Late gadolinium enhancement cardiac magnetic resonance (LGE-CMR) localization of myocardial damage as prognostic indicator of ventricular tachycardia (VT) in hypertrophic cardiomyopathy (HCM)

Poster No.: C-0876
Congress: ECR 2011
Type: Scientific Paper
Authors: S. Bertugno, G. Ligabue, F. Fiocchi, C. Ricci, C. Manicardi, M. Modena, P. Torricelli; Modena/IT
Keywords: Cardiac, MR, Experimental investigations
DOI: 10.1594/ecr2011/C-0876

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR’s endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

The purpose is to define the prognostic value of LGE-CMR, throughout the association between LGE presence/location and occurrence on VT in HCM patients.

Irreversible myocardial damage may trigger arrhythmic events and is recognized as the anatomical and electrophysiological substrate for the occurrence of VT and sudden cardiac death (SCD) in patients with HCM [1].

Late gadolinium-enhanced cardiovascular magnetic resonance (LGE-CMR) allows visualization, quantification and localization of myocardial damage (expressed as LGE% of total LV myocardium) in HCM [2][3].
Methods and Materials

Study populations:

Non-randomized, retrospective study with prospective evaluation, conducted in a single centre after appropriate institutional review board approval. 42 patients (mean age: 57.0 ± 16.2, 73.8% males) with the diagnosis of HCM based on established clinical criteria, using history, clinical examination, echocardiography, coronary angiography and ECG-Holter-monitoring during 24 h, constituted the study population. The resonance was required to confirm the diagnosis and to evaluate the apical involvement. The patients of the study were evaluated between August 2005 and September 2010 by LGE-CMR at the Institute of Radiology, University Hospital of Modena, Italy.

Patients with clinical history of atherosclerotic coronary artery disease, Implantable Cardiac Defibrillator (ICD) and patients submitted to alcohol septal ablation or surgical septal myectomy procedures were excluded.

LGE-CMR acquisition:

LGE-CMR examinations were performed on 1.5 Tesla scanners (Achieva, Philips Medical System, Best, The Netherlands). A dedicated five-element, phase-array body coil was used. Images were acquired during repeated end-expiratory breath-hold that was of 10-15 s, in depending on the heart rate. Scout images were acquired initially to identify the cardiac axes. To evaluate myocardial thickness and global cardiac function, ECG-gated cine images were then acquired using balanced turbo field echo (b-TFE) sequence.

Subsequently, LGE-MR images were obtained in same long and short axis orientation as above described b-TFE images, 15 minutes after intravenous administration of 0.1 mmol/kg gadolinium DOTA (gadolinio-DOTA, Dotarem, Guerbet S.A., Cedex, France), using a breath-hold 3D inversion-recovery turbo-field echo (IR-TFE-3D) sequence acquired in the same views as the cine images. The inversion recovery time was adjusted per patient to optimally null the signal from normal myocardium (typically 230-350 ms) [3]. Total acquisition time averaged 40 minutes.

Images analysis, determination of ventricular and atrial parameters and LGE quantification:

Volume and mass measurements were obtained by applying the simpson's method and were indexed to body surface area. In addition to volumetric measurements, one dimensional measurements of left ventricular (LV) end diastolic (ED) dimensions, posterior wall thickness, and maximum interventricular septum wall thickness were measured from ED short axis views [4].
The LGE was assessed automatically on short-axis slices. The mean signal intensity (and SD) of normal myocardium is calculated, and a threshold ≥6 SD exceeding the mean is used to define areas of LGE. Such quantitative scar analysis has been shown to be highly reproducible in a previous study [5]. Total volume of LGE (expressed in grams) is expressed as a proportion of total LV myocardium mass (% LGE/ total myocardial mass). LGE distribution was reported according to the 17 segments model: short-axis slices at apex were divided into 4 segments (anterior, inferior, septal and lateral) in addition to one segment that correspond to the heart tip, mid LV and base was divided into 6 segments each (anterior, antero-lateral, inferior, infero-lateral, antero-septal and infero-septal), for a total of 17 segments and presence or absence of scar within each segment was recorded (Fig. 1).

Electrocardiographic analysis and arrhythmia monitoring:

The occurrence of VT or any other arrhythmia was documented by performing 24 h ECG-Holter-monitoring. Presence of VT (sustained or nonsustained), was define as: three or more consecutive ventricular beats at a rate of 120 beats/ min, was documented [6].

Follow up:

The follow up was 21.6 ± 16.17 months. The subjects were routinely evaluated for presence of arrhythmia using 24 h ECG-Holter-monitoring and the occurrence of VT and history of SCD occurred during follow-up were recorded.

Statistical analysis:

The statistical correlations between presence, extension and location of LGE and the occurrence of VT was performed with university and multivariate analysis. All results were considered statistically significant when p<0.05.
**Fig. 0:** Late gadolinium enhancement (LGE) quantification in a short axis view, by using automatic method. Endocardial contour is marked by green line, epicardial contour by yellow line. An area of healthy myocardium (blue line) and an area of LGE (red line) are marked in one slice and % of LGE mass is calculated by a dedicated software.

© Servizi Diagnostici e per Immagine, Università di Modena e Reggio Emilia - Radiologia 1 - Modena/IT
Results

All patients had evidence of septal hypertrophy (maximal thickness of 1.2 cm) by CMR.

On LGE-CMR, 38 (90.5%) patients exhibited myocardial scar, with multiple sites in 24 (63.2%).

The pattern of LGE in HCM typically involves primarily the middle third of the ventricular wall and the junction of the ventricular septum with right ventricular free wall (anterior and inferior junction between the two ventricles), which are the areas that most frequently show anomalous LGE [7].

This study showed that scar involves: anterior septal segments in 31 (81.6%) patients; inferior septal segments in 27 (71.1%); LV apical segments in 9 (23.6%) (Fig. 1, Fig. 2).

No significant correlation was observed between LGE % (within the imaged myocardium) and VT (P<0.73), but we found a correlation between location of LGE and occurrence of VT. 12 of the 42 patients underwent LGE-CMR (28.6%) had VT on ambulatory ECG monitoring during the follow-up. Between those, LGE-CMR did not detect myocardial scar in only 1 case; 11 (91.7%) patients reported LGE in anterior septal segments; 8 (66.7%) in inferior septal segments; 2 TV (16.7%) in apical LV segments.
Fig. 0: Late gadolinium enhancement (LGE) anterior and inferior localization in a short axis view, of a patient with HCM.

© Servizi Diagnostici e per Immagine, Università di Modena e Reggio Emilia - Radiologia 1 - Modena/IT
**Fig. 0**: Late gadolinium enhancement (LGE) inferior localization in a short axis view, of a patient with HCM.

© Servizi Diagnostici e per Immagine, Università di Modena e Reggio Emilia - Radiologia 1 - Modena/IT
Conclusion

Presence and location of LGE may predict the occurrence of VT in HCM patients.

HCM patients with evidence of LGE in anterior septal segment show a higher prevalence of VT compared to patients with other LGE localizations.

Absence of anterior septal segment LGE exclude the occurrence of VT during 2 years follow-up.

These findings underline the potential predictive value of LGE-CMR to stratify patients with HCM by risk of occurrence of VT.
References


4. Society of Cardiovascular Magnetic Resonance, see http://www.scmr.org/technologists/protocols.html, consulted on 10-12-2009


Personal Information

Dott. Guido Ligabue
Radiologia 1 - D.A.I. Servizi Diagnostici e per Immagine
Azienda Ospedaliero-Universitaria Policlinico di Modena
via del Pozzo 71 41124 MODENA
tel: 059-422-4381; 059-422-5731
fax: 0594224290; e-mail: ligabue.guido@unimore.it