatory bowel disease
- Giant cell myocarditis
- Granulomatosis with polyangiitis (Wegener granulomatosis)
- Sarcoidosis
- Systemic lupus erythematosus
- Takayasu arteritis
- Thyrotoxicosis



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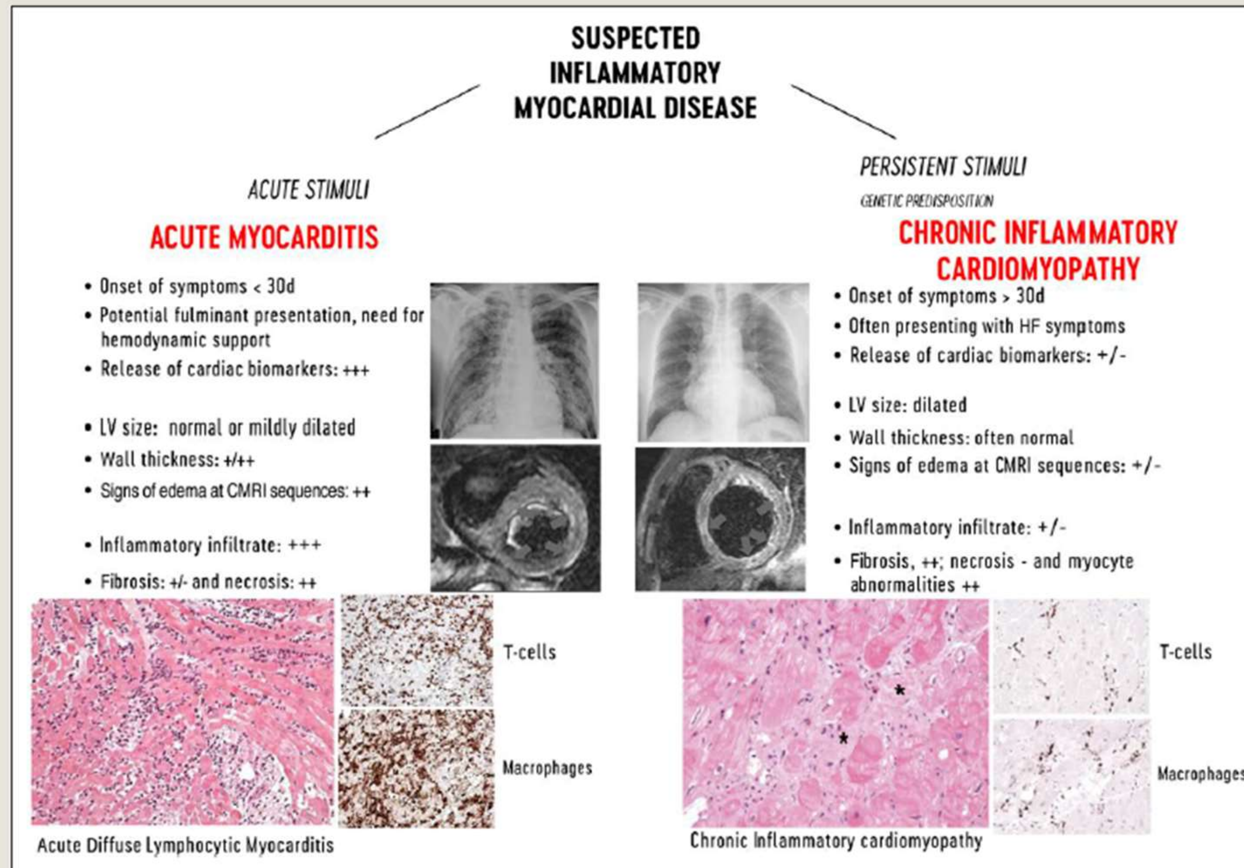

Ammirati E et al. Management of Acute Myocarditis and Chronic Inflammatory Cardiomyopathy. Circ HF 2020

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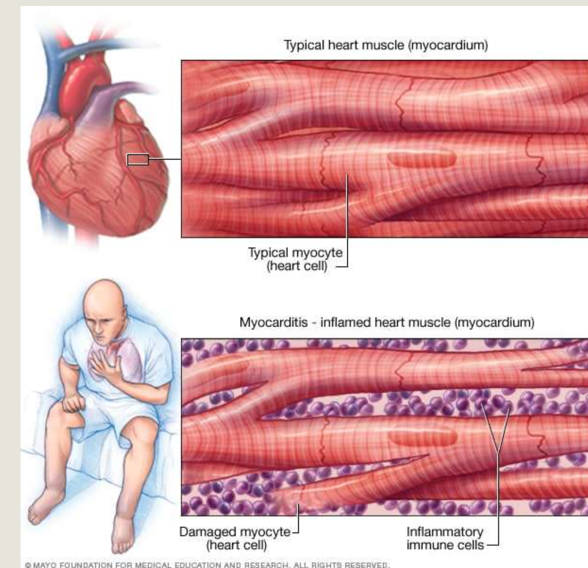
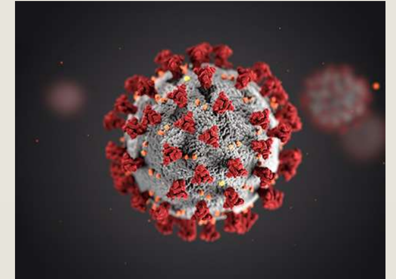
AM: presentation

- 30-45 yrs old males (60-80%);
- flu-like symptoms, respiratory tract symptoms, and gastrointestinal symptoms (18-80%);
- Chest pain (82%-95%), dyspnea (19-49%), fever (58-65%), syncope (5-7%)
- Cardiogenic shock (3-9%)
- Viral myocarditis (most common cause), autoimmune disorder (7%), ICI (1%)



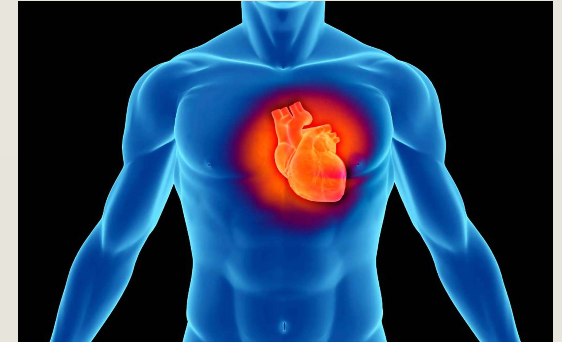


Myocarditis and COVID-19

- AM following COVID, 59 to 64 per 100K males/ 20 to 36 per 100K females
- AM post mRNA anti-COVID vaccine, 10.7 per 100K males
- (AM preCOVID 10 per 100K males)

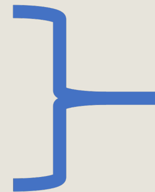
AM risk lower following vaccination compared with SARS-CoV-2 infection without vaccination

(incidence rate ratio, 5.97 [95% CI, 4.54-7.87] vs 11.14 [95% CI, 8.64-14.36])



Diagnosis

Symptoms
Clinical history
Troponins
ECG/echo abnormalities



Not enough

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Prognosis

AM mortality around 1% to 7%;

Uncomplicated AM's mortality approximately 0%

Complicated AM's mortality or need for HTx approximately 12% at 5 yrs f-up

COVID-19 and definite or probable AM -> 120-day mortality of 6.6%;

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Proposed risk-based approach to AM (what and to whom)

	ACUTE CLINICAL PRESENTATION				INITIAL MANAGEMENT				
	BP & AHF SYMPTOMS	LVEF REDUCTION	VT/VF or AVB		REFER TO HUB CENTERS	t-MCS	EMB	CMRI	STEROIDS*
	Cardiogenic shock (FM)	Severe (<30%)	PRESENT/ ABSENT	HIGH-RISK	✓	✓	✓	BEFORE discharge	CONSIDER
	AHF symptoms	Low (30-40%)	PRESENT	HIGH-RISK	✓	BE prepared	✓	BEFORE discharge	CONSIDER
	AHF symptoms	Low (30-40%)	ABSENT	INTERMEDIATE RISK	CONSIDER	Rarely needed	CONSIDER	✓	In specific cases
	Mild AHF symptoms	Moderate (41-49%)	PRESENT	INTERMEDIATE RISK					
	Absent	Mild -Normal (>50%)	ABSENT	LOW-RISK	NOT NEEDED	NOT NEEDED	⊘	✓	⊘

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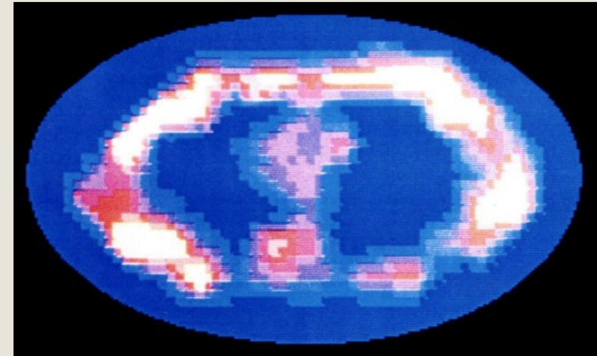
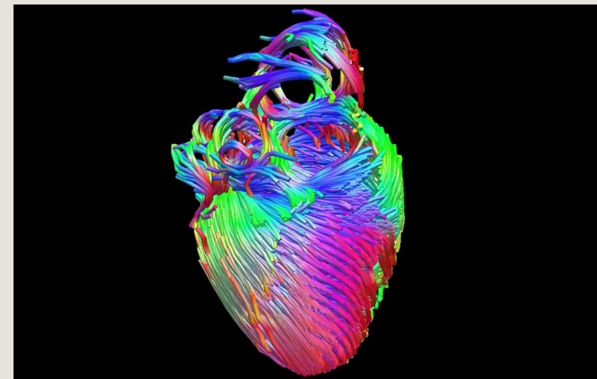
The indomitable, 1977

5 hours later…

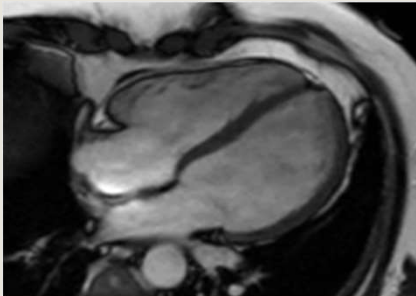


45 years later…

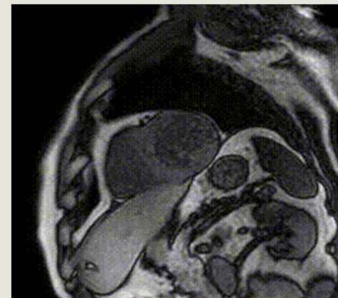


CMR strenghts: one stop-shop

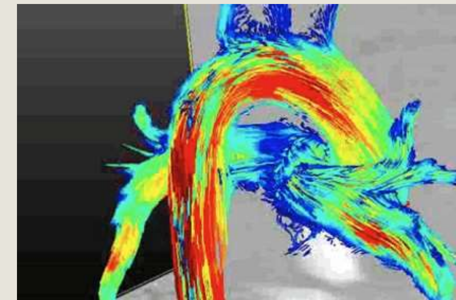
CINE



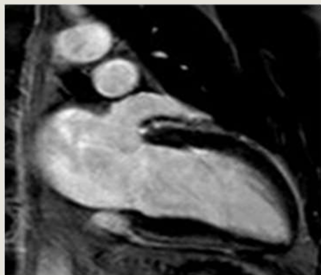
PERFUSION



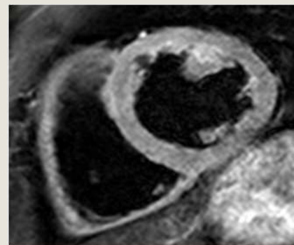
4D-FLOW

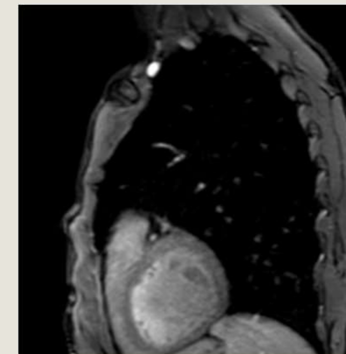


LGE



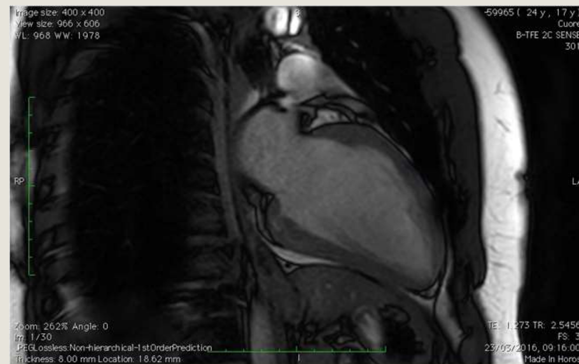
EDEMA

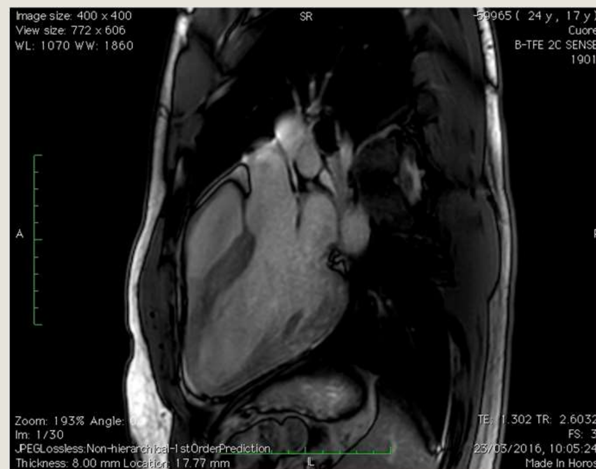


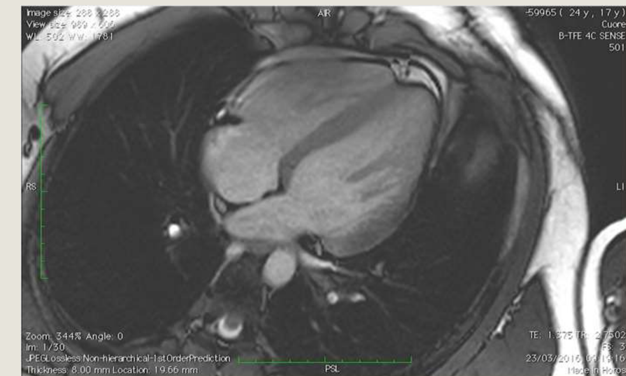


ANGIO

Case report
Cine images (for volume/function)

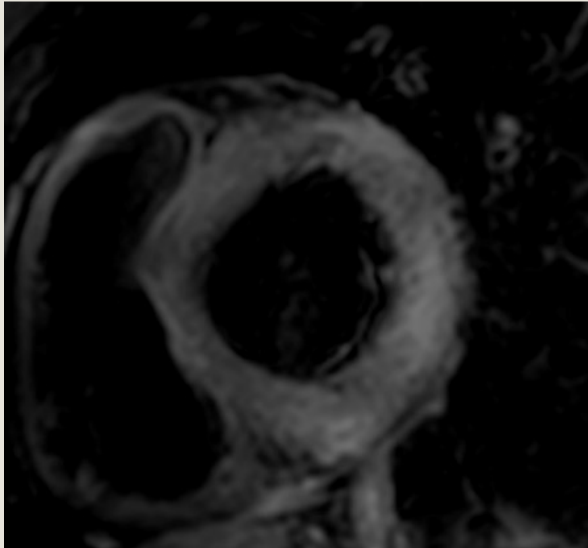


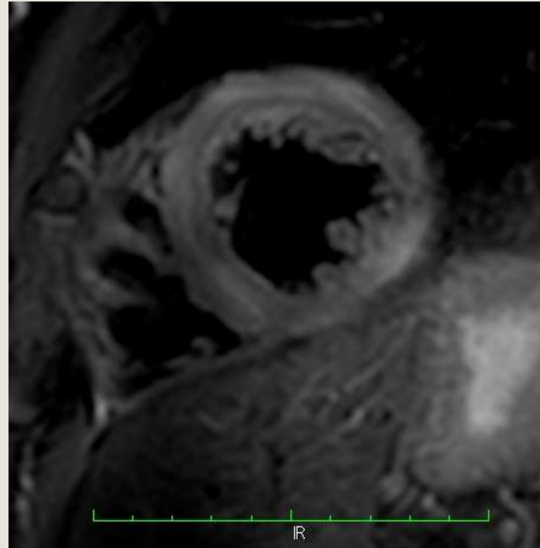


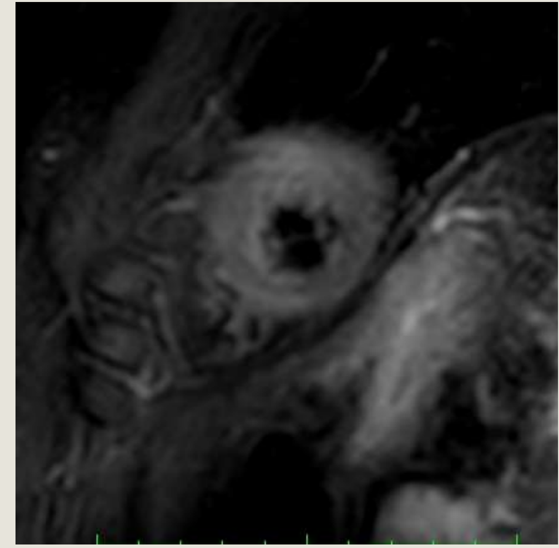


- LV, 17 yrs, male
- Typical symptoms
- 2500 ng/L peak hsTnT
- Normal echo, mild PE

T2w images (for edema)







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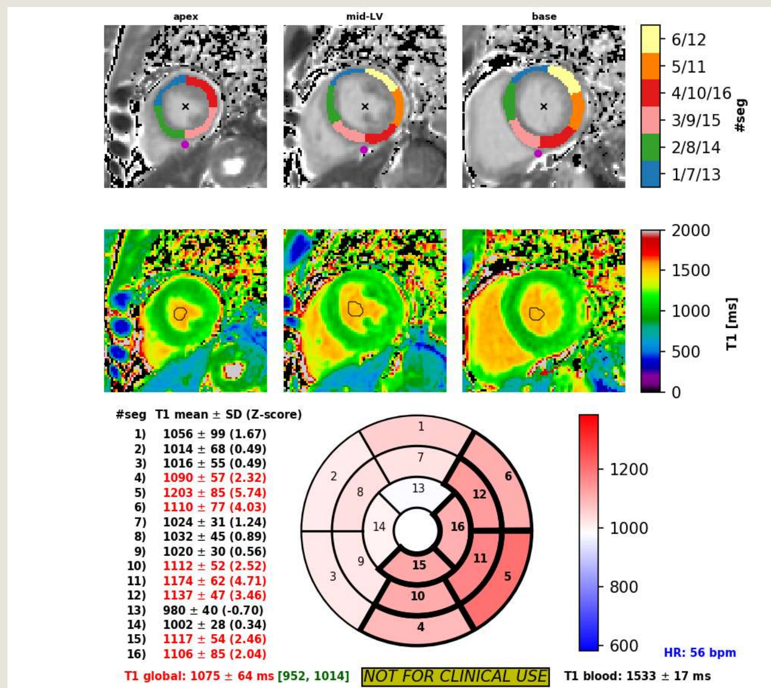
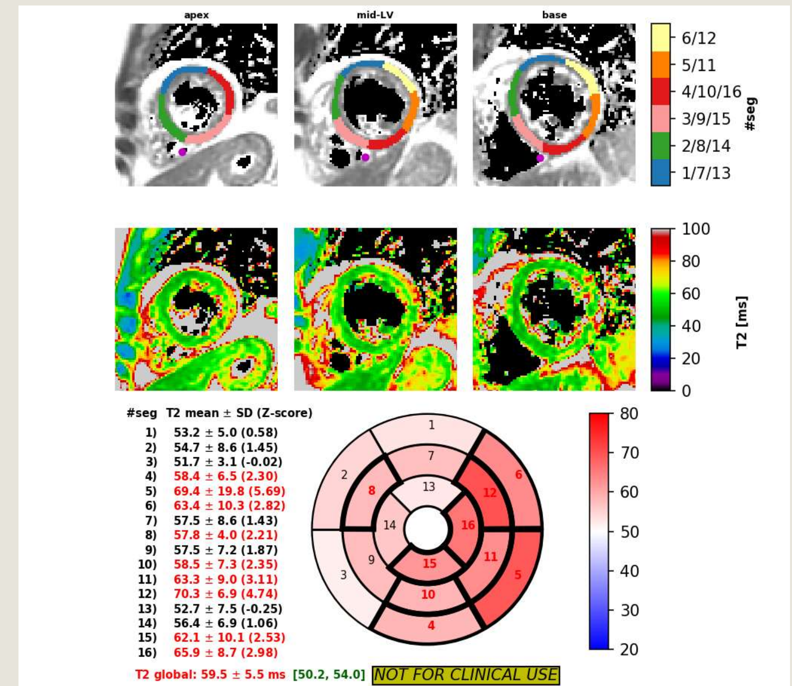
Parametric imaging (native T1/T2 mapping)

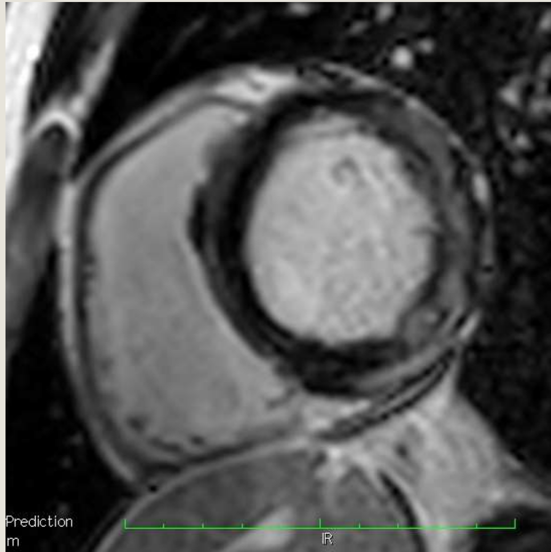


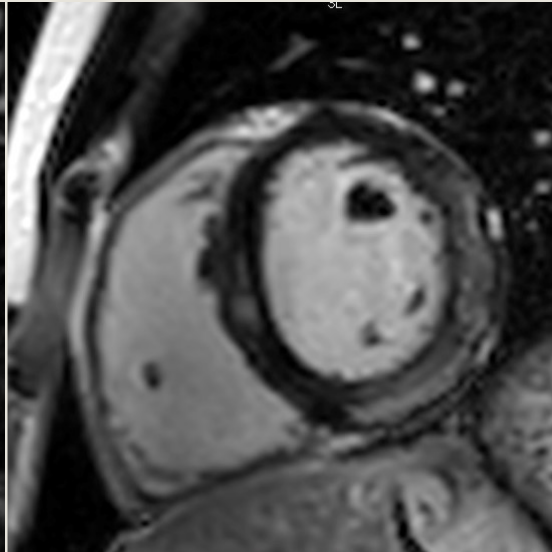
Native T1 mapping

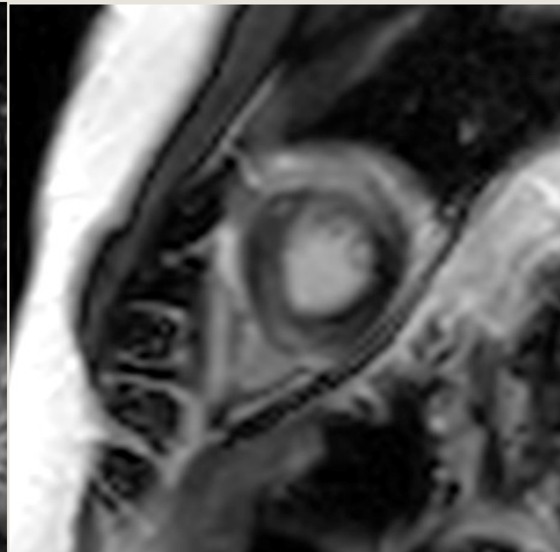


T2 mapping

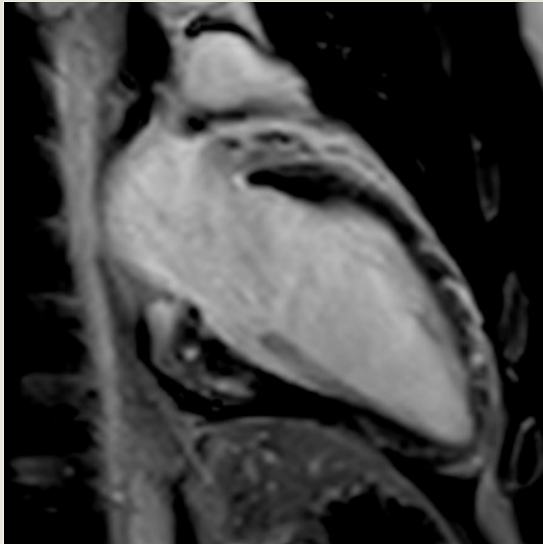
LGE images

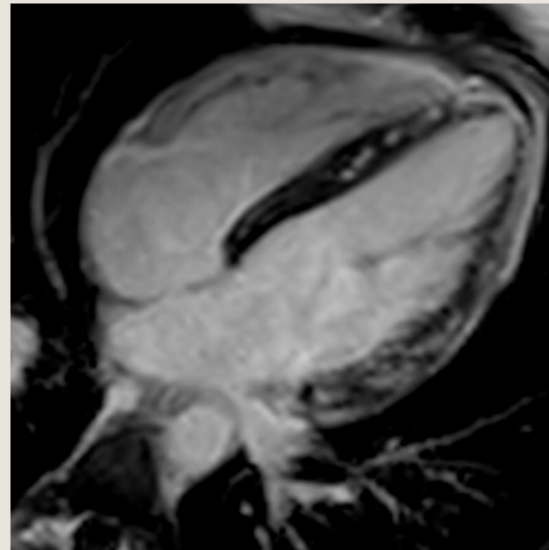


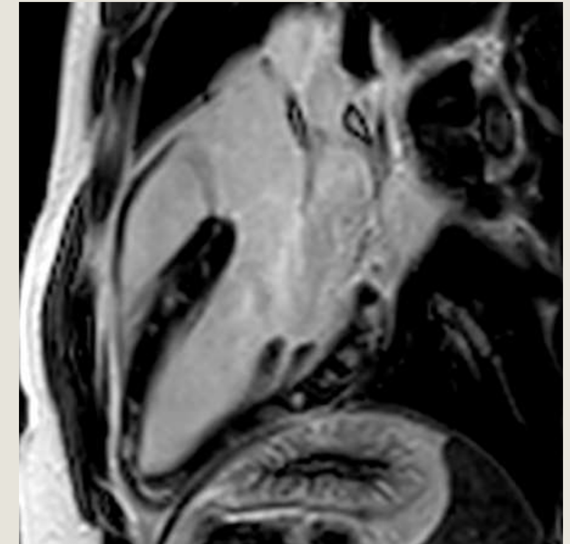




LGE images







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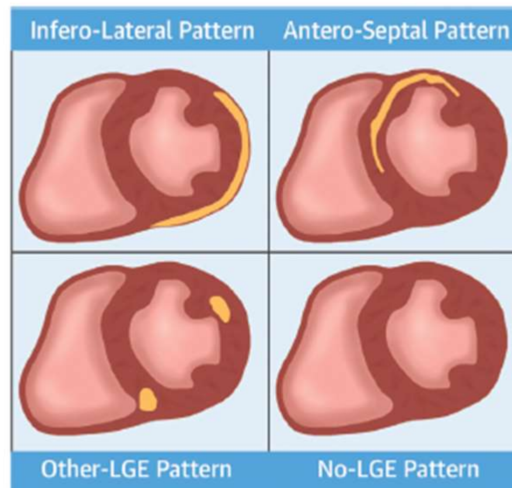
Cardiac MR With Late Gadolinium Enhancement in Acute Myocarditis With Preserved Systolic Function

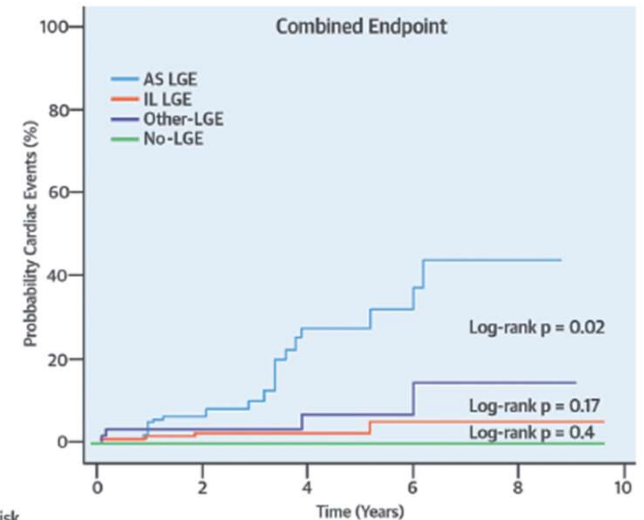
ITAMY Study

Giovanni Donato Aquaro, MD,[a] Matteo Perfetti, MD,[a] Giovanni Camastra, MD,[b] Lorenzo Monti, MD,[c] Santo Dellegrottaglie, MD,[d,e] Claudio Moro, MD,[f] Alessia Pepe, MD,[a] Giancarlo Todiere, MD,[a] Chiara Lanzillo, MD,[g] Alessandra Scatteia, MD,[h] Mauro Di Roma, MD,[i] Gianluca Pontone, MD,[j] Martina Perazzolo Marra, MD, PhD,[k] Andrea Barison, MD,[a] Gianluca Di Bella, MD, PhD,[l] on behalf of the Cardiac Magnetic Resonance Working Group of the Italian Society of Cardiology

374 AM pts, septal LGE associated with higher rates of SCD, ICD implantation, resuscitated cardiac arrest or hospitalization for HF (16%vs 8%).

CENTRAL ILLUSTRATION Prognostic Role of Different LGE Patterns in Patients With AM and Preserved EF





At Risk

	0	2	4	6	8	10
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

Aquaro, G.D. et al. J Am Coll Cardiol. 2017;70(16):1977-87.

In a population of patients with acute myocarditis (AM) and preserved ejection fraction (EF), we identified 4 main patterns of distribution of late gadolinium enhancement (LGE) **(left).** The anteroseptal pattern of late gadolinium enhancement was associated with a worse prognosis than the other patterns **(right).** AS = anteroseptal; IL = inferolateral.

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Prognostic Value of Repeating Cardiac Magnetic Resonance in Patients With Acute Myocarditis

Giovanni Donato Aquaro, MD,[a] Yacob Ghebru Habtemicael, MD,[a] Giovanni Camastra, MD,[b] Lorenzo Monti, MD,[c] Santo Dellegrottaglie, MD,[d,e] Claudio Moro,[f] Chiara Lanzillo, MD,[g] Alessandra Scatteia, MD,[h] Mauro Di Roma, MD,[i] Gianluca Pontone, MD,[j] Martina Perazzolo Marra,[k] Andrea Barison, MD,[a] Gianluca Di Bella,[l] on behalf of the "Cardiac Magnetic Resonance" Working Group of the Italian Society of Cardiology

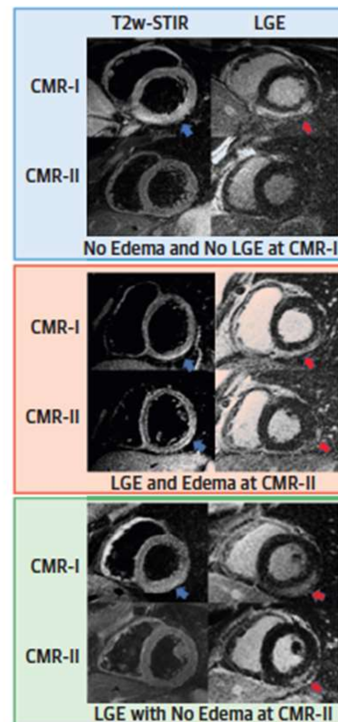
187 AM pts with CMR-II at 6 months

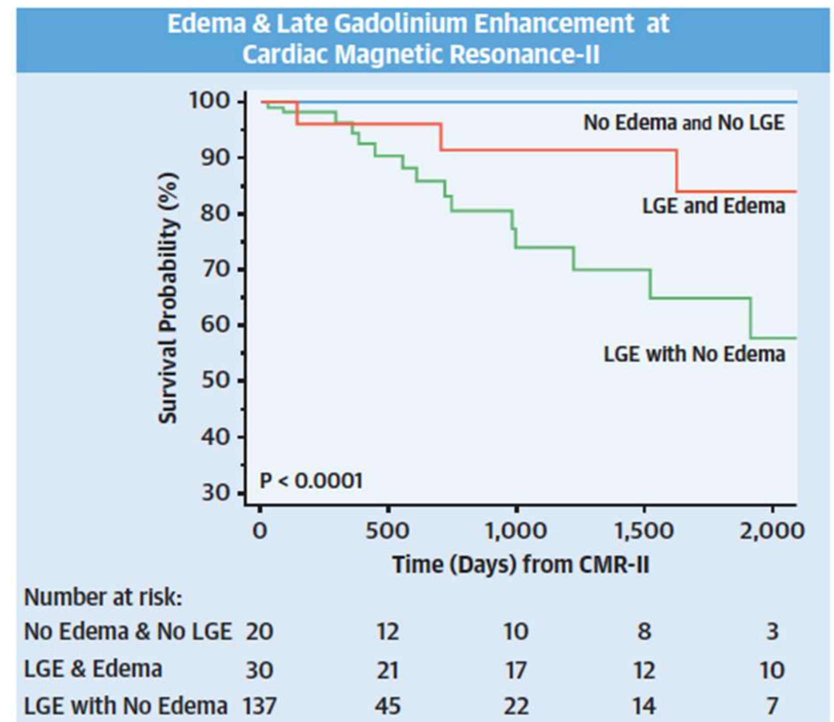
16% edema persistence at CMR-II

11% LGE resolution at CMR-II

LGE without edema ("definite fibrosis) at CMR-II had the worst prognosis

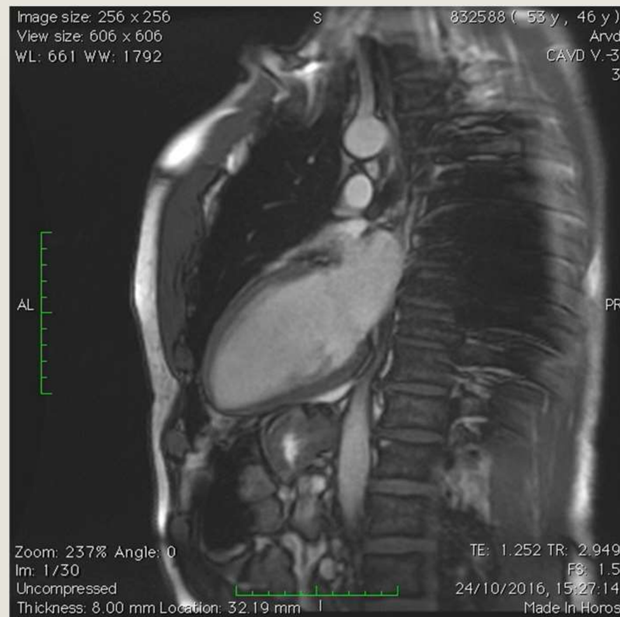
CENTRAL ILLUSTRATION Prognostic Role of 6-Month Follow-Up CMR in Myocarditis

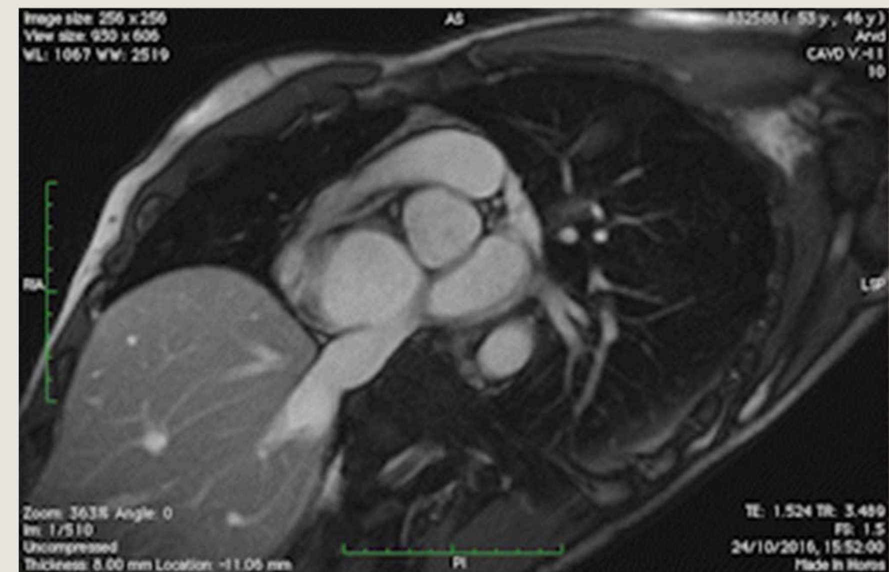




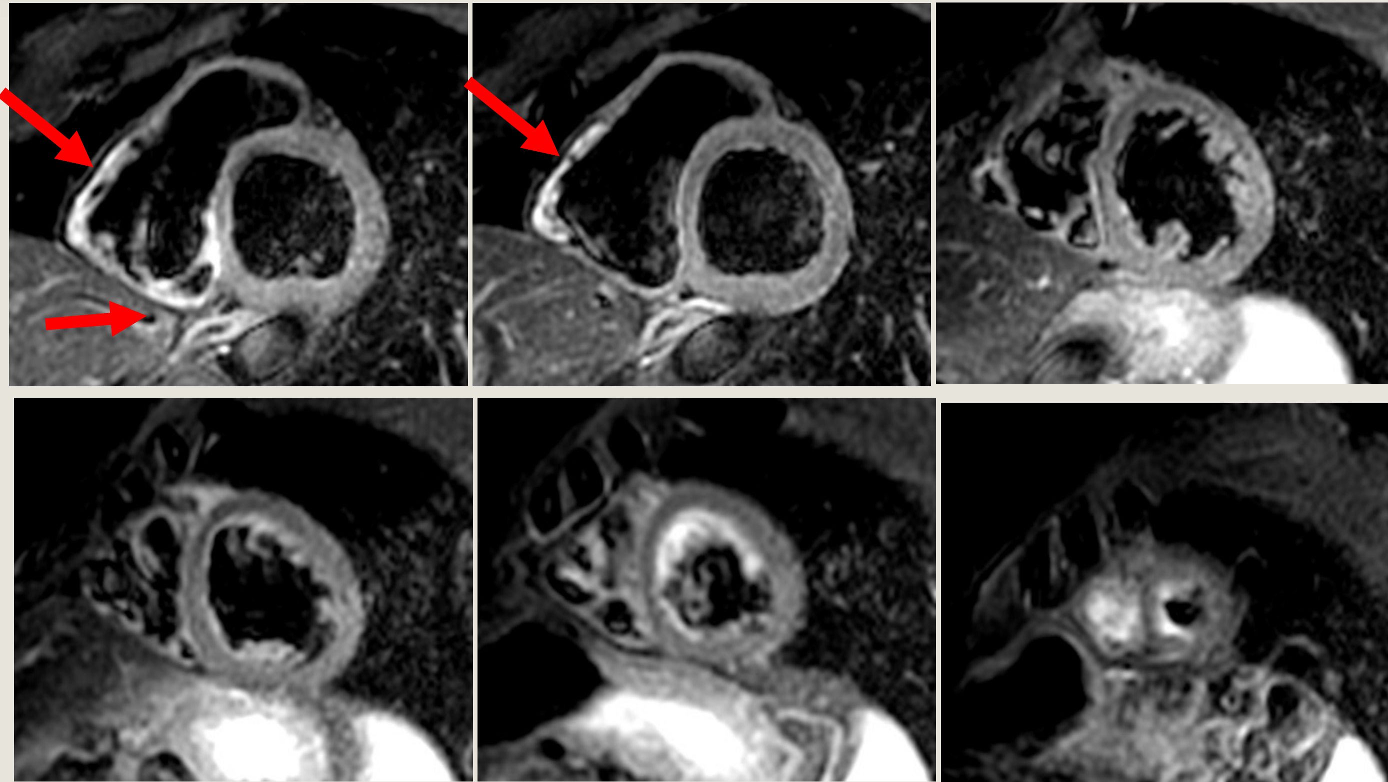
Number at risk:					
No Edema & No LGE	20	12	10	8	3
LGE & Edema	30	21	17	12	10
LGE with No Edema	137	45	22	14	7

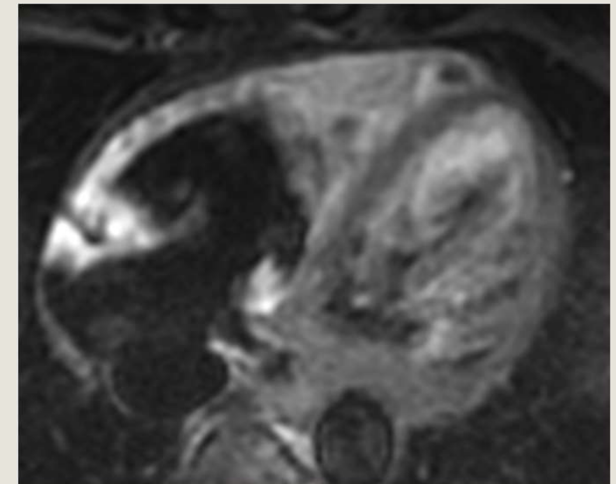
Aquaro, G.D. et al. J Am Coll Cardiol. 2019;74(20):2439-48.





- PL, 46 yrs, male
- OOH-CA -> VT -> defib
- 500 ng/L peak hsTnT
- Normal echo, small PE





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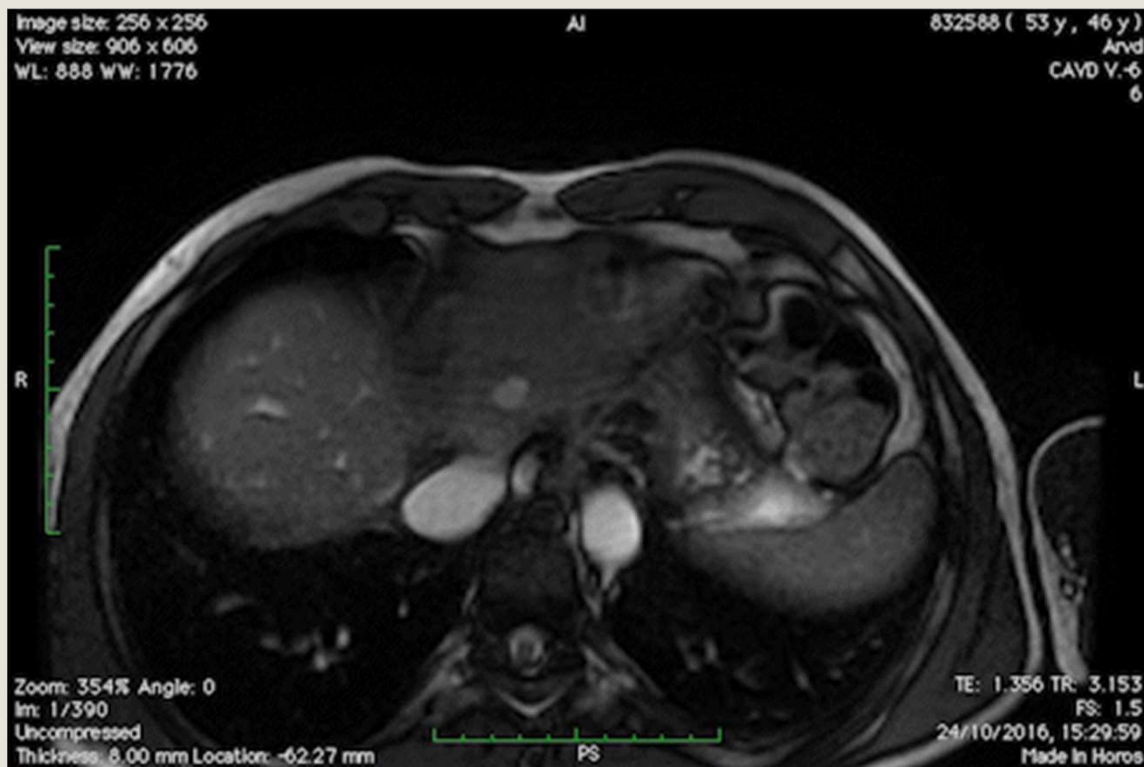
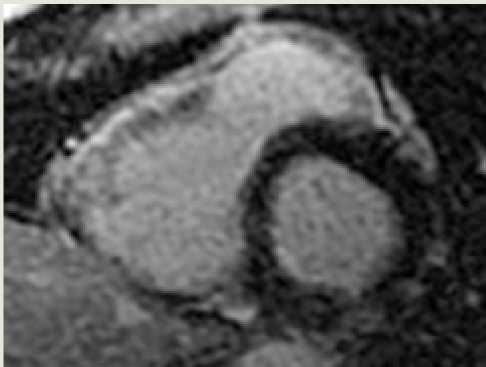
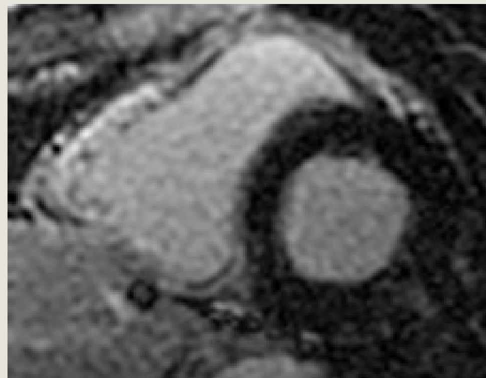
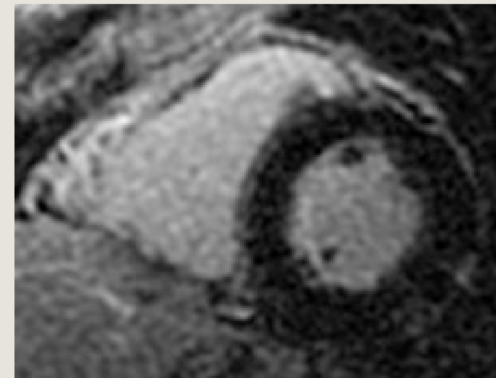
Long axis cine images

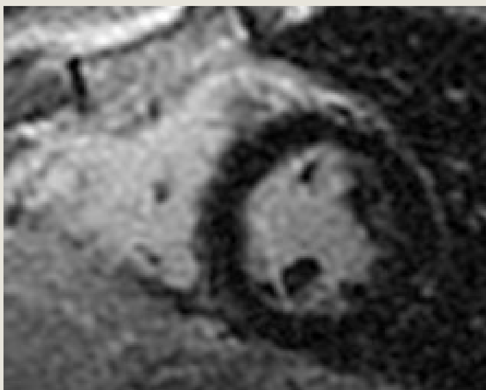


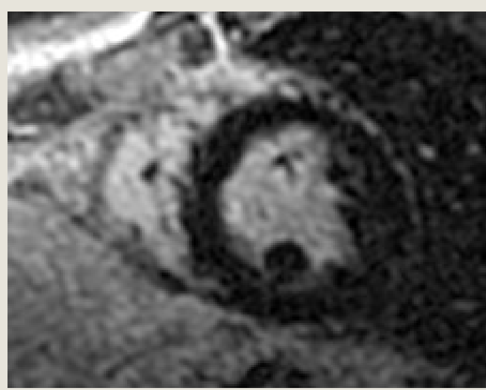
Short axis LGE

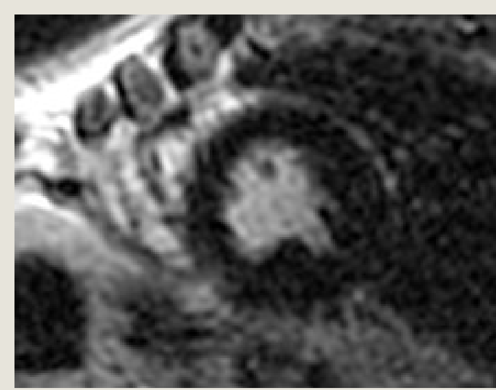












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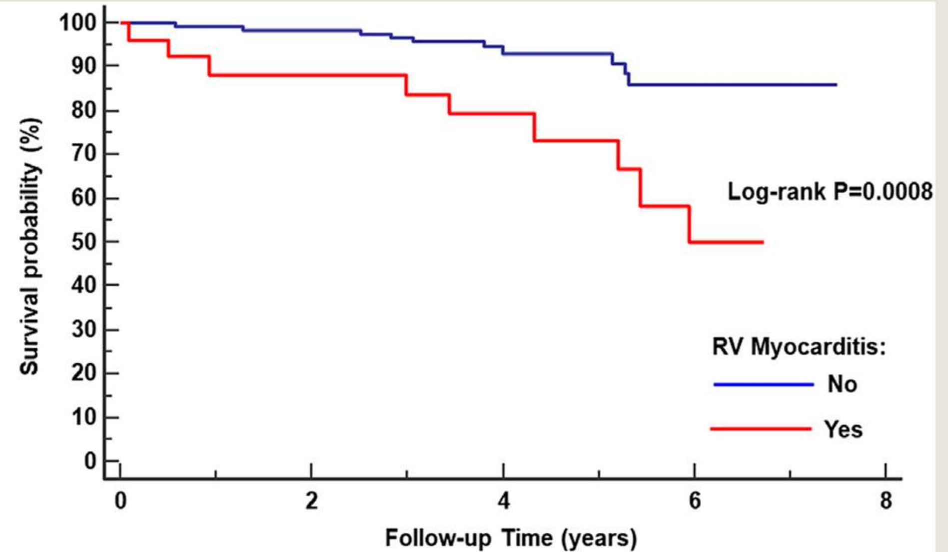
A B S T R A C T

Objectives: Right ventricular (RV) myocarditis (MY) is unrecognized, and its prevalence is unknown. We evaluated the prevalence of RV involvement in acute MY and its association with cardiac events (cardiac death, cardiac arrest, ventricular assist device, transplantation, and appropriate ICD intervention).

Methods: We enrolled 151 patients who underwent cardiac magnetic resonance for clinical suspicion of acute MY. The CMR protocol included T2-STIR images for edema detection, post-contrast cine-SSFP for hyperemia detection and late gadolinium enhancement (LGE) images.

Results: Signs of RV MY were found in 27 patients (17.8%): RV edema at T2-STIR in all of these 27 patients; RV LGE was detected in 11 patients (7.3%). The median RV myocardial segment involved was 2 (1–3). In 13 patients, RV edema was in direct continuity with LV edema of septum and inferior wall or with anterior septum and anterior wall. In 2 patients RV myocarditis was found without any signs of LV involvement. Patients with RV MY had higher RV end-diastolic volume index ($p = 0.04$) and RV mass index ($p = 0.03$), and lower RV ejection fraction ($p < 0.001$) than others. At Kaplan-Meier survival curve patients with RV MY had more cardiac events than those without RV involvement ($p = 0.015$). RV involvement, anteroseptal LGE and RV LGE were associated with cardiac events.

Conclusion: RV involvement in acute MY is more frequent than previously hypothesized. RV MY was associated with cardiac events.



Number at risk

RV Myocarditis:					
No	124	118	55	27	0
Yes	26	21	13	6	0

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Role of right ventricular involvement in acute myocarditis, assessed by cardiac magnetic resonance

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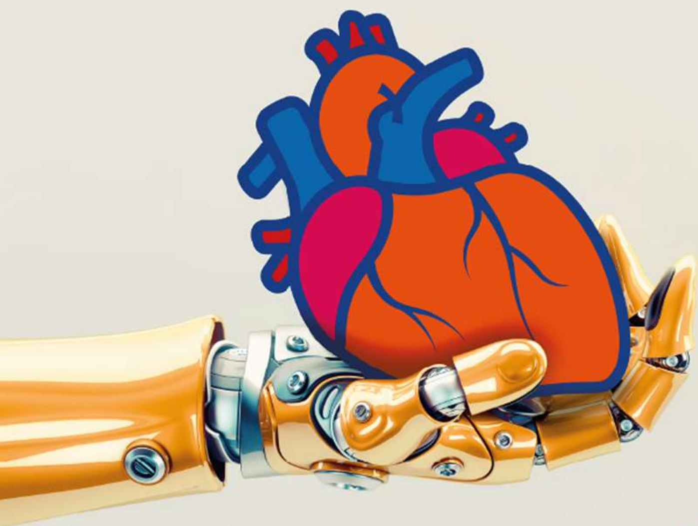
AM-CMR keypoints

- Isolated posterior LGE → “benign” prognosis
- Septal LGE and/or RV-LGE → arrhythmias/worst prognosis
- Follow-up scan for edema resolution and “final” LGE (fibrosis)
- More LGE → worst prognosis



17° Meeting
CardioLucca
Heart Brings Heart 2023

Lucca, 22-24 Giugno 2023
Centro Congressi Auditorium San Francesco

Chrysanthos Grigoratos

Stato dell'arte della miocardite acuta

Fondazione Monasterio
la ricerca che cura