



# Μαγνητική Τομογραφία Εφαρμογές στην Καρδιολογία

**Θεόδωρος Καραμήτσος**

Hon Consultant Cardiologist

University of Oxford Research Lecturer

John Radcliffe Hospital

*Θεσσαλονίκη, 25 Μαΐου 2012  
11<sup>ο</sup> Βορ. Καρδιολογικό Συνέδριο*

# Indications for CMR imaging

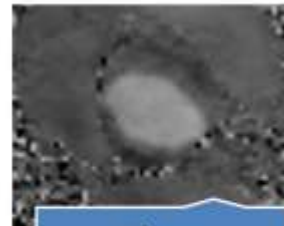
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- Ischemic Heart Disease – viability & ischemia
- Non-ischemic Cardiomyopathies
- Valvular heart disease
- Congenital heart disease
- Aorta
- Masses/Tumours
- Pericardium

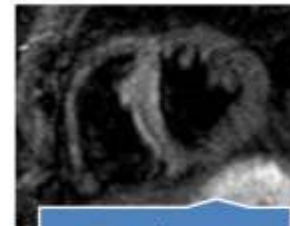
# CMR: a powerful tool in Cardiology



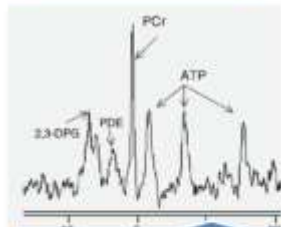
Function



Flow



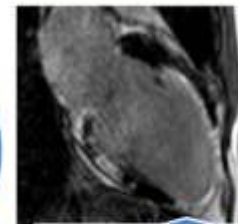
Oedema



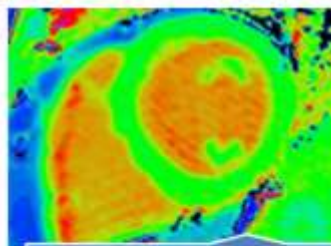
Spectroscopy



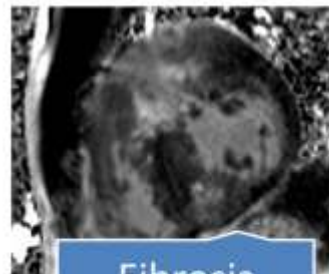
CMR



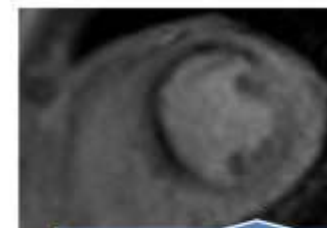
Viability



Tissue  
Characterization



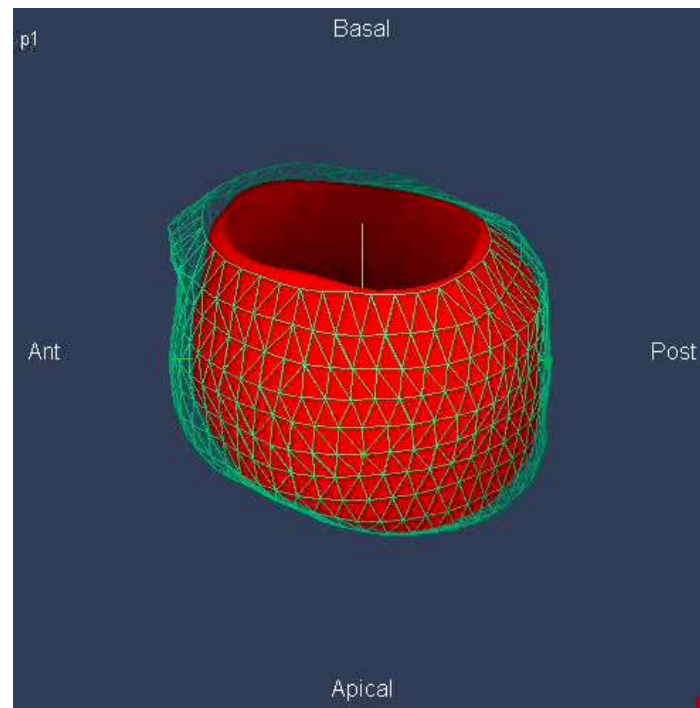
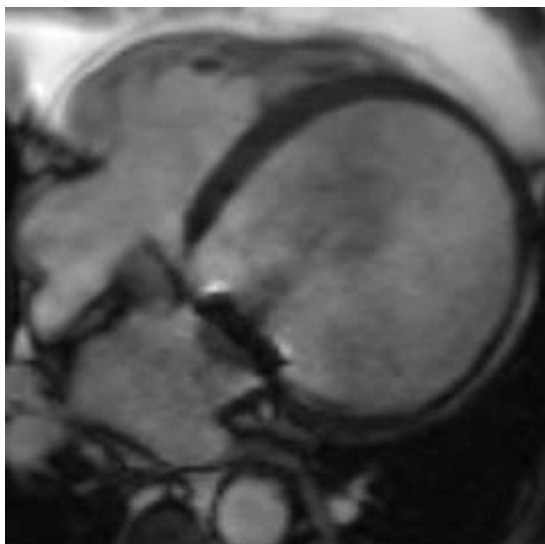
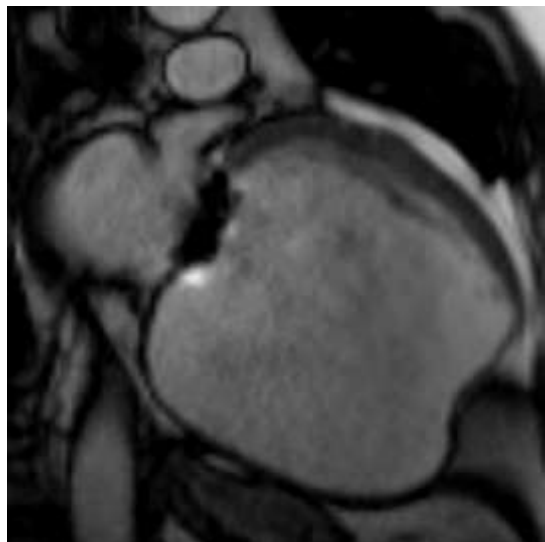
Fibrosis



Perfusion

Karamitsos T, Neubauer S. Progr Card Dis 2011

# Function in IHD



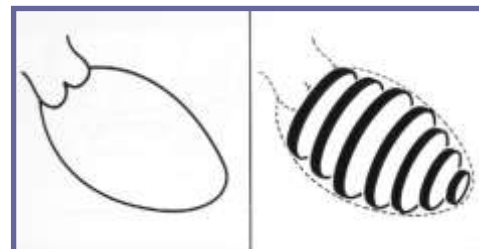
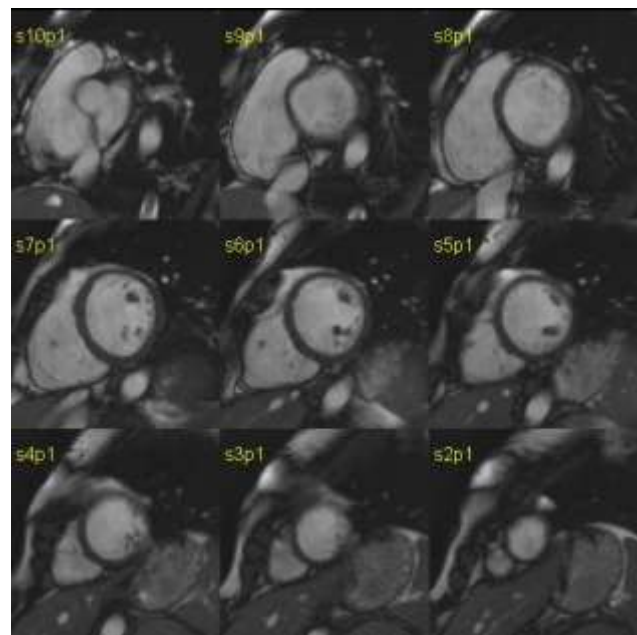
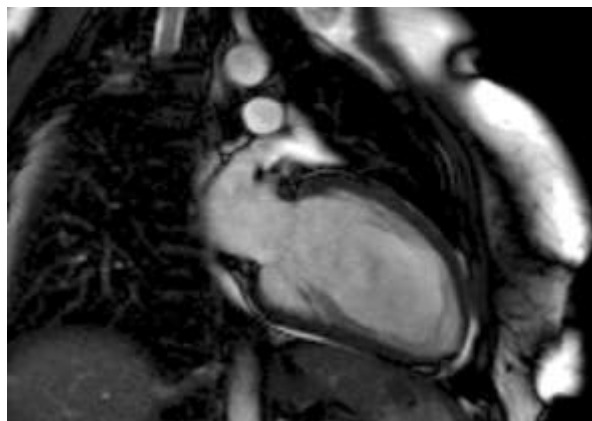
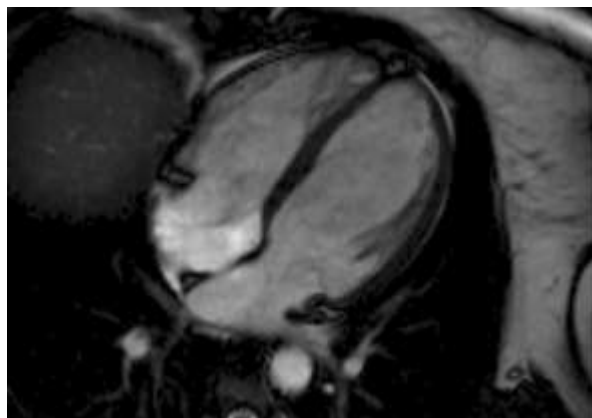
EDV 870ml (EDD 11cm)

ESV 778 ml

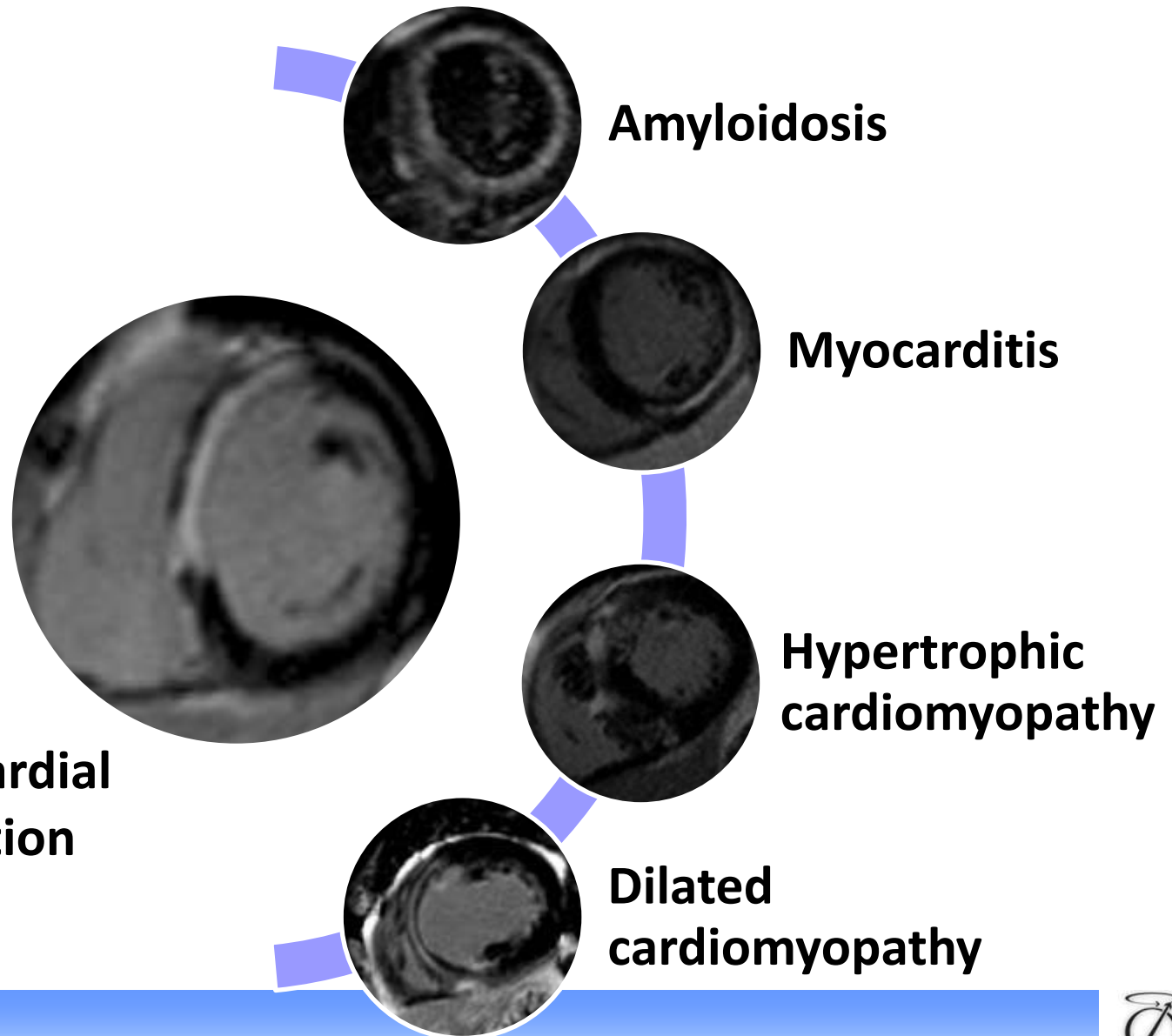
EF= 11%

LV mass 224gr

# How to assess Function with CMR

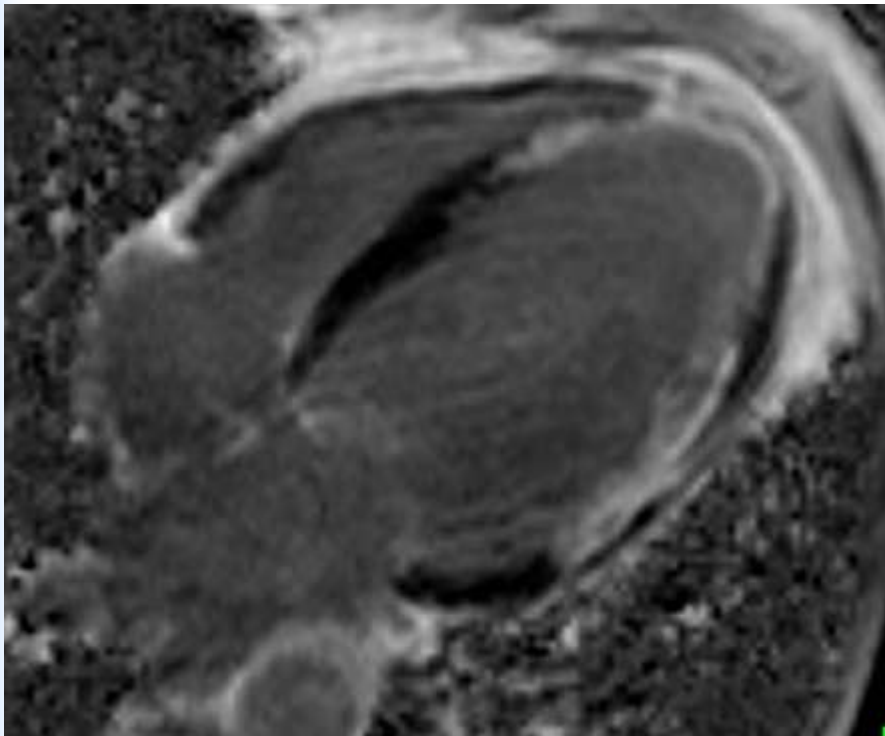


# Late Gadolinium Enhancement Patterns

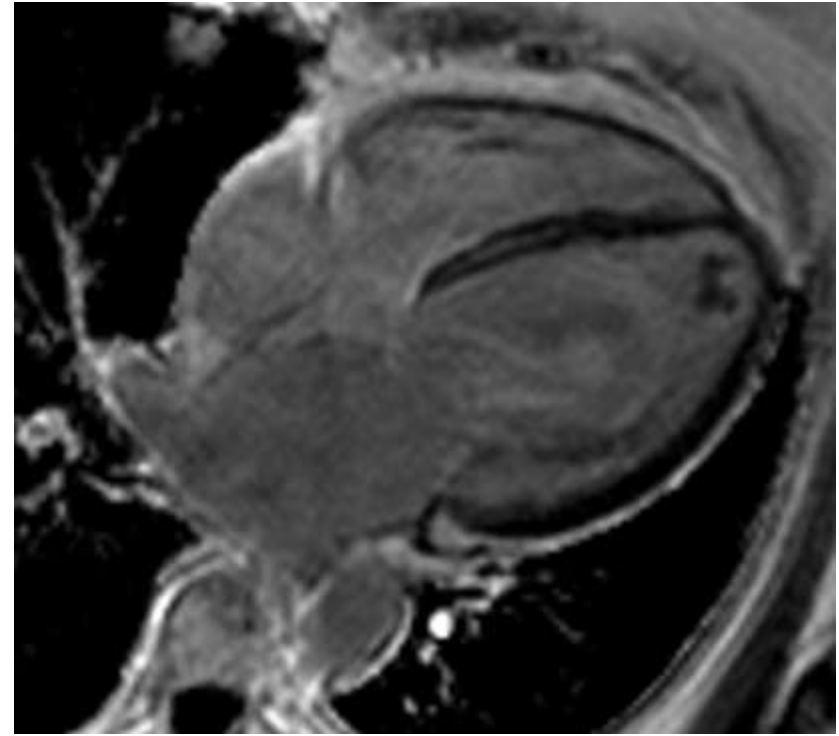


# *Heart Failure: ischaemic vs non-ischaemic aetiology*

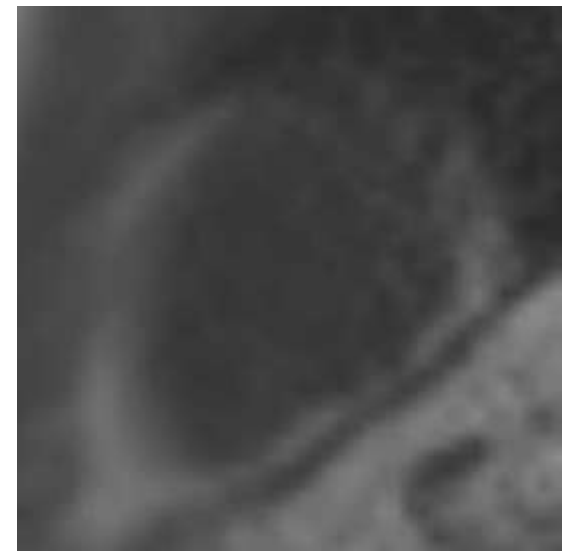
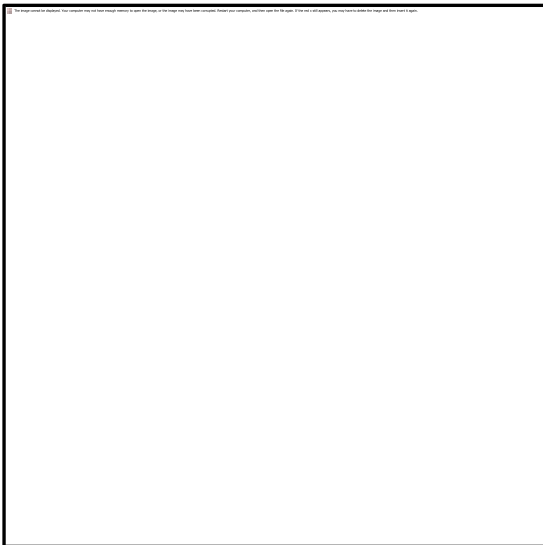
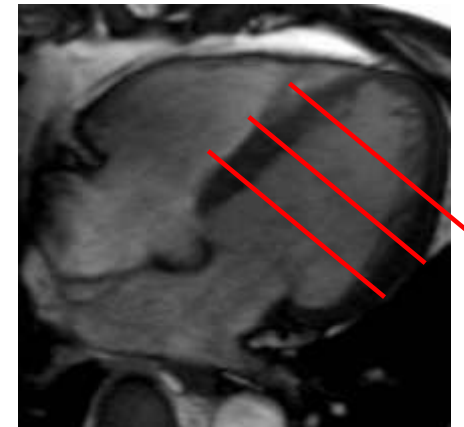
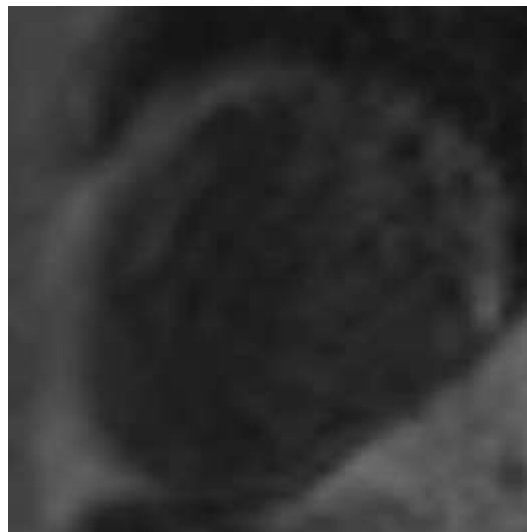
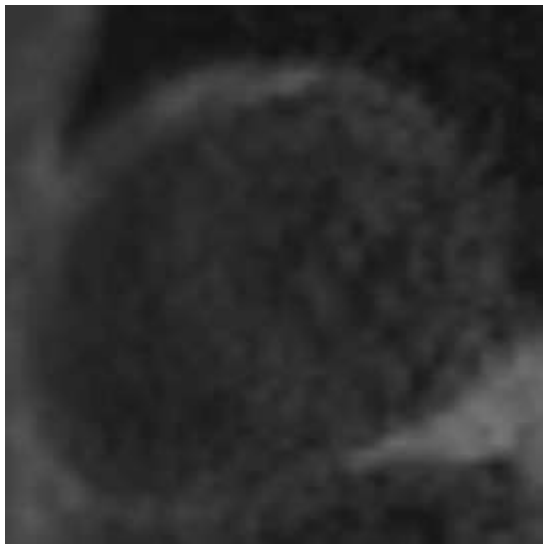
Ischaemic Cardiomyopathy



Non-ischaemic dilated cardiomyopathy



# *Stress perfusion CMR for ischemia*





# CE-MARC *study*

## CMR

Ευαισθησία 86.5%

Ειδικότητα 83.4%

## SPECT

Ευαισθησία 66.5%

Ειδικότητα 82.6%

752 ασθενείς

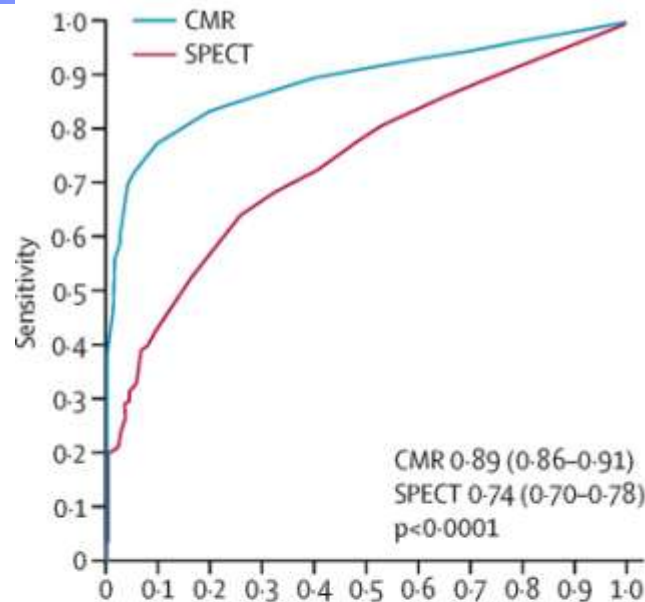
Gated SPECT

Adenosine

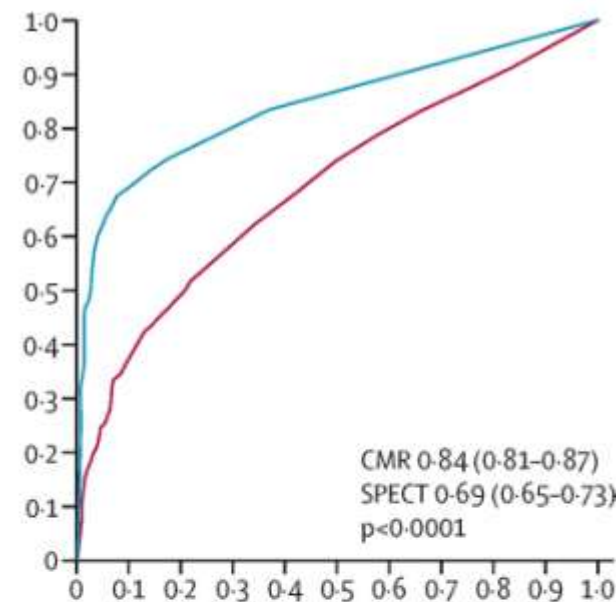
<sup>99m</sup>Tc tetrofosmin

Lancet 2012;379:453-60

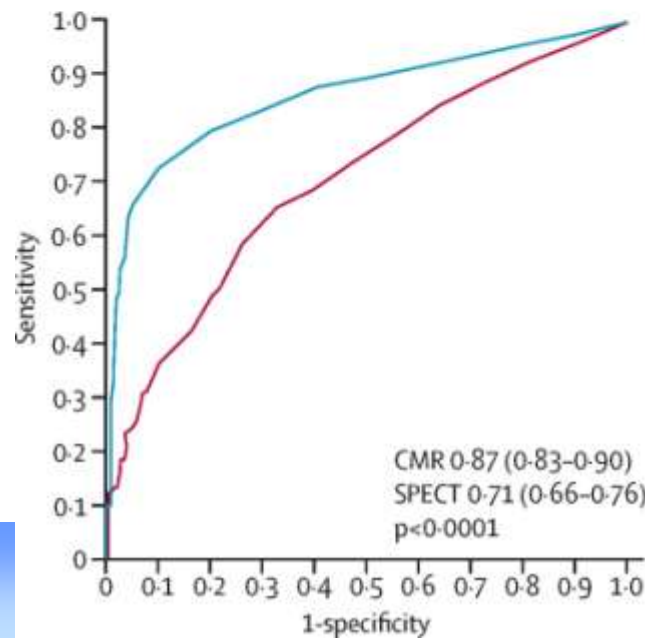
**A** All patients (angiographic cutoff  $\geq 50\%$  LMS;  $\geq 70\%$  for LAD, LCx, and RCA)



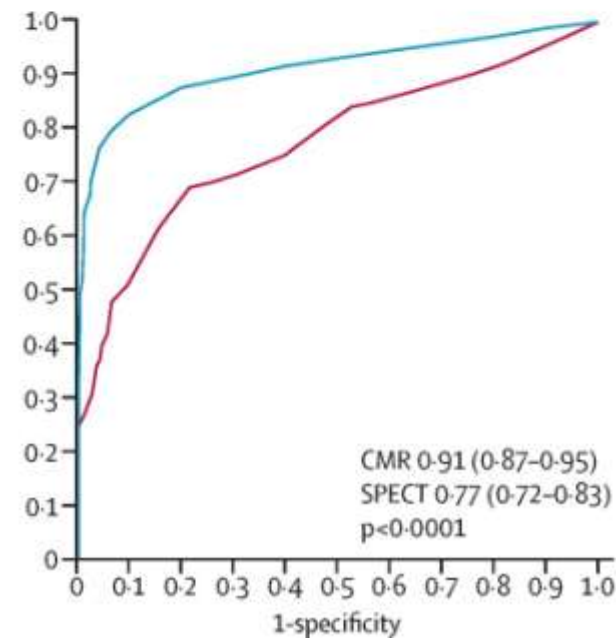
**B** All patients (angiographic cutoff  $\geq 50\%$  LMS, LAD, LCx, and RCA)



**C** Single vessel disease (angiographic cutoff  $\geq 50\%$  LMS;  $\geq 70\%$  for LAD, LCx, and RCA)

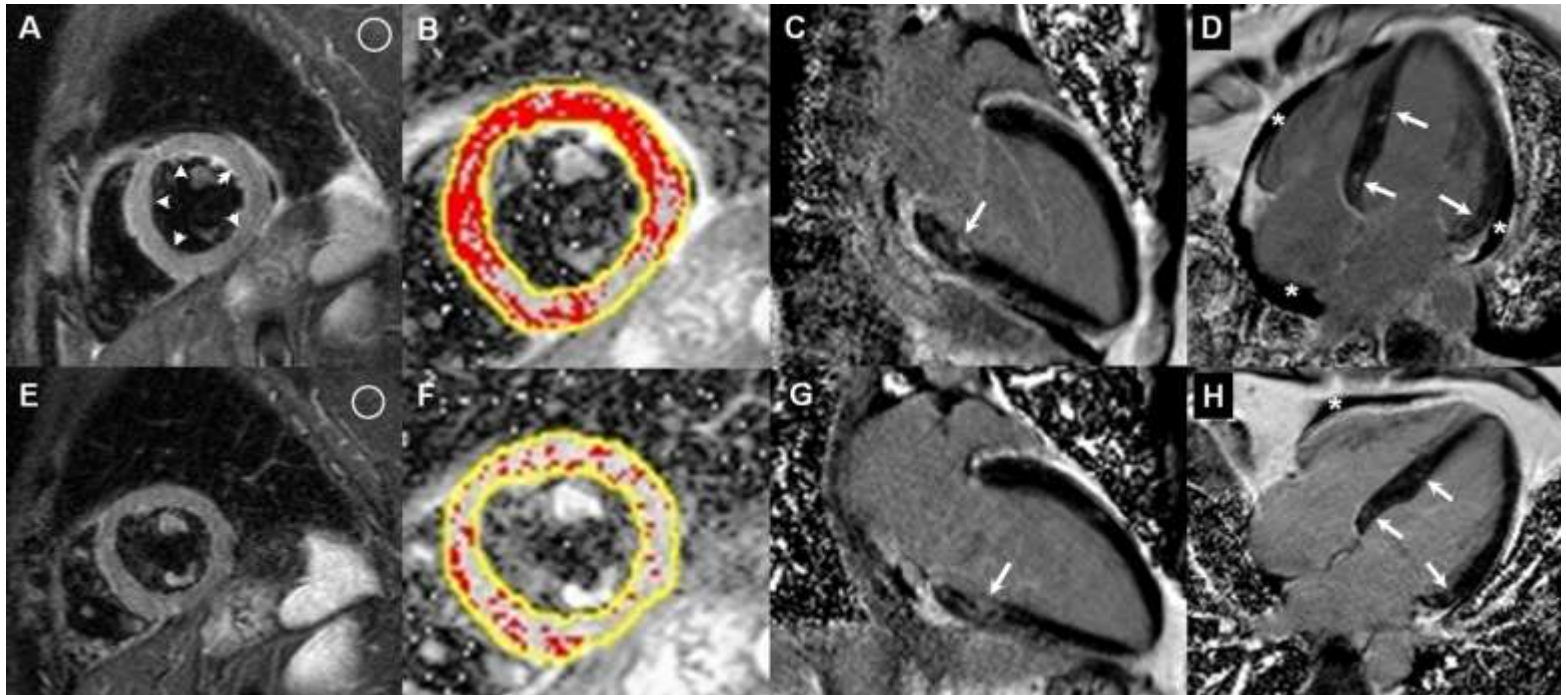


**D** Two or three vessel disease (angiographic cutoff  $\geq 50\%$  LMS;  $\geq 70\%$  for LAD, LCx, and RCA)



# *Myocarditis mimicking reverse Tako-tsubo Cardiomyopathy*

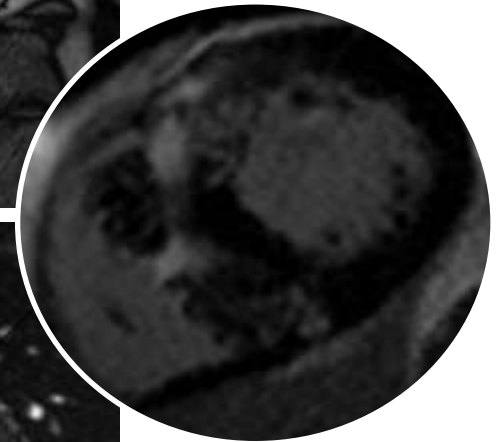
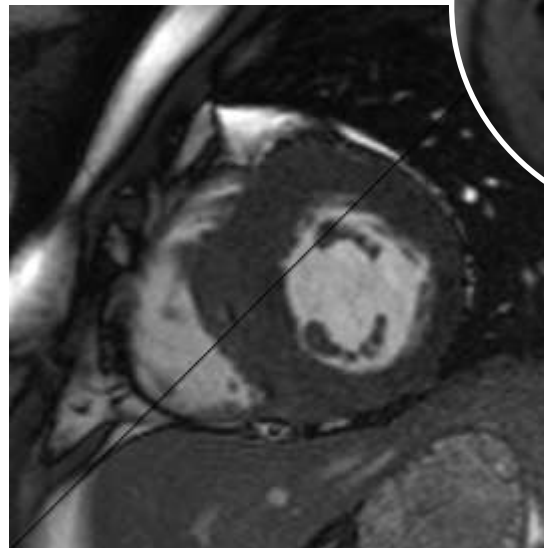
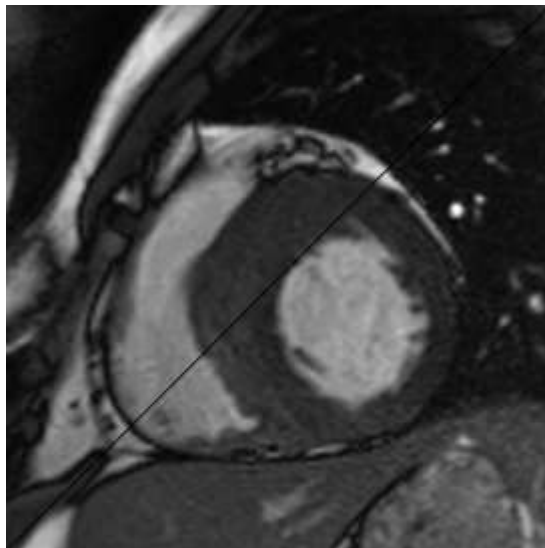
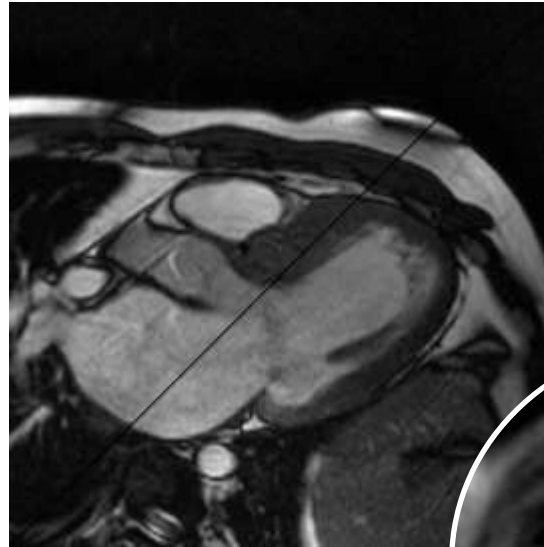
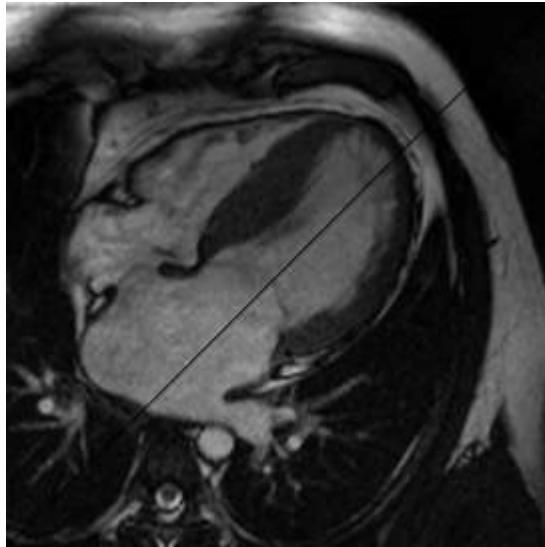
Baseline



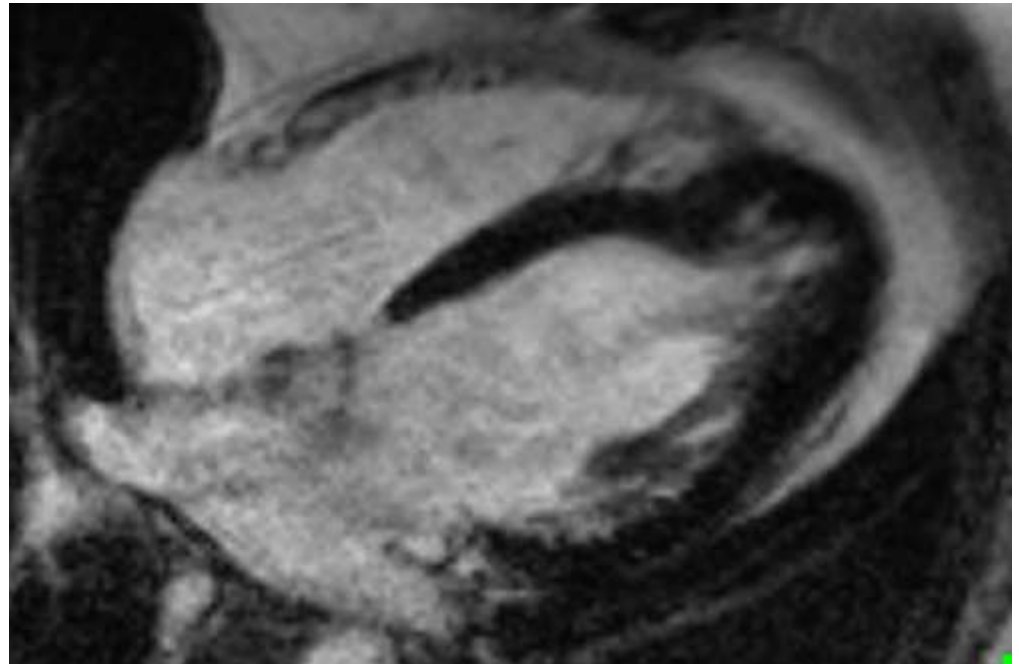
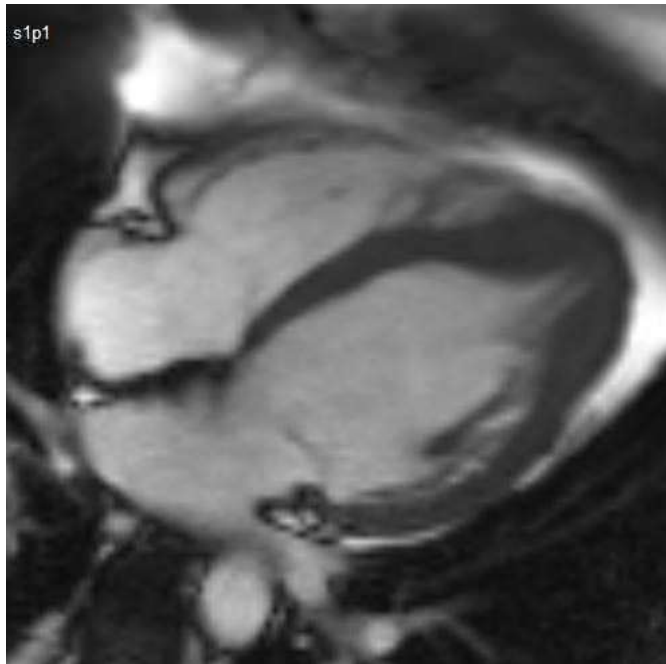
1 month  
f-up

Karamitsos et al. Circulation 2011

# HCM

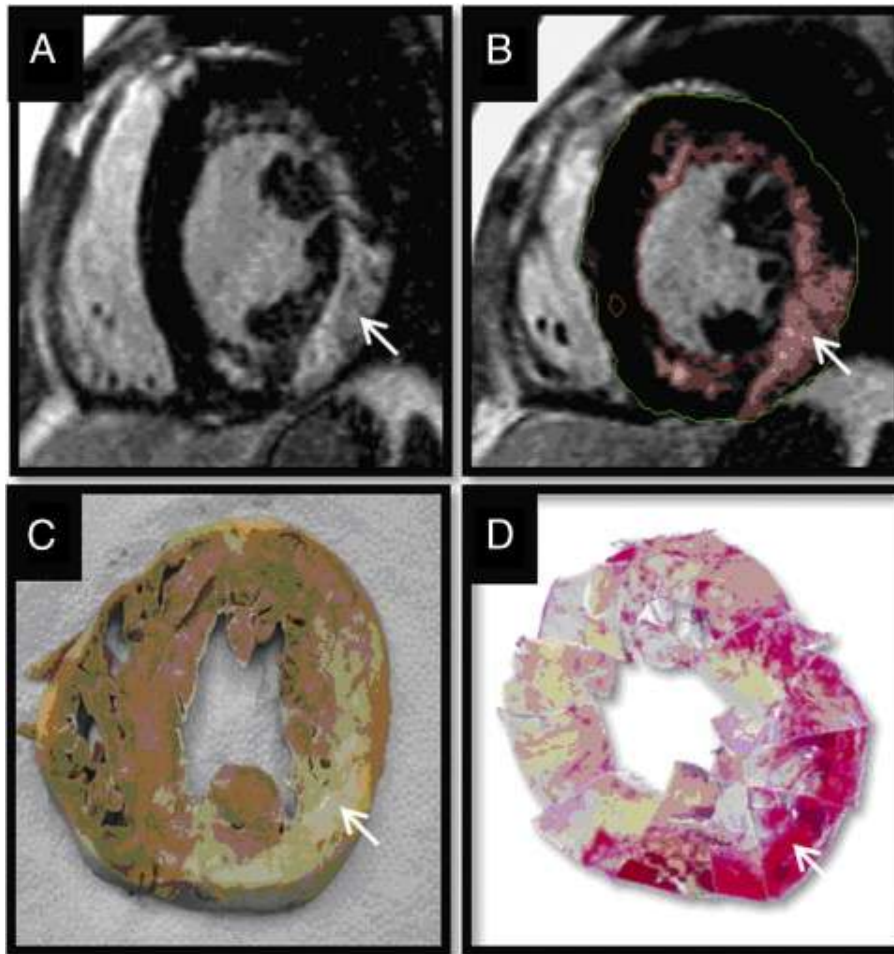


# *Apical HCM*



Detected by echo – further characterised by CMR

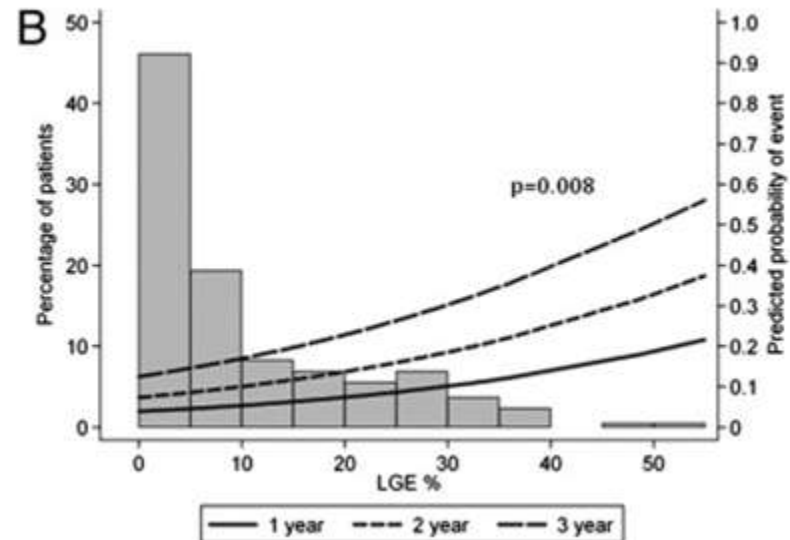
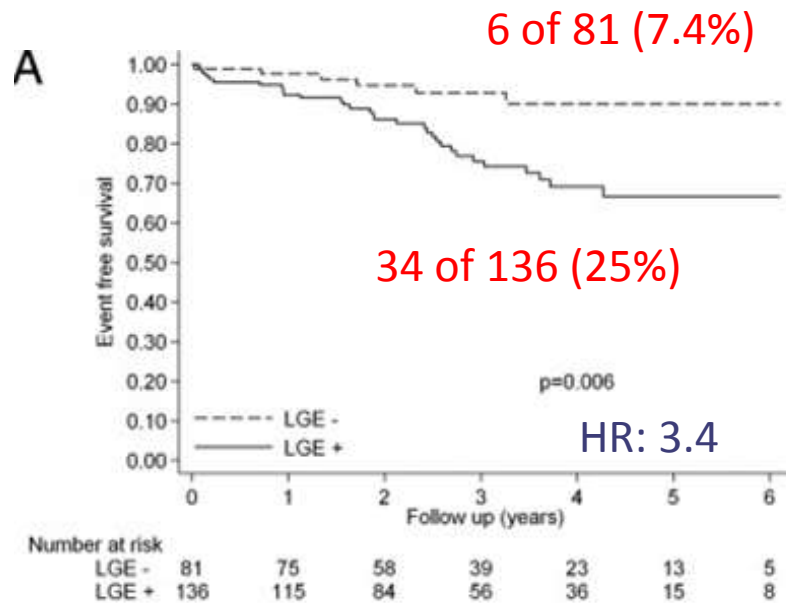
# HCM - Fibrosis



J Am Coll Cardiol, 2010; 56:867-874

# Prognostic Significance of LGE-CMR in HCM

n= 217 patients



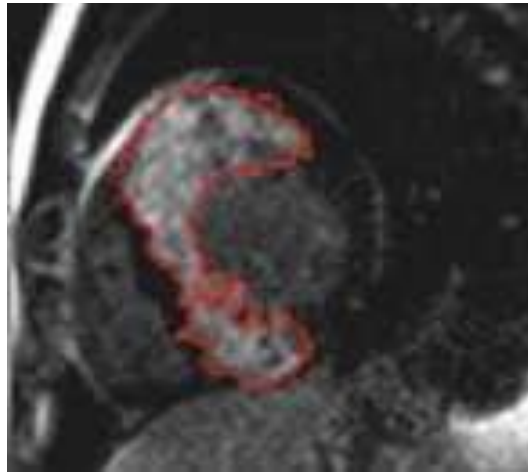
Primary Endpoint:  
 cardiovascular death  
 unplanned CV admission  
 sustained VT or VF,  
 appropriate ICD discharge

For every **5% increase in fibrosis**  
 the risk of reaching the primary end  
 point increases by **15%**

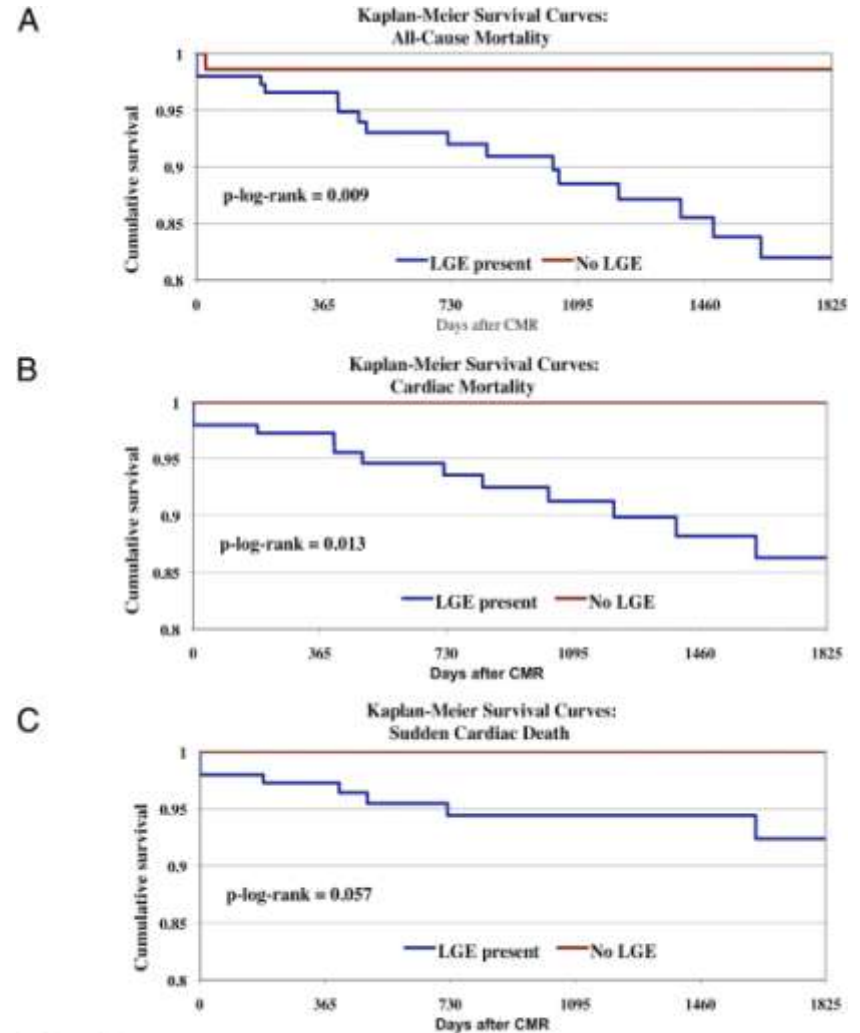
J Am Coll Cardiol, 2010; 56:867-874

# Prognostic Significance of LGE-CMR in HCM

- 220 HCM patients
- 20 patients died (9%)  
(16 cardiac death)
- 2 appropriate ICD discharges

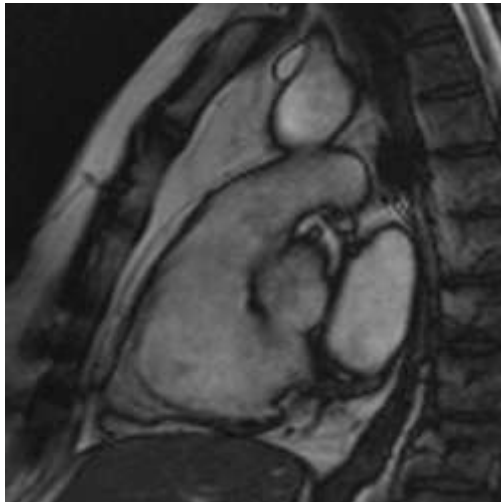
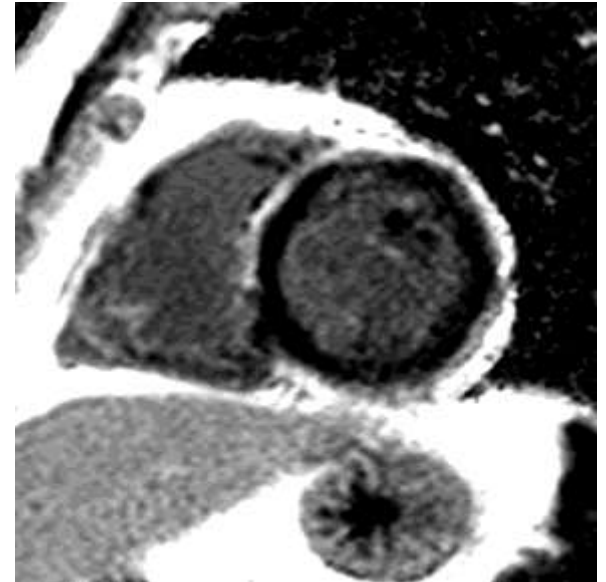
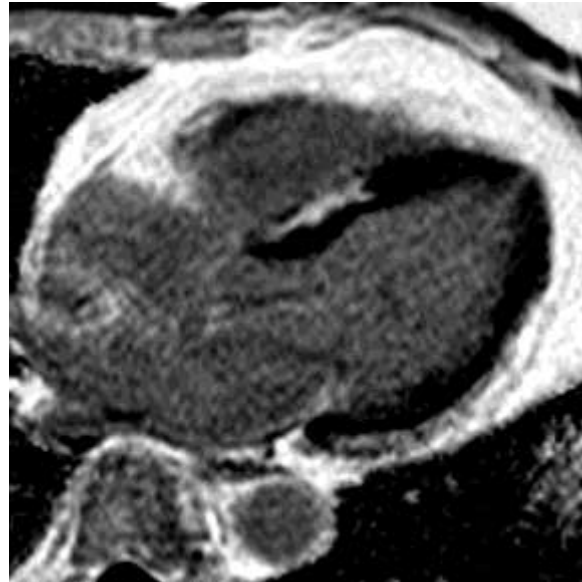
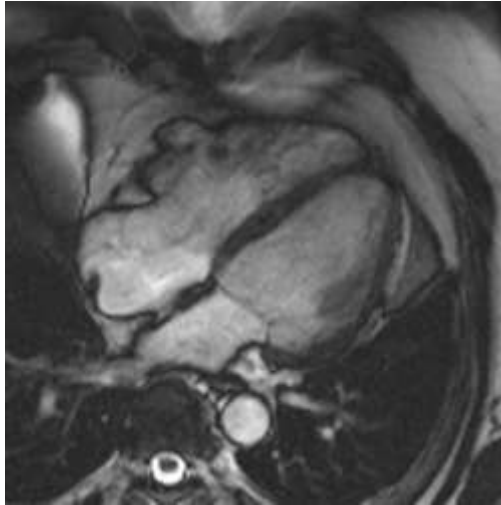


J Am Coll Cardiol, 2010; 56:875-887



Patients at risk	0	365	730	1095	1460	1825
LGE present	148	117	90	70	49	40
No LGE	72	64	49	39	26	19

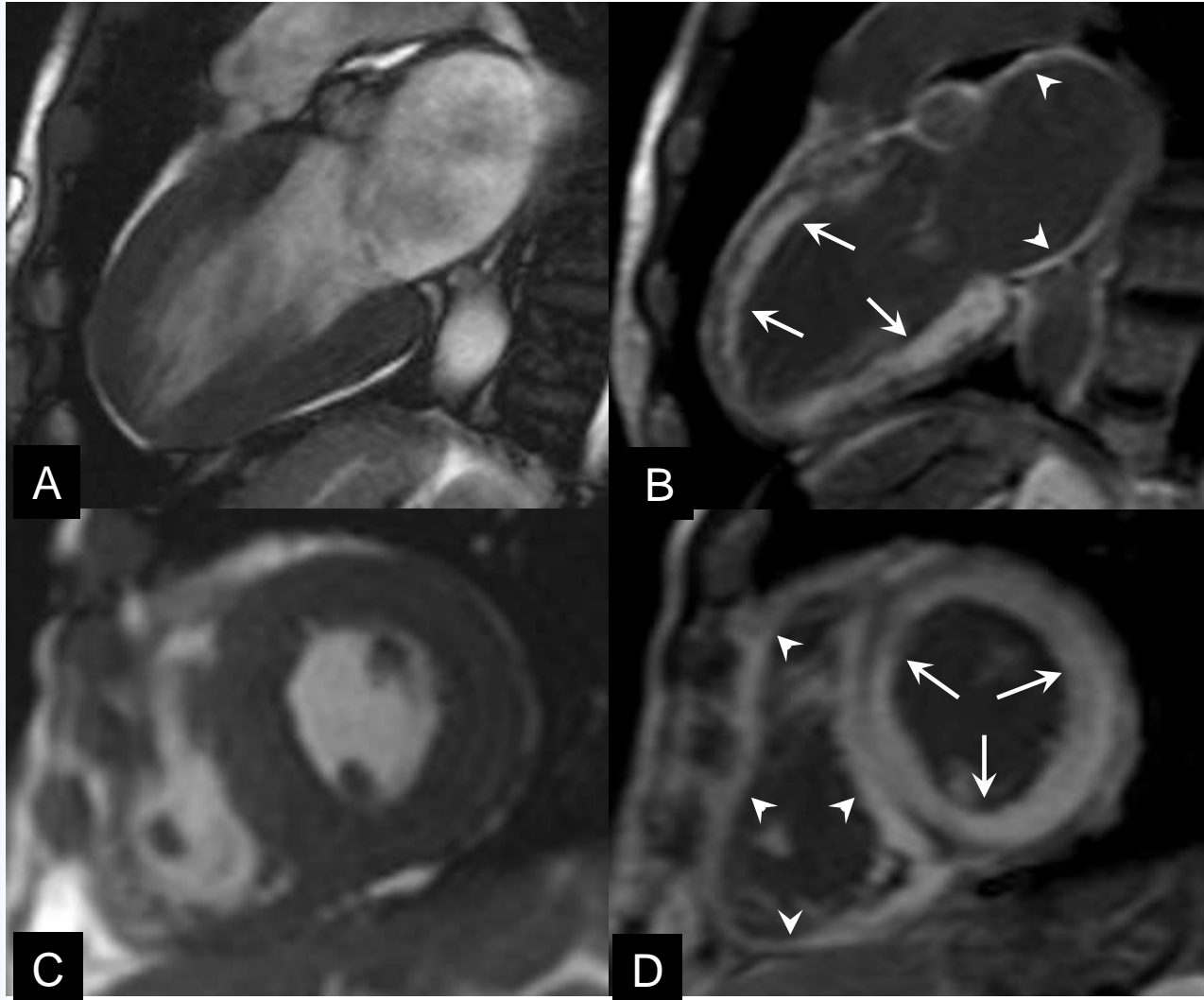
# ARVC



ARVC is the most well recognized form of a broad disease spectrum that includes left-dominant and biventricular subtypes

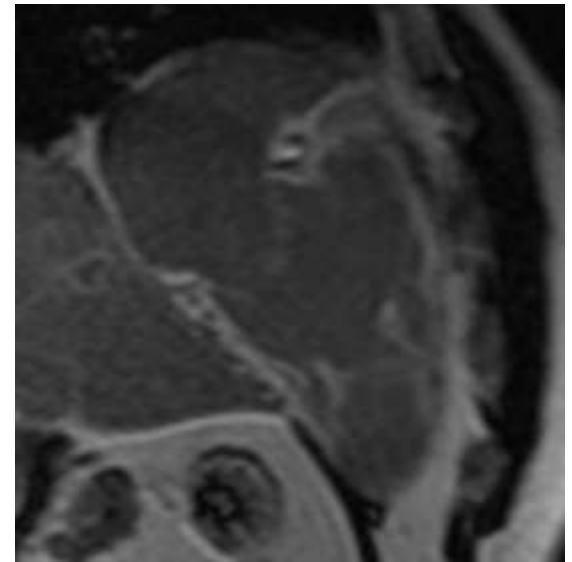
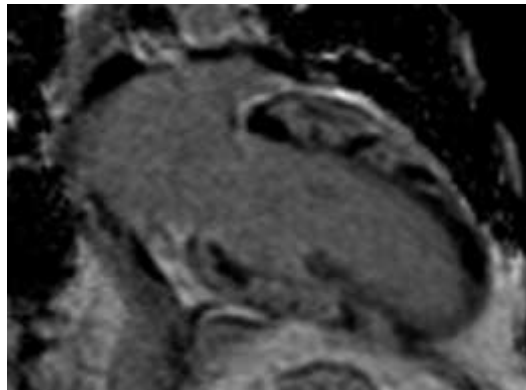
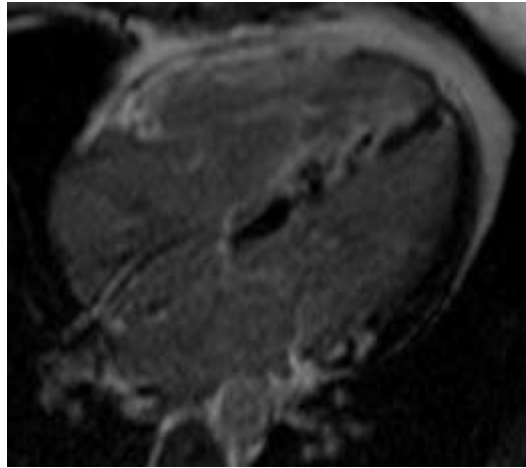


# Amyloidosis



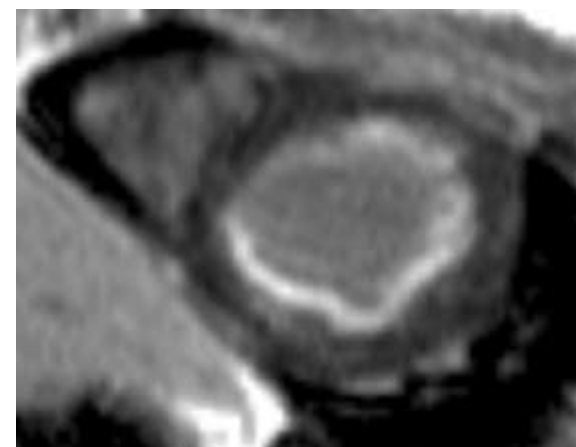
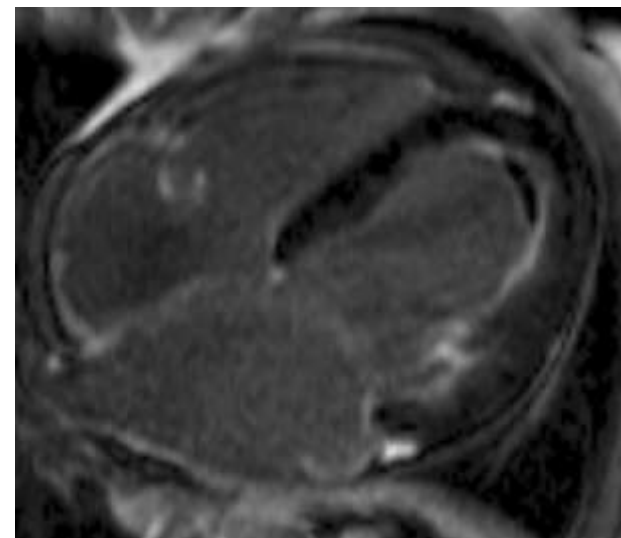
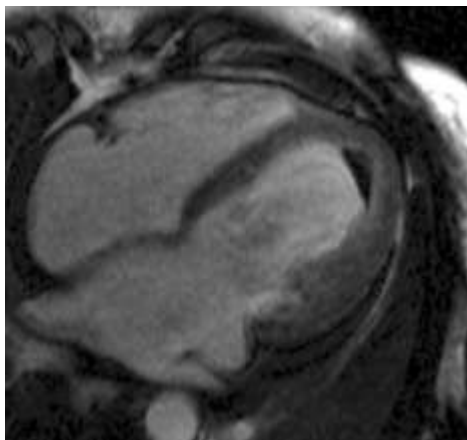
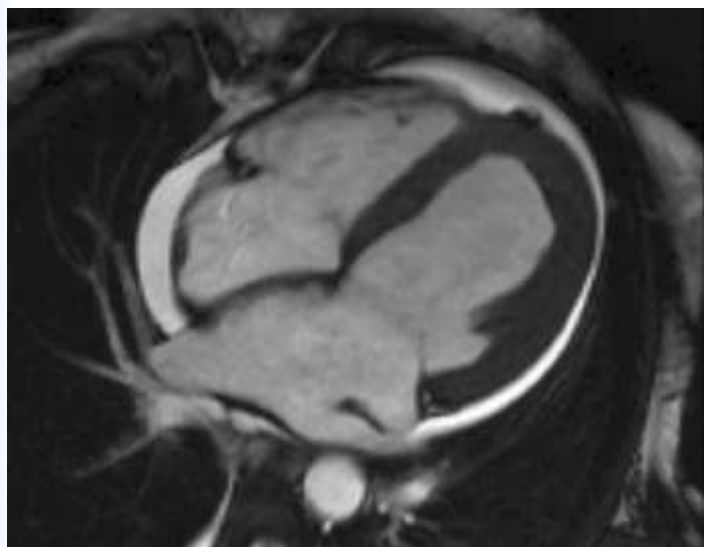
Karamitsos TD et al.  
JACC 2009;54:1407-24

# *Cardiac Sarcoidosis*



# *Endomyocardial Fibrosis*

Severe Rh A (many years of DMARDs)  
LVH & reduced function on echo. Also Mod MR ?cause

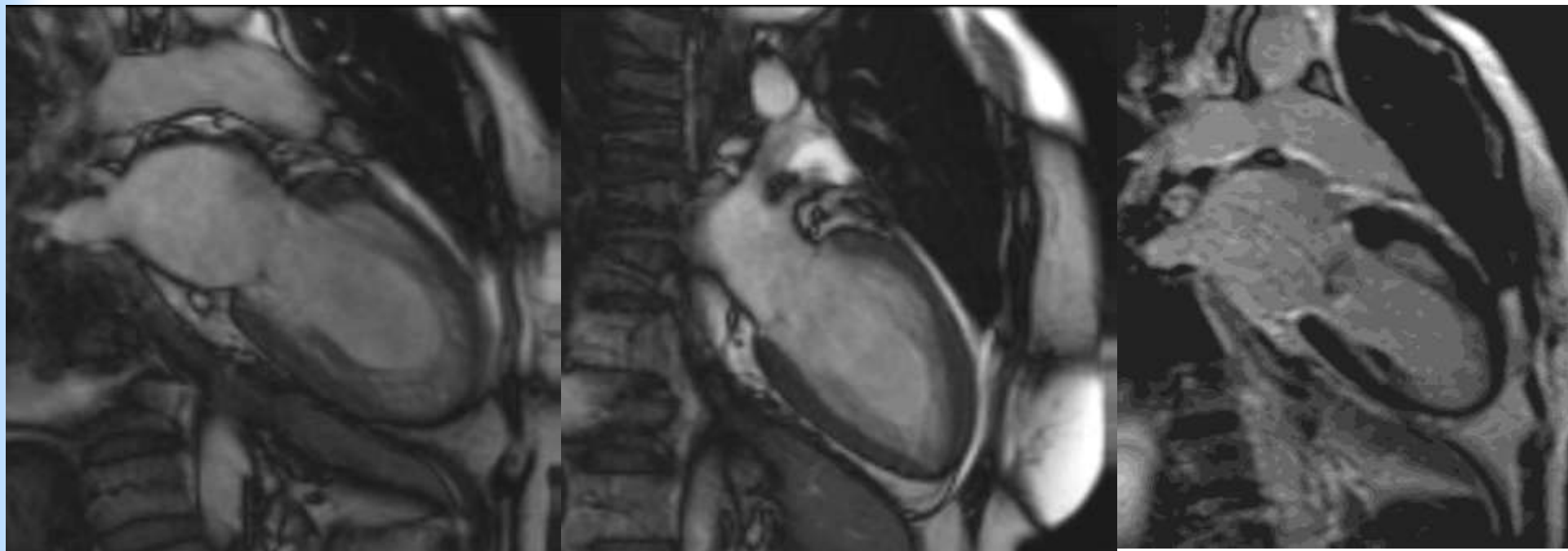


No prev Hx of eosinophilia but subsequent investigation revealed prev eosinophilia of up to 34%  
- may be assoc with methotrexate/other DMARDs

# *Tako-tsubo Cardiomyopathy*

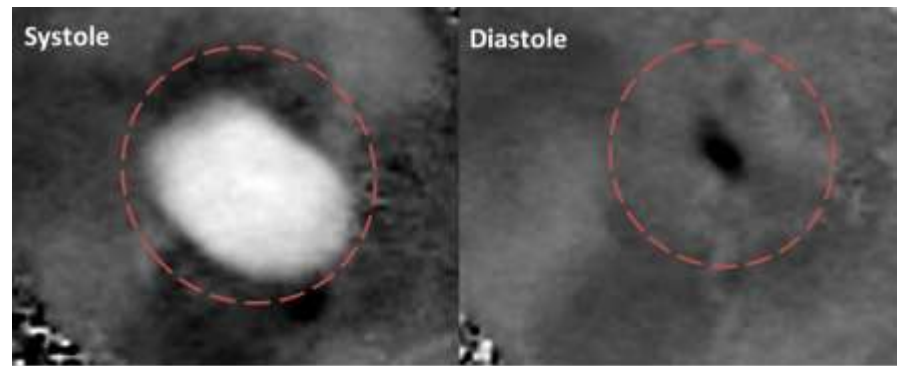
Initial CMR

F/up 2 months

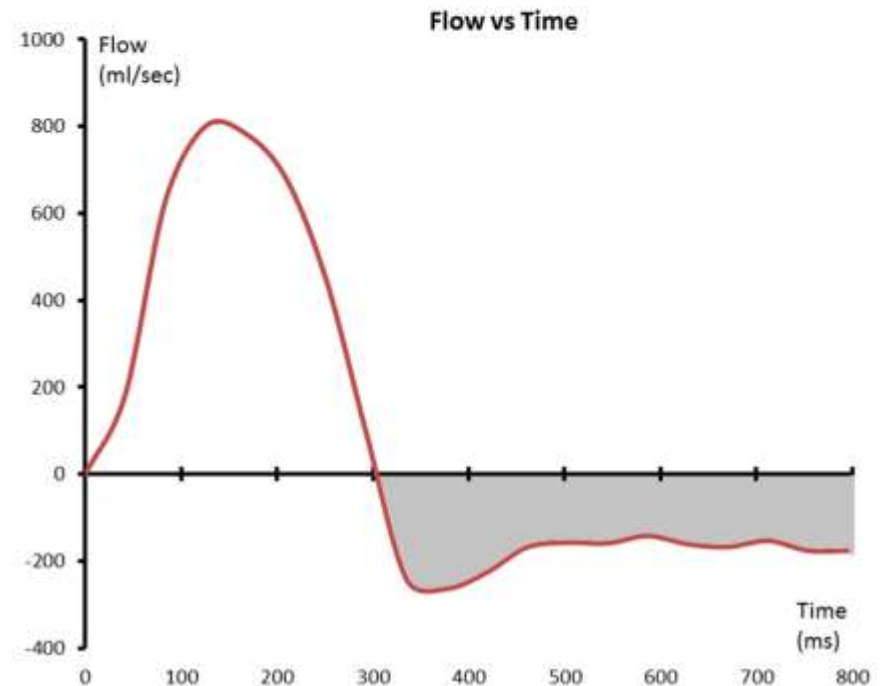


Karamitsos TD et al. Int J Cardiol. 2008;128:e34-6

# Aortic Regurgitation



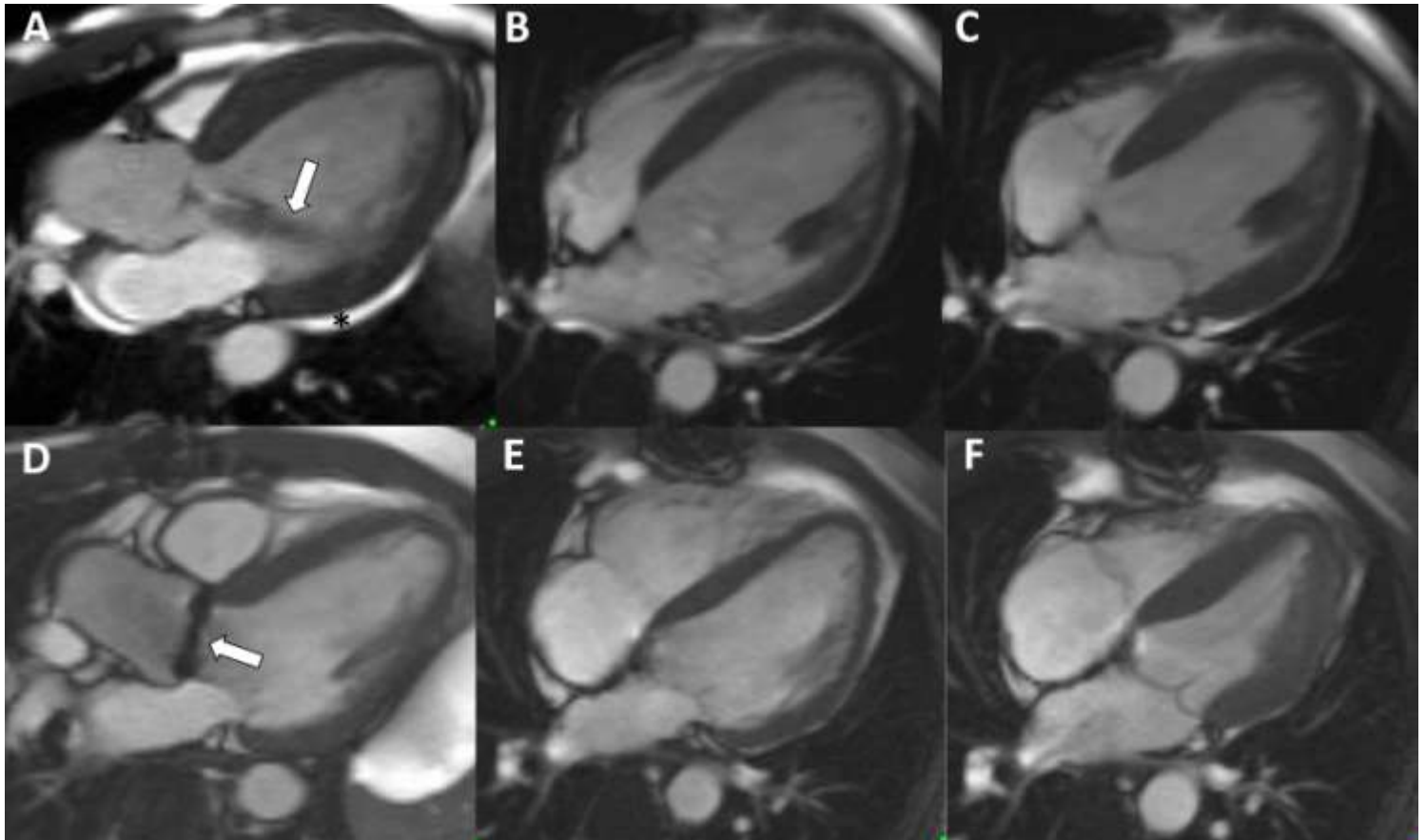
Forward flow: 125ml  
Regurgitant volume: 47ml  
Regurgitant Fraction:  $47/125 = 38\%$



Karamitsos TD et al. Prog Cardiovasc Dis – 2011

# AORTIC REGURGITATION – LV remodelling

2009

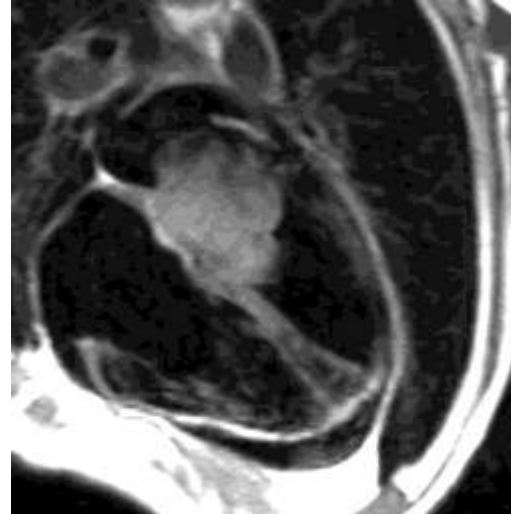
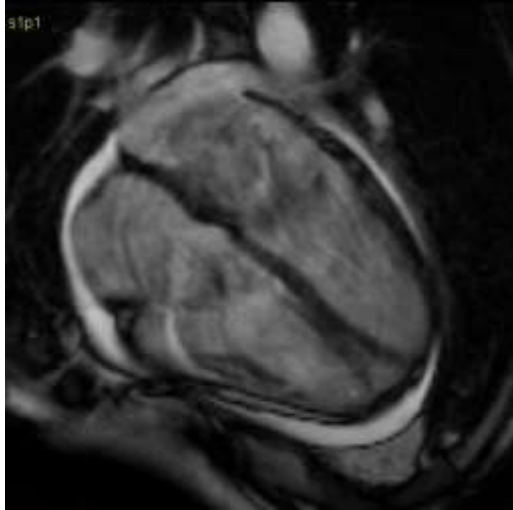


2010

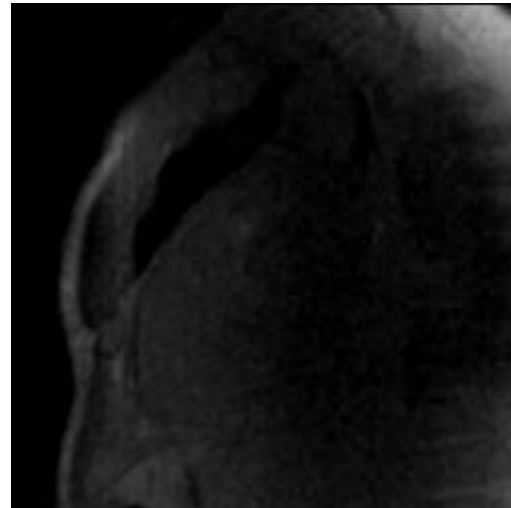
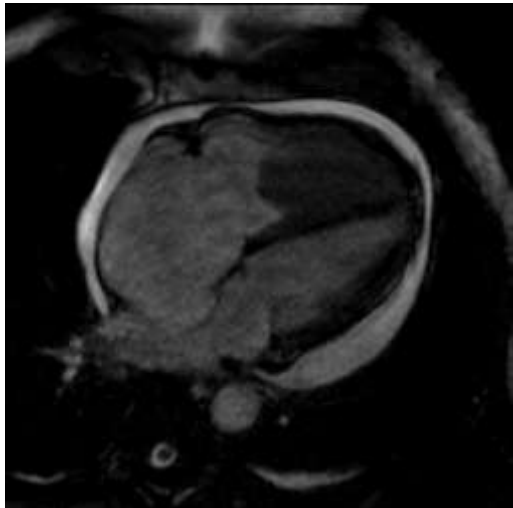
Karamitsos TD, Myerson SG. Prog Cardiovasc Dis – 2011

# Cardiac Masses

Cardiac  
Myxoma

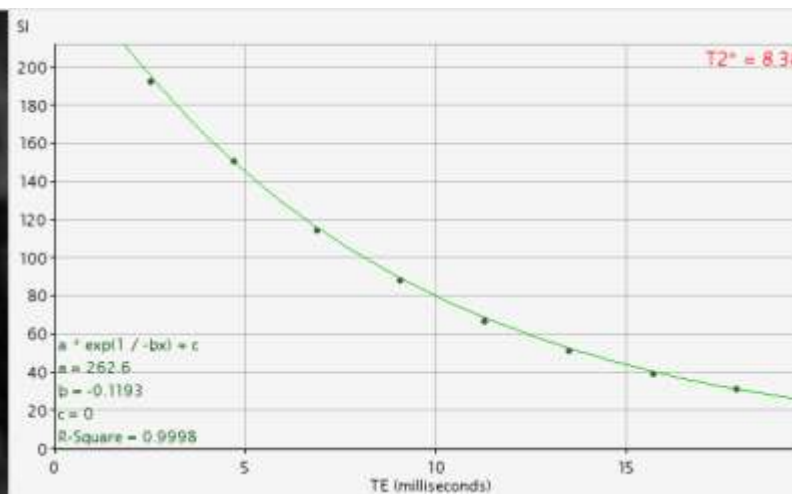
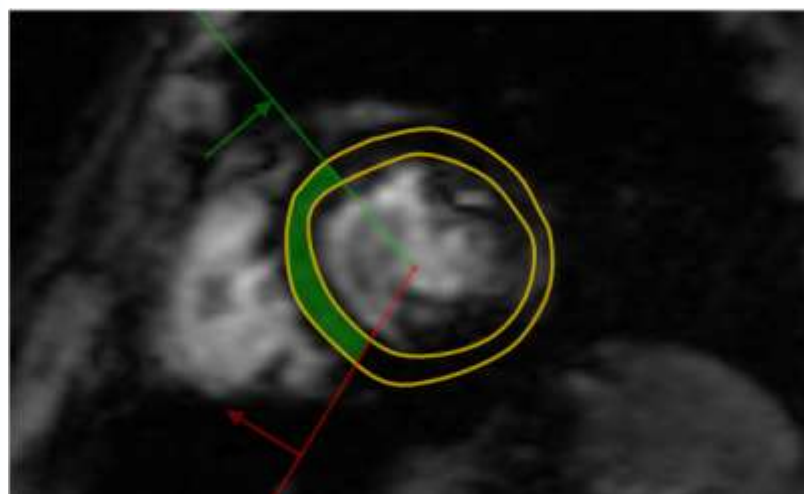
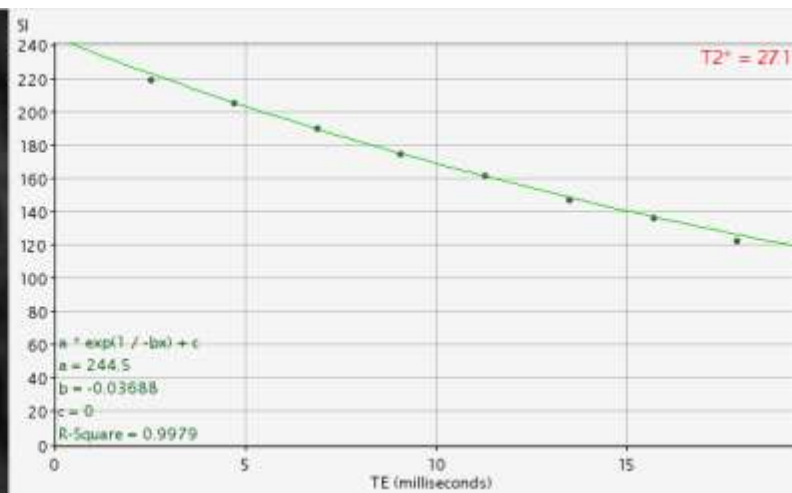
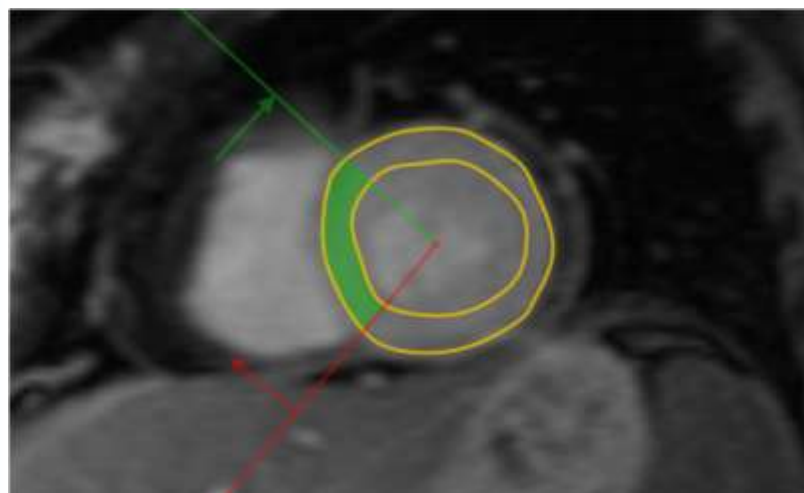


Cardiac  
Melanoma



Karamitsos TD, et al.  
Int J Cardiol 2011

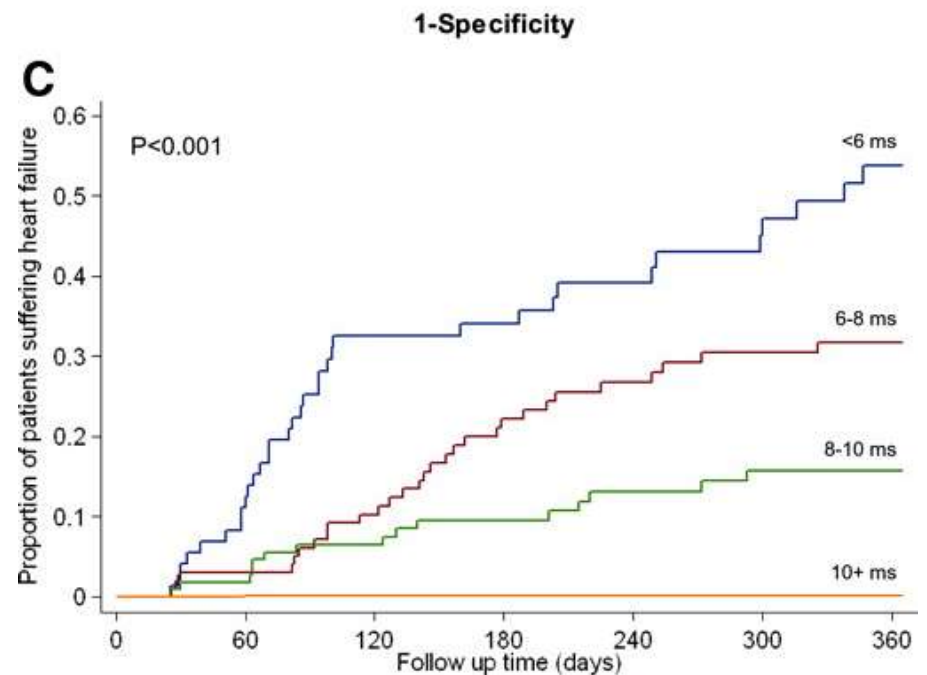
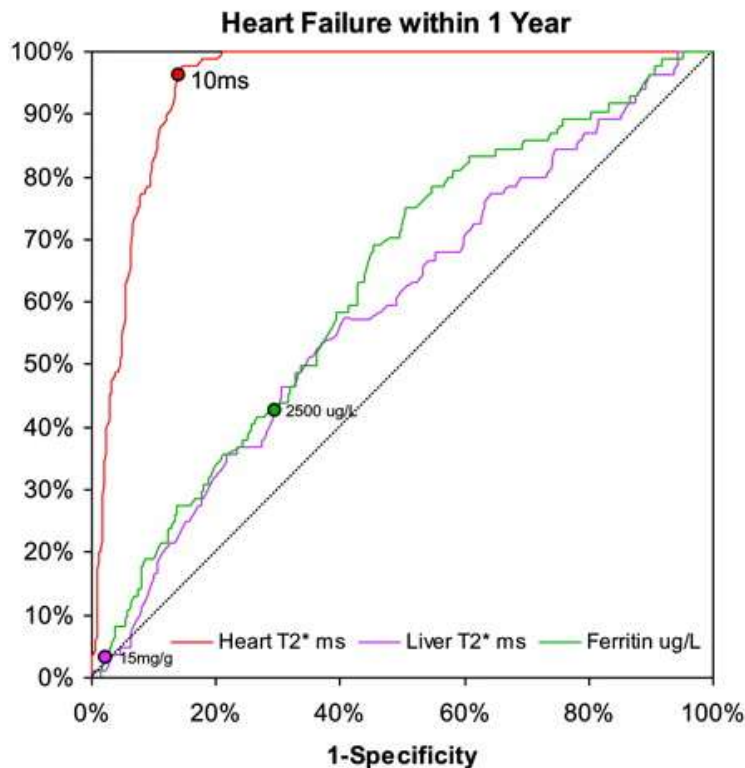
# T2\* imaging: Myocardial Iron Overload





# Cardiac $T2^*$ & Prognosis

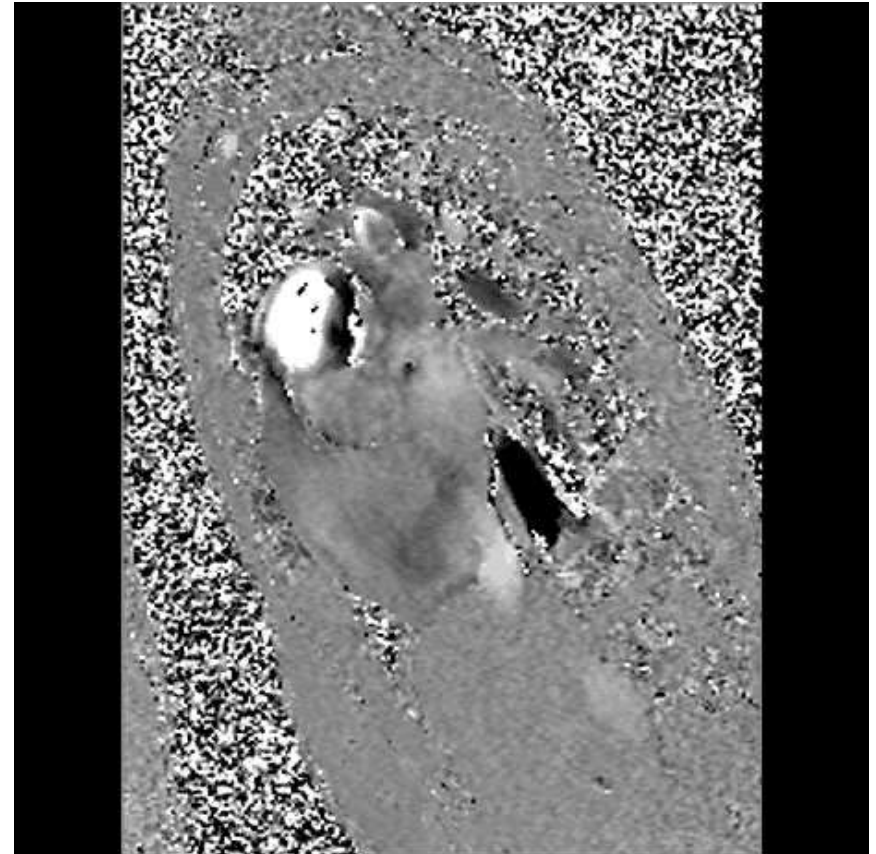
652 thalassaemia major patients



Kirk P et al. *Circulation*. 2009;120:1961-8.

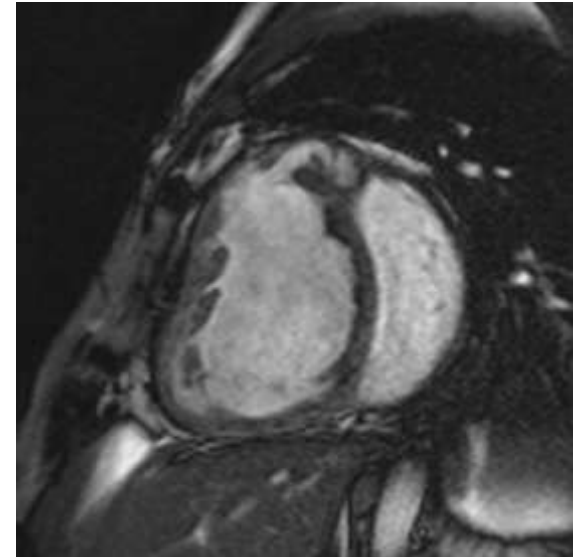
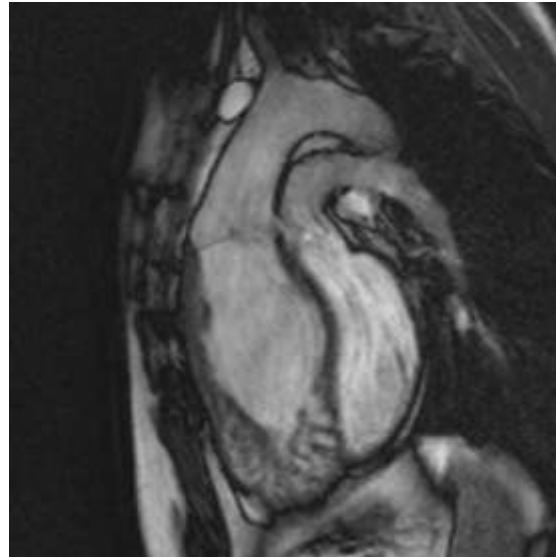
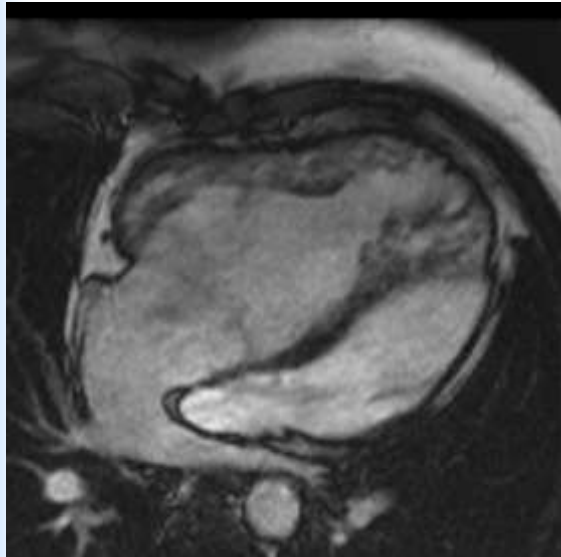
# Congenital Heart Disease

## Atrial Septal Defect



# Congenital Heart Disease

26 yrs old man with TGA – Senning procedure 1993

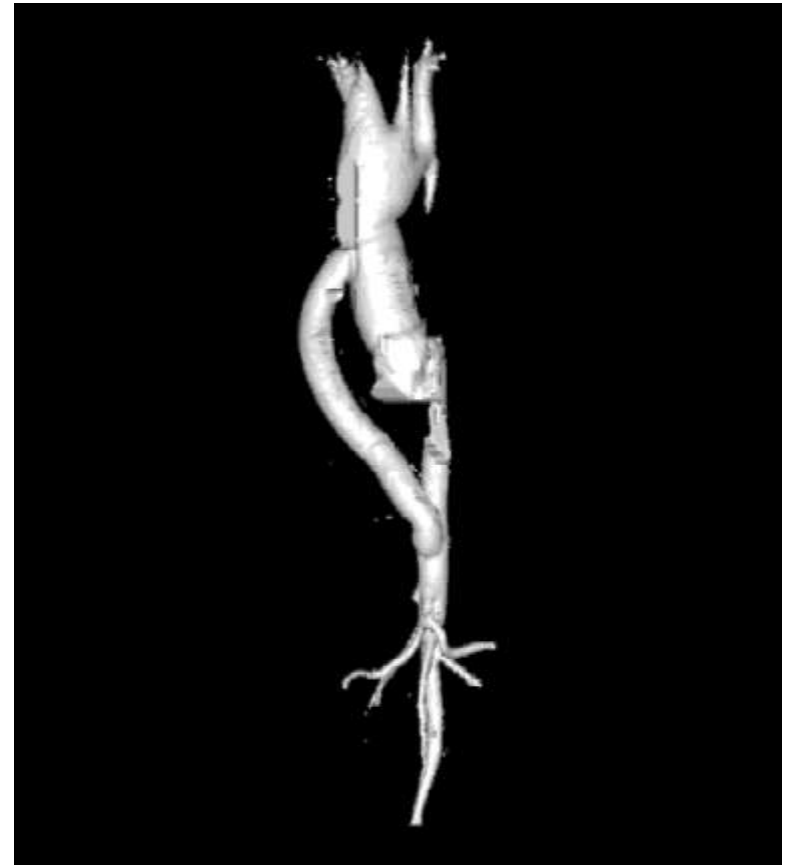


Systemic ventricle (RV) – dilated & hypertrophied with moderate dysfunction  
Baffle functioning well; Systemic and pulmonary venous pathways unobstructed

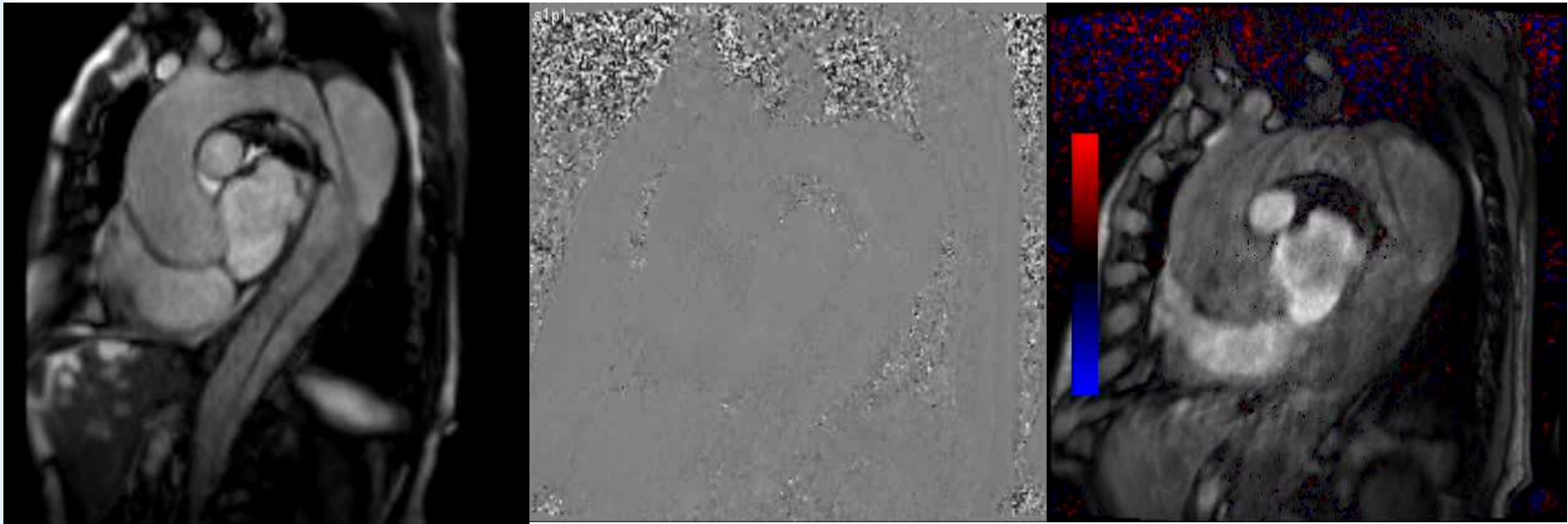
	<b>EDV (ml)</b>	<b>ESV (ml)</b>	<b>EF (%)</b>	<b>Mass (g)</b>
<b>Pulmonary LV</b>	<b>150</b> (102-218)	<b>47</b> (18-82)	<b>69</b> (57-81)	<b>132</b> (81-165)
<b>Systemic RV</b>	<b>324</b> (124-256)	<b>190</b> (38-118)	<b>41</b> (50-71)	<b>212</b> (25-57)

# Contrast-Enhanced MR Angiography

## *Surface Rendering 3D Angio*

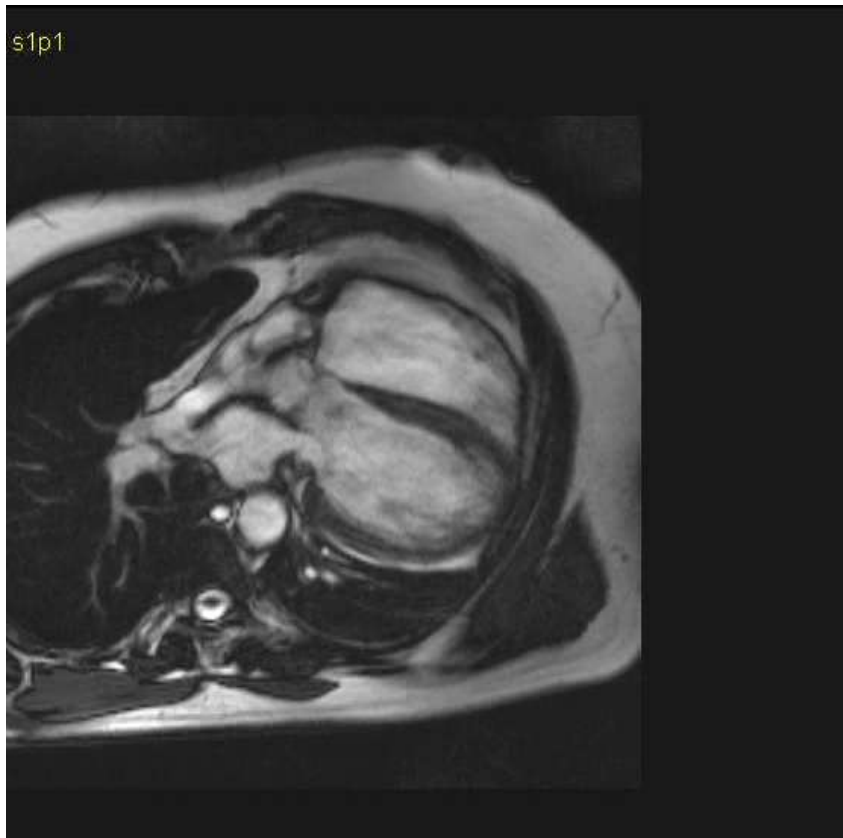


# Aortic Imaging - Dissection

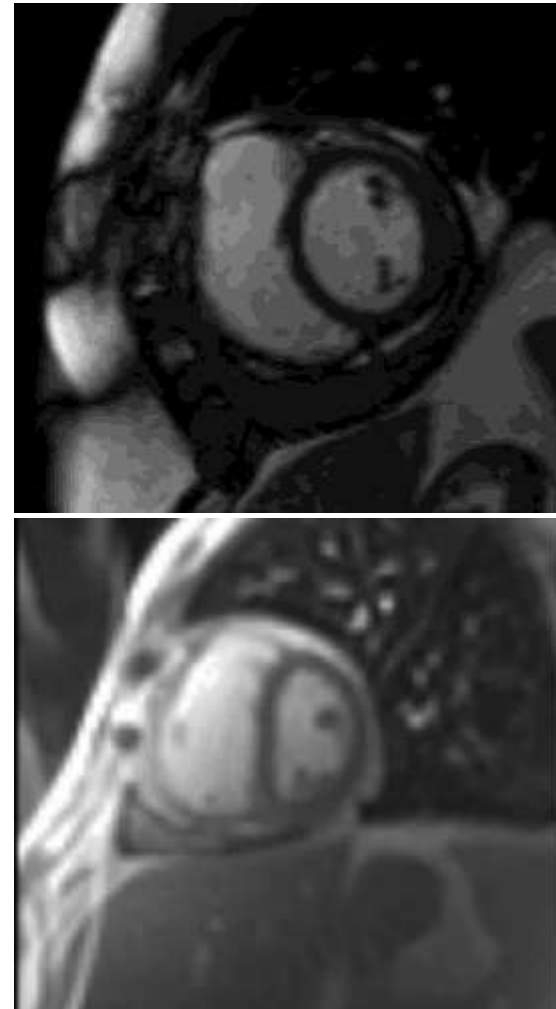


# Pericardium

Congenital Absent Pericardium



Constriction



# Greece & CMR imaging

## The Future of Cardiovascular Magnetic Resonance in Greece: Expectations and Reality

Hellenic J Cardiol 2009; 50: 92-98

PERIKLIS A. DAVLOUROUS<sup>1</sup>, ELENI MAVRONASIOU<sup>1</sup>, PETER DANIAS<sup>2</sup>, JOHN CHILADAKIS<sup>1</sup>,  
GEORGE HAHALIS,<sup>1</sup> DIMITRIOS ALEXOPOULOS<sup>1</sup>

<sup>1</sup>Cardiology Department, Patras University Hospital, Rion, Patras, <sup>2</sup>Hygeia Hospital, Athens, Greece

**Table 2.** Answers to the question: If you have ever referred a patient for cardiac magnetic resonance imaging, for which of the 6 indications listed have you done that?

Indication	No. of cardiologists	Percentage (%)
Myocardial anatomy	25	41.7
Aortography	12	20
Myocardial viability	12	20
Myocardial ischaemia	11	18.3
Myocardial function	10	16.7
Valvular function	4	6.7

**Table 3.** Answers to the question: Which of the following is a contraindication for cardiac magnetic resonance imaging?

Contraindication	Yes	No	Don't know
Pacemakers/ICDs	45 (75%)	7 (11.7%)	8 (13.3%)
Metallic valves	32 (53.3%)	18 (30%)	10 (16.7%)
Stents	13 (21.7%)	29 (48.3%)	18 (30%)
Metallic implants*	27 (45%)	18 (30%)	15 (25%)

\*Non-ferromagnetic. Wrong answers are shown in bold italics.

# Conclusions

## CMR in Cardiology

- Diagnosis
- Treatment monitoring
- Prognosis
- Cost Effectiveness

**But...below European average  
in Greece**