

PERICARDITI E MIOCARDITI: FRATELLI O CUGINI?



Società Italiana di Ecografia Cardiovascolare
WWW.SIEC.IT



ECOCARDIOGRAFIA 2015
XVII Congresso Nazionale SIEC

*Ruolo della RMN nella
diagnosi precoce di
miocardite*

*Gianluca Di Bella MD PhD
dibellag@unime.it*

Myocarditis

"Inflammation of the myocardium" diagnosed by
histological criteria *, immunological,
immunohistochemical criteria **
and MRI ✓ .

* *Dallas Criteria*

** ≥ 14 leukocytes / mm² + 4 monocytes / mm² with the presence of T LINF
CD3 positive (≥ 7 cells / mm²)

✓ *T2W, Iperemia, DCE*

Inflammatory cardiomyopathy

Dilated cardiomyopathy

Heterogeneity of clinical presentation

- HF
- Arrhythmias
- Chest pain.

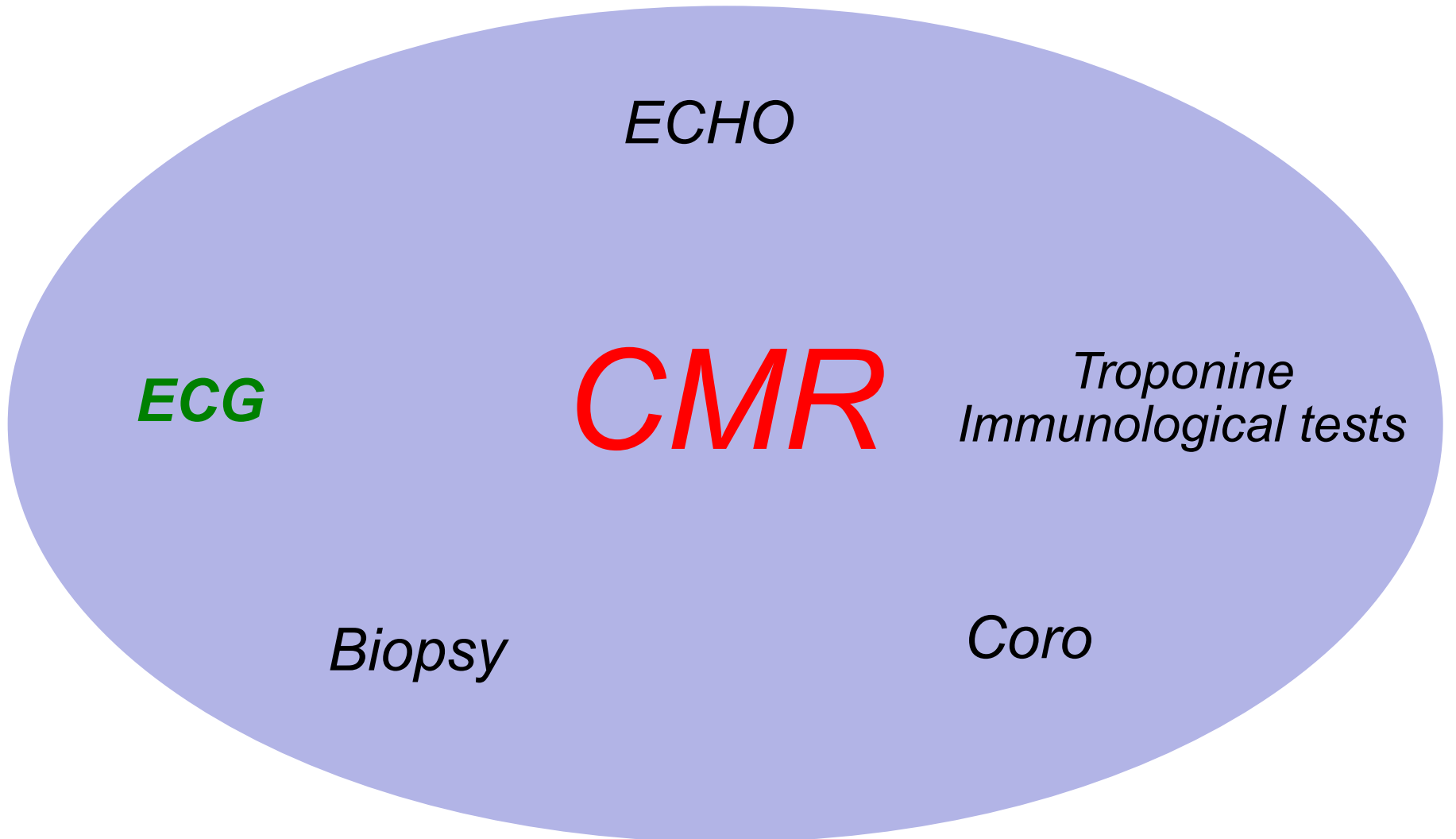
+ + etiology and pathogenesis

++++ time

Diagnosis myocarditis

Miocarditis

Diagnosis



CMR in Myocarditis

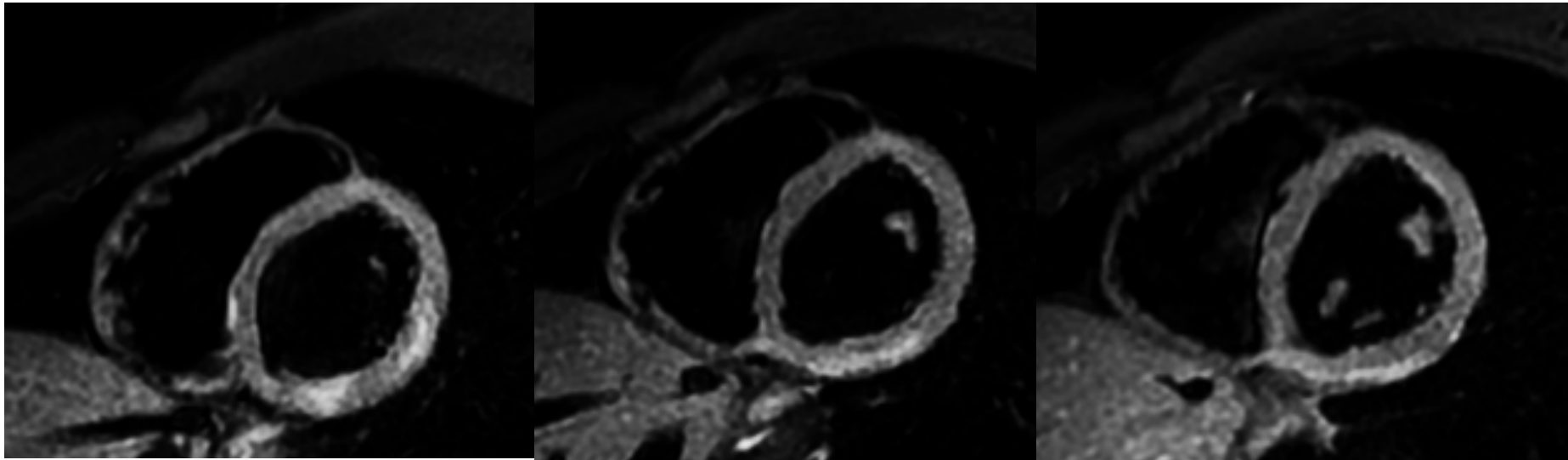
2nd cause of indication

- Edema
- Hyperemia
- Necrosis / scar
- Ventricular function
- Effusion and / or inflammation of the pericardium
- Other atypical signs and complications

Myocarditis

EDEMA

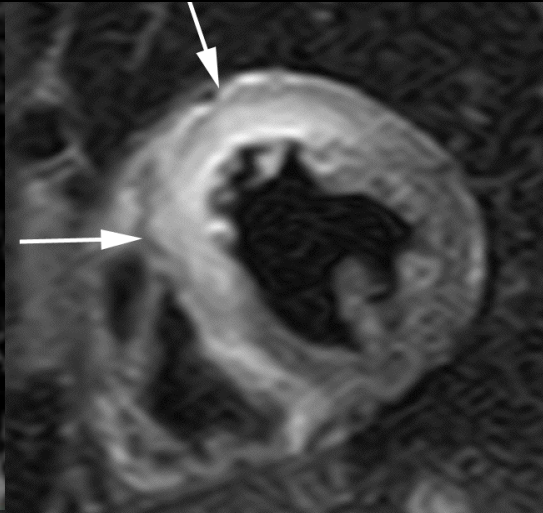
T2-STIR



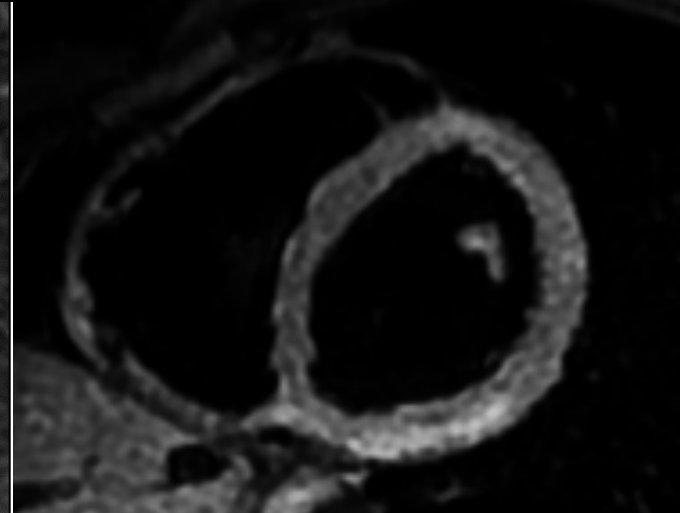
Acute myocardial damage



HCM



AMI

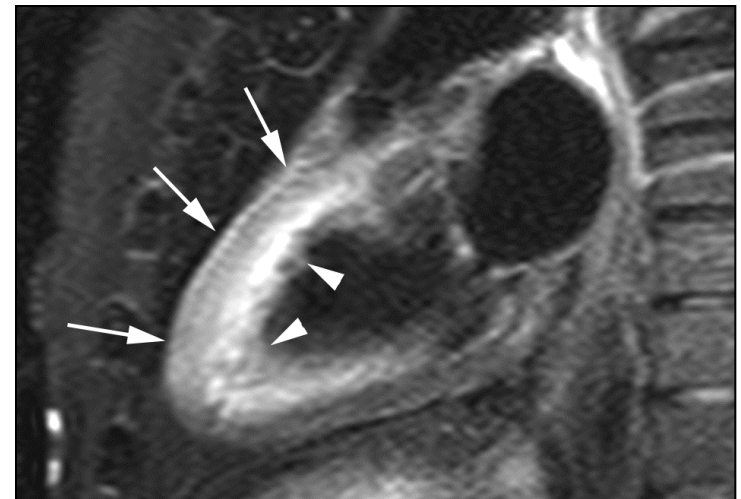


Myocarditis

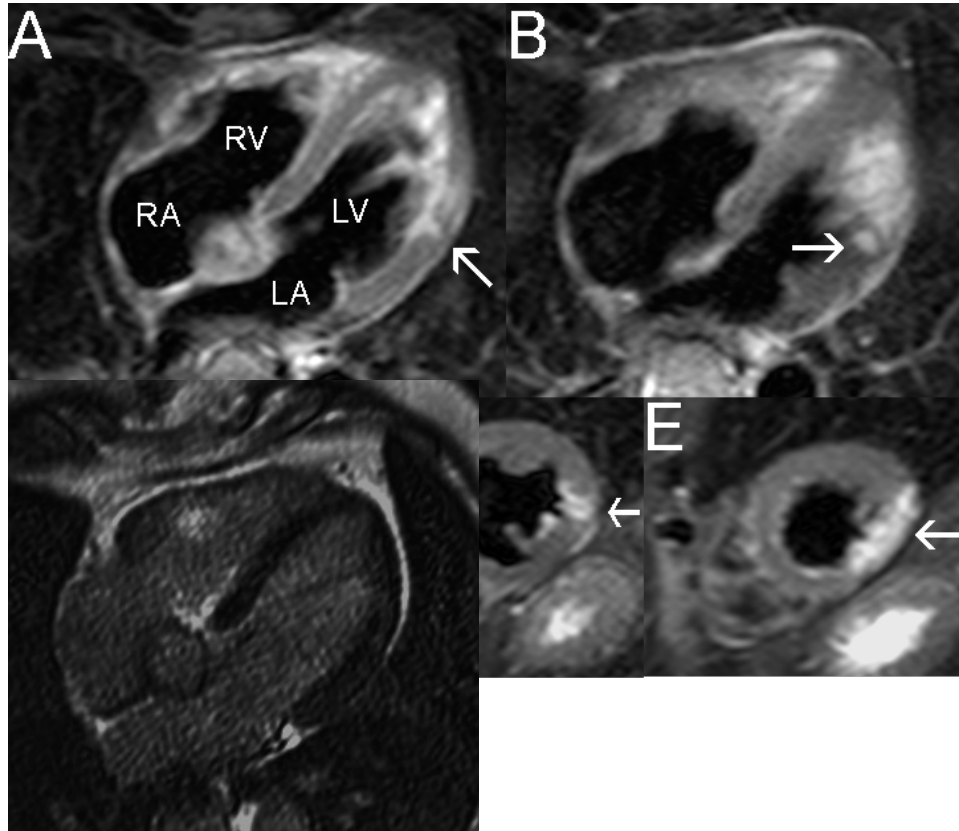
Others...

T2-weighted Imaging: Limitations

- Increased free water content does not necessarily reflect myocardial necrosis/ischemia (**nonspecific**)
 - overestimation ($\pm 80\%$) of the true necrotic area (\Rightarrow jeopardized myocardium)
 - abnormalities other than infarction (eg, myocarditis, HCM, AMI)
- Adjacent slow moving/stagnant blood: hyperintense
- Chronic infarcts (scar): no abnormalities
- Image “degradation” and long acquisition times

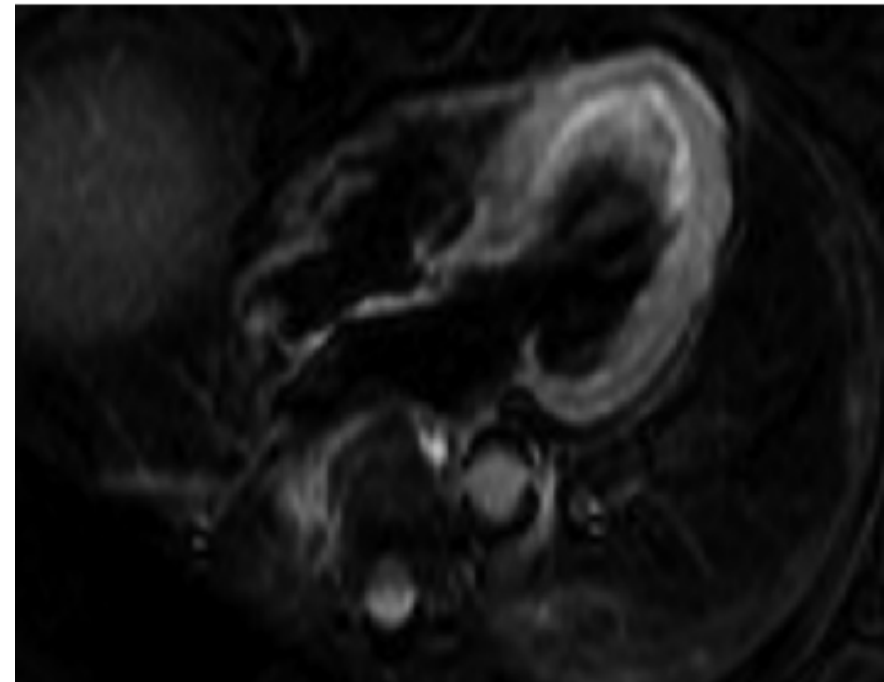


T2-weighted Imaging: Advantages



Myocardial contusion

Di Bella G. No published report



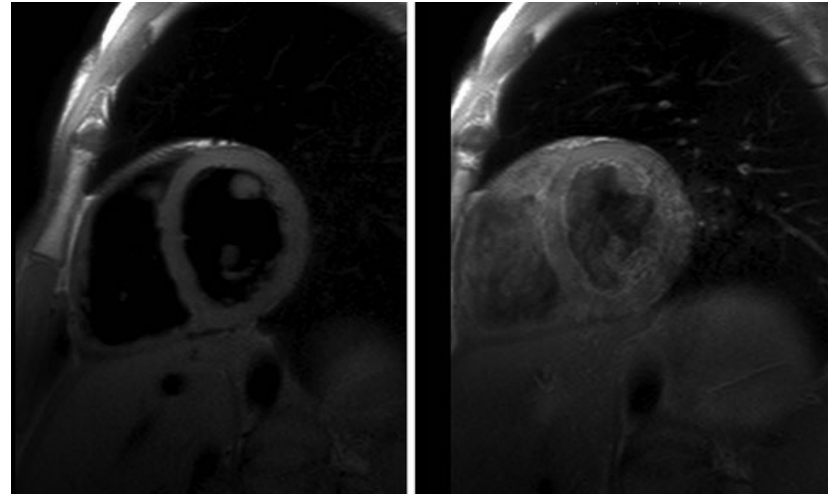
Takotsubo cardiomyopathy

Myocarditis

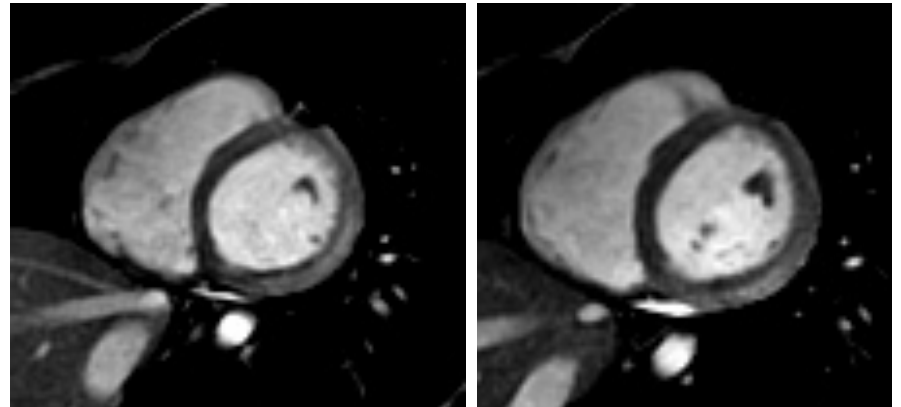
HYPEREMIA

obtained by the ratio of the myocardial SI before and early (3 min) post-contrast administration, and compared to that of skeletal muscle (global relative enhancement ratio). A ratio $[> 4$ (1.5T GE scanner) $[> 5$ (1.5T Siemens scanner) is concordant with myocardial hyperemia and increased capillary leakage (Zagrosek et al. 2009).

Post-Contrast T1-SE



Post-Contrast SSFP



Myocarditis

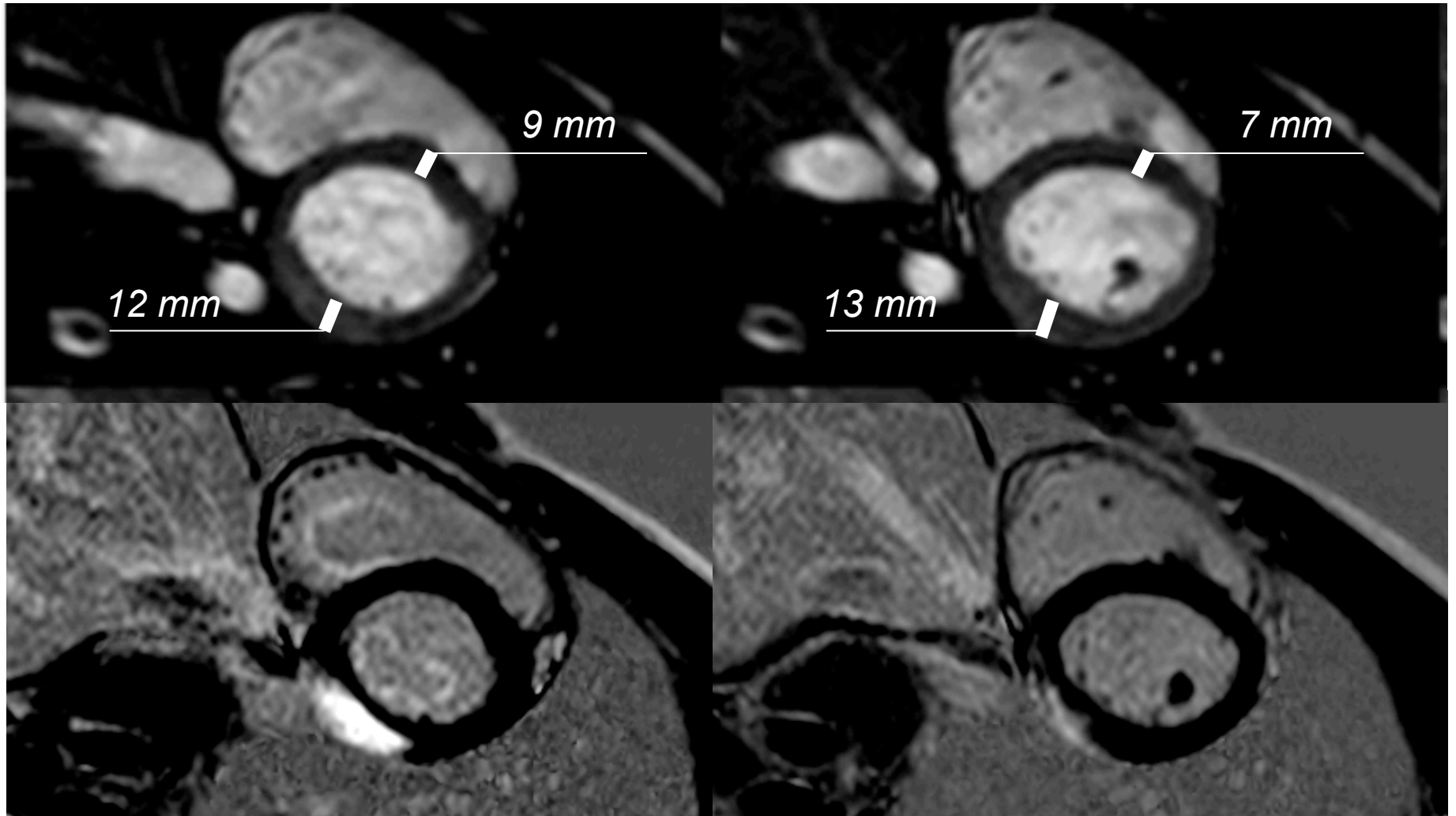
HYPEREMIA

Post-Contrast SSFP



16 years old man - Flu like disease- chest pain - elevated troponin - No ECG abnormalitis -

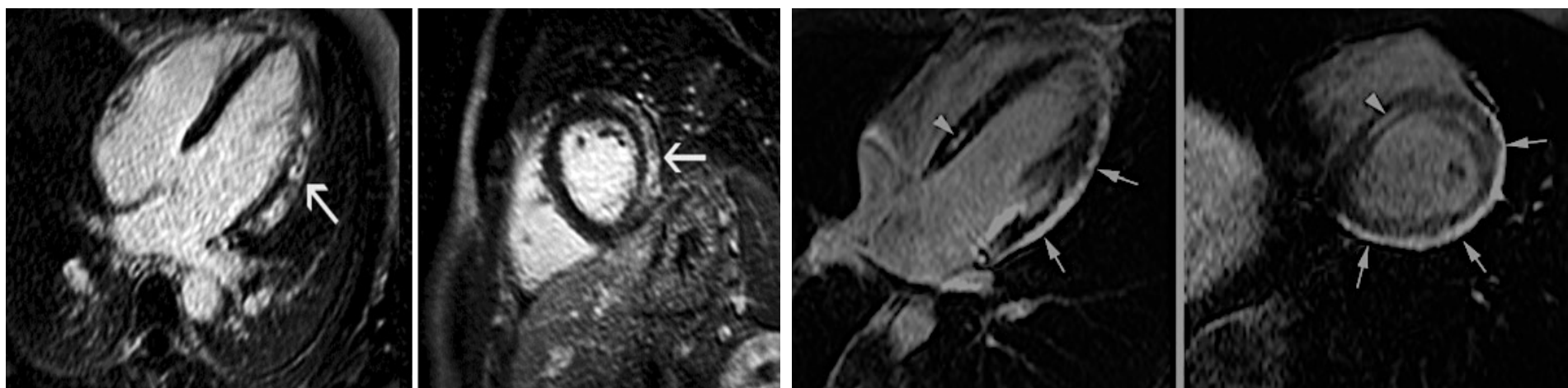
Myocarditis



Myocarditis

DELAYED ENHANCEMENT, IR-GRE

- Myocardial necrosis (acute phase)
- Fibrosis (chronic phase)
- typically non-ischemic, enabling rule out of acute myocardial infarction
- Most frequently, the subepicardial part of the lateral free LV wall is involved
- Not infrequently, the enhancement may extend to the adjacent pericardium \pm a small pericardial effusion (Yelgec et al. 2007; Ong et al. 2011).
- The second most frequent pattern is midwall enhancement of the ventricular septum
- The enhancement may be multifocal or diffuse in distribution. Functionally, wall motion is usually mildly to moderate impaired in the regions showing myocardial edema/enhancement).



Cardiovascular Magnetic Resonance in Myocarditis: A JACC White Paper

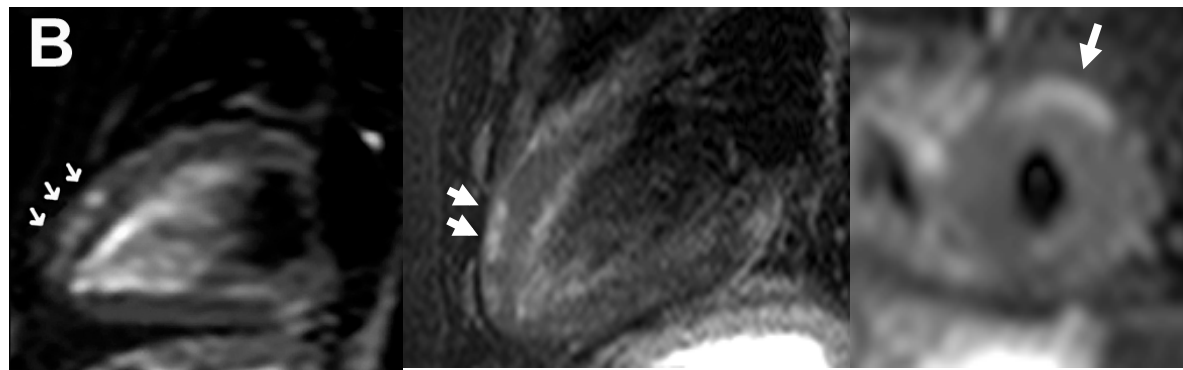
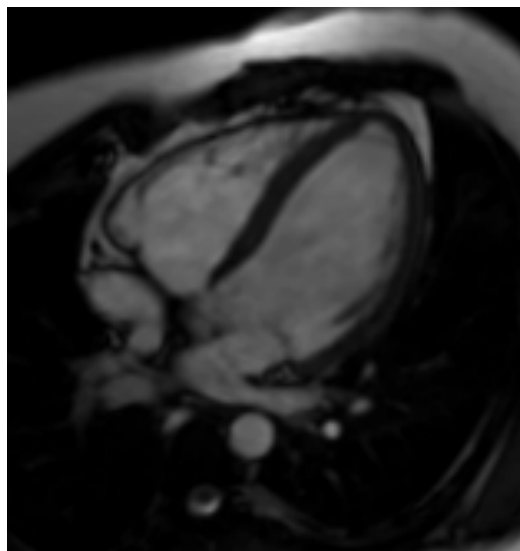
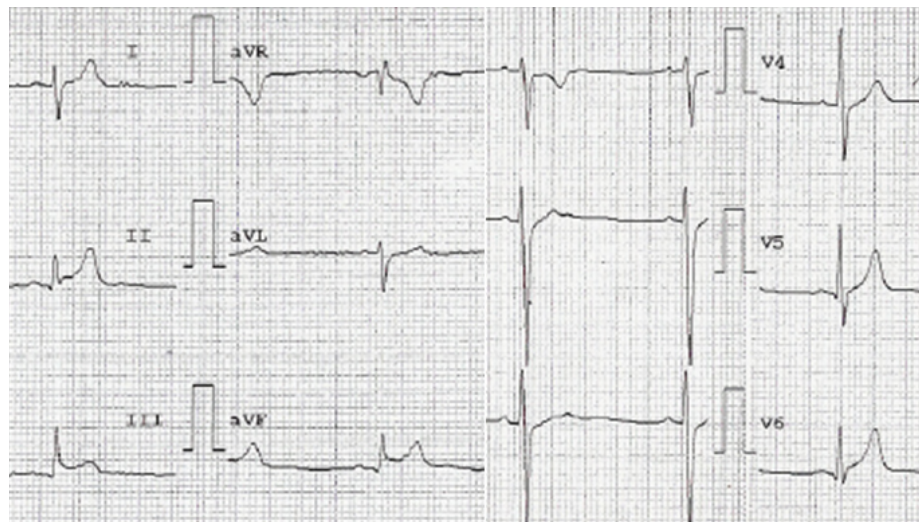
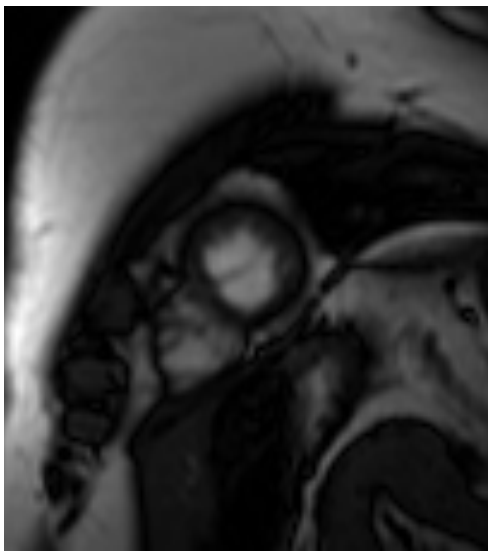
Matthias G. Friedrich, MD,* Udo Sechtem, MD,‡ Jeanette Schulz-Menger, MD,§
Godtfred Holmvang, MD,|| Pauline Alakija, MD,† Leslie T. Cooper, MD,¶ James A. White, MD,#
Hassan Abdel-Aty, MD,§ Matthias Gutberlet, MD,** Sanjay Prasad, MD,††
Anthony Aletas, PhD,‡‡ Jean-Pierre Laissy, MD,§§ Ian Paterson, MD,|||
Neil G. Filipchuk, MD,* Andreas Kumar, MD,* Matthias Pauschinger, MD,¶¶
Peter Liu, MD,## for the *International Consensus Group on Cardiovascular Magnetic Resonance
in Myocarditis*

Cardiovascular magnetic resonance (CMR) has become the primary tool for noninvasive assessment of myocardial inflammation in patients with suspected myocarditis. The International Consensus Group on CMR Diagnosis of Myocarditis was founded in 2006 to achieve consensus among CMR experts and develop recommendations on the current state-of-the-art use of CMR for myocarditis. The recommendations include indications for CMR in patients with suspected myocarditis, CMR protocol standards, terminology for reporting CMR findings, and diagnostic CMR criteria for myocarditis (i.e., “Lake Louise Criteria”).

Lake-louise criteria \geq 2

- T1-W early post Gd
- T2-W
- LGE

Myocarditis: ST elevation

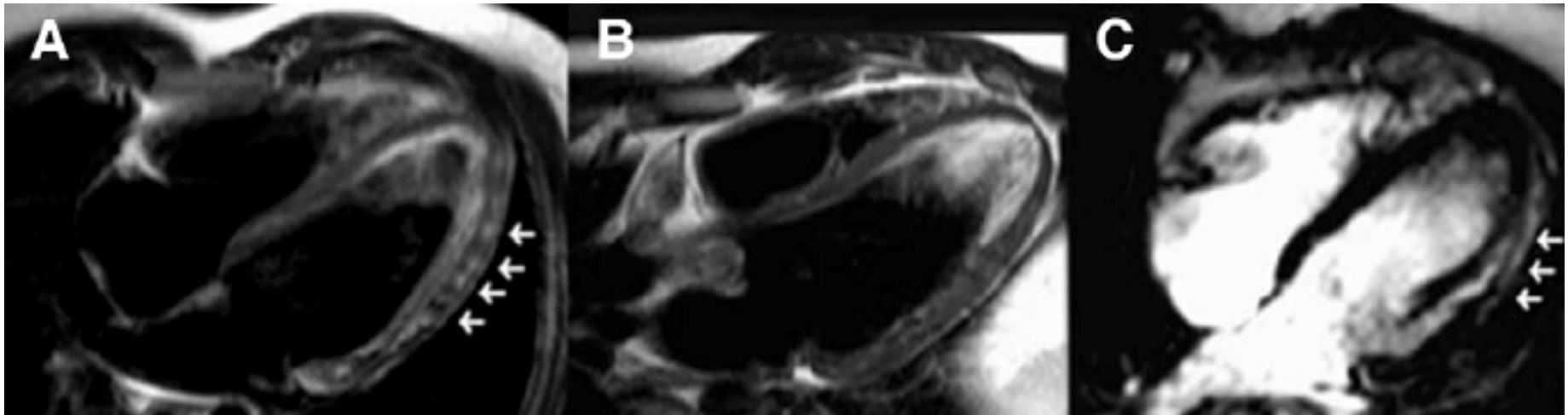


Di Bella G et al. Early diagnosis of focal myocarditis by cardiac magnetic resonance. International Journal of Cardiology, Received 22 November 2005; accepted 8 January 2006

Acute myocarditis vs Follow-up

Acute phase

Cronic phase 3 month later



T2-weighted image

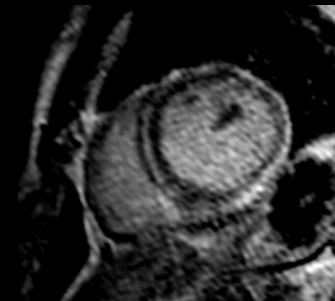
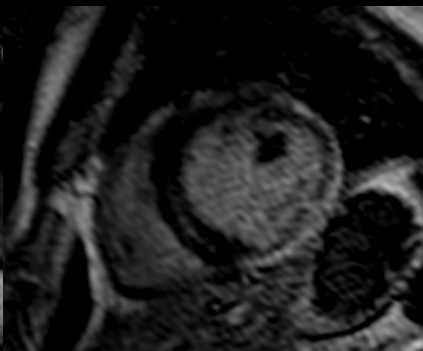
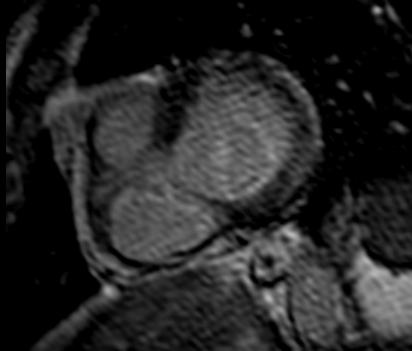
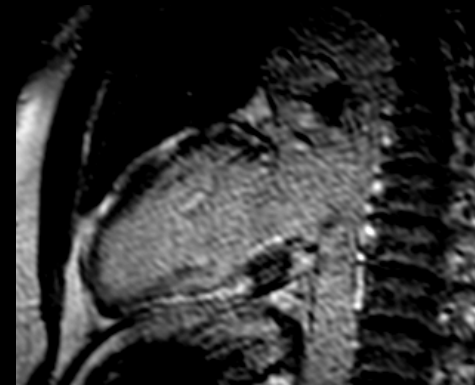
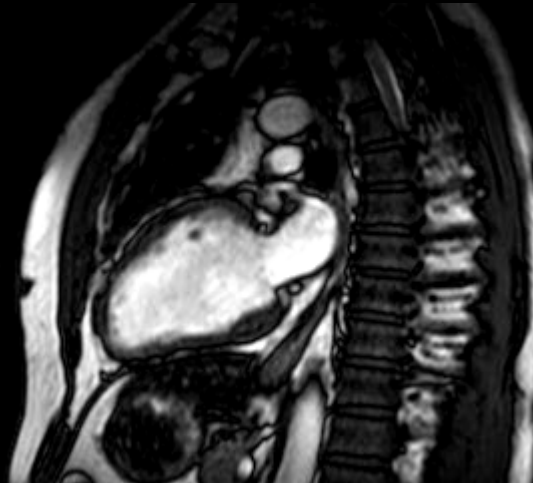
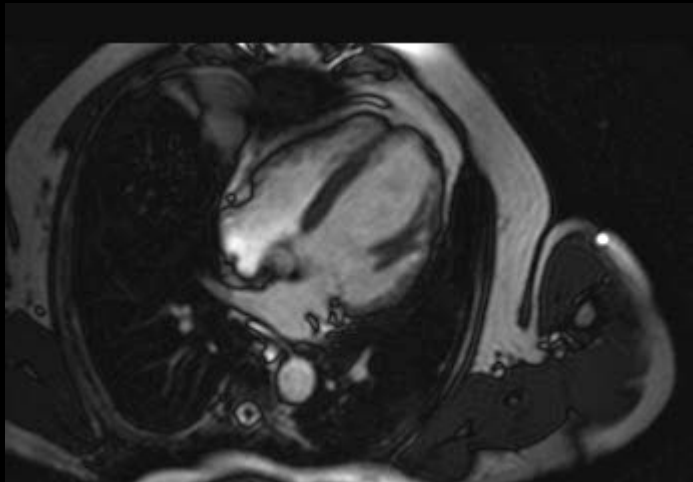
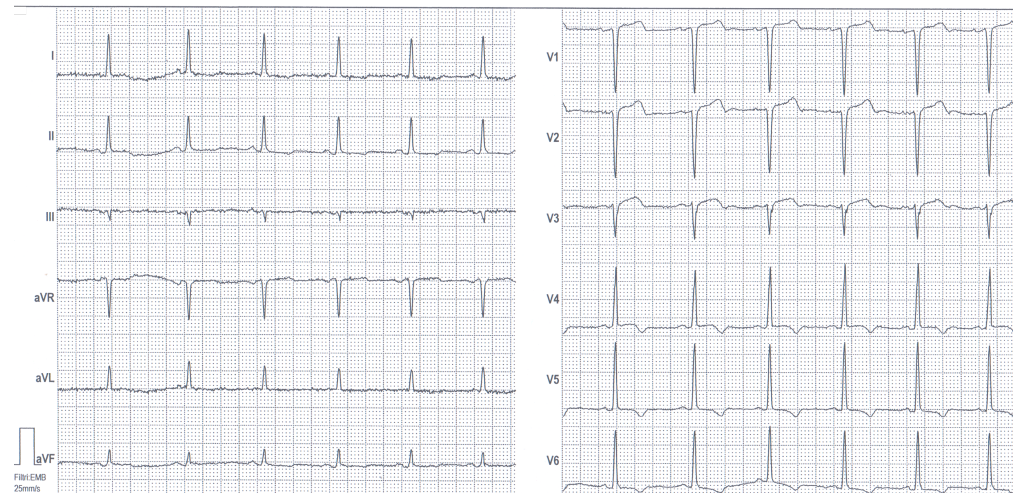
delayed enhancement image

Myocarditis

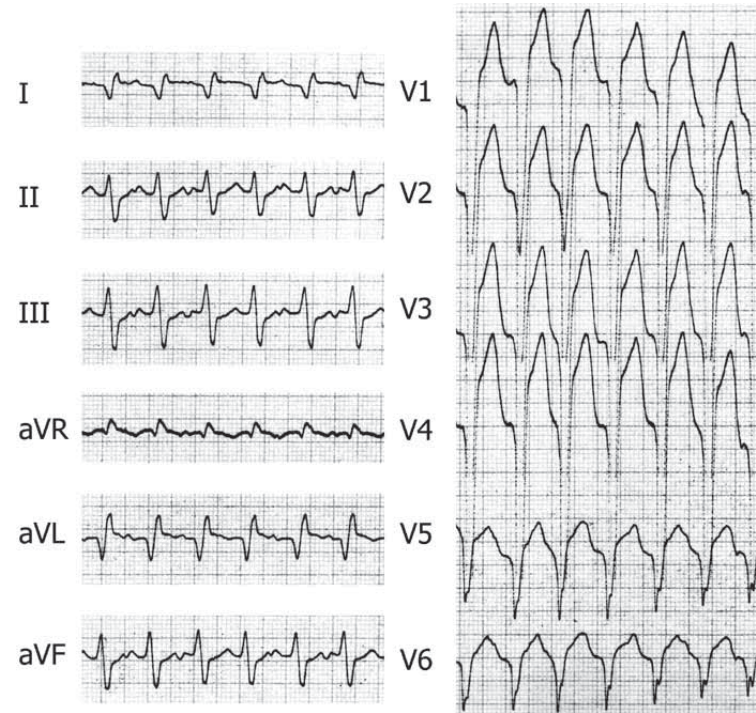
Ventricular function

Myocarditis

Heart failure

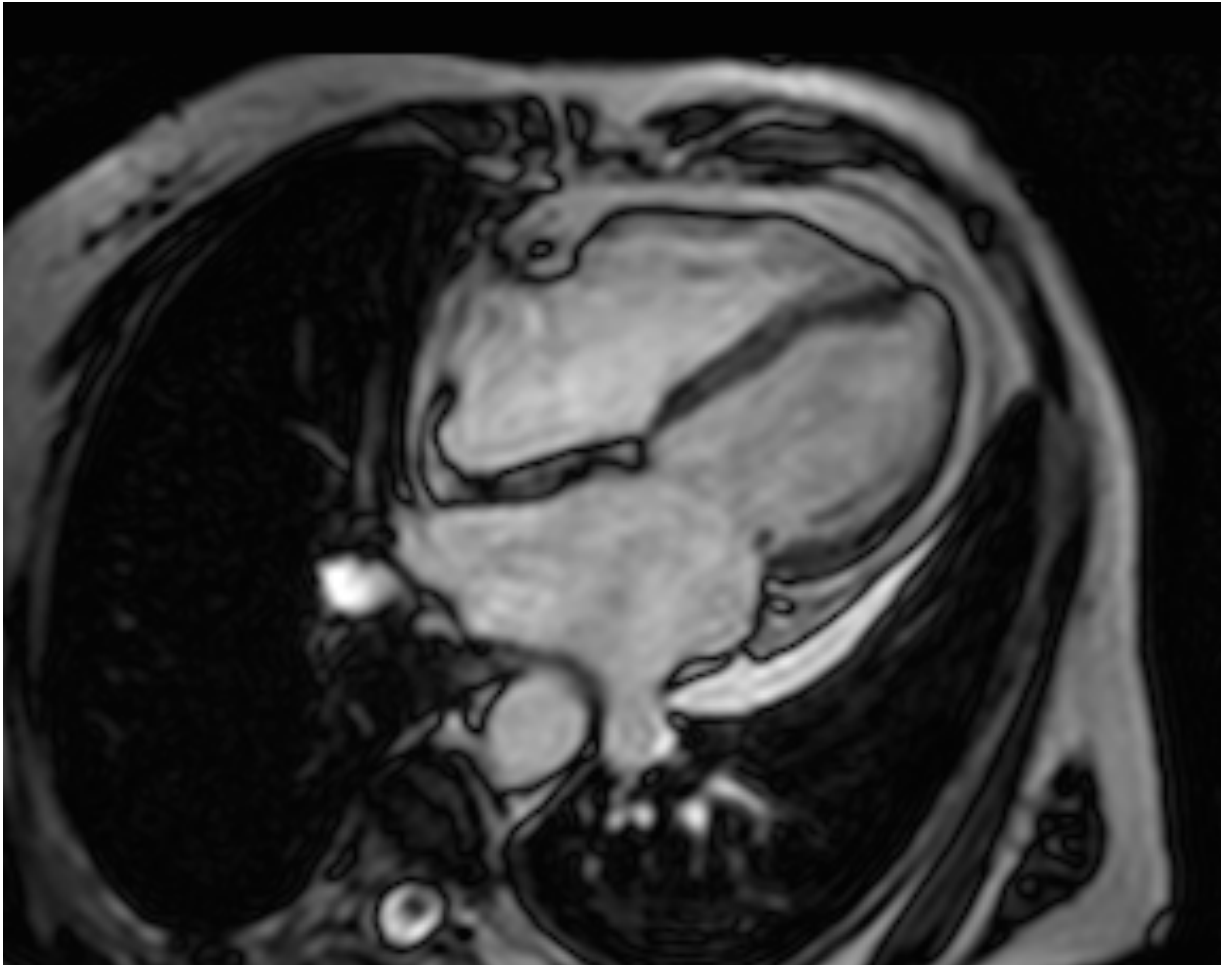


Ventricular tachycardia



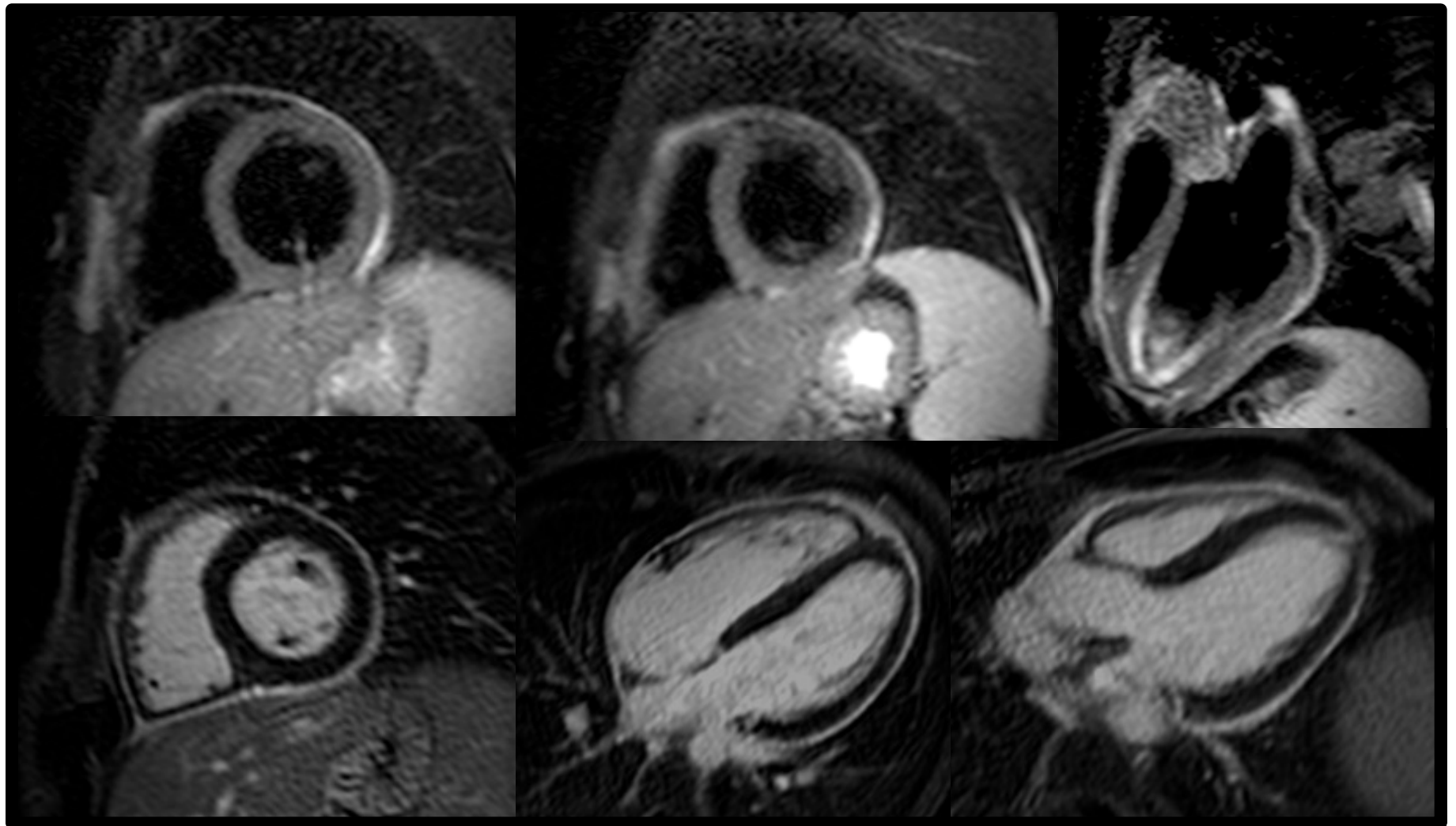
Miocardite

Versamento pericardico



Miocardite

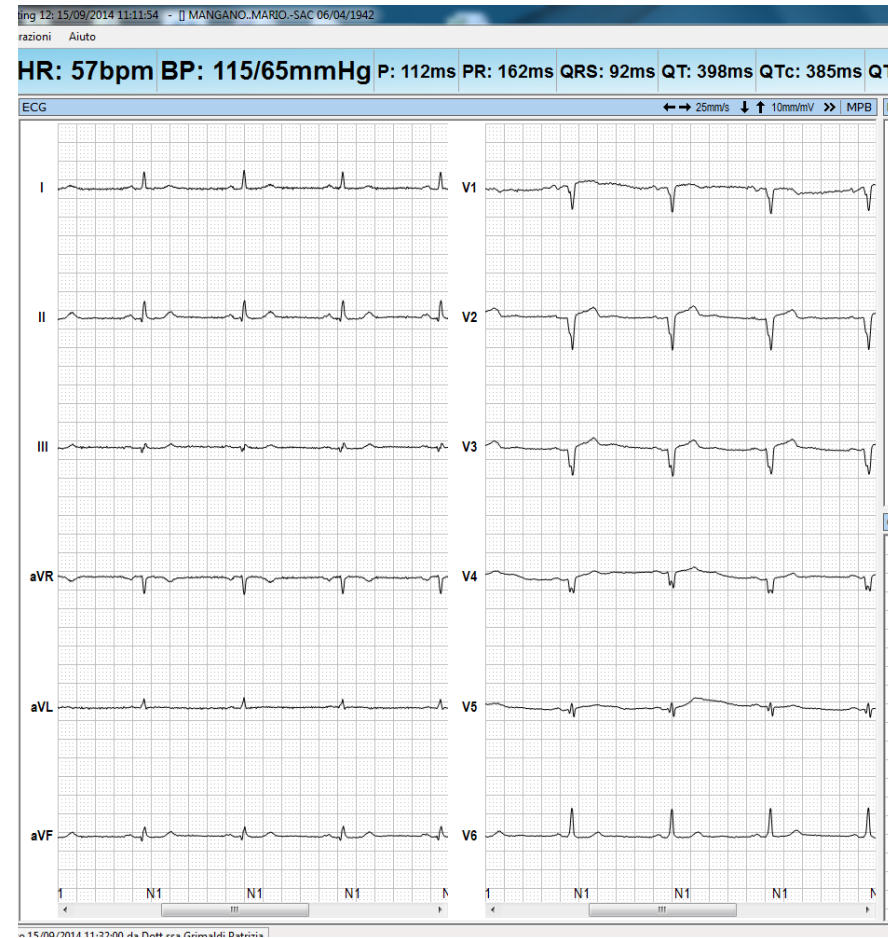
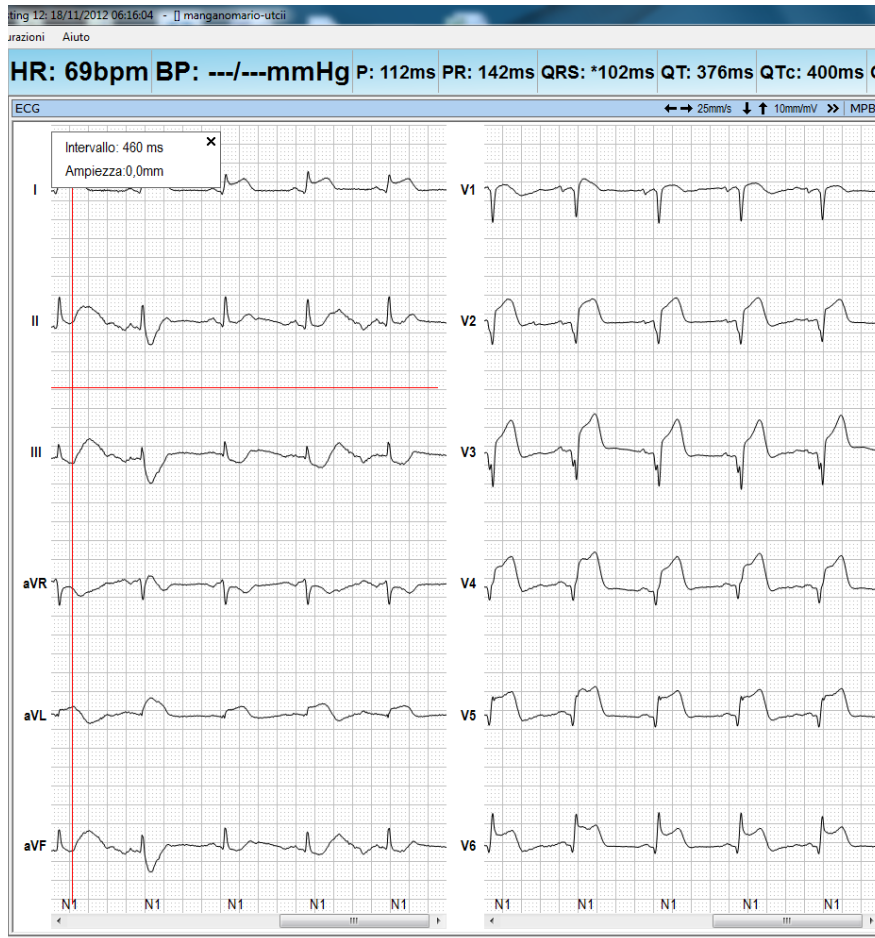
Inflammatione pericardico



Case 1

2012 STEMI – PTCA and STENT DA

September 2014 FU



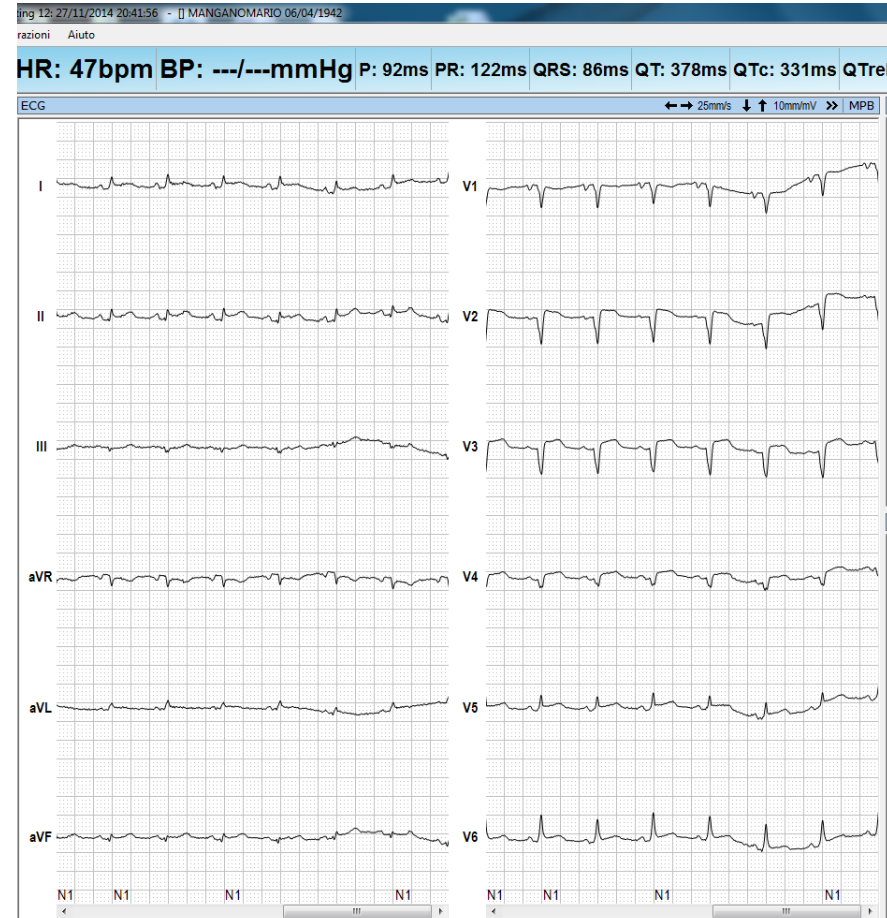
Case 1

November 2014

November 2014 Chest pain

Day-1.

- Asthenia and chest pain
- ECG: “new” ST elevation
- Coro:
 - ✓ no further abnormalities respect to 2012;
 - ✓ No restenosis intra-STENT
- Troponine negative
- No further abnormalities on TTE



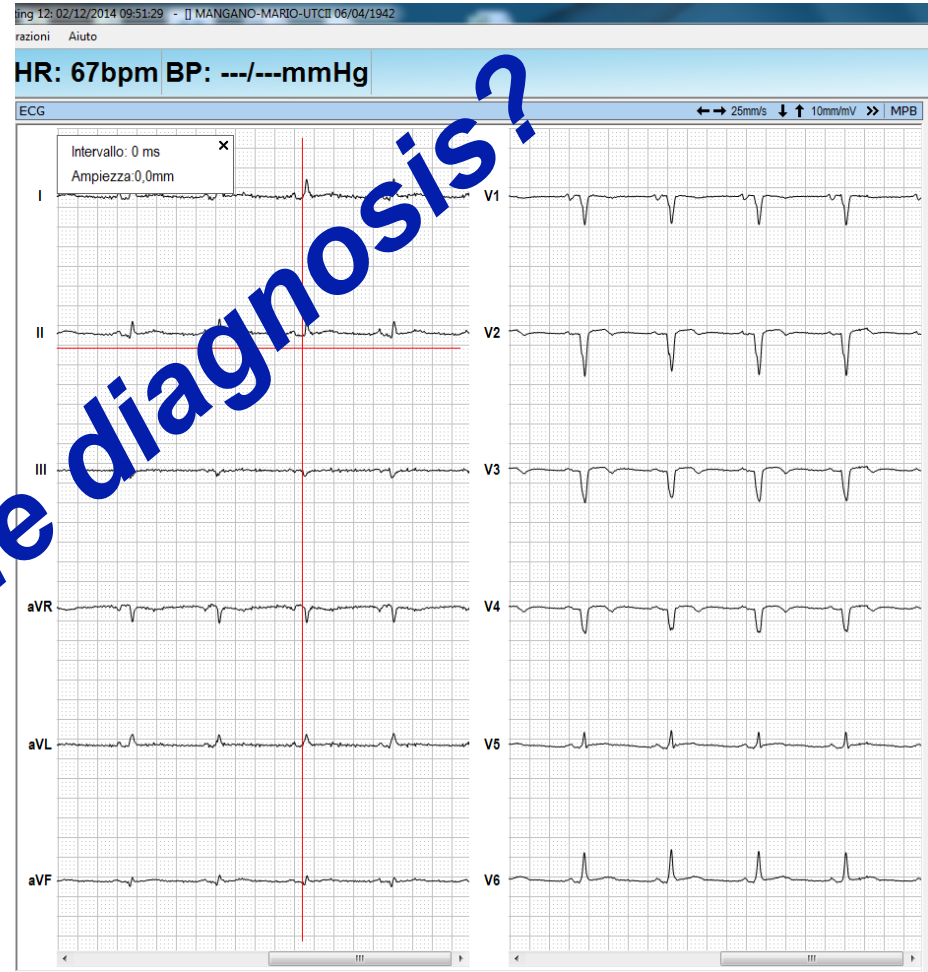
Case 1

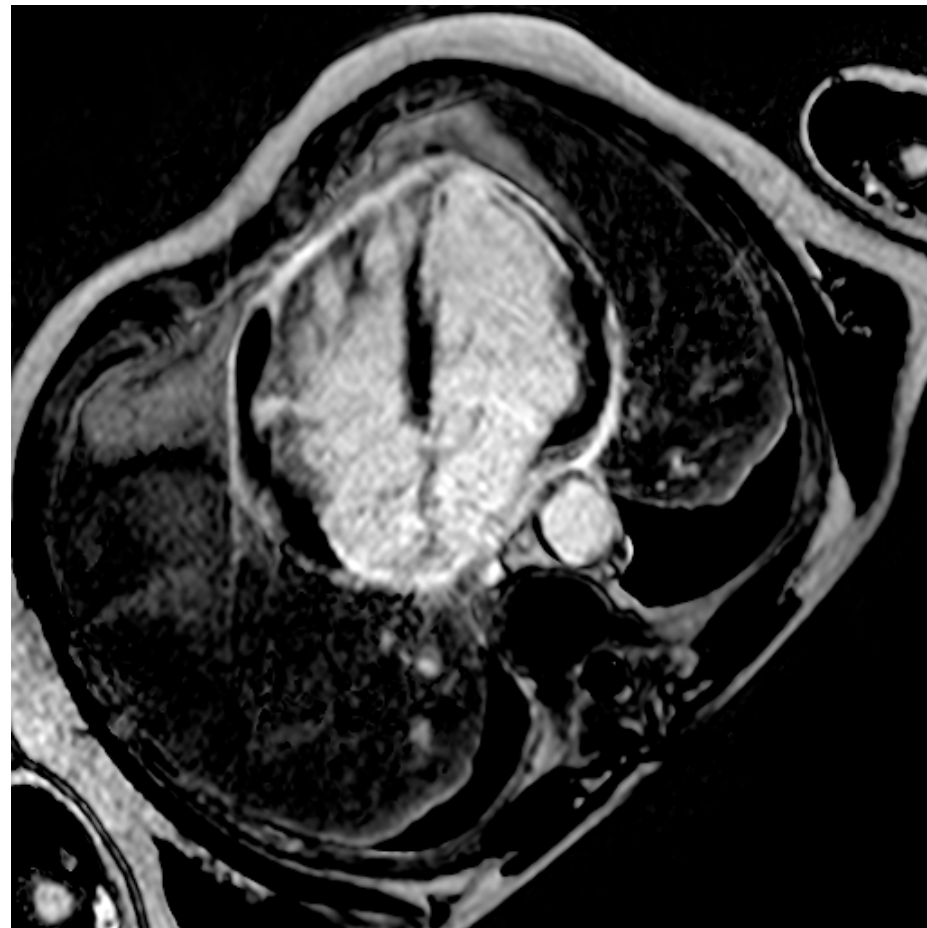
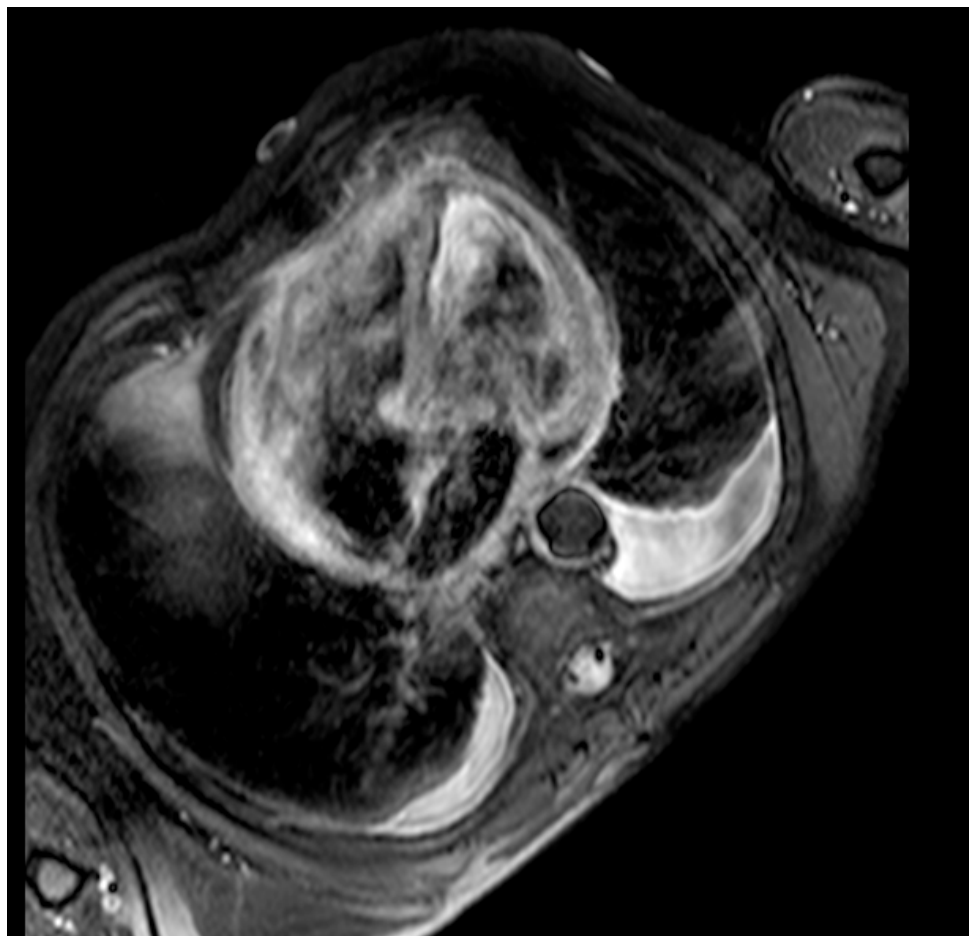
November 2014, hospitalization

Day-2.

- ✓ Negative T-wave on precordial leads
- ✓ troponine 0.4 ng/ml (nv <0.05)

Which is the diagnosis?





Myocarditis



CMR

ECHO

ECG

Electrocardiographic findings and myocardial damage in acute myocarditis detected by cardiac magnetic resonance

Gianluca Di Bella · Anca Florian · Lilia Oreto · Carmela Napolitano ·
Maria Chiara Todaro · Rocco Donato · Sara Calamelli · Giovanni Salvatore Camastra ·
Concetta Zito · Scipione Carerj · Jan Bogaert · Giuseppe Oreto

Received: 2 December 2011 / Accepted: 20 February 2012
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Abstract Delayed-contrast-enhancement (DCE) magnetic resonance imaging (MRI) can identify areas of myocardial damage in patients with acute myocarditis (AM). The aim of this study was to assess the electrocardiographic findings in AM diagnosed by DCE-MRI. Eighty-one patients (72 men, 35 ± 13 years) with AM were prospectively enrolled. All of them underwent MRI and 12-lead-ECG recordings. In the admission electrocardiogram (ECG 1), as well as in that obtained 48 h later (ECG 2), the following parameters were analyzed: rhythm, PR, QRS, and QTc-intervals, intraventricular conduction, abnormal Q waves, ST segment elevation, and T wave inversion. On admission, 77 patients (95%) were in sinus rhythm, while four patients (6%) manifested severe arrhythmias. No difference between ECG 1 and ECG 2 was observed regarding abnormal Q waves, PR, QRS, and QTc-

(32%, normal ECG group), and abnormal in 55 patients (68%, abnormal ECG group). ST elevation was found in 46 patients (57%), inverted T wave in seven patients (9%) and left bundle branch block (LBBB) in two patients (3%). Areas of DCE suggesting AM were found in each patient. No relationship concerning the location of the involved region (s) was found between ECG (leads with ST/T abnormalities) and MRI (areas showing DCE). The ECG in AM can either be normal or reflect abnormalities including arrhythmias, LBBB, ST segment elevation, and T wave inversion. The location of myocardial involvement deduced on the basis of ECG leads showing ST/T changes is not in close relationship with the areas of ventricular damage detected by MRI.

Keywords Electrocardiogram · MRI · Myocarditis

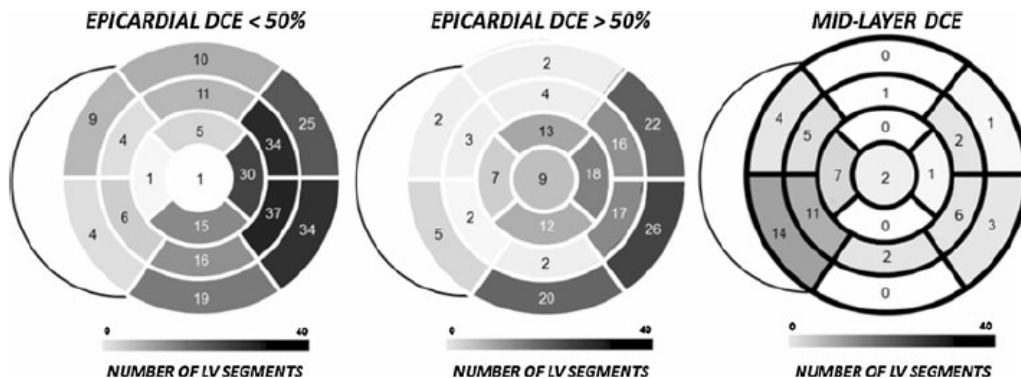


Fig. 2 Distribution of segments with epicardial DCE <50 of LV thickness (a), epicardial DCE >50 of LV thickness (b), and mid-ventricular DCE (c) in a 17-segment model (bull's-eye display). The

total number of involved segments is reported for each location. The greater the number of DCE involved segments in each segment, the darker the segment is (range 0–40)

Electrocardiographic findings and myocardial damage in acute myocarditis detected by cardiac magnetic resonance

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Table 2 Cardiac MRI findings in normal and abnormal ECG patients

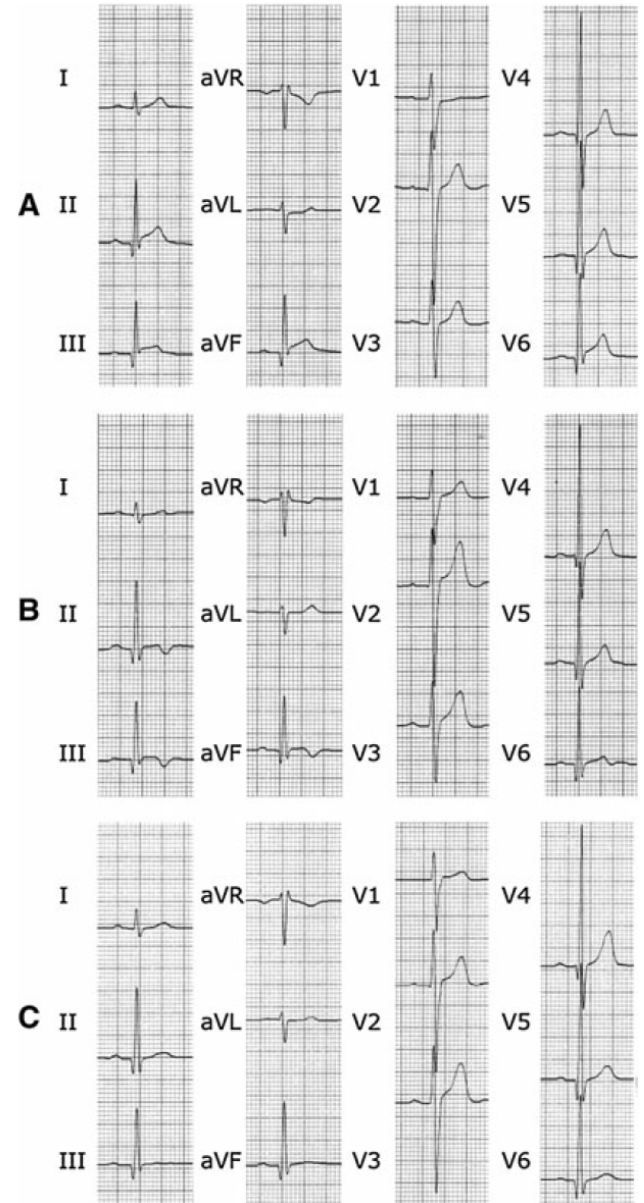
	Normal ECG (<i>n</i> = 26)	Abnormal ECG (<i>n</i> = 55)	<i>p</i>
LVEDV (ml)	161 ± 43	178 ± 54	NS
LVESV (ml)	75 ± 28	90 ± 49	NS
LVEF (ml)	56 ± 7	52 ± 12	NS
LV mass (g)	121 ± 20	119 ± 28	NS
Segments with DCE (%)	40	35	NS
Segments with DCE <50% (%)	20	20	NS
Segments with DCE >50% (%)	16	11	NS
Mid-DCE segments (%)	4	4	NS
Inferior septum DCE segments (%)	38	35	NS
Anterolateral DCE segments (%)	88	67	0.04
Inferolateral DCE segments (%)	96	80	NS
Anterior DCE segments (%)	27	36	NS
Anteroseptal DCE segments (%)	12	20	NS
Inferior DCE segments (%)	77	58	NS
Pericardial DCE (%)	71	46	0.04
Pericardial effusion (%)	46	46	NS

LV left ventricle, *EDV* end diastolic volume, *ESV* end systolic volume, *EF* ejection fraction, *DCE* delayed contrast enhancement

Miocarditi ECG and CMR

“dolore toracico”

“about 1/3 of patients that have suffered from a recent acute inflammatory myocardial disease detected by CMR, the ECG did not show any abnormality”



A 48 ore

A 72 ore

Fig. 3 Electrocardiograms recorded on admission (a), 48 h later (b) and 78 h later (c) from a patient with AM

ECG



Myocardial Deformation in Acute Myocarditis With Normal Left Ventricular Wall Motion – A Cardiac Magnetic Resonance and 2-Dimensional Strain Echocardiographic Study –

Gianluca Di Bella, MD, PhD; Michele Gaeta, MD*; Alessandro Pingitore, MD, PhD[†];
Giuseppe Oreto, MD; Concetta Zito, MD; Fabio Minutoli, MD*;
Carmelo Anfuso, MD*; Giuseppe Dattilo, MD, PhD; Annalisa Lamari, MD;
Sebastiano Coglitore, MD; Scipione Carerj, MD

Background: The aim of our study was to assess longitudinal (L), circumferential (C) and radial (R) strain (S) of the left ventricle (LV) in patients with acute myocarditis and preserved LV wall motion.

Methods and Results: Of the 26 male patients that were enrolled, 13 patients (26±8 years) suffered from acute myocarditis and 13 (25±2 years) were healthy participants (controls). Both patients and controls underwent cardiac magnetic resonance (CMR) and 2-dimensional S imaging (2D-S) echocardiography on the same day. Myocardial strains (RS, LS and CS) were quantified by 2D-S. In patients with myocarditis, a delayed enhancement (DE) CMR study was performed to identify damaged myocardial segments. In the myocarditis group there was a significant LS reduction compared with controls (-25 ± 7 vs -20 ± 7 , $P<0.0001$), whereas no difference was found between the 2 groups concerning CS and RS. Subepicardial DE areas were found in 12 of 13 patients. Segments with DE showed a significantly lower LS in comparison with segments without DE (-19 ± 4 vs -23 ± 6 , $P<0.0001$). In contrast, no difference in CS and RS was found when comparing segments with DE vs segments without DE.

Conclusions: In patients with acute myocarditis, evidence of subepicardial damage and no wall motion abnormalities, longitudinal deformation is diffusely impaired, whereas circumferential impairment is regionally sited in the areas of subepicardial damage. (*Circ J* 2010; **74**: 1205–1213)

Key Words: Magnetic resonance imaging; Myocarditis; Tissue Doppler imaging

Miocarditi

ECHO

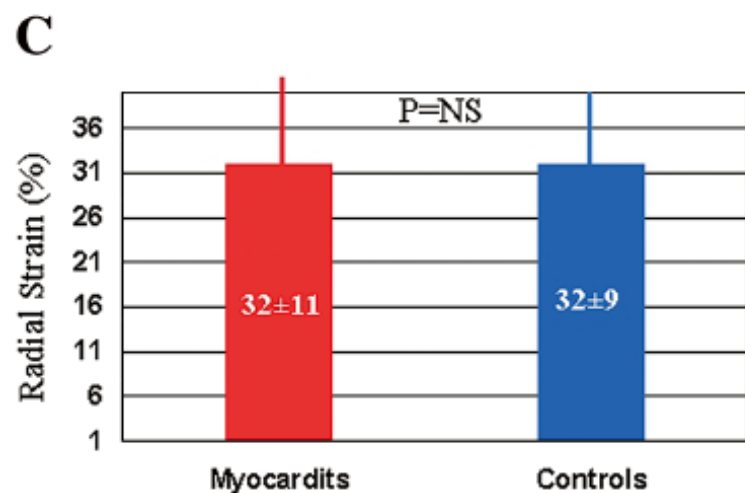
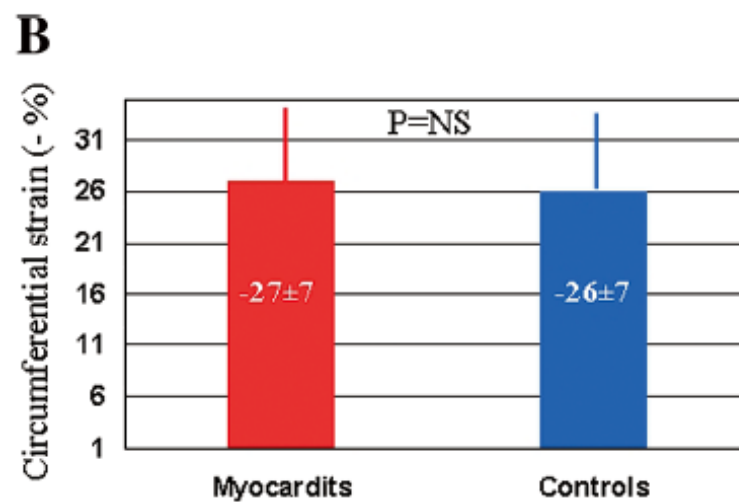
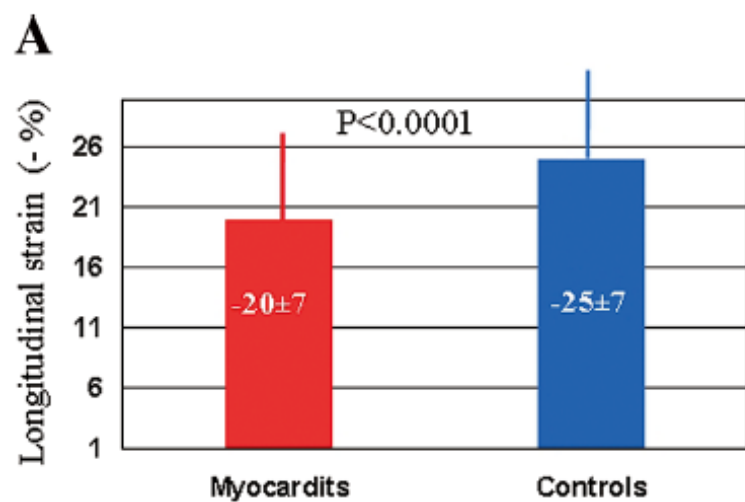


Figure 3. (A) Longitudinal, (B) circumferential and (C) radial strain in patients with myocarditis and in controls.

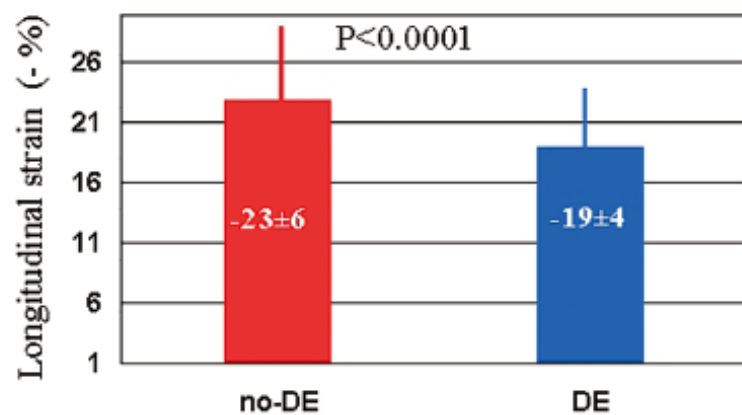
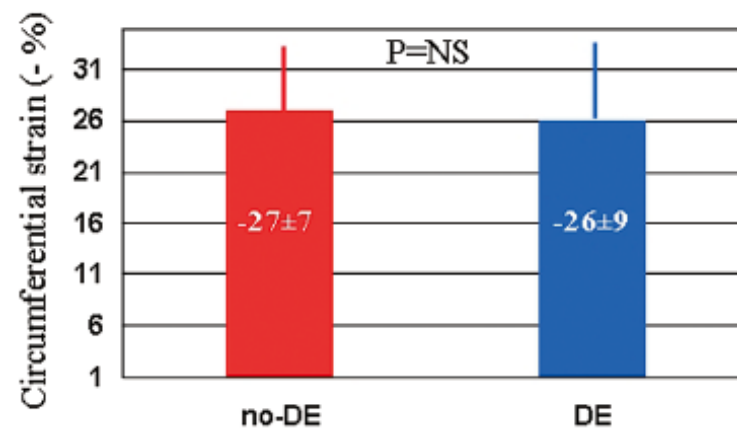
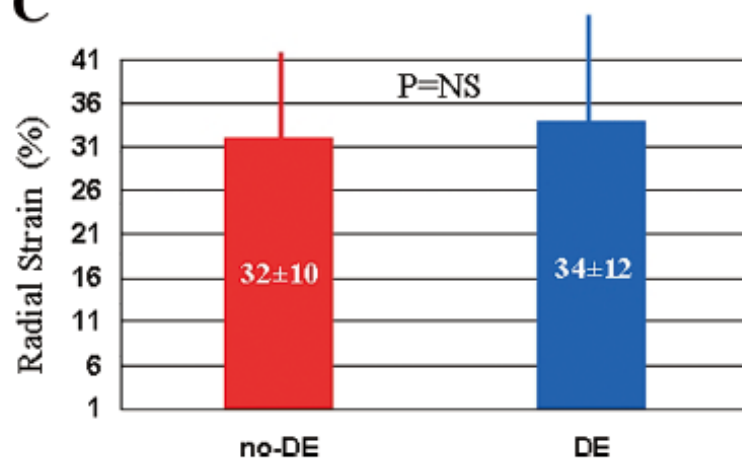
A**B****C**

Figure 4. (A) Longitudinal, (B) circumferential and (C) radial strain in myocardial segments without (no-DE) and with (DE) delayed enhancement (data relative to the whole population, including both patients and controls).

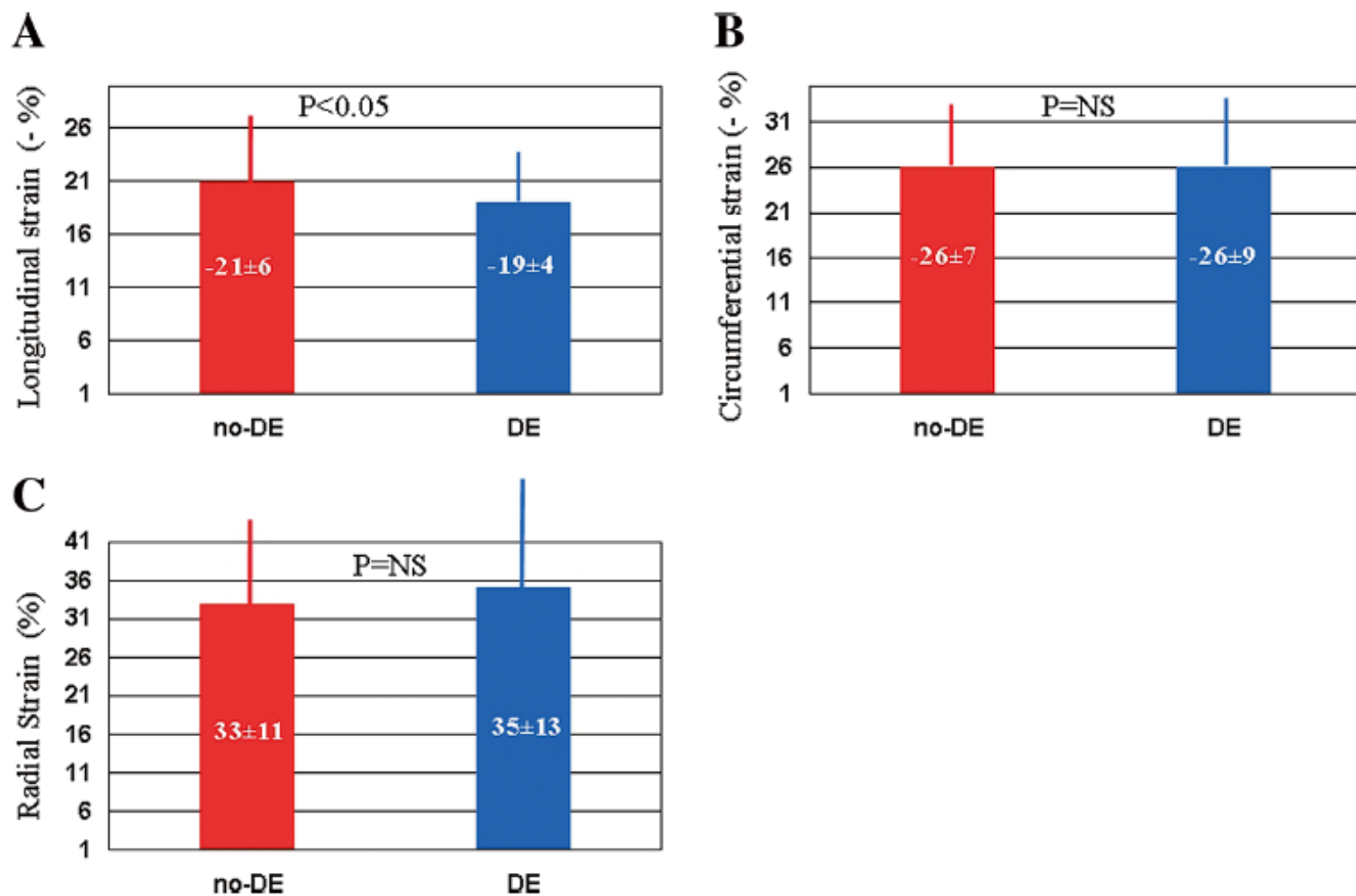


Figure 5. (A) Longitudinal, (B) circumferential and (C) radial strain in myocardial segments without (no-DE) and with delayed enhancement (data relative to patients with myocarditis).

Early use of cardiac magnetic resonance reduces hospitalization time and costs in patients with acute myocarditis and preserved left ventricular function: a single center experience

Gianluca Di Bella^a, Michele Gaeta^b, Maria C. Todaro^a, Lilia Oreto^a, Rocco Donato^b, Roberto Caruso^a, Alfredo Blandino^b, Concetta Zito^a, Sebastiano Coglitore^a, Scipione Carerj^a and Giuseppe Oreto^a

J Cardiovasc Med 2011, 12:493–497

Keywords: cardiac MRI, costs, hospitalization time, myocarditis

^aClinical and Experimental Department of Medicine and Pharmacology and ^bDepartment of Radiological Science, University of Messina, Messina, Italy

Correspondence to Gianluca Di Bella, MD, PhD, Clinical and Experimental Department of Medicine and Pharmacology, University of Messina, Via Consolare Valeria N 1, Messina 98100, Italy
Tel: +39 0902 213 531; fax: +39 0902 213 531;
e-mail: gianluca.dibella@tiscali.it

Received 30 November 2010 Revised 18 February 2011
Accepted 22 March 2011

To the Editor. Re: greatly modified the increase in both dia; Due to the heterog chest pain, dyspnea acute myocarditis re

Data from the lit acute myocarditis f damage of subepic ejection fraction.^{6,7} carditis, clinical dist drome (ACS) can t several invasive and leading to increase c ization time.

Cardiac MRI has i cation of the presen damage (inflammati by myocarditis or the differential di ties.^{9–14} In myocardi always involves th myocarditis, subepi affected.

Nowadays, cardiac l many medical cente the most versatile a modality to diagnose

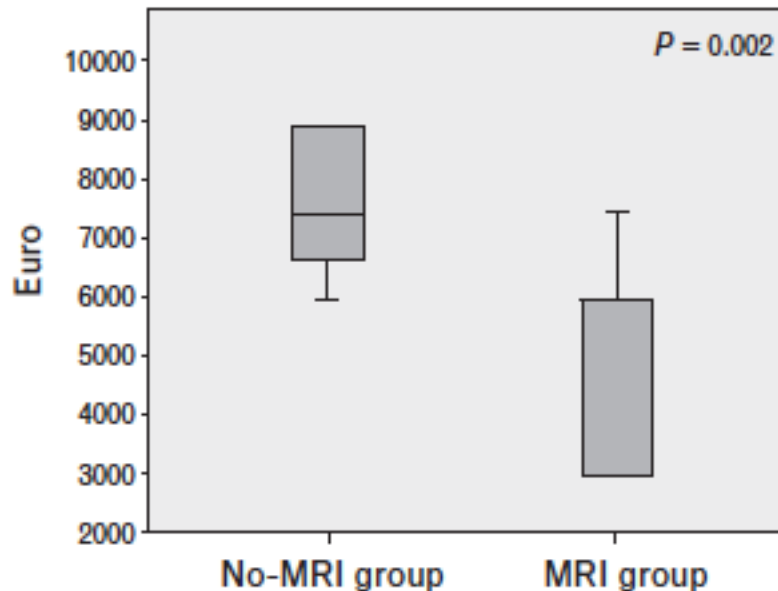
The aim of this study was to assess the clinical and economic impact of an early use of cardiac MRI in the management of patients with acute myocarditis.

Methods

From January 2003 to December 2009, a series of 23 consecutive white patients (38 ± 14 years, two women) discharged from our cardiac care unit with a noninvasive diagnosis of acute myocarditis were evaluated retrospectively.

At admission, the diagnosis of suspected acute myocarditis was based on the following criteria: history of

Cost of hospitalization days



Total cost of hospitalization

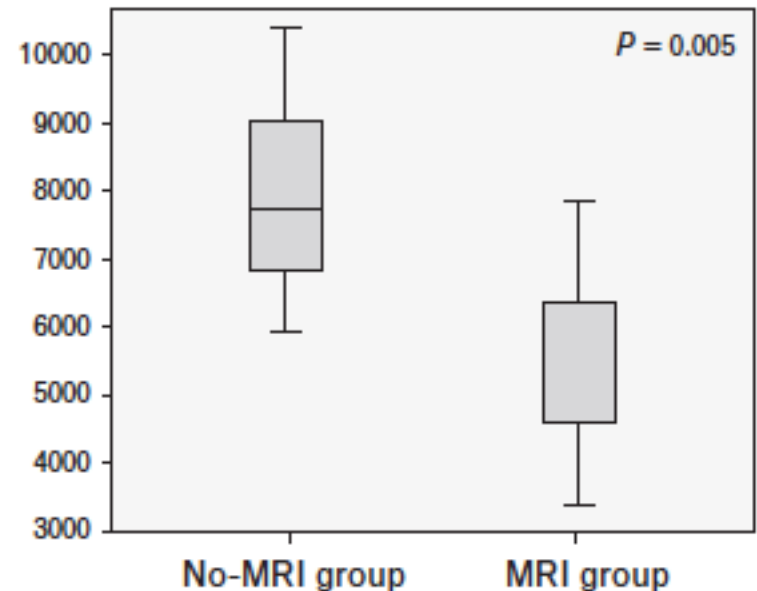
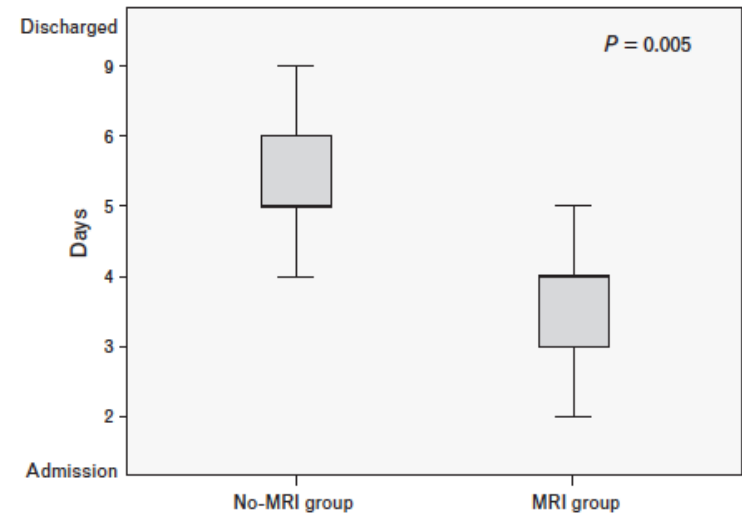


Fig. 1



ITALian CMR on **MY**ocarditis **ITAMY**

On the behalf of the working group **“Applicazioni della Risonanza** **Magnetica” of SIC**

*Studio multicentrico ITAMY
organizzato dal GdS delle
Applicazioni della RM in
Cardiologia*

- ✓ *pazienti con diagnosi di
miocardite acuta mediante RM
cardiaca*
- ✓ *Pisa-IFC_Monasterio,*
- ✓ *Rozzano Humanitas*
- ✓ *Roma ospedale Vannini*
- ✓ *Roma Pol.Casilino*
- ✓ *Messina Pol. Martino*
- ✓ *Padova Azienda Ospedaliera,*
- ✓ *Milano Monzino*
- ✓ *Napoli Villa dei Fiori Acerra,*
- ✓ *Roma, 'San Giovanni di Dio.*



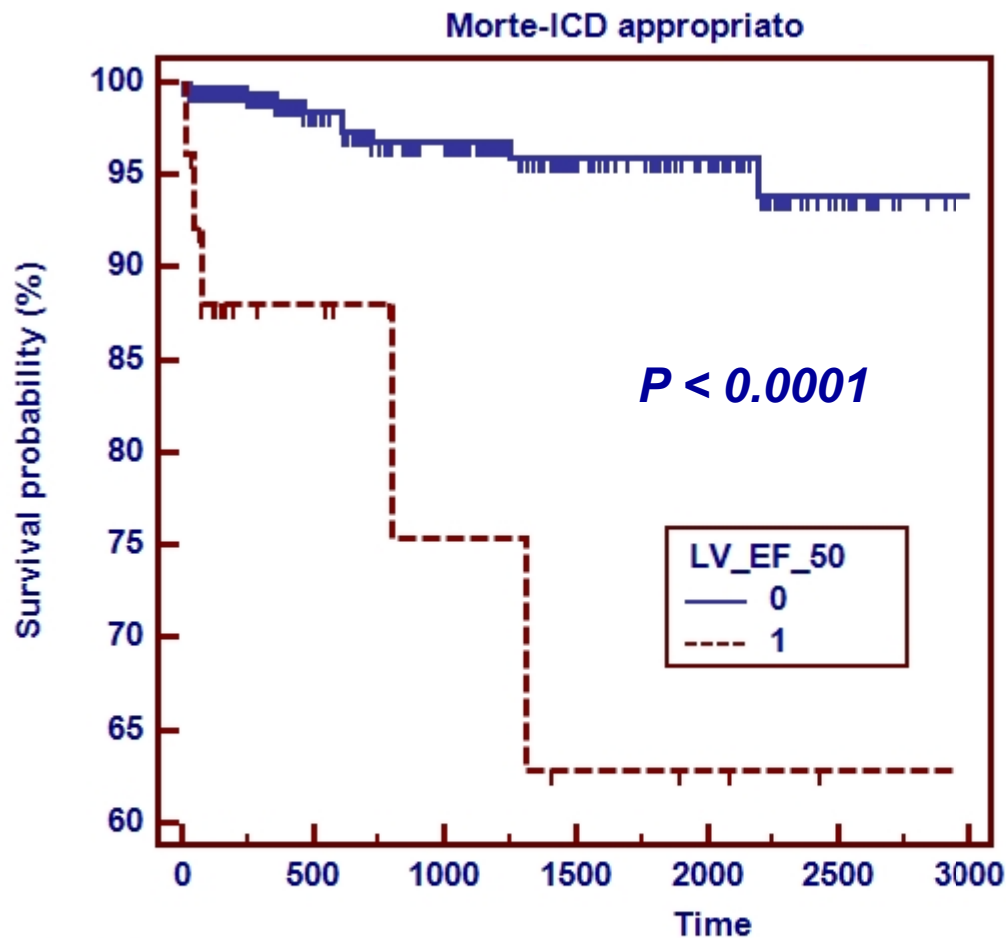
Studio multicentrico ITAMY

Dati preliminari e parziali

413 pts

26 exitus o equivalenti

LVEF < 50%



Studio multicentrico ITAMY

Dati preliminari e parziali

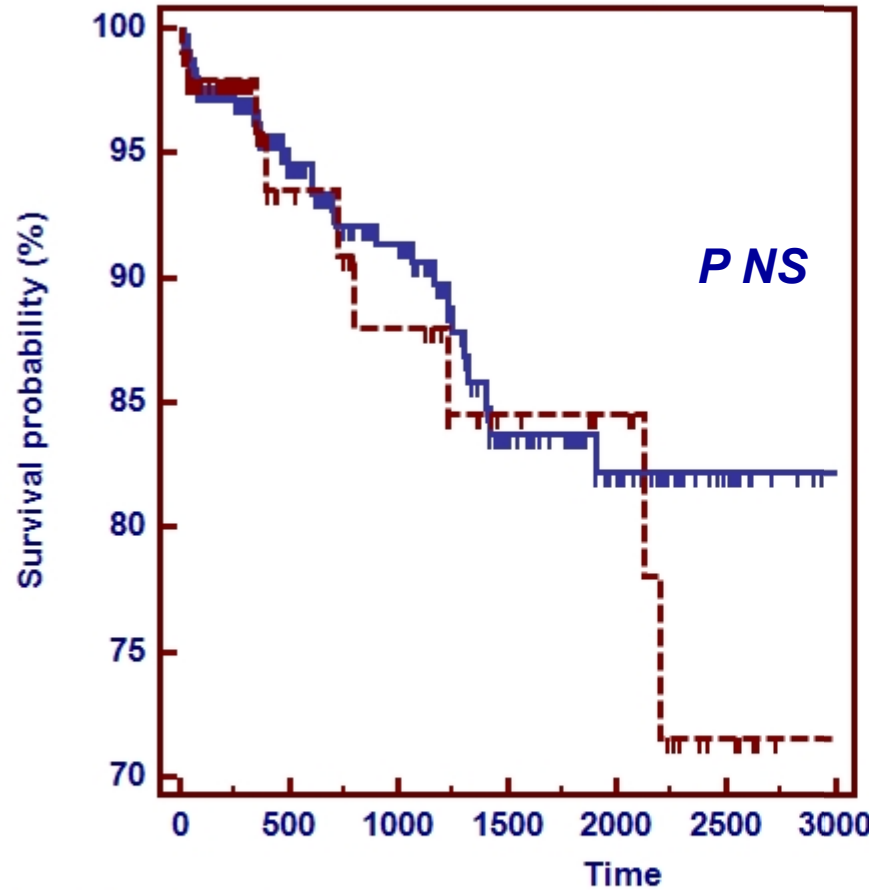
413 pts

26 exitus o equivalenti

DCE

Segments

>3



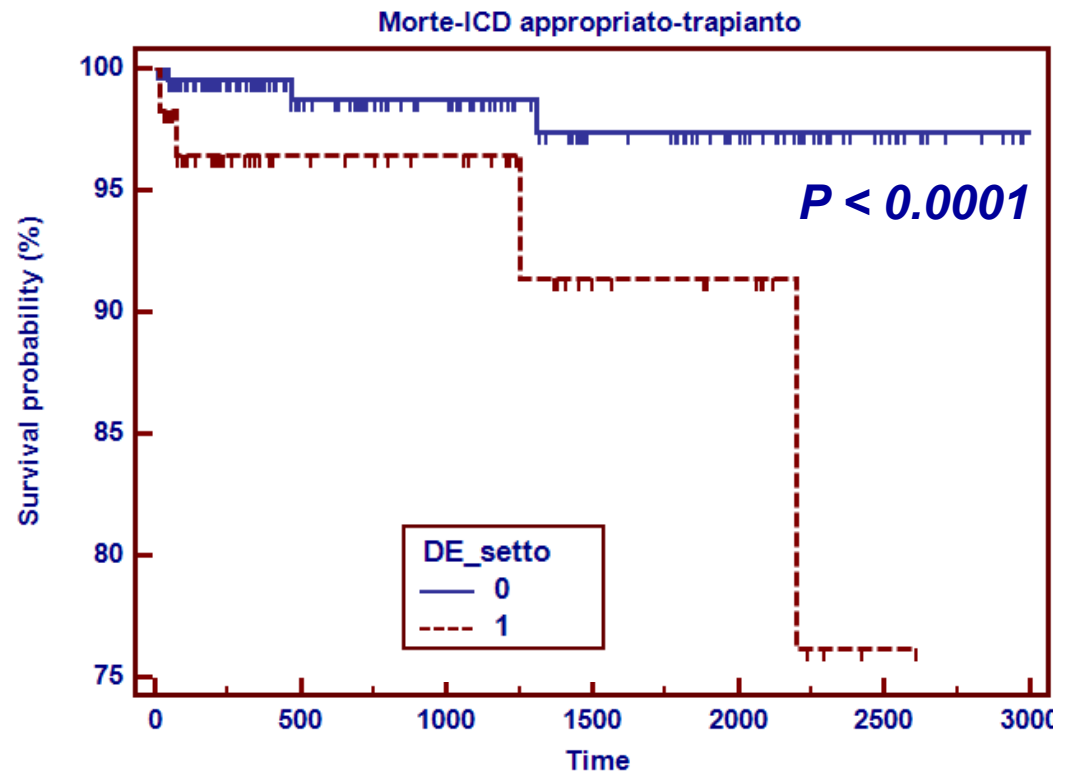
Studio multicentrico ITAMY

Dati preliminari e parziali

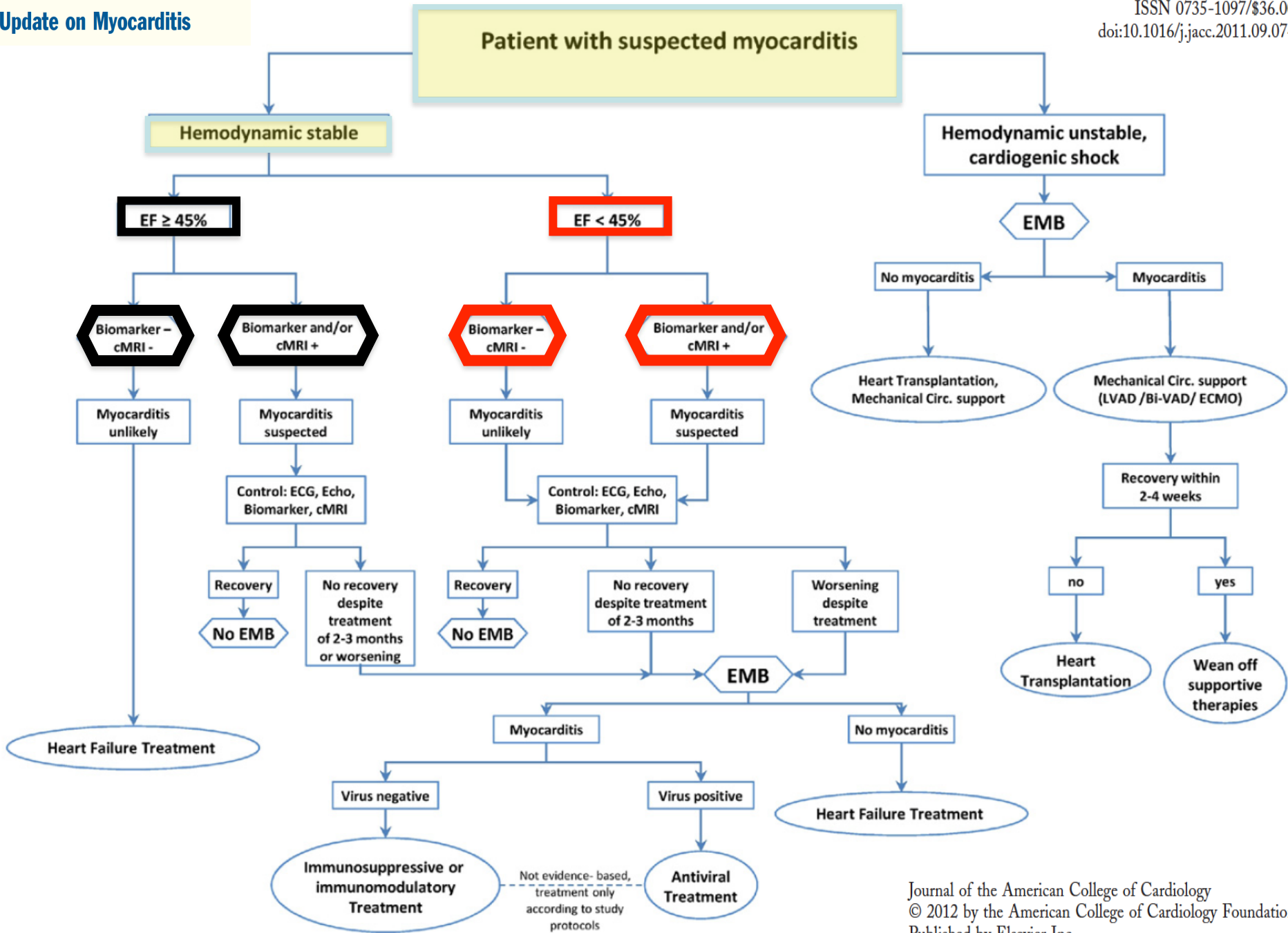
413 pts

26 exitus o equivalenti

DCE Septum

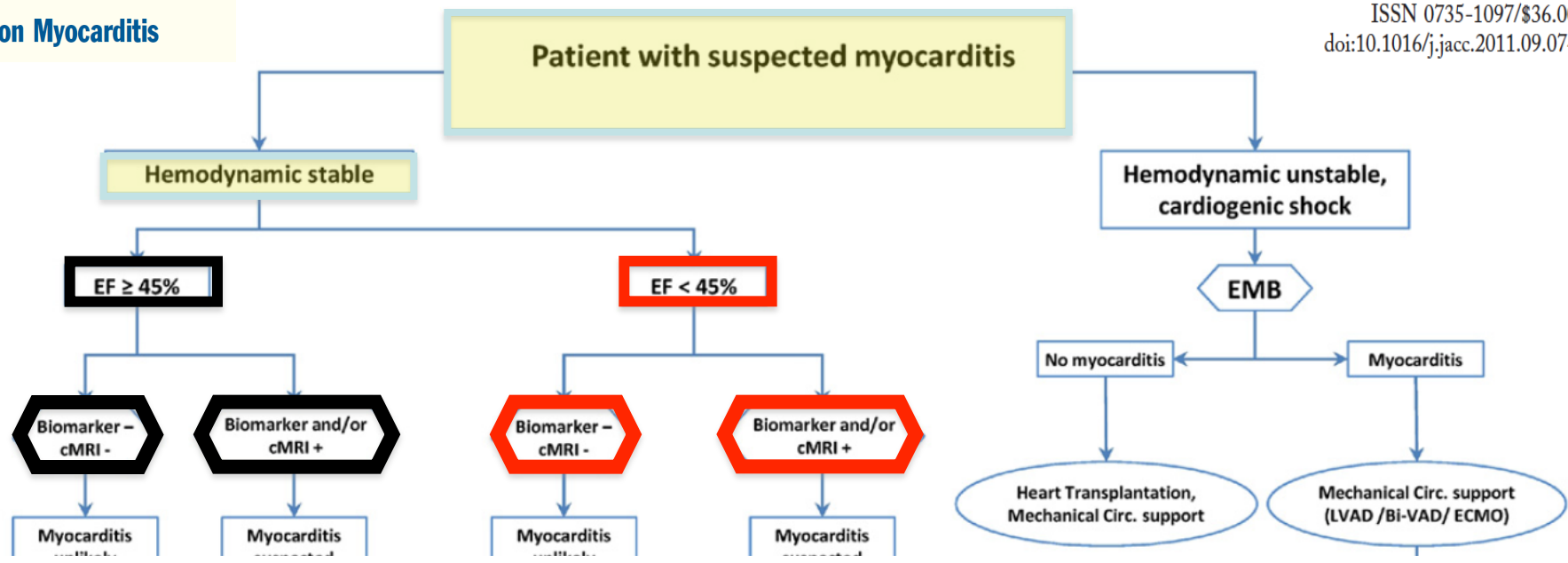


Update on Myocarditis



Not evidence-based, treatment only according to study protocols

Update on Myocarditis



*"Inflammation of the myocardium" diagnosed by histological criteria *, immunological, immunohistochemical criteria ** and MRI ✓.*

* Dallas Criteria

** ≥14 leukocytes / mm² + 4 monocytes / mm² with the presence of T LINF CD3 positive (≥ 7 cells / mm²)

