

# IMAGING FOR ACUTE VS CHRONIC MYOCARDITIS

Matthias Friedrich

Departments of Medicine and Diagnostic Radiology, McGill University, Montreal

Department of Medicine, Heidelberg University

Département de Radiologie, Université de Montréal

Departments of Medicine and Radiology, University of Calgary

Centre universitaire  
de santé McGill



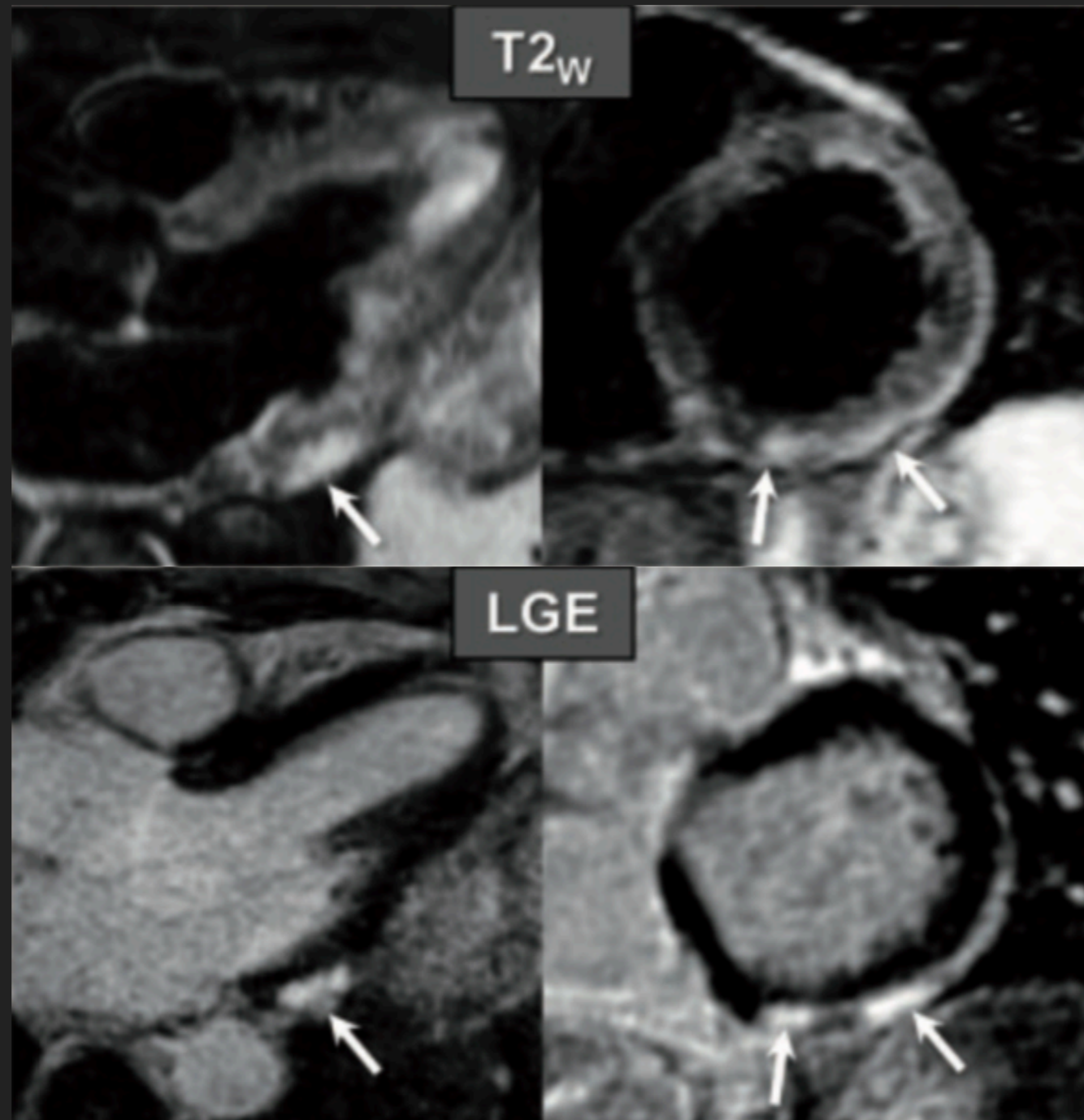
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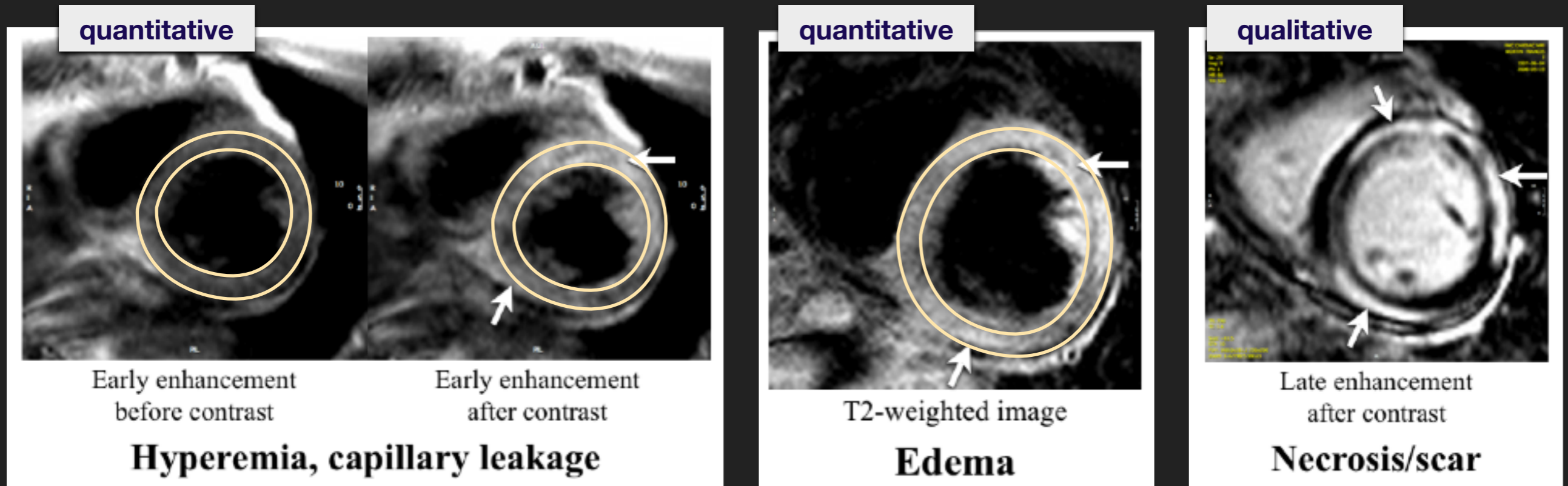
## IMAGING MODALITIES FOR TISSUE INFLAMMATION

- Radionuclide scintigraphy
- PET
- MRI

# REGIONAL EDEMA AND INJURY IN ACUTE MYOCARDITIS



# CMR IN MYOCARDITIS: ORIGINAL LAKE LOUISE CRITERIA



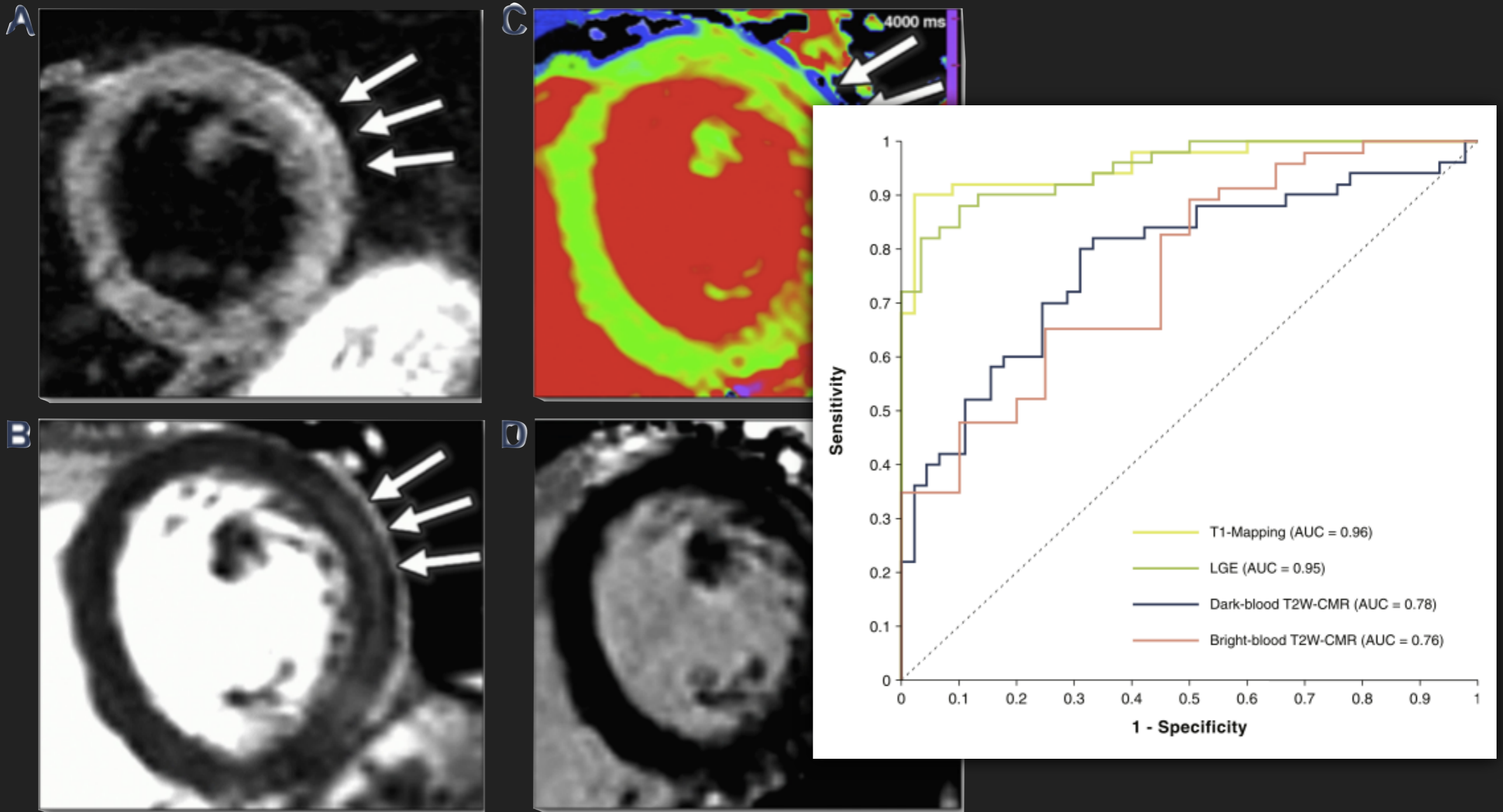
**Indicates myocarditis, if 2 out of 3 criteria are positive**

# IMPACT OF CMR ON THE OBSERVED INCIDENCE OF MYOCARDITIS

**TABLE 2 Comparison of Diagnoses Based on Cardiac Magnetic Resonance Imaging Between 2015 and 2016\***

Diagnosis	2015 (n = 88)	2016 (n = 199)	2015 and 2016 (n = 287)
Normal heart	68 (77.3)	110 (55.3)	178 (62)
Coronary ischemia	8 (9.1)	26 (13.1)	34 (11.9)
Pericarditis	0 (0)	4 (2)	4 (1.4)
Amyloidosis	1 (1.1)	2 (1)	3 (1)
Sarcoidosis	1 (1.1)	1 (0.5)	2 (0.7)
Fabry disease	1 (1.1)	1 (0.5)	2 (0.7)
Takotsubo cardiomyopathy	0 (0)	4 (2)	4 (1.4)
Dilated cardiomyopathy	0 (0)	1 (0.5)	1 (0.3)
HCM	2 (2.3)	9 (4.5)	11 (3.8)
Myocarditis	4 (4.6)	26 (13.1)	30 (10.5)
Others	3 (3.4)	15 (7.5)	18 (6.3)

# MYOCARDITIS: MYOCARDIAL MAPPING



# MAPPING

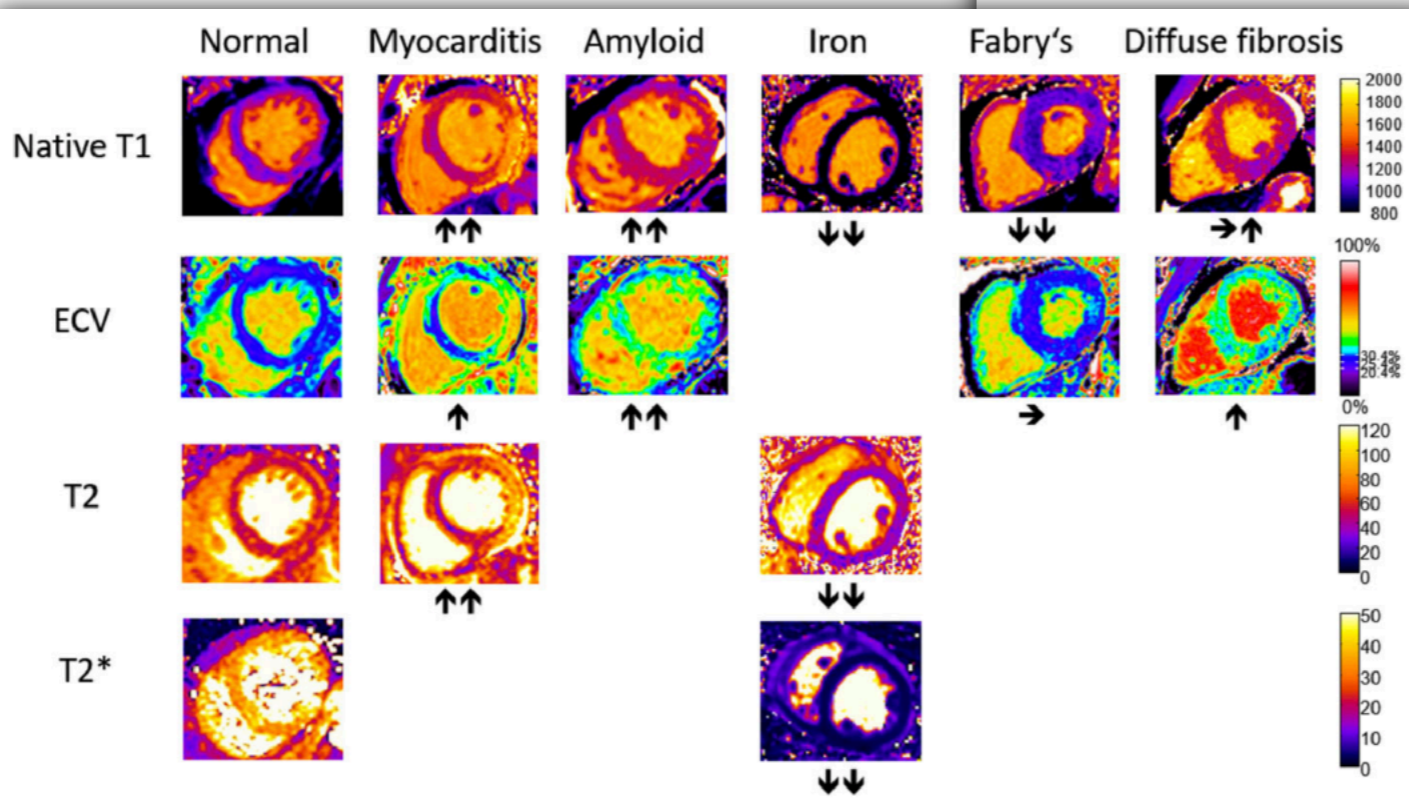
## Clinical recommendations for cardiovascular magnetic resonance mapping of T1, T2, T2\* and extracellular volume: A consensus statement by the Society for Cardiovascular Magnetic Resonance (SCMR) endorsed by the European Association for Cardiovascular Imaging (EACVI)

Daniel R. Messroghli<sup>1,2,3\*</sup>, Jaume Sureda<sup>4</sup>, Peter Kellman<sup>8</sup>, Julia Maschke<sup>5</sup>, Richard Thompson<sup>16</sup>, Martijn J. B. de Toorn<sup>6</sup>, ...

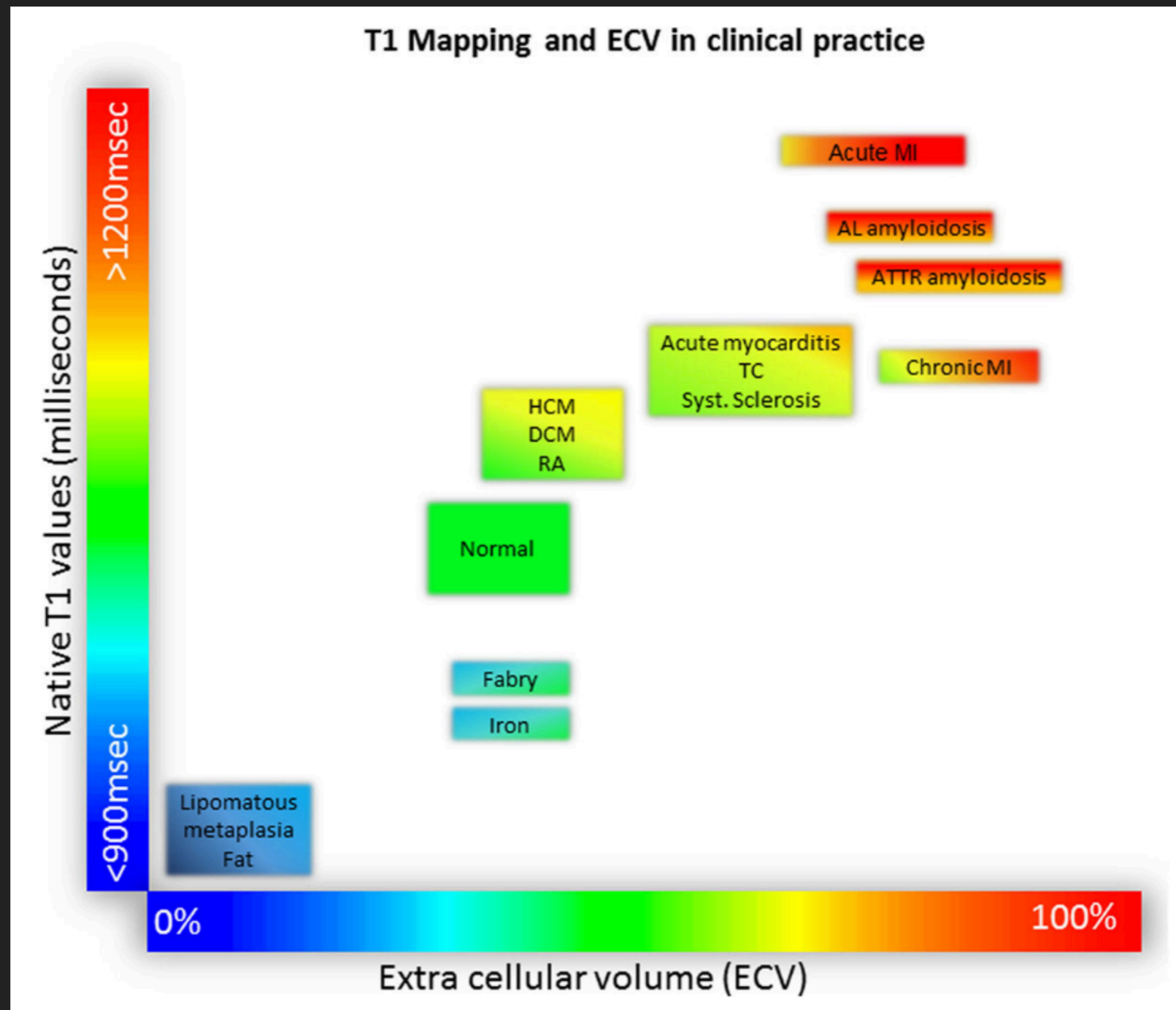


**Table 3** Clinical utility of parametric mapping techniques according to expert opinion

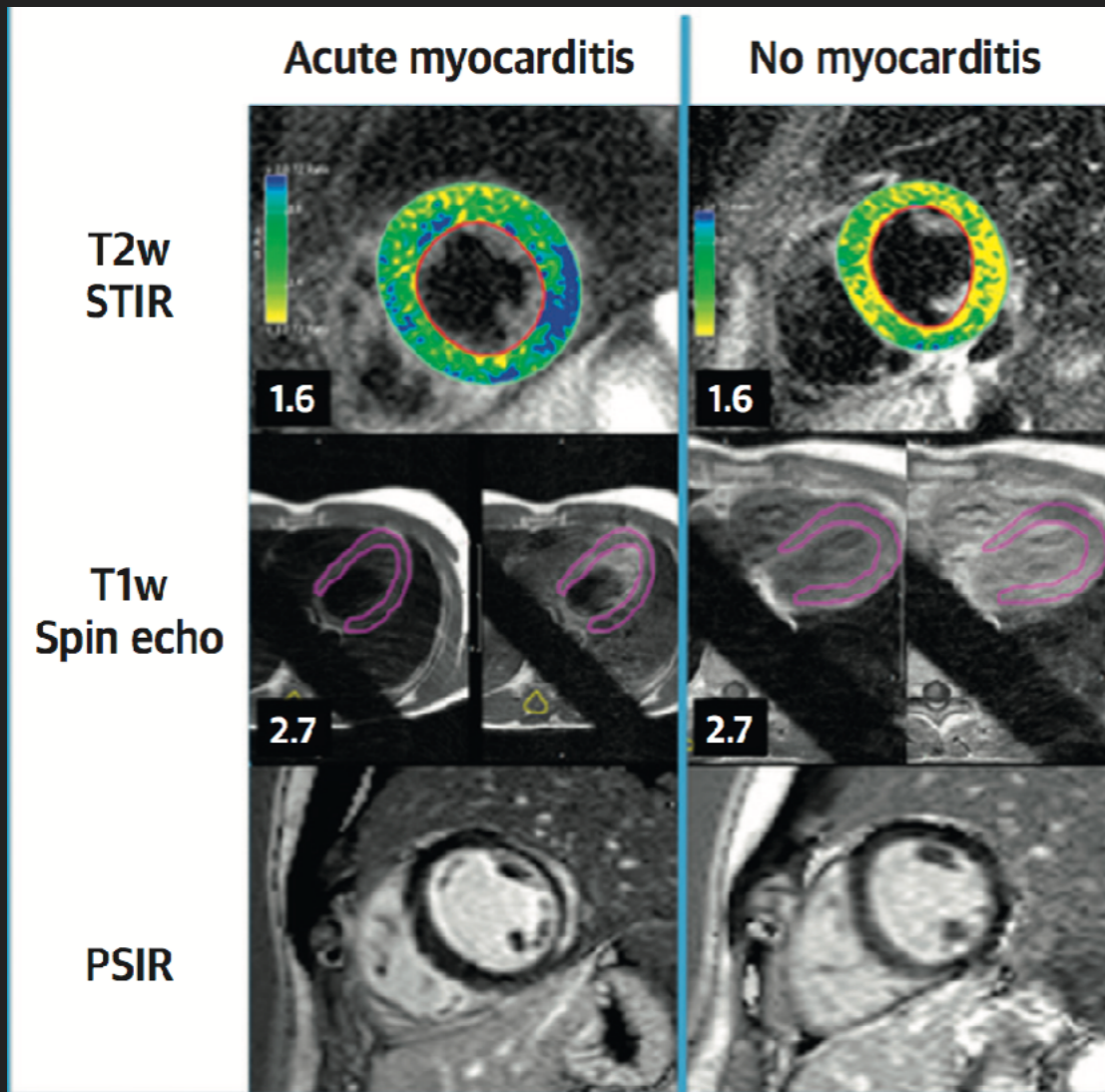
Proven clinical utility	Iron deposition
	Amyloid disease
	Anderson-Fabry disease
	<b>Myocarditis</b>
	Cardiomyopathy
	Heart failure
	Congenital heart disease
	Acute/chronic myocardial infarction
	Myocardial ischemia
	Suspected transplant rejection
	Athlete's heart
	(Para-)cardiac masses



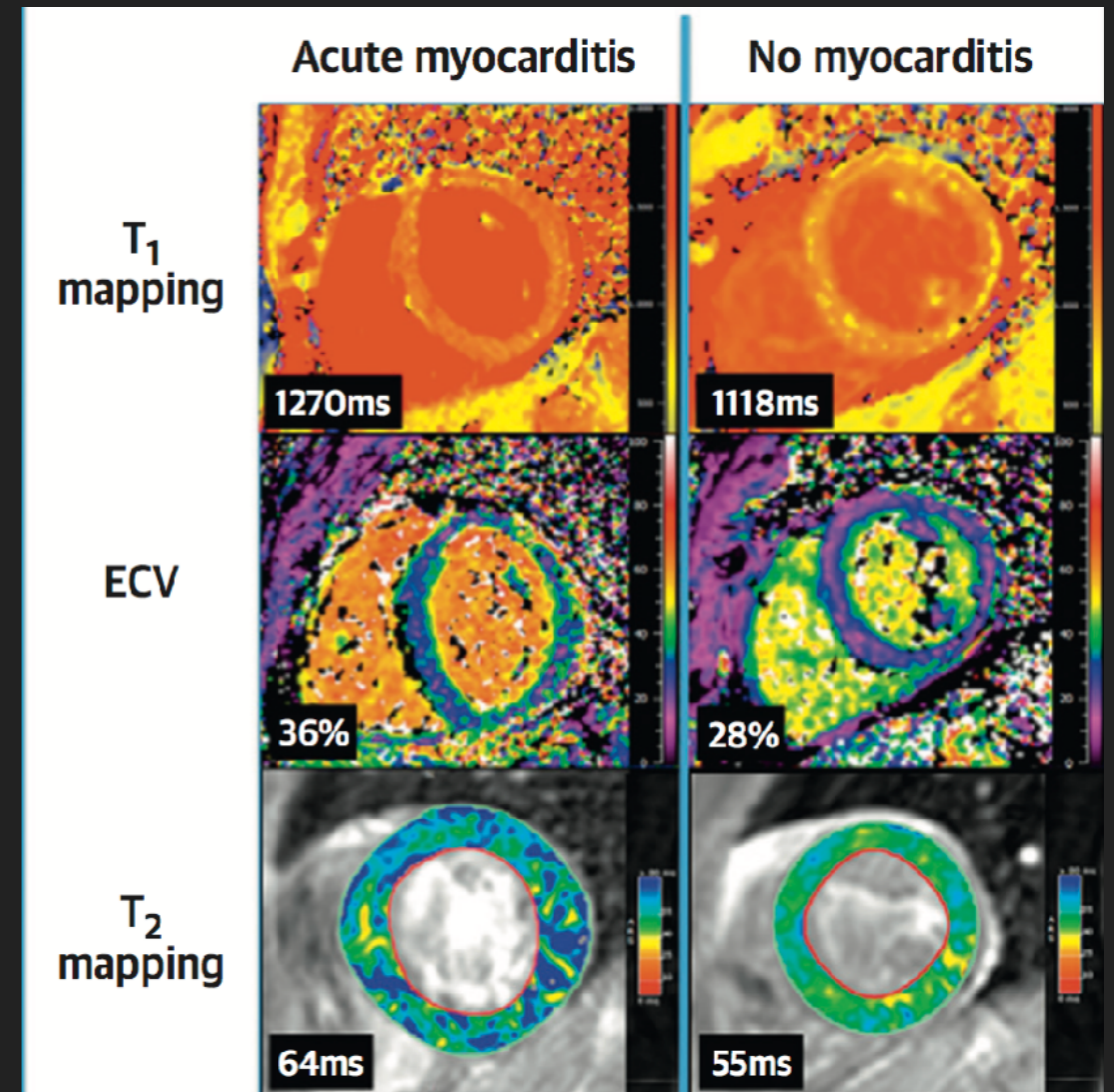
# MYOCARDIAL MAPPING



# MYOCARDITIS: MAPPING VS CLASSIC CRITERIA



Lake Louise Criteria



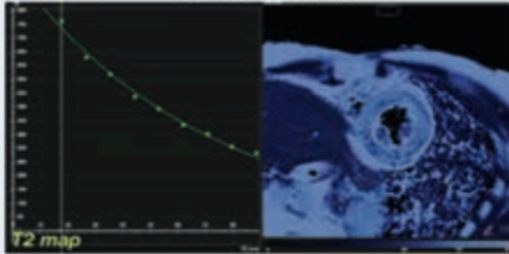
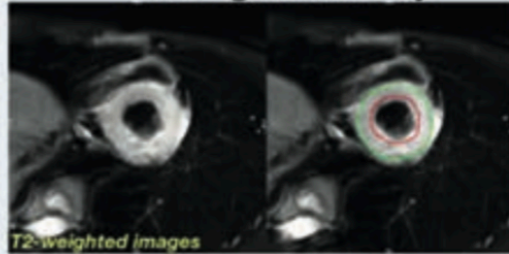
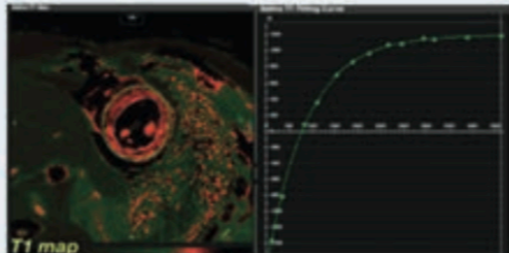
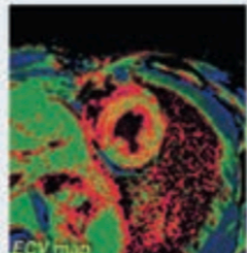
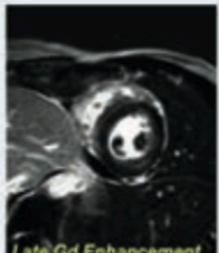
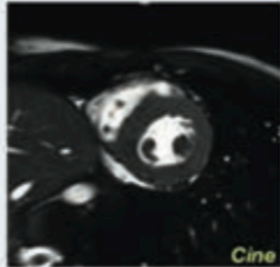
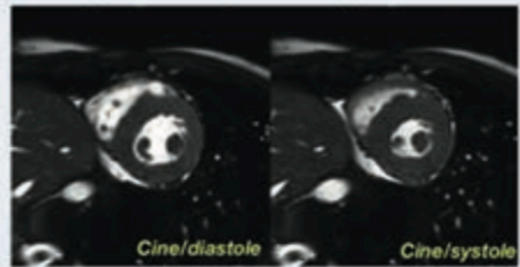
Mapping

# MYOCARDITIS: MAPPING VS CLASSIC CRITERIA

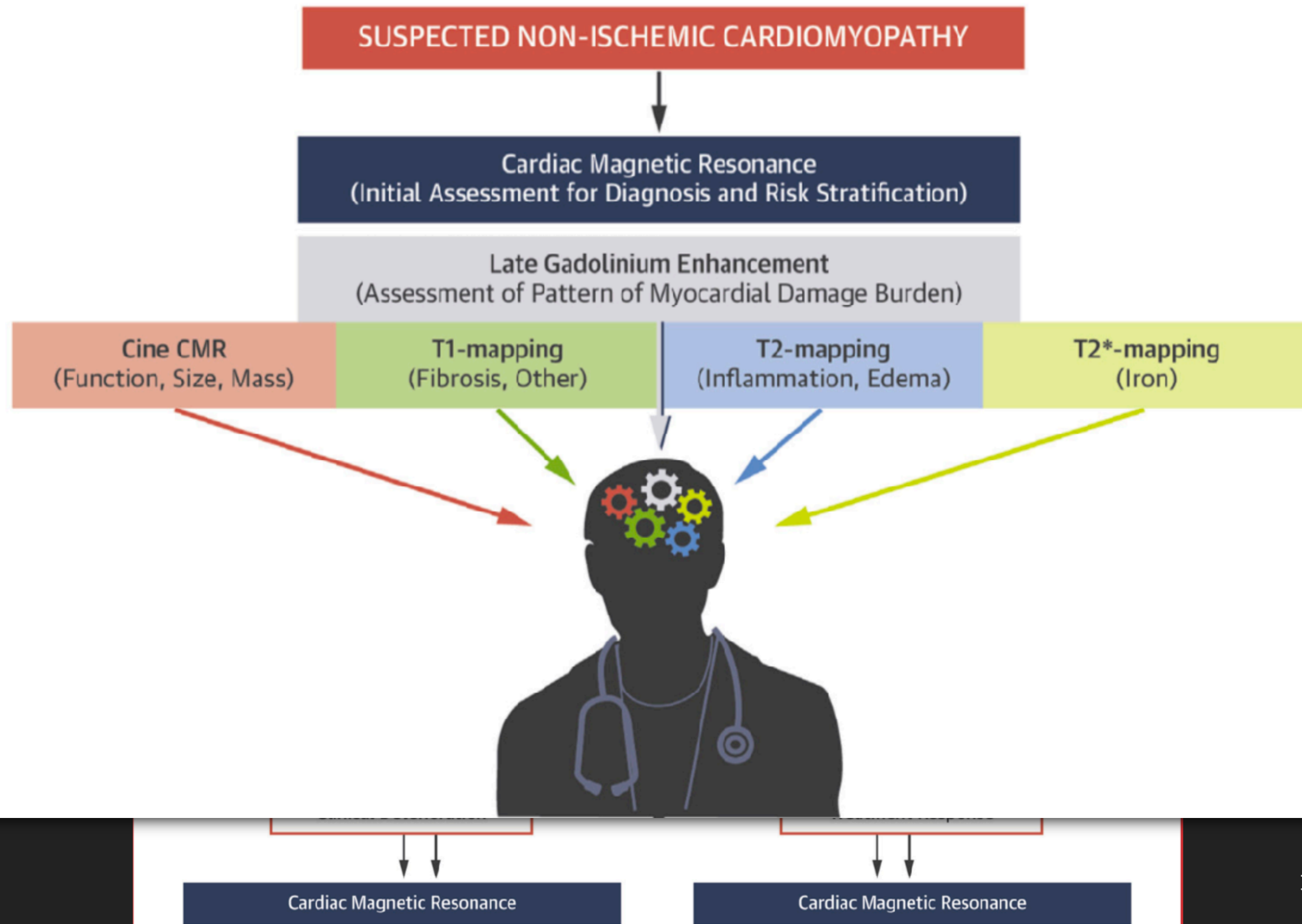
Modality	Sensitivity	Specificity	Diagnostic OR
LLC	74 [67–80]	86 [77–92]	17.7 [9.4–33.2]
ECV	77 [66–85]	76 [60–87]	10.5 [4.6–23.6]
T1	85 [78–90]*	86 [76–93]	36.6 [17.1–78.5]†
T2	76 [65–84]	82 [68–91]	14.4 [6.1–34.2]

Meta analysis  
N = 1,308

# UPDATED LAKE LOUISE CRITERIA

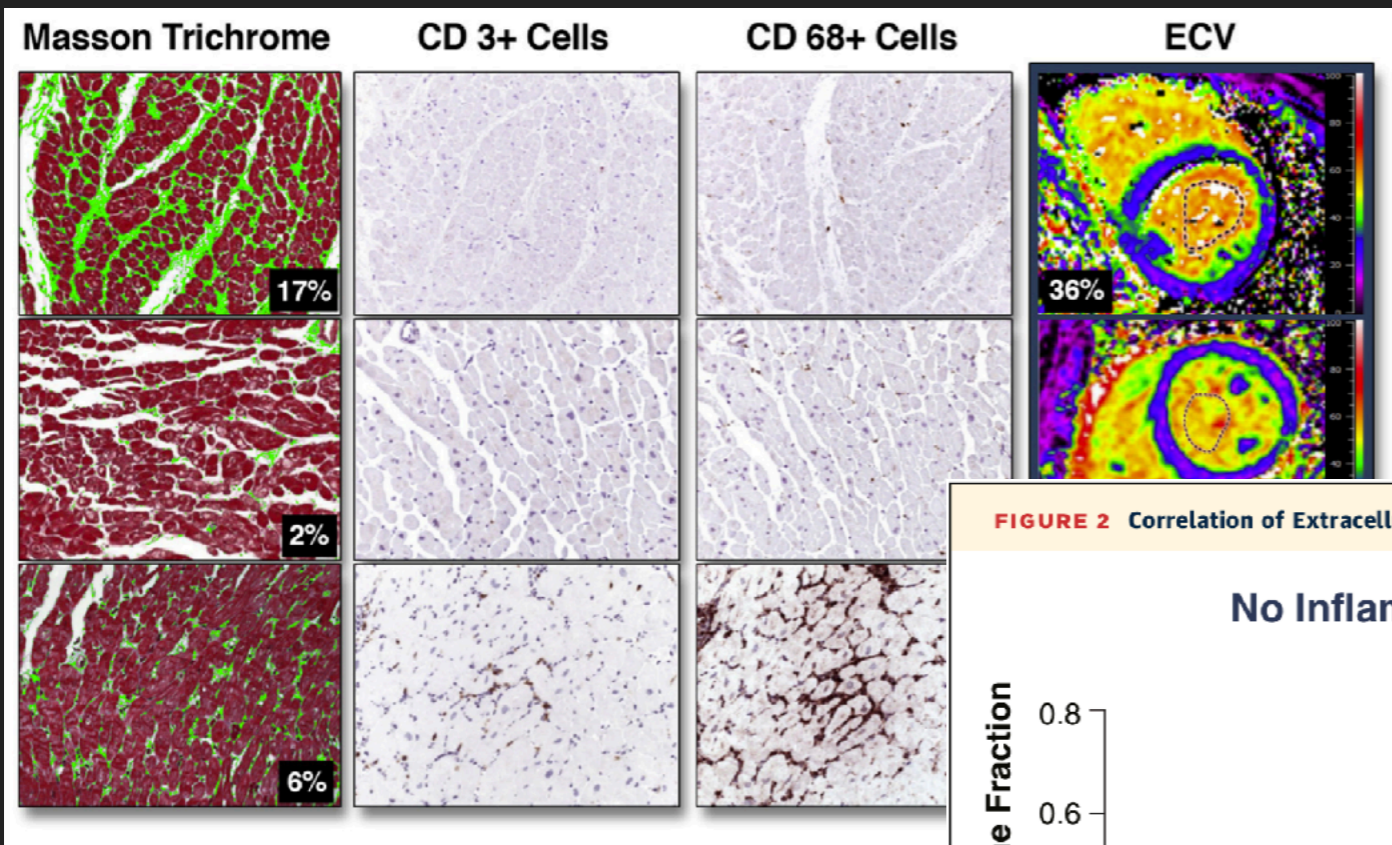
	2018 Lake Louise Criteria	CMR Image Examples
Main Criteria	<p><b>Myocardial Edema</b> (T2-mapping or T2W images)</p>	<p>Regional or global increase of native T2</p>  <p>OR</p> <p>Regional or global increase of T2 signal intensity</p> 
	<p><b>Non-ischemic Myocardial Injury</b> (Abnormal T1, ECV, or LGE)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

## CENTRAL ILLUSTRATION Evaluation of Nonischemic Cardiomyopathy Using CMR

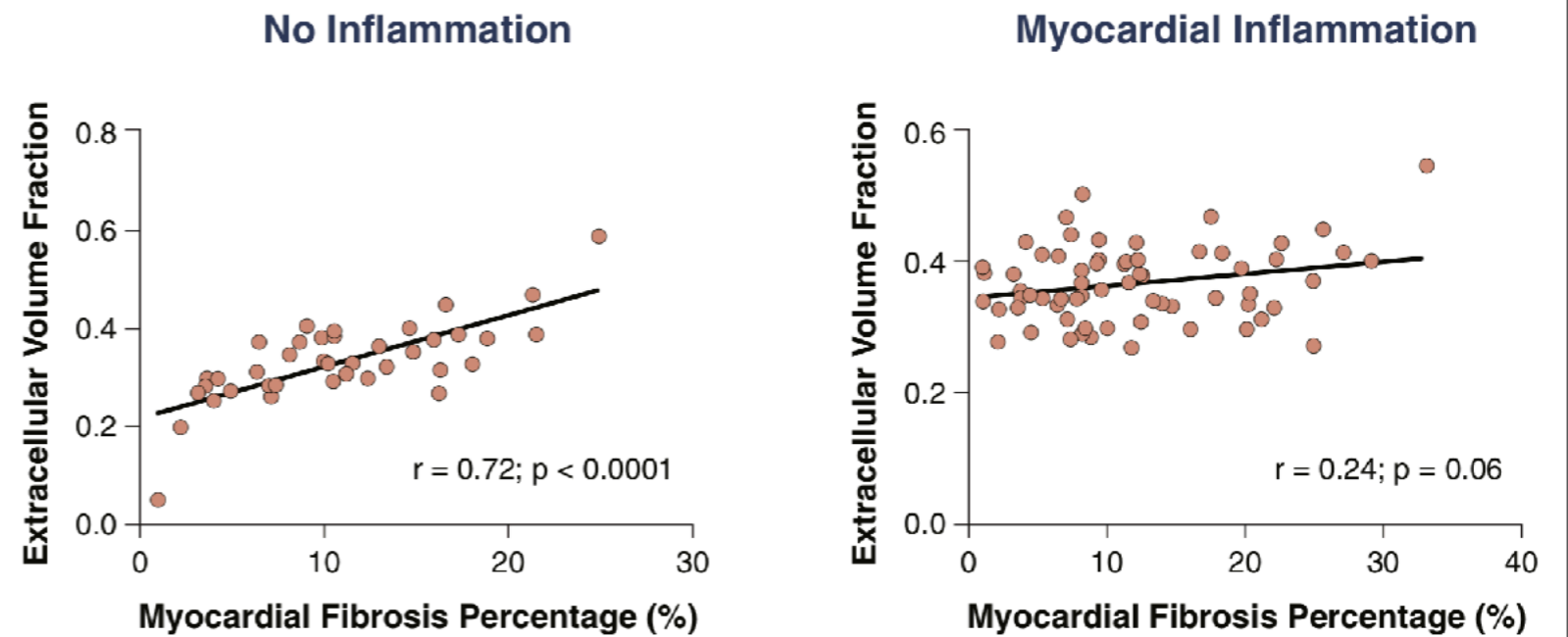


mod. From  
Patel et al.

# MYOCARDITIS: ECV IN CMP WITH AND WITHOUT INFLAMMATION



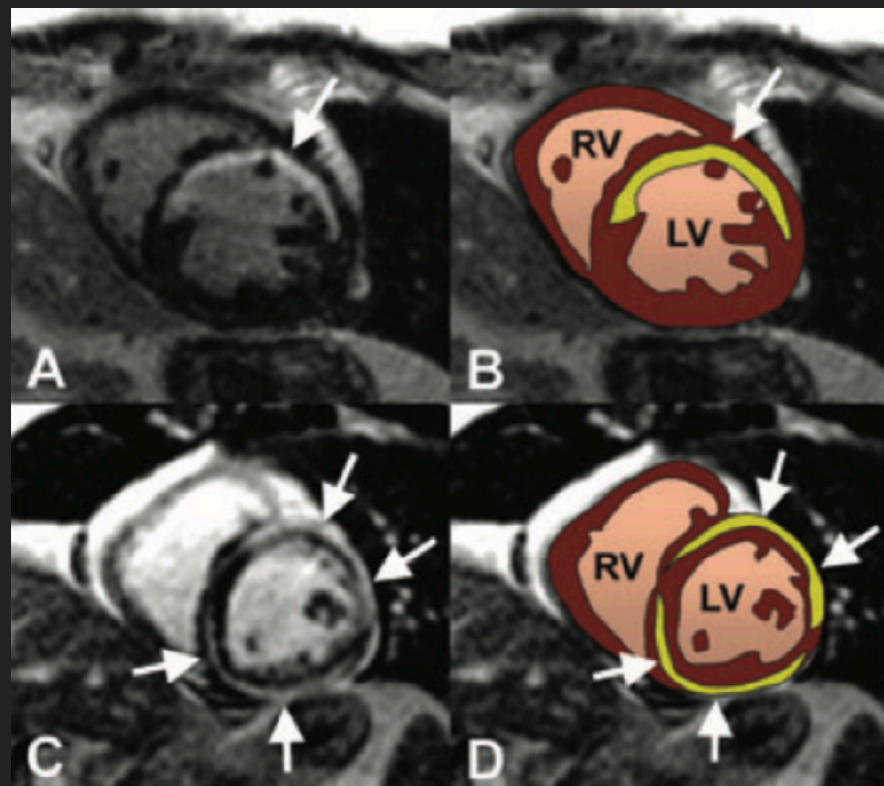
**FIGURE 2** Correlation of Extracellular Volume Fraction and Extent of Fibrosis in Patients With and Without Inflammation



Correlations between myocardial fibrosis percentage and extracellular volume fraction in patients without inflammation (**left**) and with inflammation (**right**).

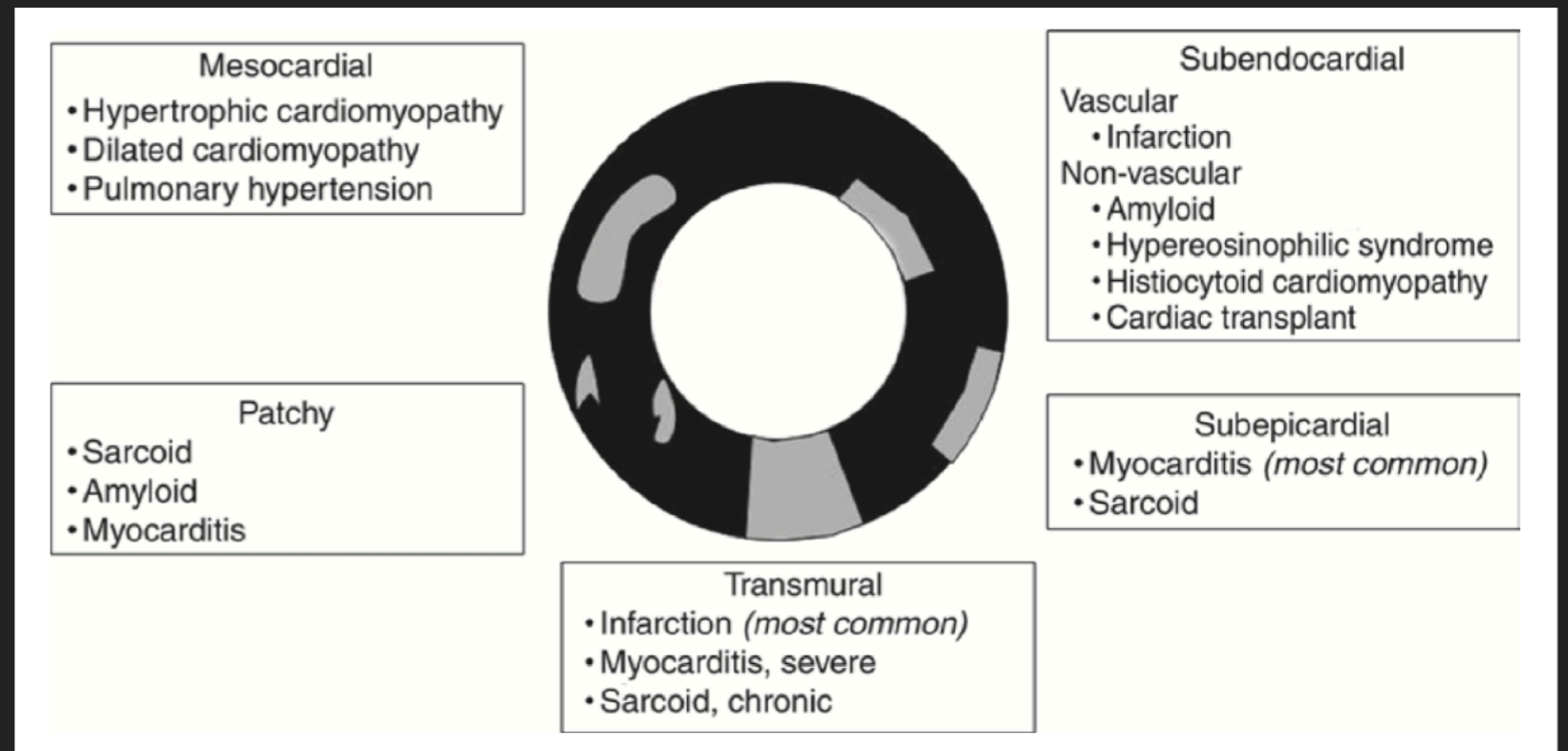
n=107

# APPEARANCE OF MYOCARDIAL LESIONS



Sanz. Ann N Y Acad Sci 2012

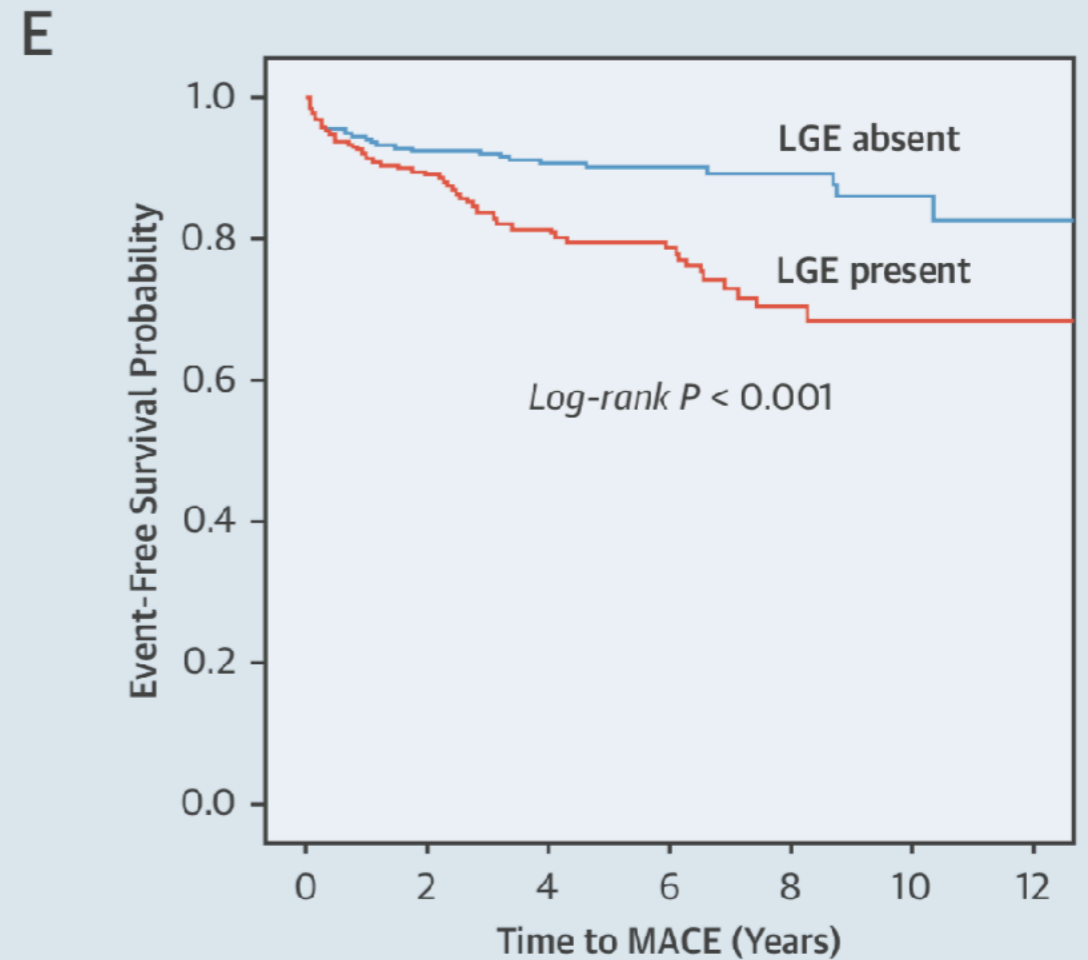
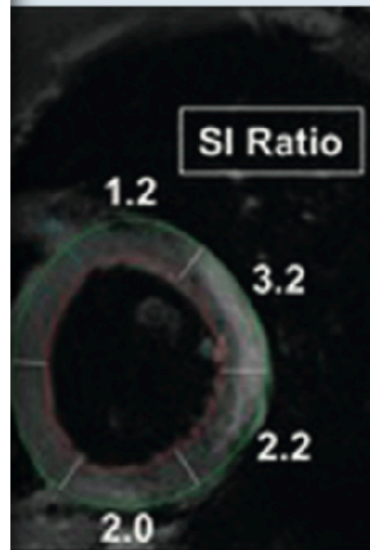
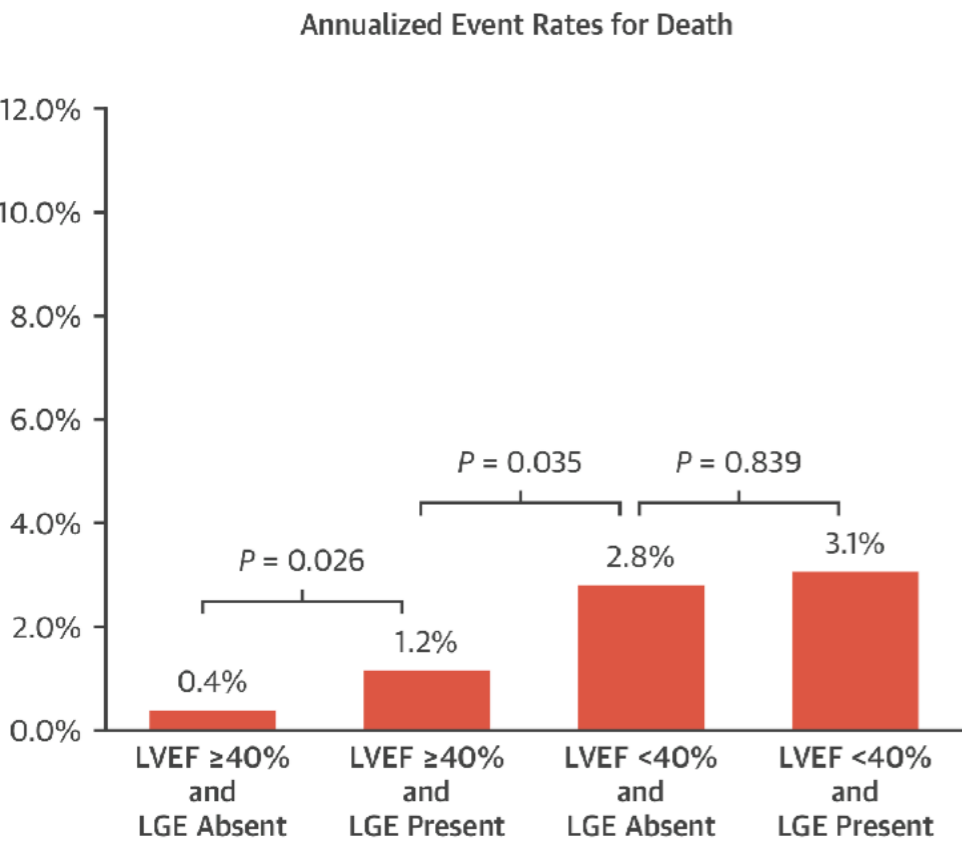
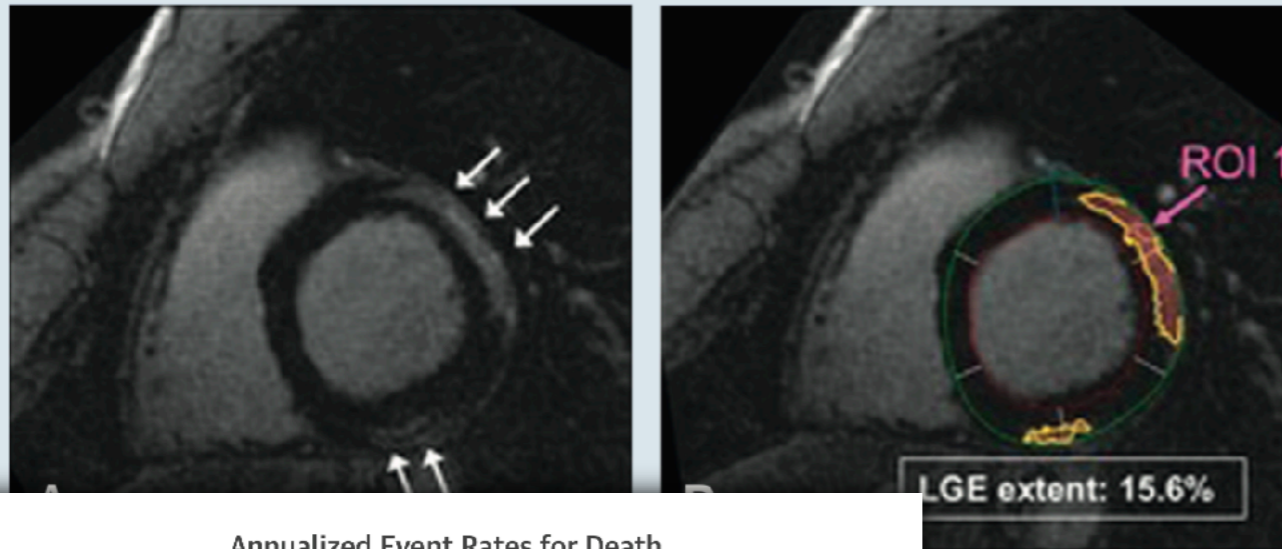
Ischemic vs non-ischemic



Cummings et al. Radiographics 2009

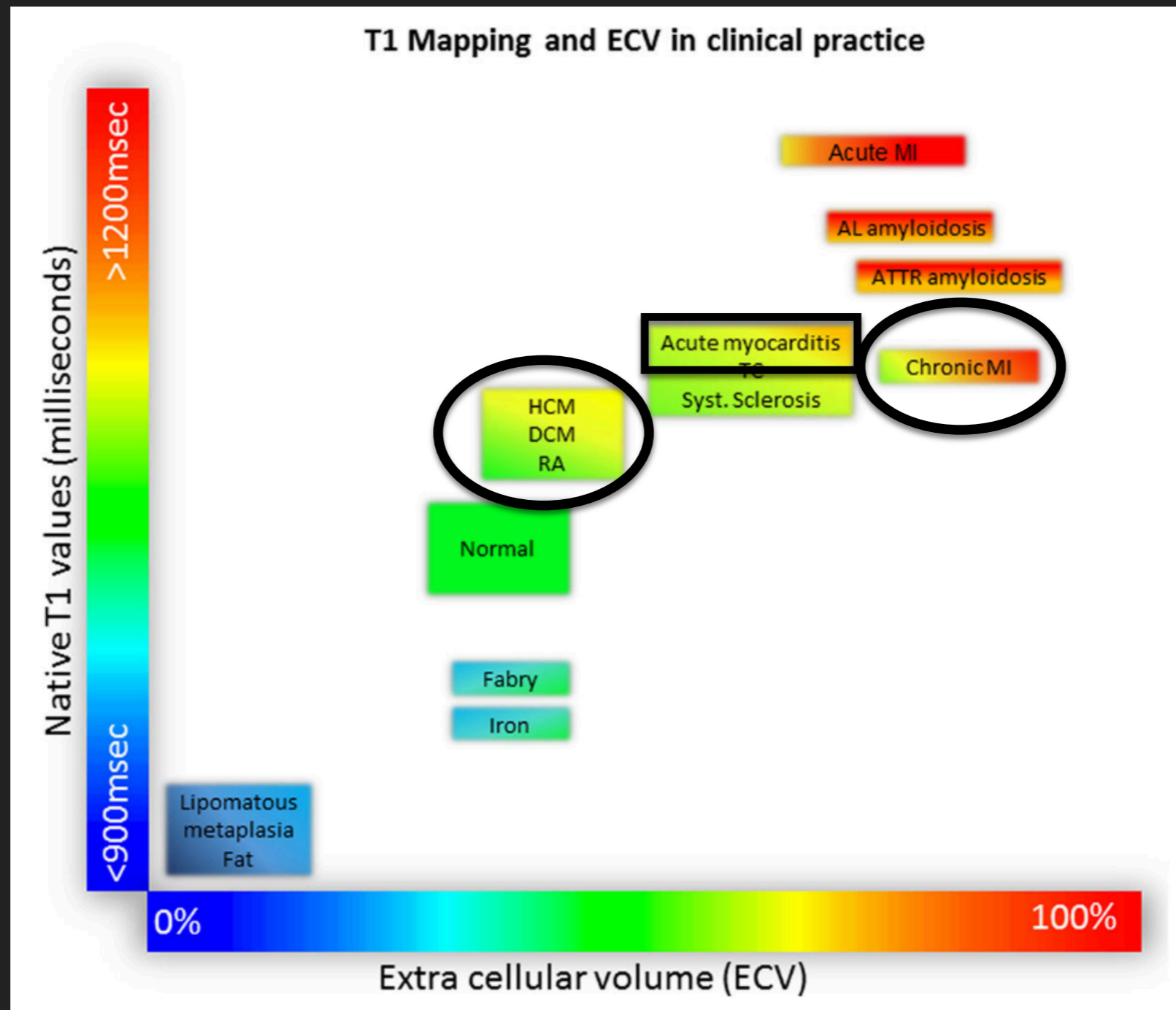
Non-ischemic etiology

# CMR IN MYOCARDITIS: PROGNOSTIC VALUE OF SCARS

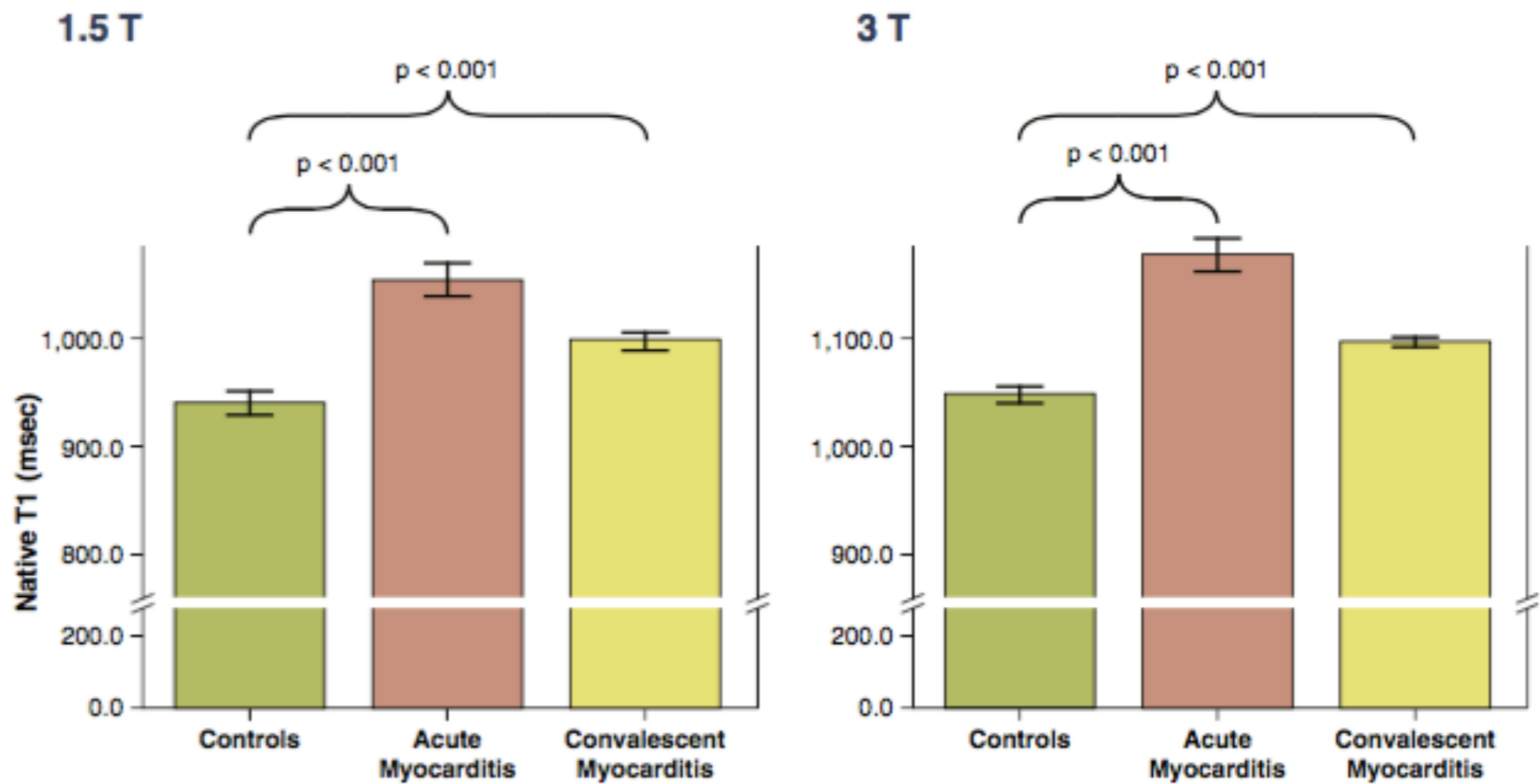


Patients at risk	670	480	329	236	117	43	21
LGE absent	376	274	189	138	74	31	15
LGE present	294	206	140	98	43	12	6

# MYOCARDIAL MAPPING



# NATIVE T1 IN MYOCARDITIS



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# SUMMARY

- Acute myocardial inflammation is characterized by edema and typically by associated irreversible injury (necrosis, scar), while chronic myocarditis is less well defined.
- CMR can identify both, edema (T2) and irreversible injury (T1) and differentiate acute from chronic myocarditis.
- Because of its specificity for edema and thus acute stages, T2 mapping or T2-weighted imaging is required for verifying or excluding acute myocardial inflammation.

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