

# CMR in Routine Cardiology Care

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CMR Unit, Beacon Hospital

# Why Do We Want an Imaging Test?

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This is the key question we should always ask when requesting any test

- To establish a diagnosis
- To assess mechanism of symptoms
- To assess risk of complications
- To guide treatment

# Tests Tests Tests !

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have been worsening lately. She experiences skipped beats twice daily but reports occasional episodes where she feels that her heart is racing. These happen at least once a week and can happen on exertion or at rest. They slowly resolve. She reports having several presyncopal episodes where she feels she can't breathe.

Her prolonged holter only captured her experiencing the skipped beats and showed some occasional PVC's at the time with 2 dropped beats. Her EST from May 2015 did not show any significant ST changes. Test was stopped due to leg discomfort.

Overall my impression is that she may be experiencing symptoms of SVT. I will book a CMR perfusion, EP study +/- ablation and a 5 day holter.

was referred for occasional shortness of breath on exertion and feeling weak. This happens sometimes, but not regularly.

She has a history of hypercholesterolaemia. She is a non smoker. She is taking Atorvastatin 10mg. Her mother died at the age of 59 of MI.

Today, physical examination is unremarkable.

We will do non invasive testing. I have referred her for exercise stress test, echo, routine bloods, 24 hour holter monitoring and cardiac MRI with perfusion in Blackrock Clinic. We will review her with the results of the above tests.



**RESEARCH**

**Open Access**

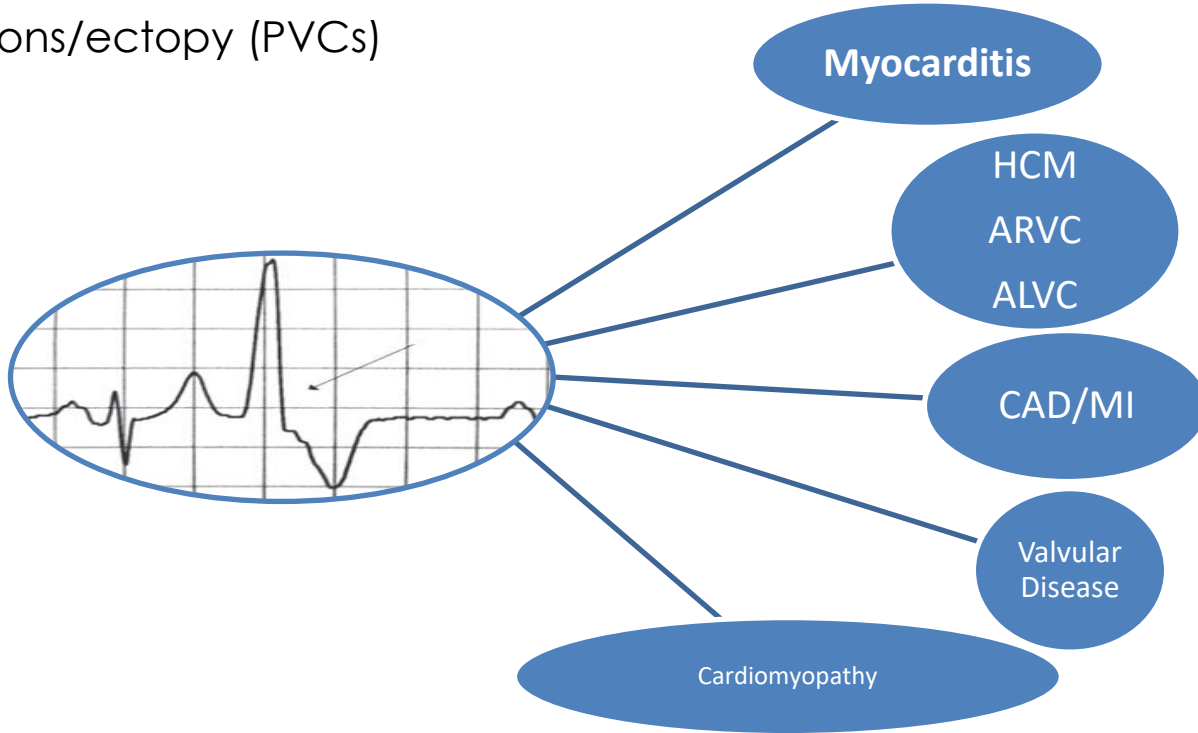
European cardiovascular magnetic resonance  
(EuroCMR) registry – multi national results from  
57 centers in 15 countries

**Table 6 Additional diagnostic procedures avoided due to results of CMR**

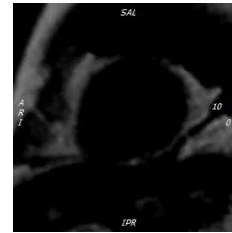
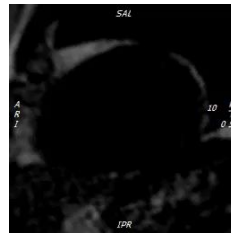
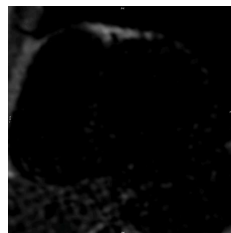
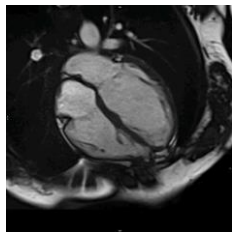
	All (n = 27025)		No stress (n = 16526)		Stress (n = 10113)	
Invasive angiography	24%	(n = 6483)	11.6%	(n = 1921)	45%	(n = 4555)
Nuclear (SPECT/PET)	20.6%	(n = 5574)	9.8%	(n = 1624)	39%	(n = 3946)
Coronary CT	11.8%	(n = 3182)	5.9%	(n = 976)	21.8%	(n = 2202)
Hospital discharge			10.4%		14.3%	6.9%
Hospital admission			1.1%		1.5%	1.9%
Impact on patient management (new diagnosis and/or therapeutic consequence)			55.1%		71.4%	71.5%

# An Example

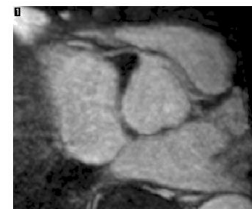
Palpitations/ectopy (PVCs)



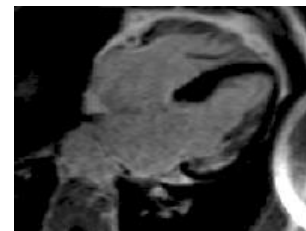
## Cine Imaging



## Stress Perfusion

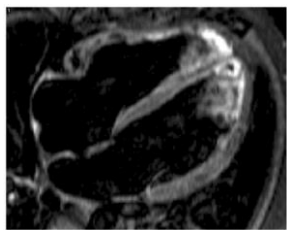


## Anomalous Coronaries

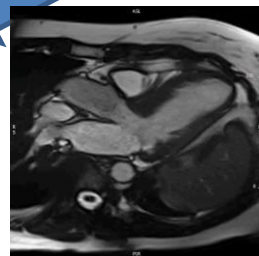


## Late Gadolinium Scar imaging

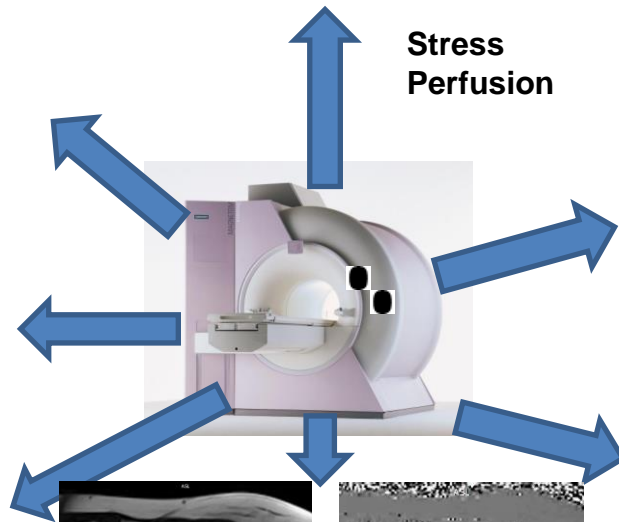
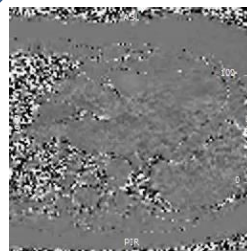
## T2\* Imaging Iron overload



## STIR imaging for inflammation/oedema

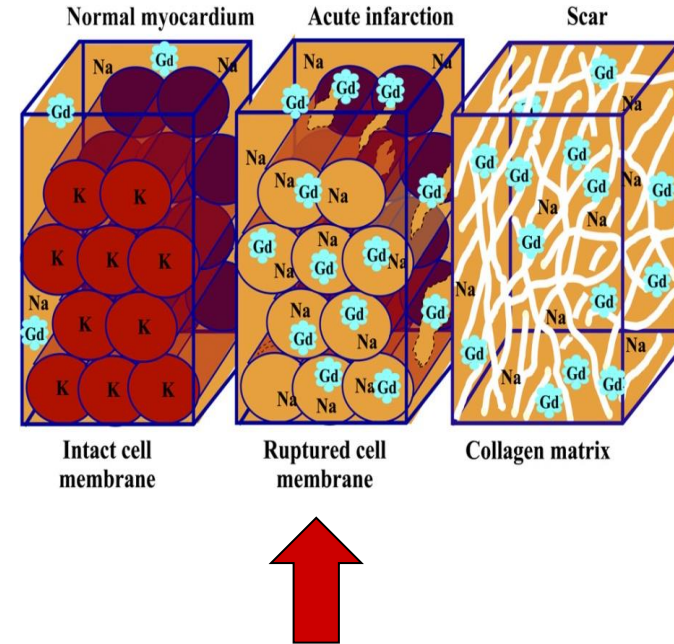
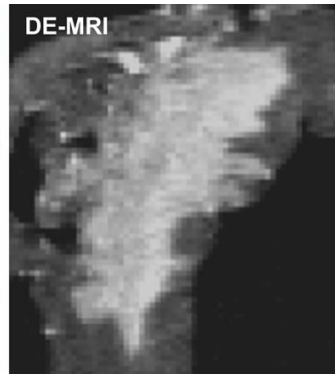
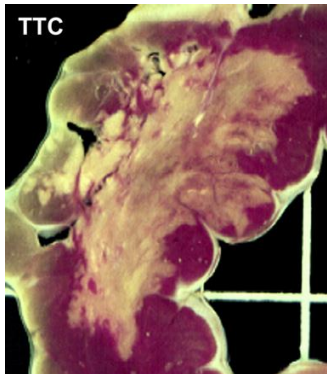


## Flow Mapping for valves/shunts



# Gadolinium Contrast

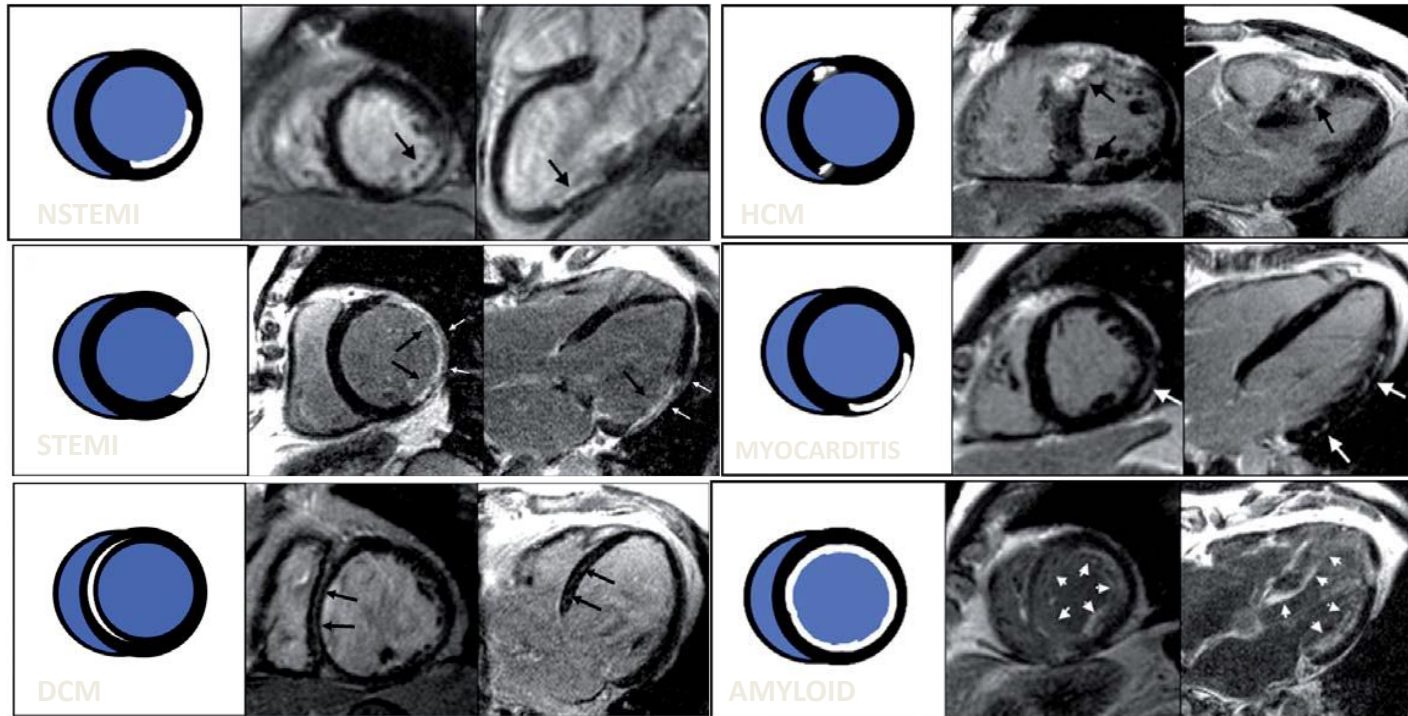
- Gadolinium will help image for scarring of the heart



**Not only in acute infarction but also in acute oedema/inflammation**



# Contrast Enhancement



# Has CMR Moved into Mainstream?

2010

- 540 scans

2011

- 1100 scans

2012

- 1700 scans

2021

- 5500 scans
- >110 scans a week
- 7 day service
- 7am to 11pm Monday to Friday



## New dedicated scanner in Beacon Hospital 2021

- Already scanning 7 days week -fastest development of a CMR programme in Ireland.
- 2500 additional scans a year

## Damar Hamlin shows 'signs of improvement' while still in ICU in critical condition, Bills say, after mid-game cardiac arrest





Sports

World Cup

Tennis

Golf

Motorsport

Football

US Sports

Olympics

Climbing

Esports

Hockey

## BREAKING NEWS

[Sixth speaker vote expected as Kevin McCarthy's path remains uncertain. Watch CNN](#)

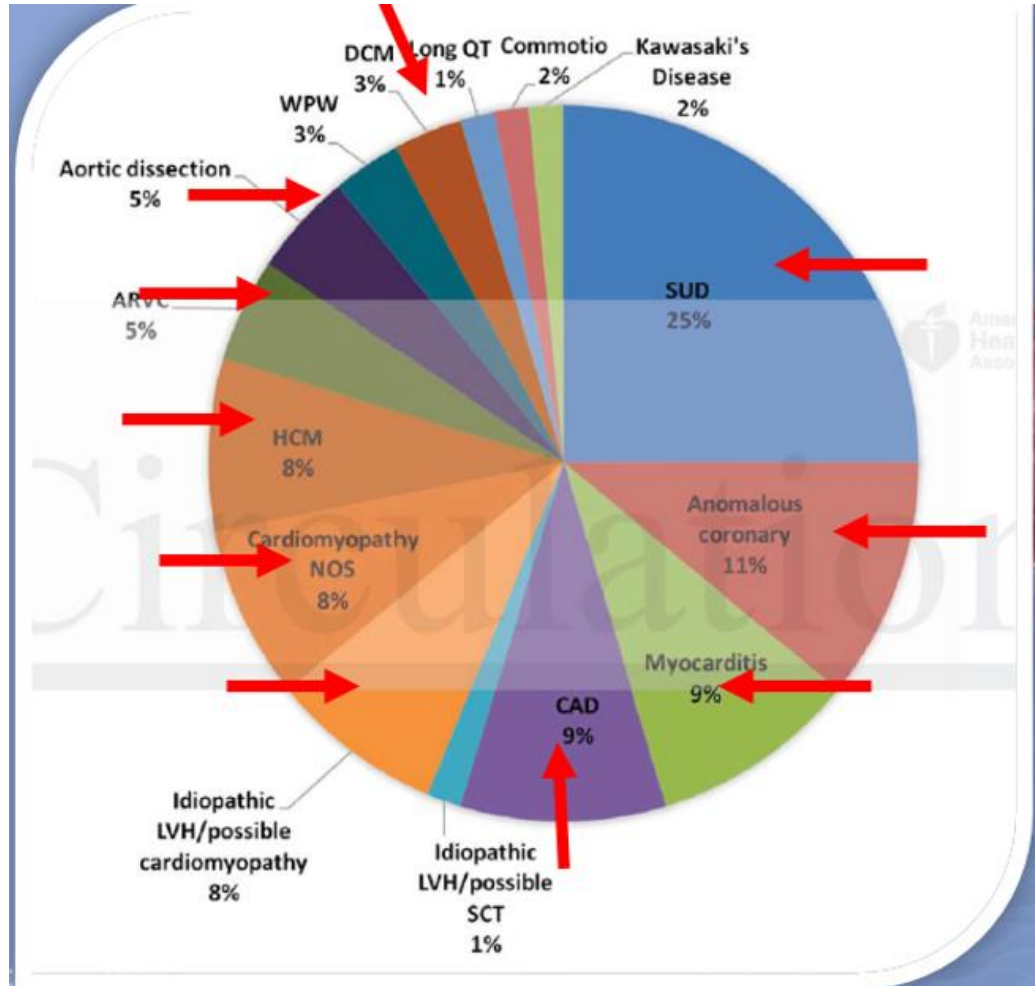
# How Christian Eriksen returned to football after suffering cardiac arrest on pitch

By Ben Church, CNN

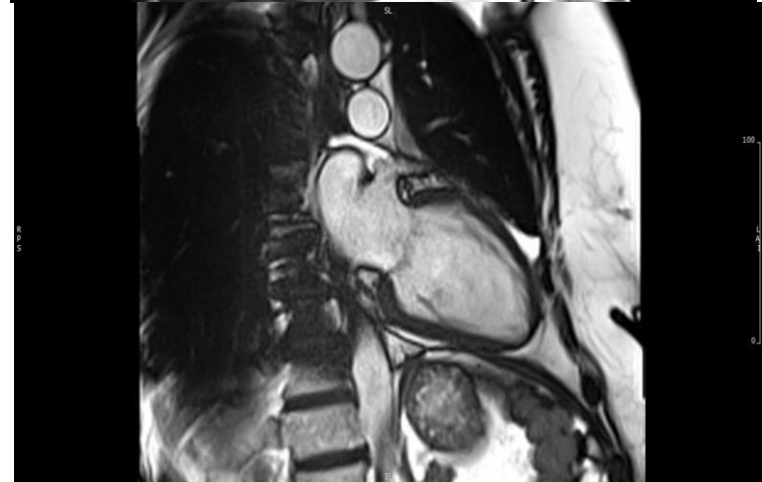
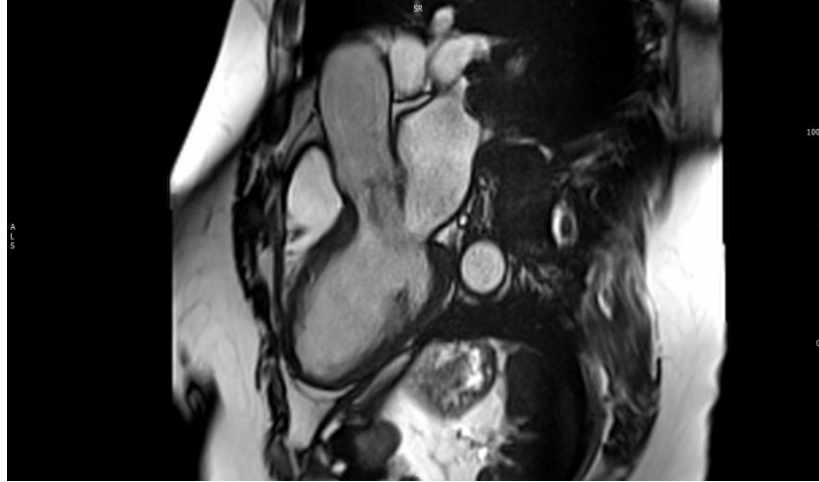
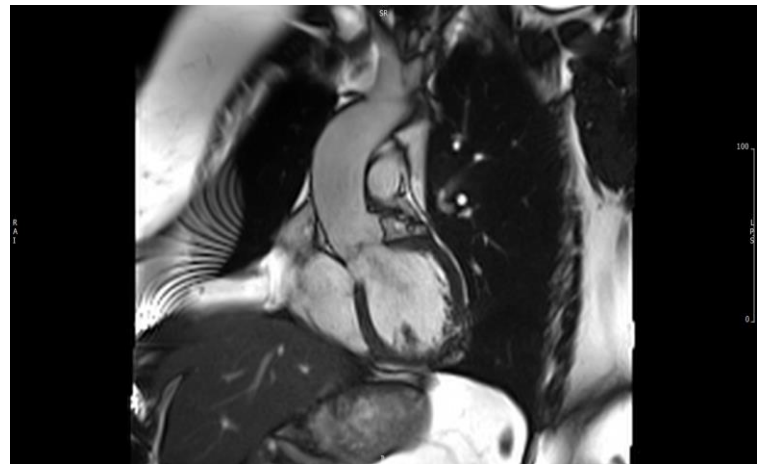
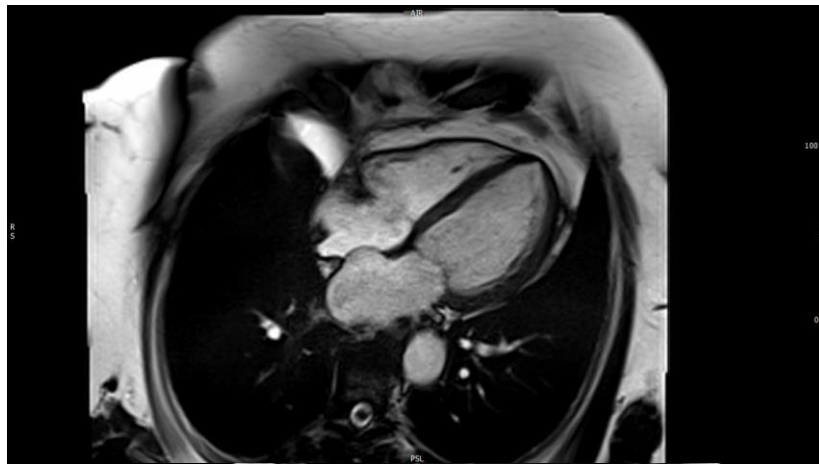


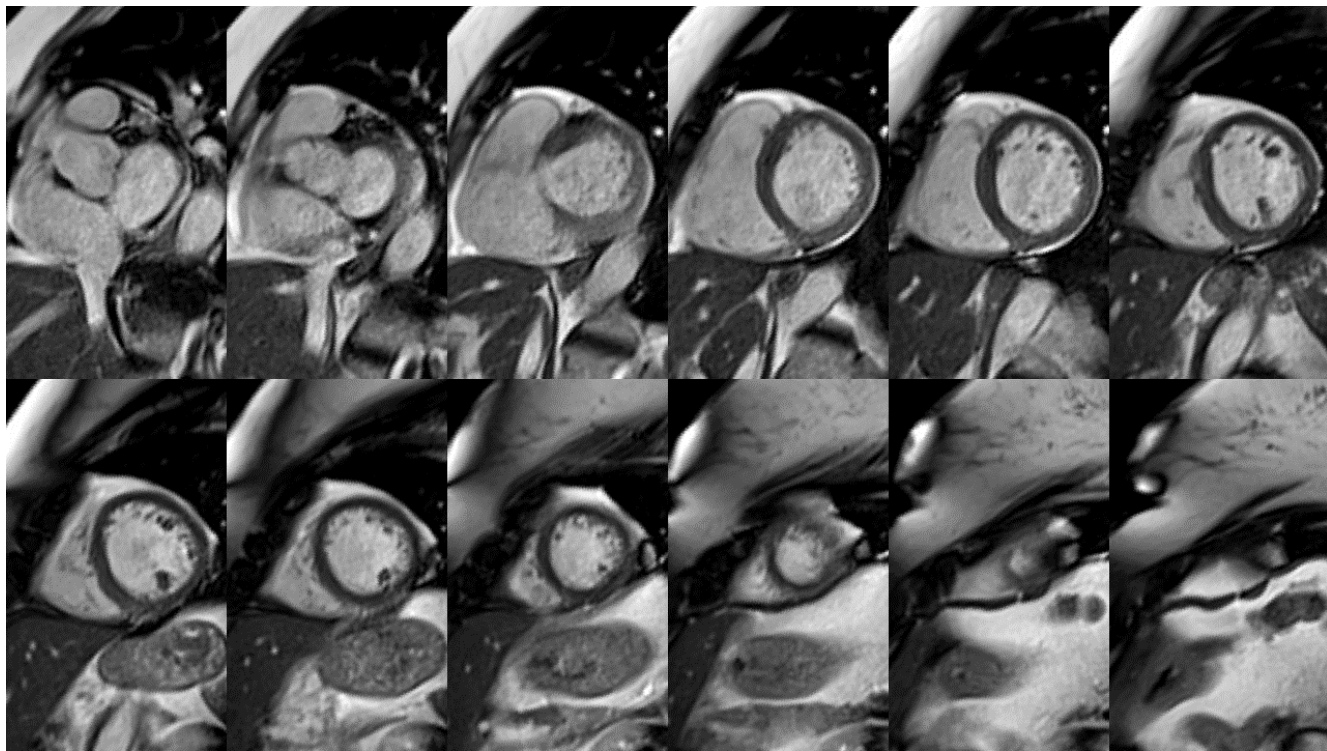
Incidence, Etiology, and Comparative Frequency of Sudden Cardiac Death in  
NCAA Athletes: A Decade in Review

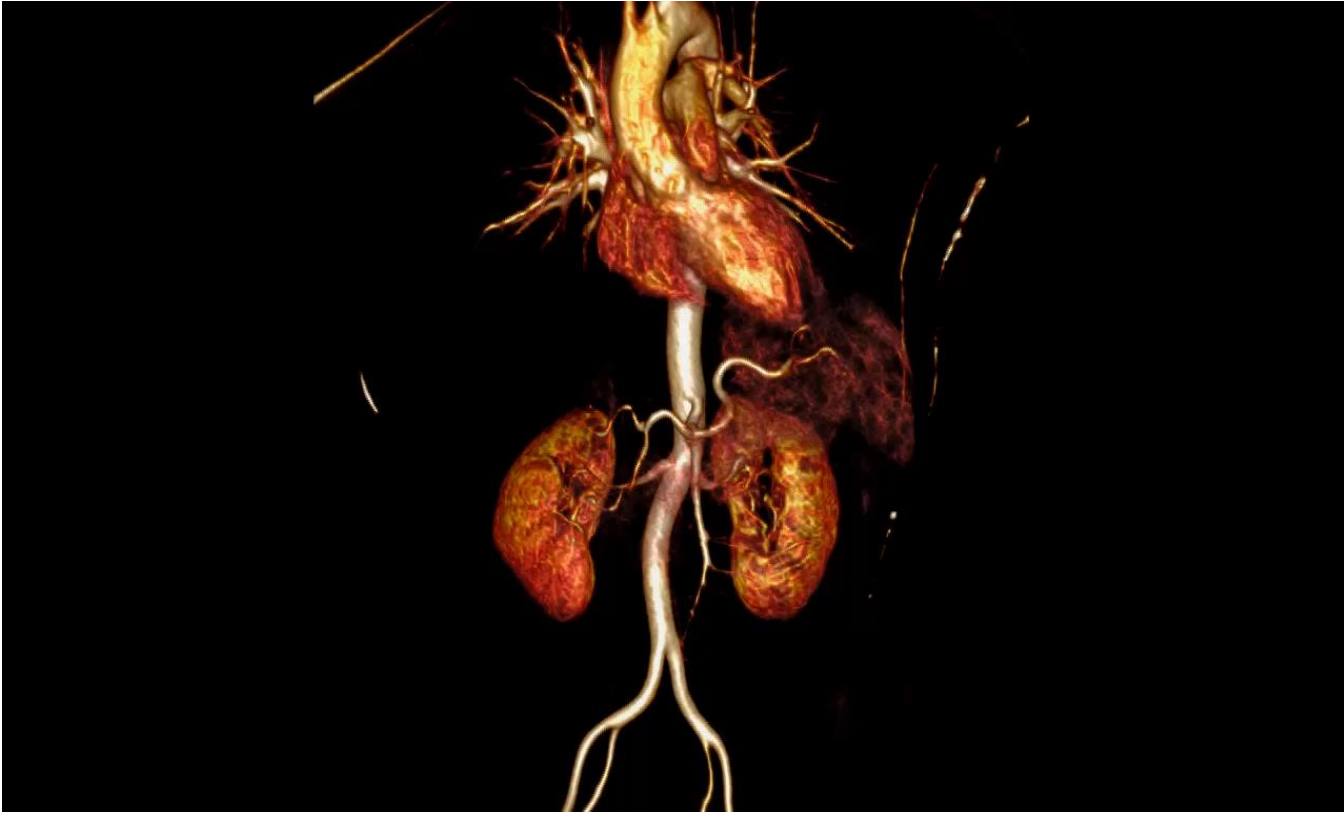
Running title: *Harmon et al.; Sudden Cardiac Death in NCAA Athletes: 10-Years*





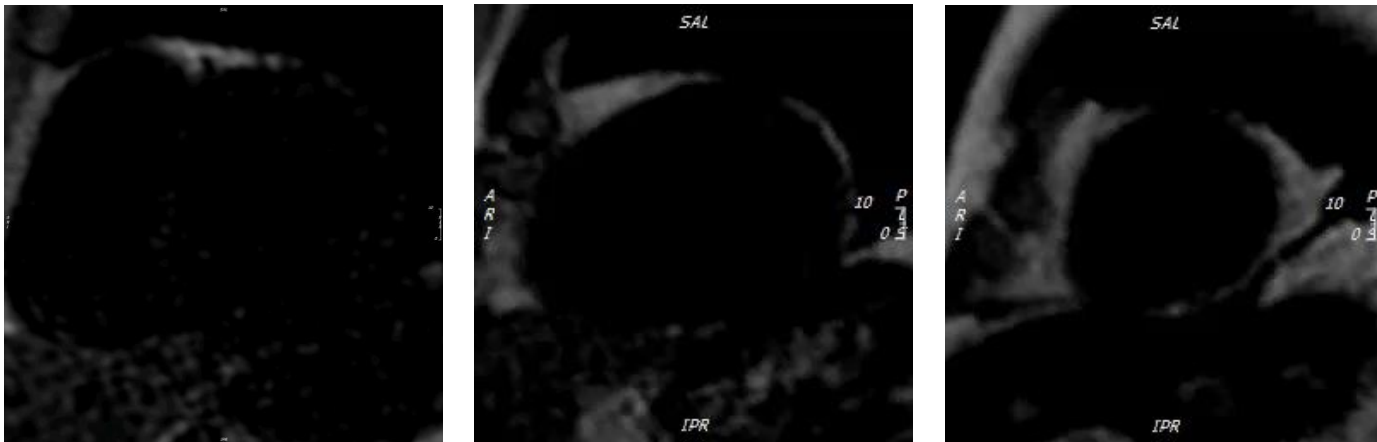




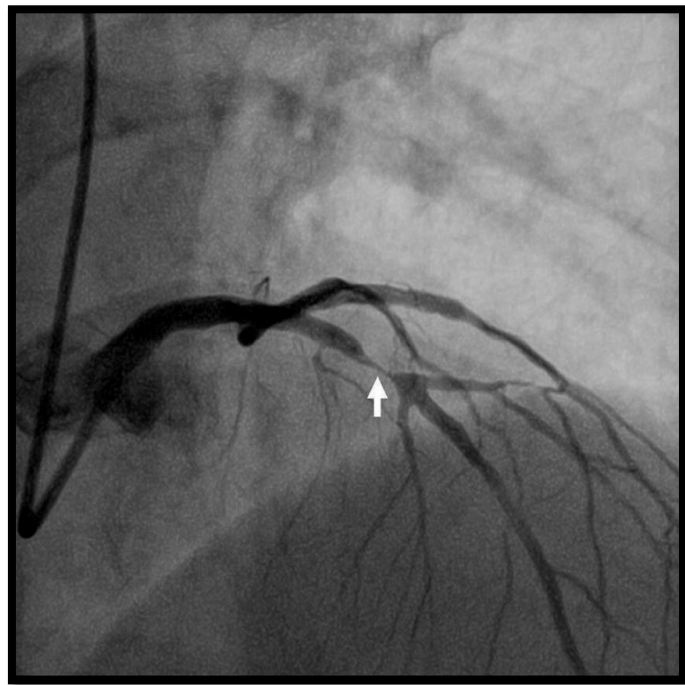
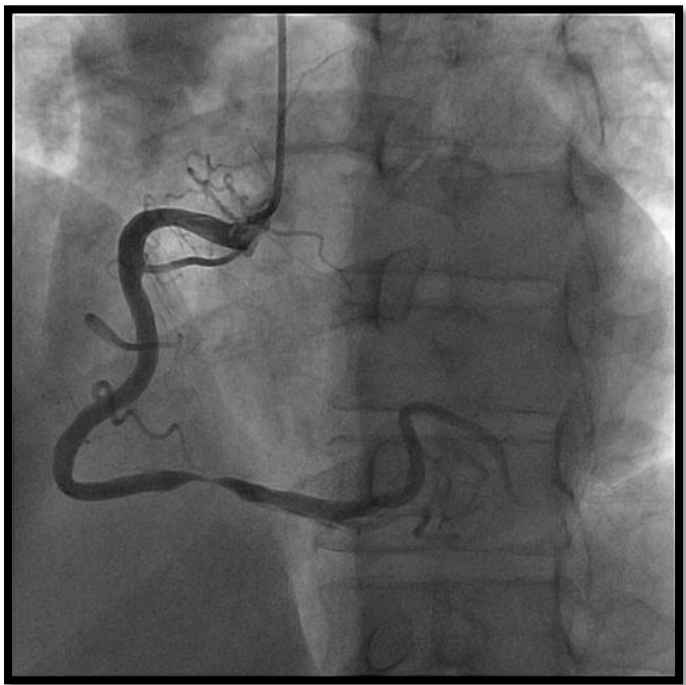


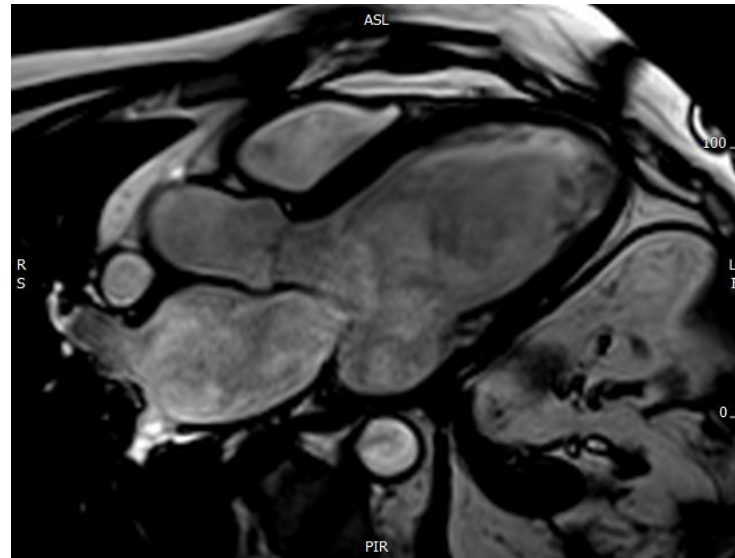
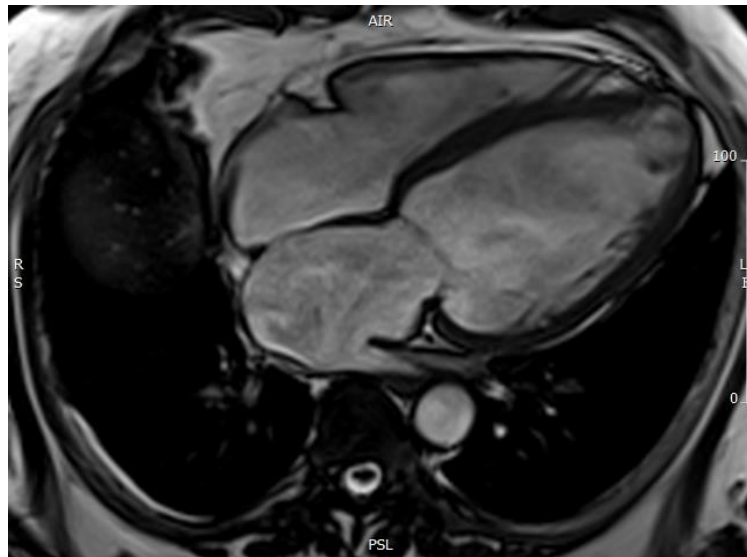


# Cases to Guide Treatment Decisions in IHD



- 62 year old male
- Lockdown life changes
- Fam hx, LDL 3.8, BP 141/81 on 24 hr BP
- Slight disproportionate unexplained fatigue in afternoons
- Worried re family hx

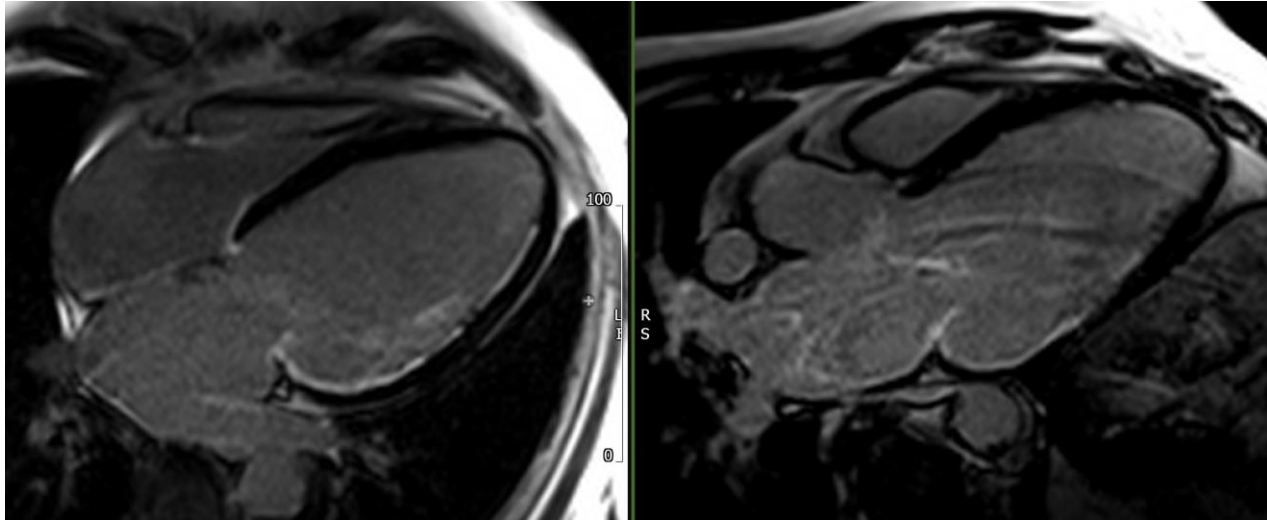




71 year old attends GP with worsening SOB. No angina. NTproBNP 1100  
HTN. Chol.  
OPD echo shows severe LV impairment. Referred cardiology through ED

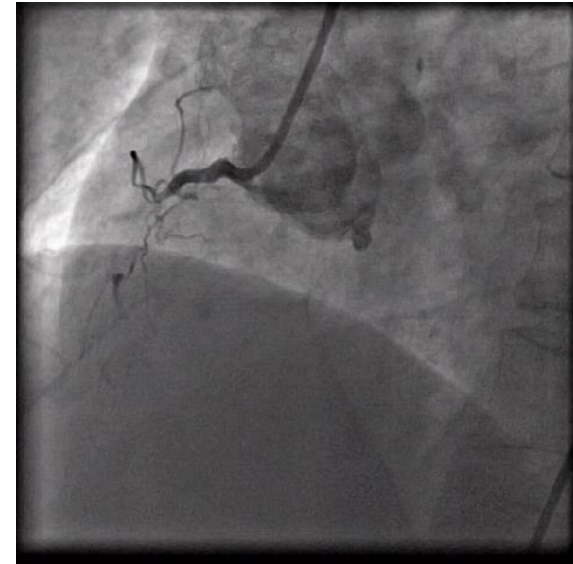
**Angio- Occluded LAD. Significant LCX disease. Non dominant RCA**

Decision – CABG (LAD and LCX) vs PCI (LCX as LAD presumed non viable) vs  
Medical therapy (no angina)



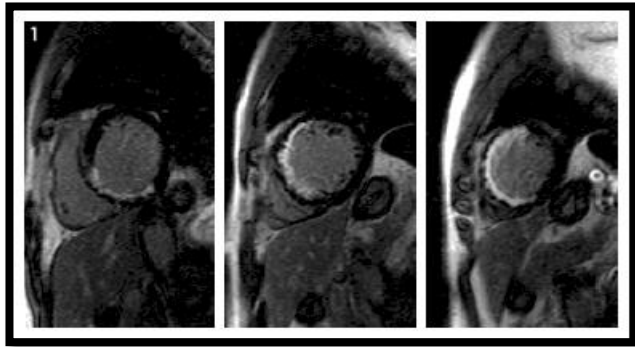
# When Not to Revascularise!

- 60 yr old male
- EF 31%
- Occluded RCA and LAD
- CMR to assess for viability
- **No angina**
- NYHA III



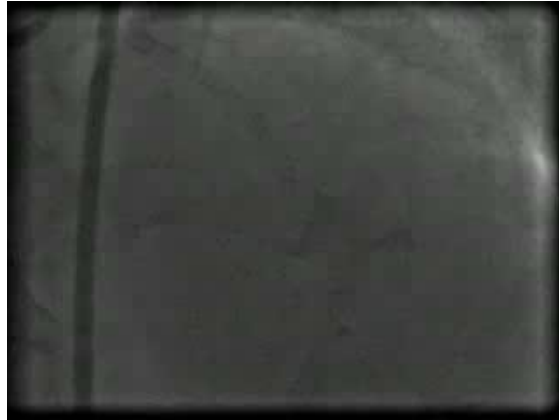
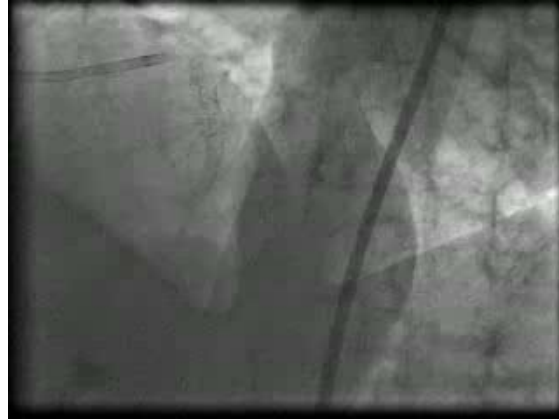
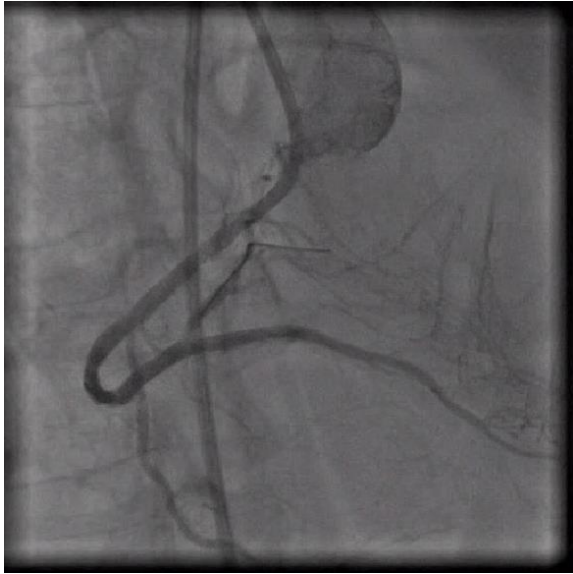
# Occluded LAD/RCA, EF 30%

**Non viable myocardium  
Recommend Medical Mx**



# PCI was Performed!

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**CKD, eGFR 29  
New Apical  
Thrombus  
No Angina, NYHA III  
EF Unchanged**

## CABG vs PCI



CTO LAD and RCA.

Large LCx with 50-70% proximal stenosis and collaterals to RCA and LAD

CCS 1, NYHA II<sup>+</sup>

## LGE Study



No scar –hence its all viable  
Should respond very well to revascularisation

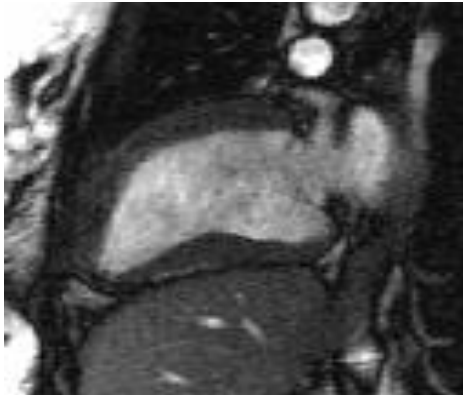
# Hibernating Myocardium

Pre  
revasc

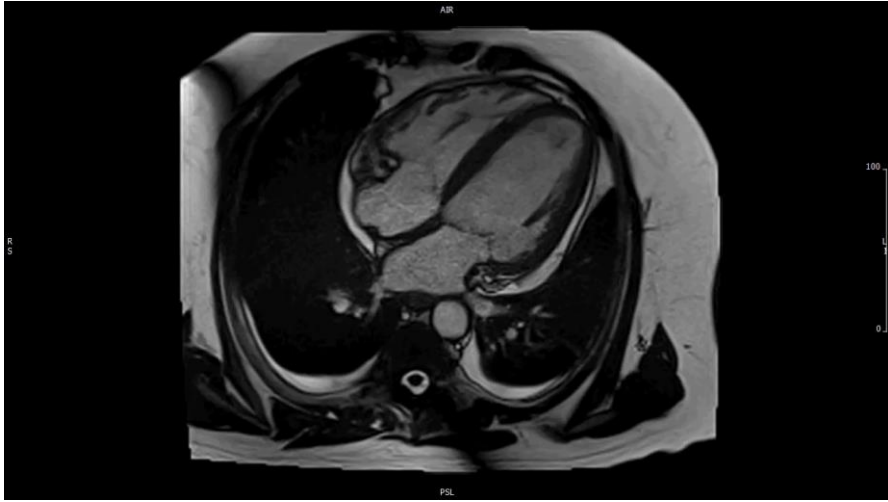


EF: 19%

Post  
revasc



EF: 37%

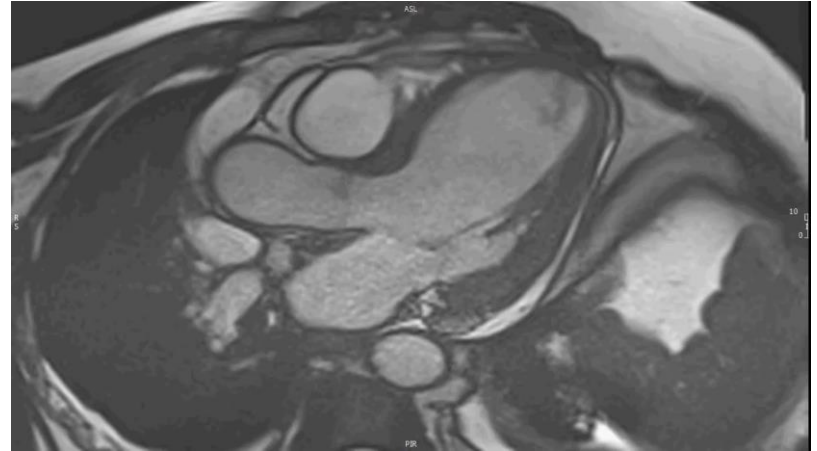


61 Yr old ex smoker  
STEMI and primary PCI performed

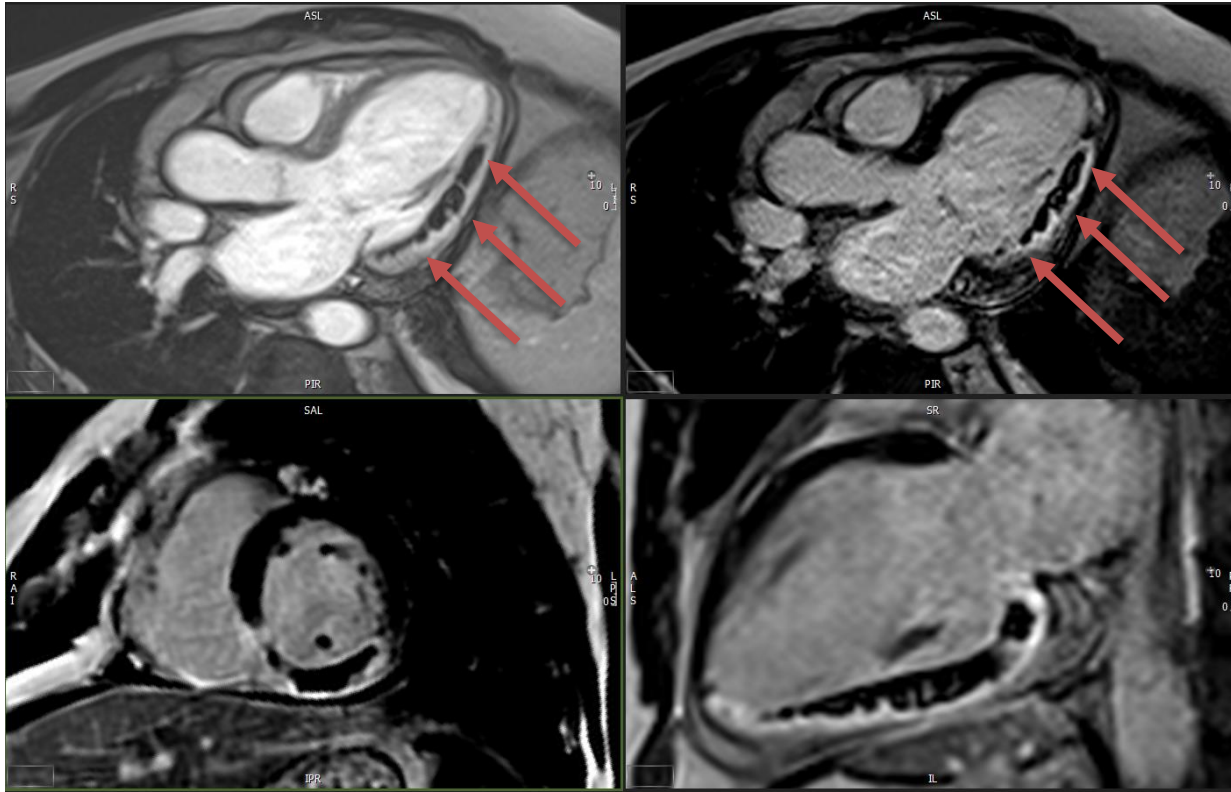
Told it was an excellent angiographic result

Echo said mild inferior and lateral wall  
hypokinesis but good LVEF

Discharged to GP and planned follow-up  
hopefully 3-6 months

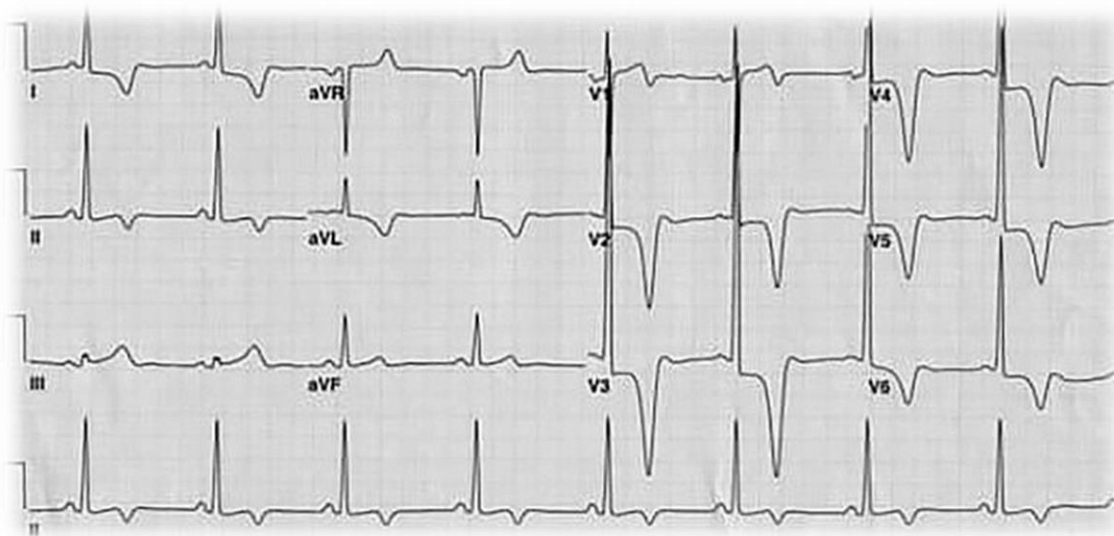


# Post Contrast Images



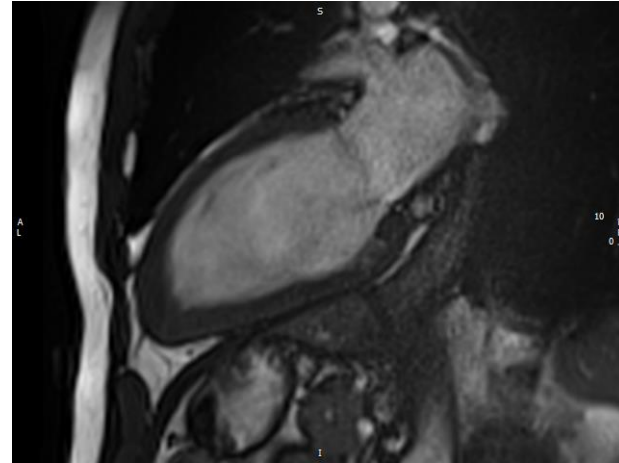
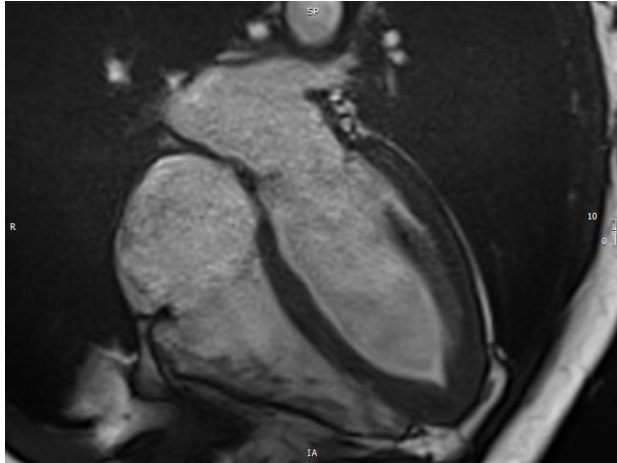
# CMR and An Abnormal ECG

Internal use only by approved personnel. Unpublished Work © Beacon Hospital. All rights Reserved. In Strict Confidence.

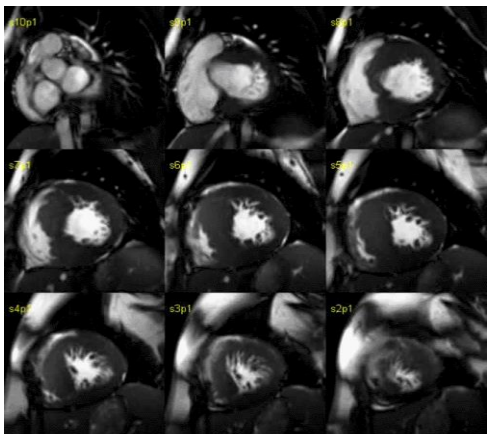
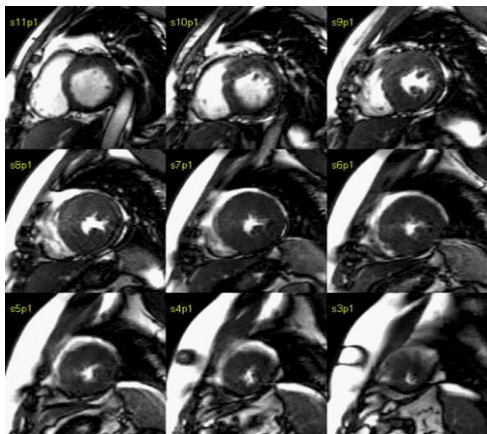


- 51 year high level runner
- Sinus brady 46bpm but significant TWI throughout
- Normal echo

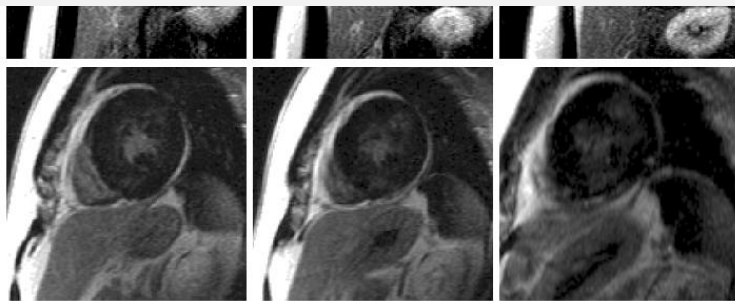


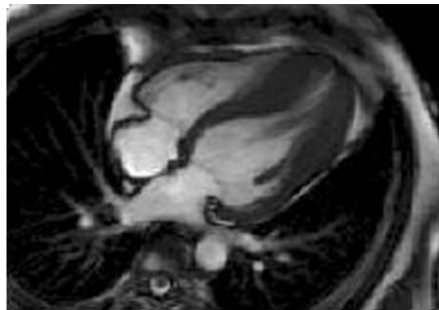


# CMR and Decision Making

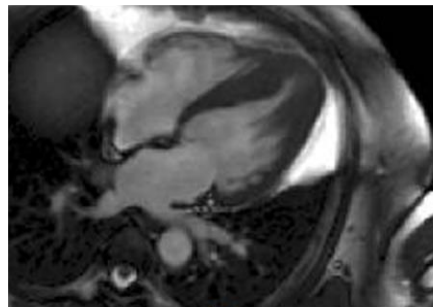


- What if one patient had 3 beats on NSVT on 48 hr holter
- What if holter showed couplets, frequent PVCs(5-10%)?
- How long to do a holter for?
  - ILR vs 48hr?

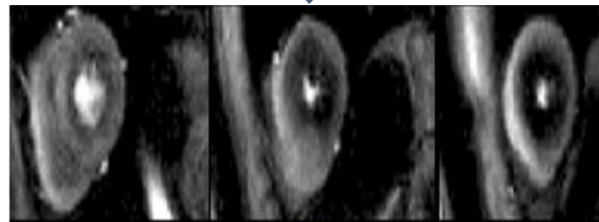
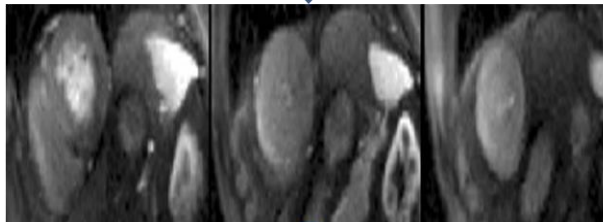




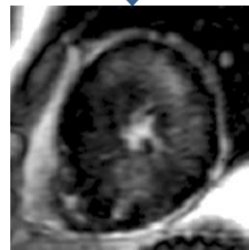
CINE



PERFUSION



LGE



## HCM Risk-SCD Calculator

Age 65 Years

Age at evaluation

Maximum LV wall thickness 26 mm

Transthoracic Echocardiographic measurement

Left atrial size 42 mm

Left atrial diameter determined by M-Mode or 2D echocardiography in the parasternal long axis plane at time of evaluation

Max LVOT gradient 70 mmHg

The maximum LV outflow gradient determined at rest and with Valsalva provocation (irrespective of concurrent medical treatment) using pulsed and continuous wave Doppler from the apical three and five chamber views. Peak outflow tract gradients should be determined using the modified Bernoulli equation:  $\text{Gradient} = 4V^2$ , where  $V$  is the peak aortic outflow velocity

Family History of SCD ☒ No ☐ Yes

History of sudden cardiac death in 1 or more first degree relatives under 40 years of age or SCD in a first degree relative with confirmed HCM at any age (post or ante-mortem diagnosis).

Non-sustained VT ☒ No ☐ Yes

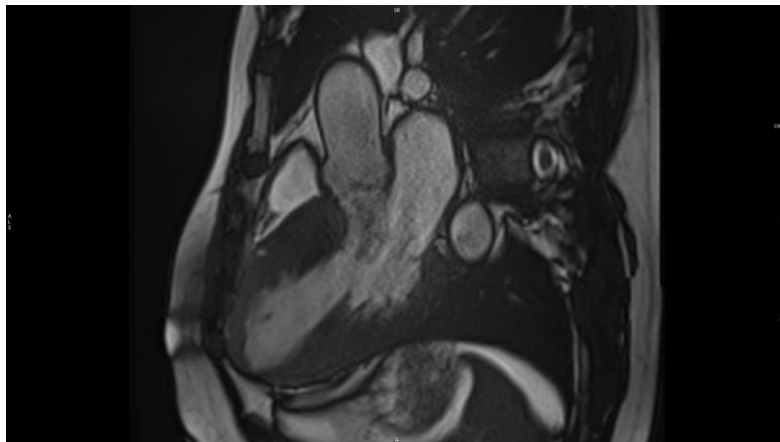
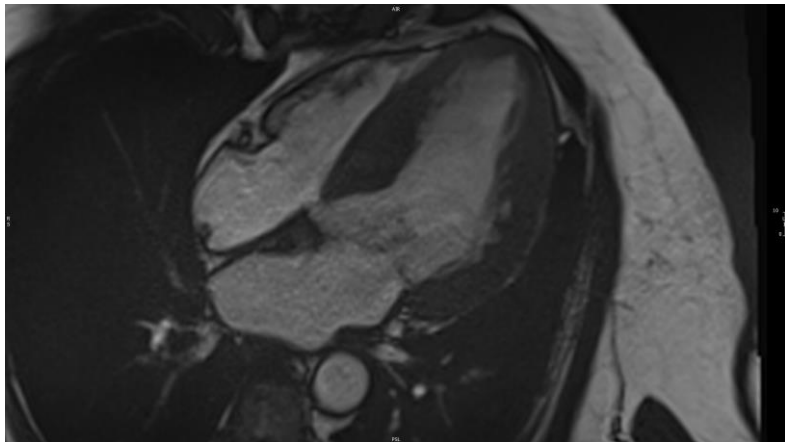
3 consecutive ventricular beats at a rate of 120 beats per minute and <30s in duration on Holter monitoring (minimum duration 24 hours) at or prior to evaluation.

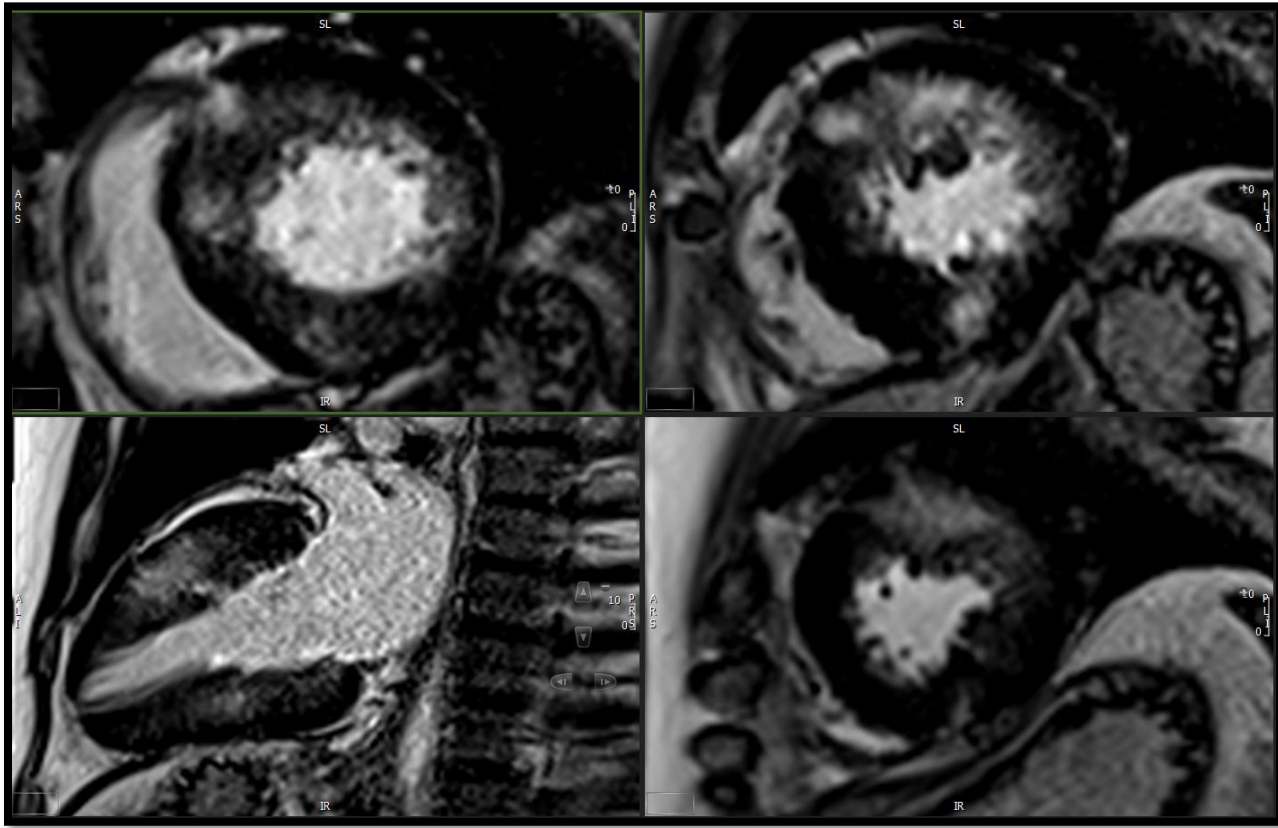
Unexplained syncope ☒ No ☐ Yes

History of unexplained syncope at or prior to evaluation.

Risk of SCD at 5 years (%): 2.15

ESC recommendation: ICD generally not indicated \*\*



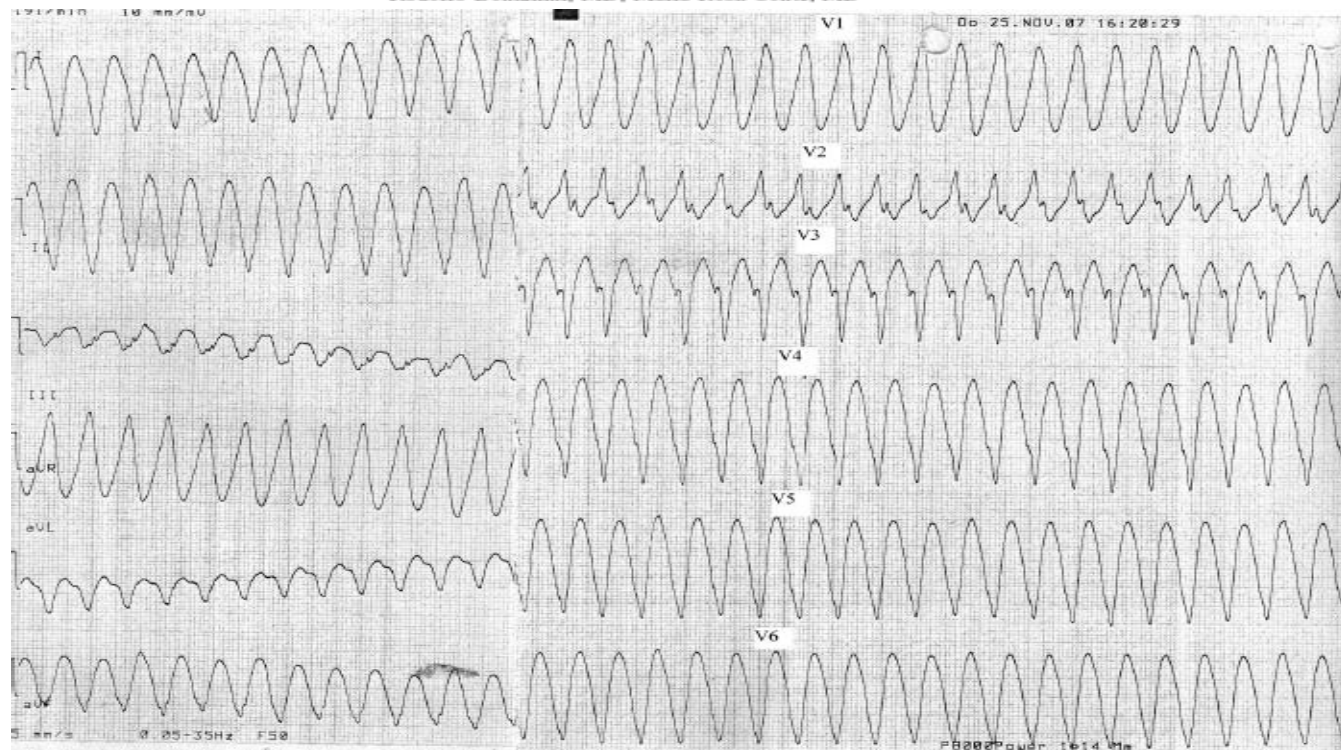


I REMAIN CONCERNED



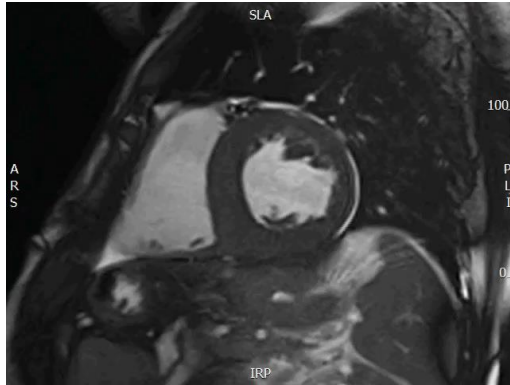
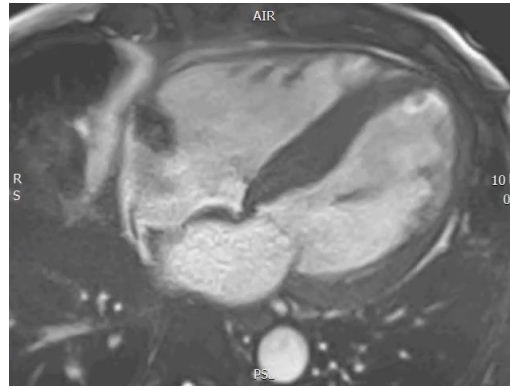
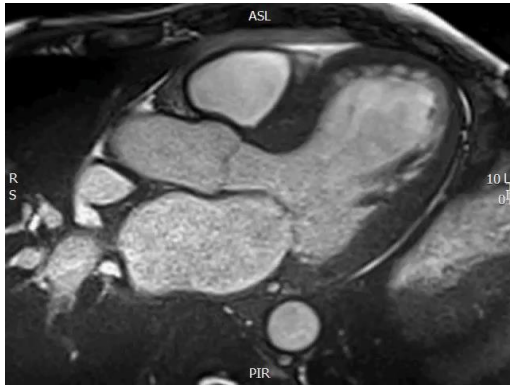
### Extensive Myocardial Fibrosis in a Patient With Hypertrophic Cardiomyopathy and Ventricular Tachycardia Without Traditional High-Risk Features

Sergio Bongioanni, MD; Paolo Spirito, MD; Andrea Sibona Masi, MD; Amedeo Chiribiri, MD;  
Rodolfo Bonamini, MD; Maria Rosa Conte, MD

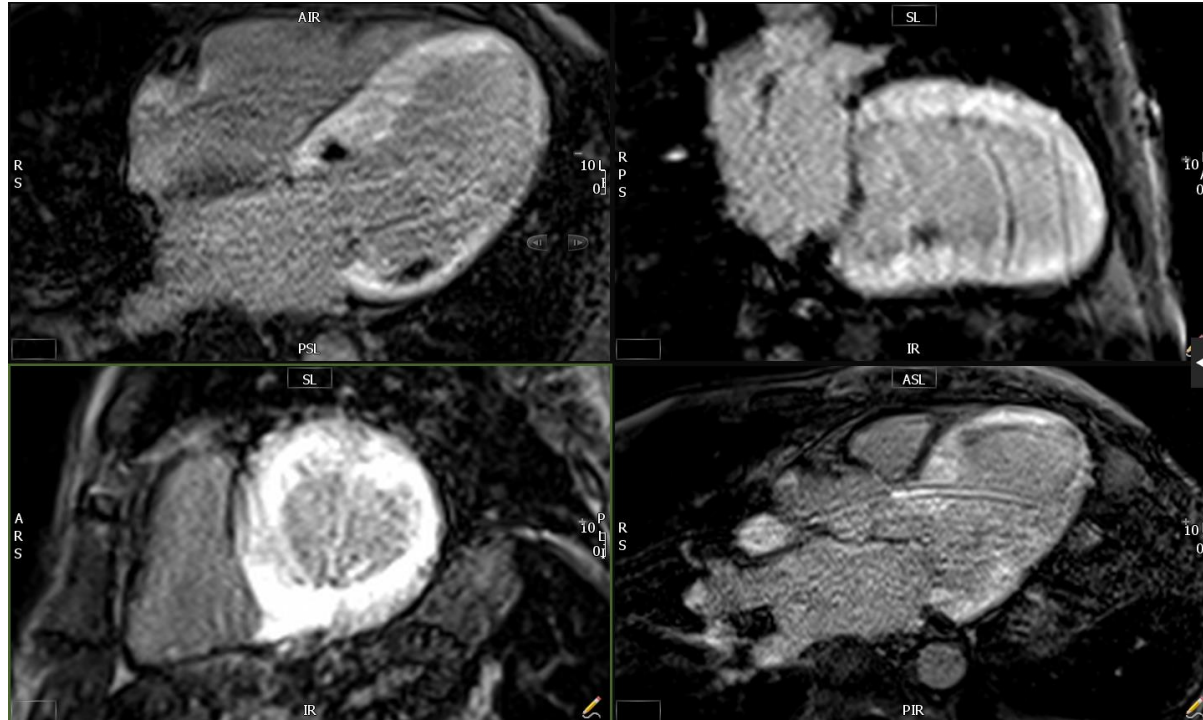


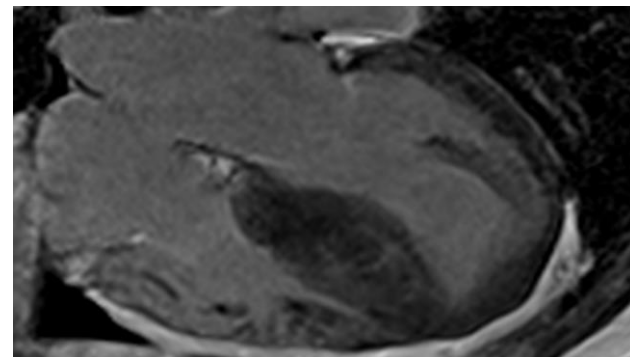
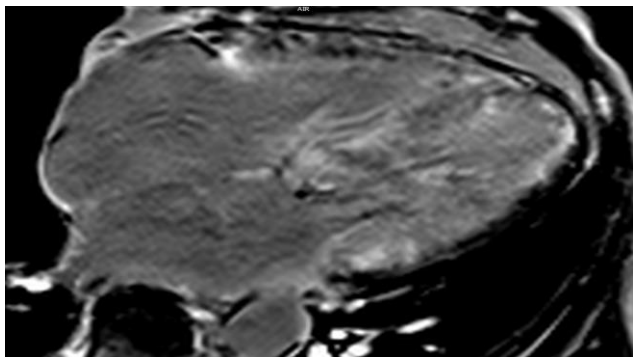
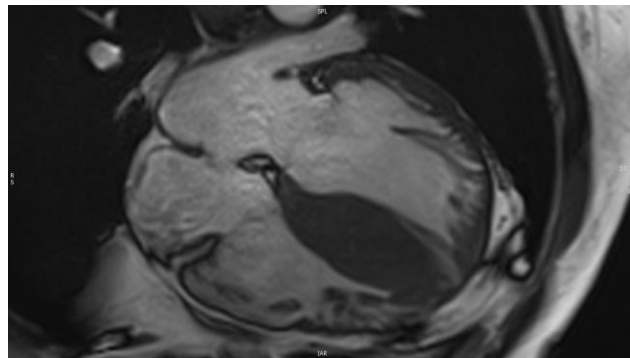
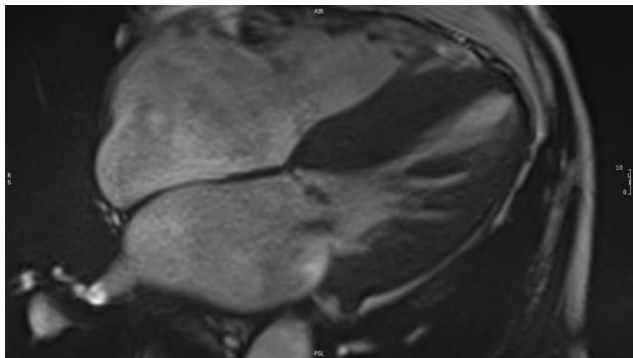


## Other Causes of LVH



# Is It Long Standing HTN Heart Disease?





# CMR and the dilated heart

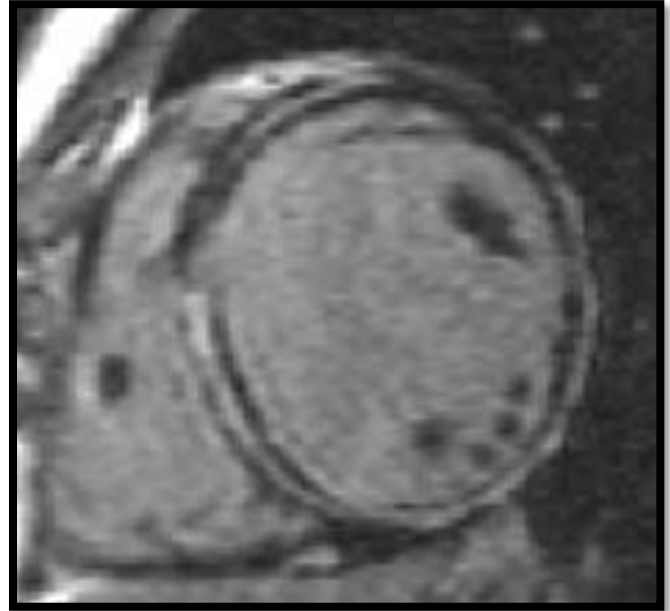
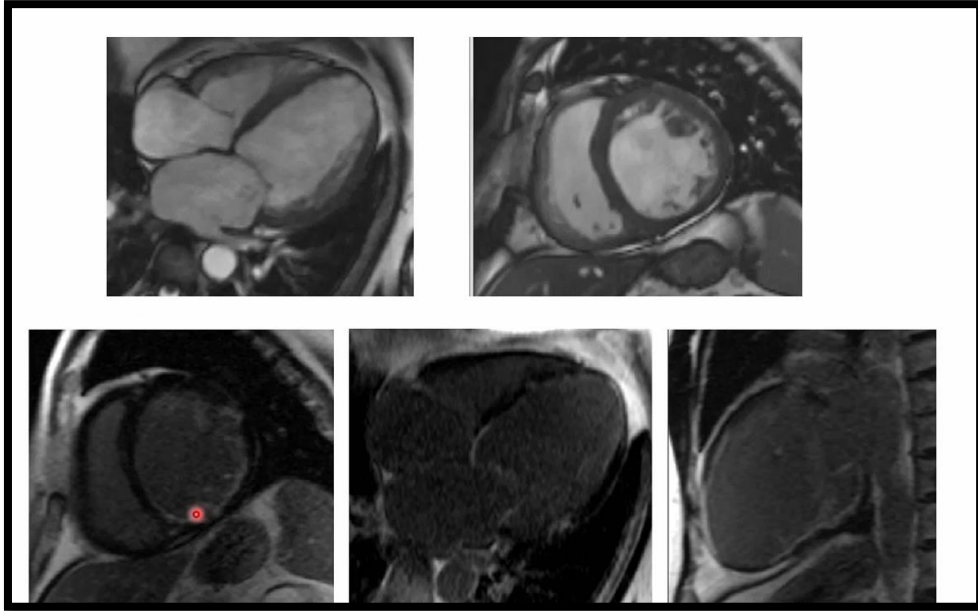
# Case

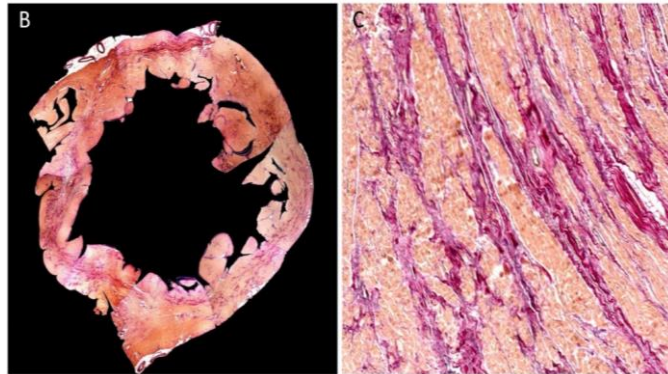
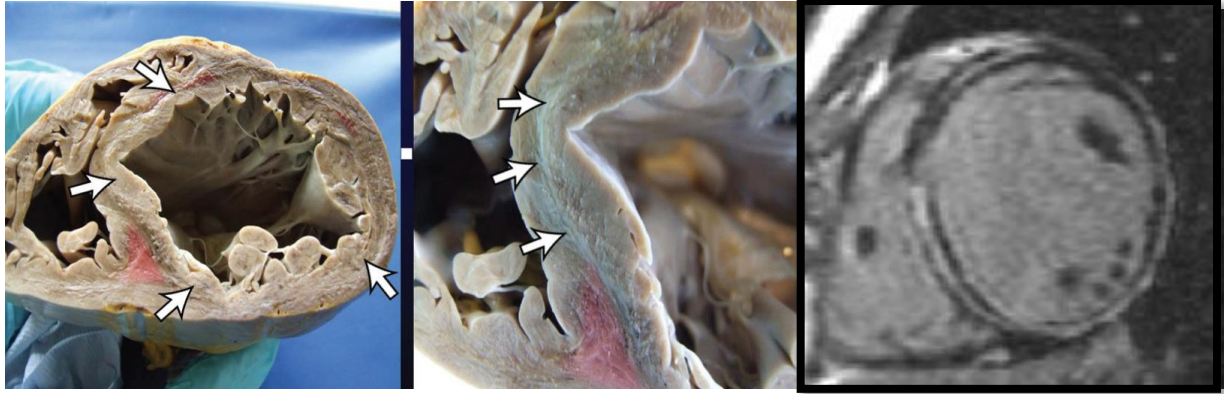
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- 48 year old regular exerciser
- Presents with worsening SOB/OE.
- LBBB
- Poor EF
- Normal angiogram

So what now?

# The Dilated Heart







# The Prognostic Value of Late Gadolinium-Enhanced Cardiac Magnetic Resonance Imaging in Nonischemic Dilated Cardiomyopathy



## A Review and Meta-Analysis

Marthe A.J. Becker, MD,<sup>a,b</sup> Jan H. Cornel, MD, PhD,<sup>a</sup> Peter M. van de Ven, PhD,<sup>b</sup> Albert C. van Rossum, MD, PhD,<sup>b</sup>  
Comelis P. Allaart, MD, PhD,<sup>b</sup> Tjeerd Germans, MD, PhD<sup>a,b</sup>

**RESULTS** Data from 34 studies were included, with a total of 4,554 patients. Contrast enhancement was present in 44.8% of DCM patients. Patients with LGE had increased cardiovascular mortality (odds ratio [OR]: 3.40; 95% confidence interval [CI]: 2.04 to 5.67), ventricular arrhythmic events (OR: 4.52; 95% CI: 3.41 to 5.99), and rehospitalization for heart failure (OR: 2.66; 95% CI: 1.67 to 4.24) compared with those without LGE. Moreover, the absence of LGE predicted left ventricular reverse remodeling (OR: 0.15; 95% CI: 0.06 to 0.36).

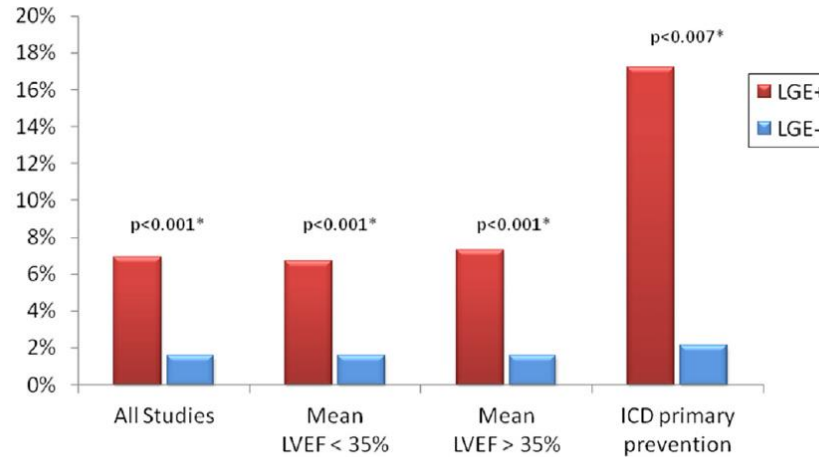
**CONCLUSIONS** The presence of LGE on CMR substantially worsens prognosis for adverse cardiovascular events in DCM patients, and the absence indicates left ventricular reverse remodeling. (J Am Coll Cardiol Img 2018;11:1274-84)  
© 2018 by the American College of Cardiology Foundation.

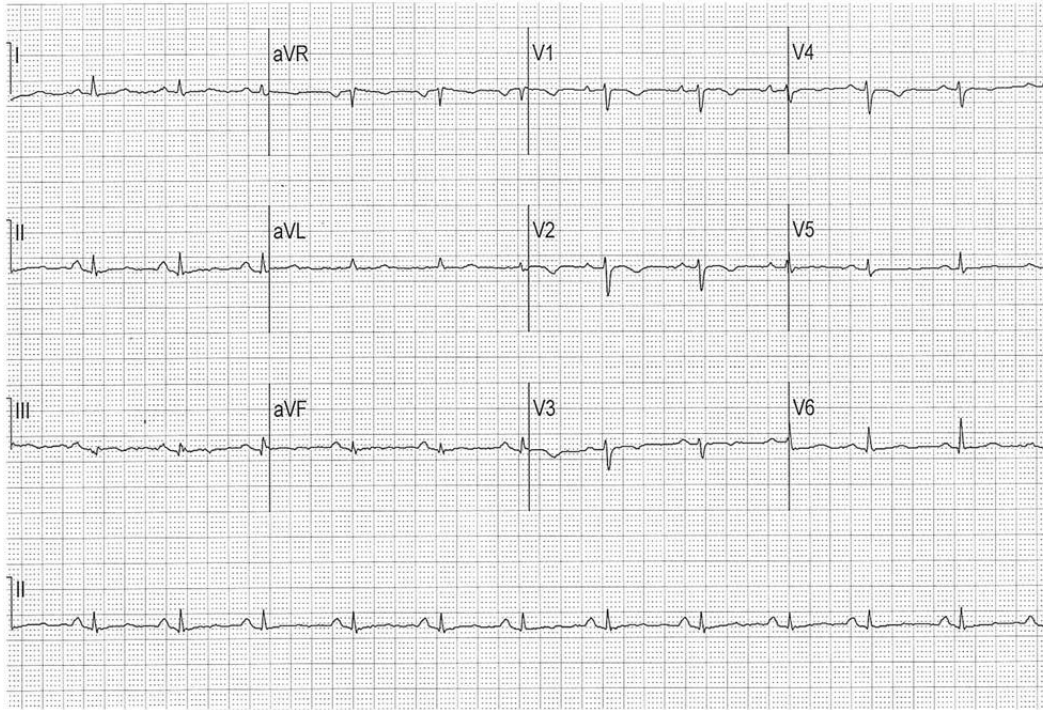
# Late Gadolinium Enhancement and the Risk for Ventricular Arrhythmias or Sudden Death in Dilated Cardiomyopathy



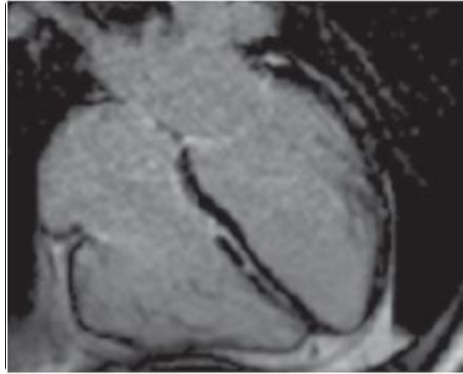
## Systematic Review and Meta-Analysis

**FIGURE 3** Annual Rate of the Arrhythmic Endpoint According to Late Gadolinium Enhancement Status

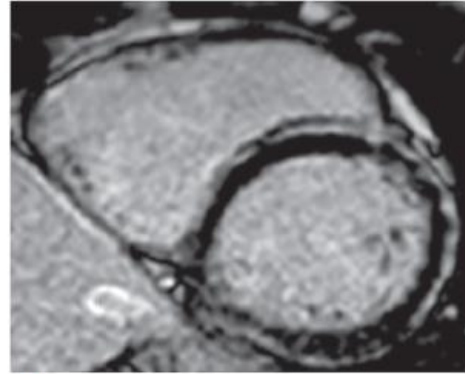




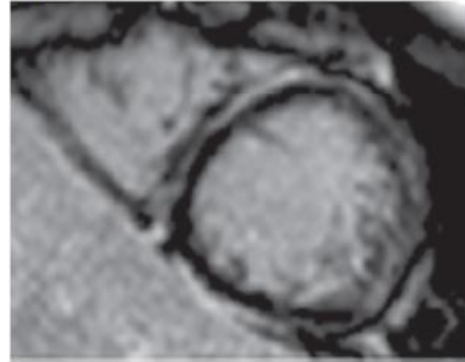
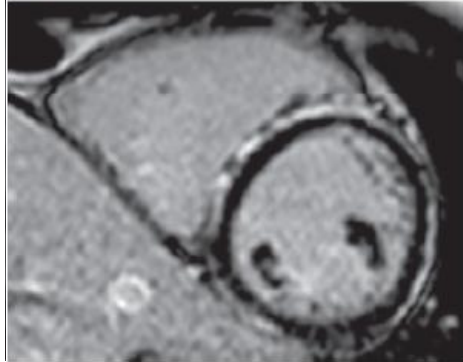
28 year old male. Unaware of family hx  
Palpitations  
One syncopal event. No real warning  
Holter shows 15% burden of PVCs  
Unremarkable ETT  
Normal ECHO

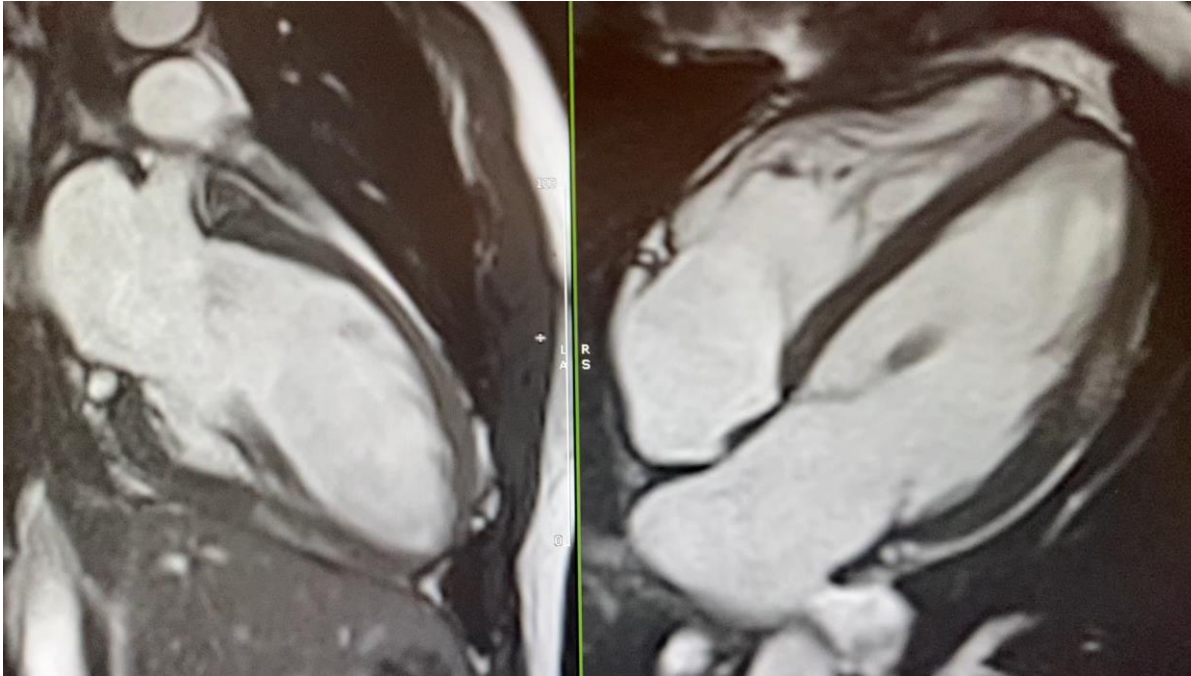


G

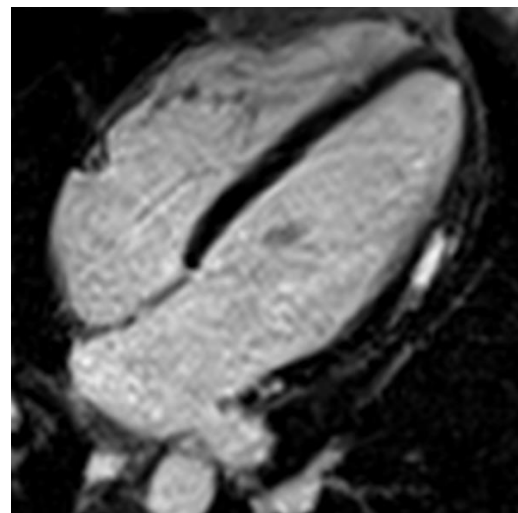
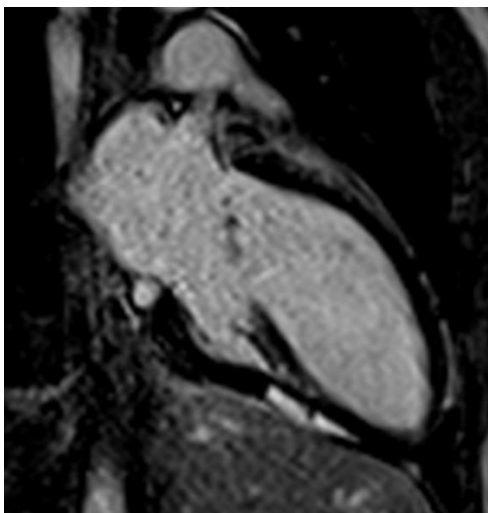
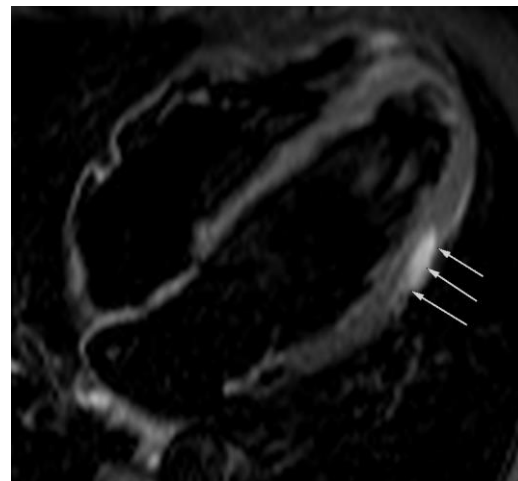
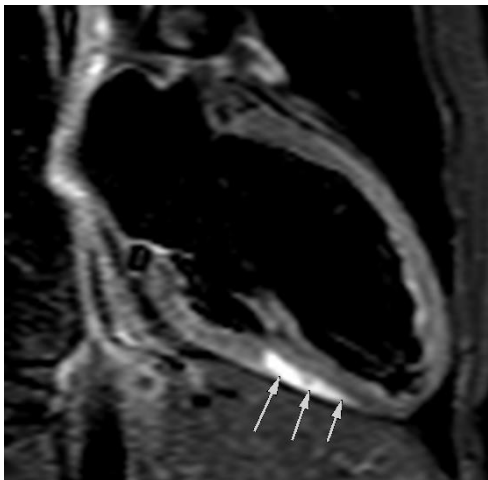


H

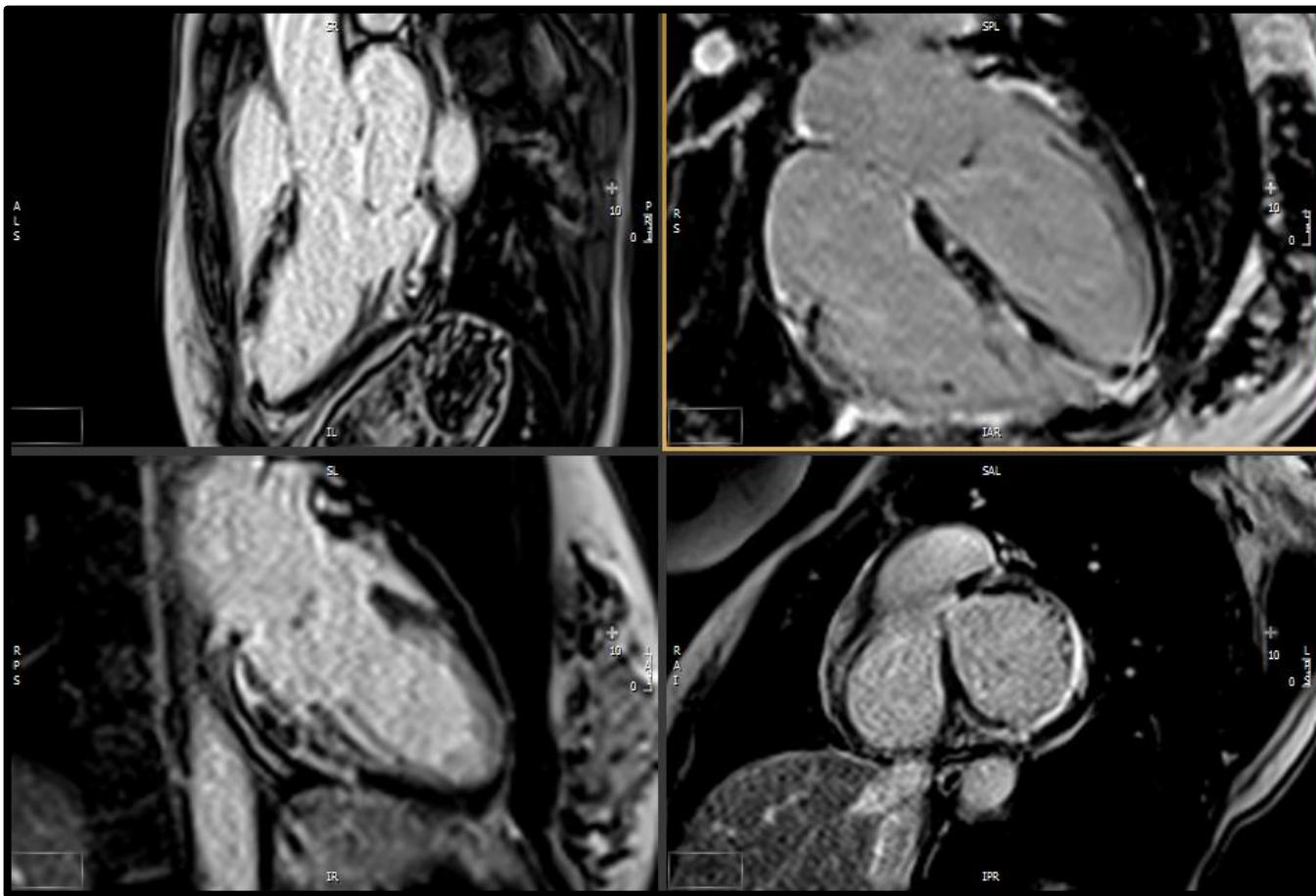




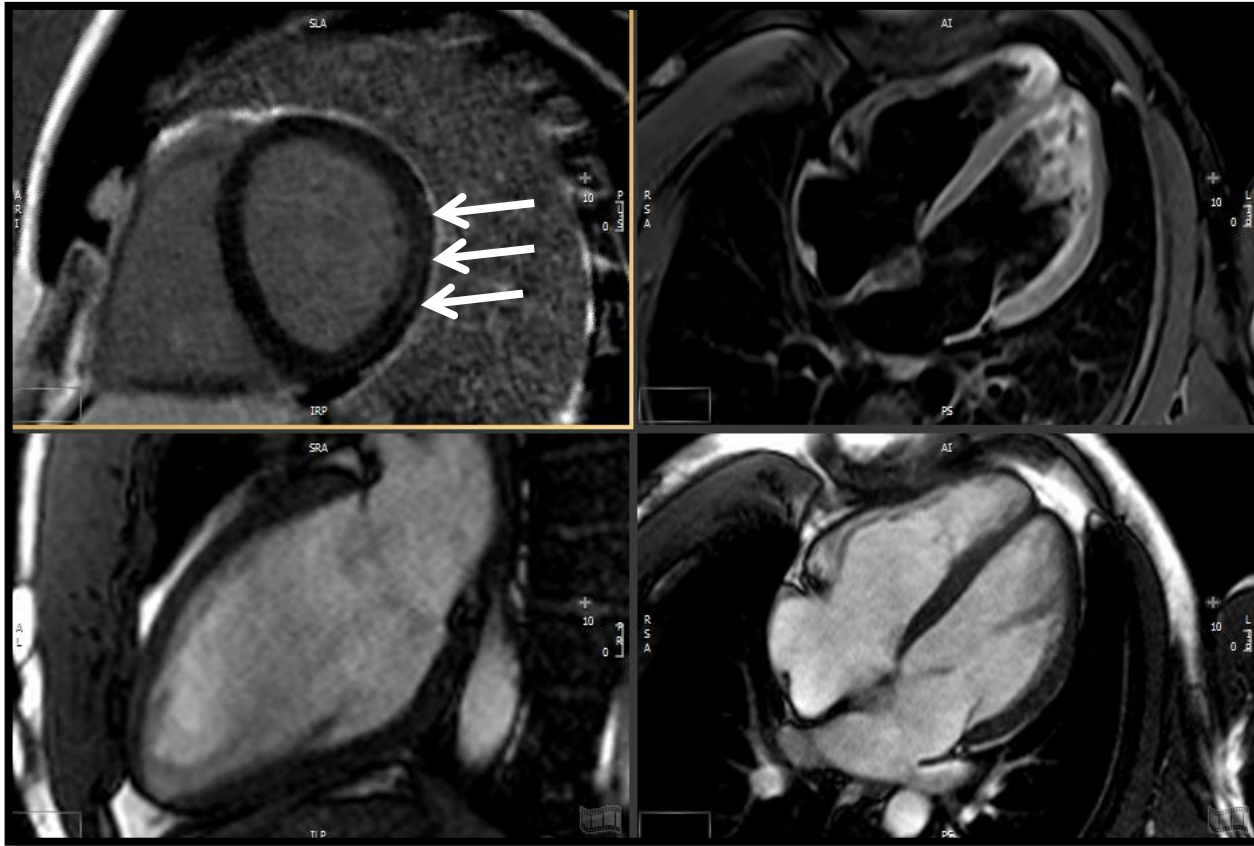
22 Year old. Tnl positive chest pain.  
Recent COVID.





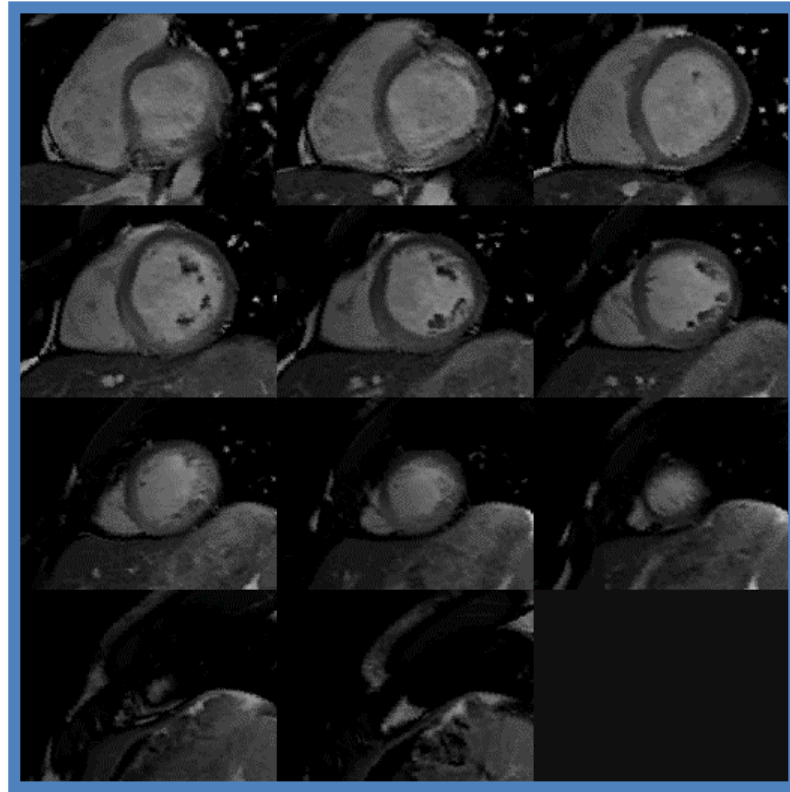
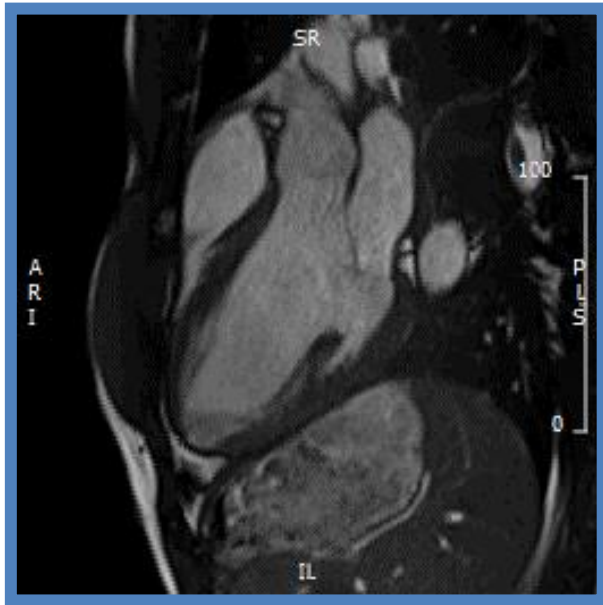


**41 year old athlete- possible sarcoid. Negative biopsy. Vague palpitations. No syncope. Normal echo and normal 24 hr holter.**



**33 yr old athlete. 100 Triathlons. 6 Iron Men.  
Tachycardia and palpitations with exercise.**





Male 36, army. High level exerciser. Recent palpitations and collapse overseas. Normal echo. RBBB. Couplets, triplets and bigeminy on holter.

