Is There a Place for Cardiovascular Magnetic Resonance Imaging in the Evaluation of Cardiovascular Involvement in Rheumatic Diseases?

Sophie Mavrogeni, MD,* and Dimitrios Vassilopoulos, MD, FESC†

Cardiovascular magnetic resonance (CMR) is a noninvasive, nonradiating imaging technique, which provides novel information for the evaluation of cardiovascular diseases. Until now it has been successfully used for the evaluation of congenital and acquired heart diseases, cardiac tumors-mass, iron overload, and myocardial fibrosis detection.

Recently, its diagnostic capabilities have been extended to the evaluation of myocardial inflammation and myocardial perfusion. Currently, it is considered the gold standard for the evaluation of volumes, mass, ejection fraction of atriums and ventricles, quantification of iron overload in different organs, detection and follow-up of myocardial inflammation, myocardial infarction and its complications, evaluation of the aorta, detection of anomalous coronary arteries, and ectatic or aneurysmatic coronary arteries.

All the above applications and mainly the CMR ability to detect myocardial inflammation, perfusion defects, fibrosis, coronary and great arteries aneurysms make it a valuable tool for cardiovascular system assessment, commonly affected during the course of rheumatic diseases. The technique has been already successfully used in the evaluation of vasculitides, systemic lupus erythematosus, myositis, and scleroderma. However, further studies are needed to evaluate its usefulness as a diagnostic and monitoring tool of cardiovascular involvement in rheumatic patients.

 Semin Arthritis Rheum 41:488-496

Keywords: *rheumatic diseases, cardiovascular magnetic resonance imaging*

Cardiovascular magnetic resonance (CMR) is a noninvasive, nonradiating imaging technique, increasingly useful and powerful in evaluating the heart. Until now it has been successfully used for the evaluation of a number of cardiac diseases including congenital heart diseases, quantification of iron overload, valvular and pericardial diseases, cardiomyopathies, and great and coronary vessel diseases (1-12). Recently, its diagnostic capabilities have been also extended to the evaluation of inflammatory processes affecting the heart and to myocardial perfusion using stress techniques (13,14). CMR is of value in Rheumatology due to its ability to early and reliably detect myocardial inflammation, perfusion defects, and fibrosis, commonly found in rheumatic diseases that remain undetected by other commonly used imaging techniques. Additionally, magnetic resonance angiography (MRA) is the technique of choice for the noninvasive evaluation of coronary arteries (aneurysms, ectasia) and great vessels (inflammation, aneurysms) that are frequently involved in systemic rheumatic diseases (15,16).

HOW DOES IT WORK?

Images are derived from signals produced by protons (hydrogen nuclei), which are present in abundance in the human body, consisting mainly of water. The relaxation of net vector of protons is attributable to 2 distinct but simultaneous processes, referred to as the longitudinal (T1) and the transverse (T2) relaxation times, which can give important information about human tissues. Basic pulse sequences used in CMR are gradient-echo that can

*Onassis Cardiac Surgery Center, Hippokration General Hospital, Athens University School of Medicine, Athens, Greece.

†2nd Department of Medicine, Hippokration General Hospital, Athens University School of Medicine, Athens, Greece.

The authors have no conflicts of to disclose.

Address reprint requests to Sophie Mavrogeni, MD, FESC, 50 Esperou Street, 175-61, P. Faliro, Athens, Greece. E-mail: soma13@otenet.gr.

 0049-0172/11/$-see front matter © 2011 Elsevier Inc. All rights reserved.
doi:10.1016/j.semarthrit.2011.04.004

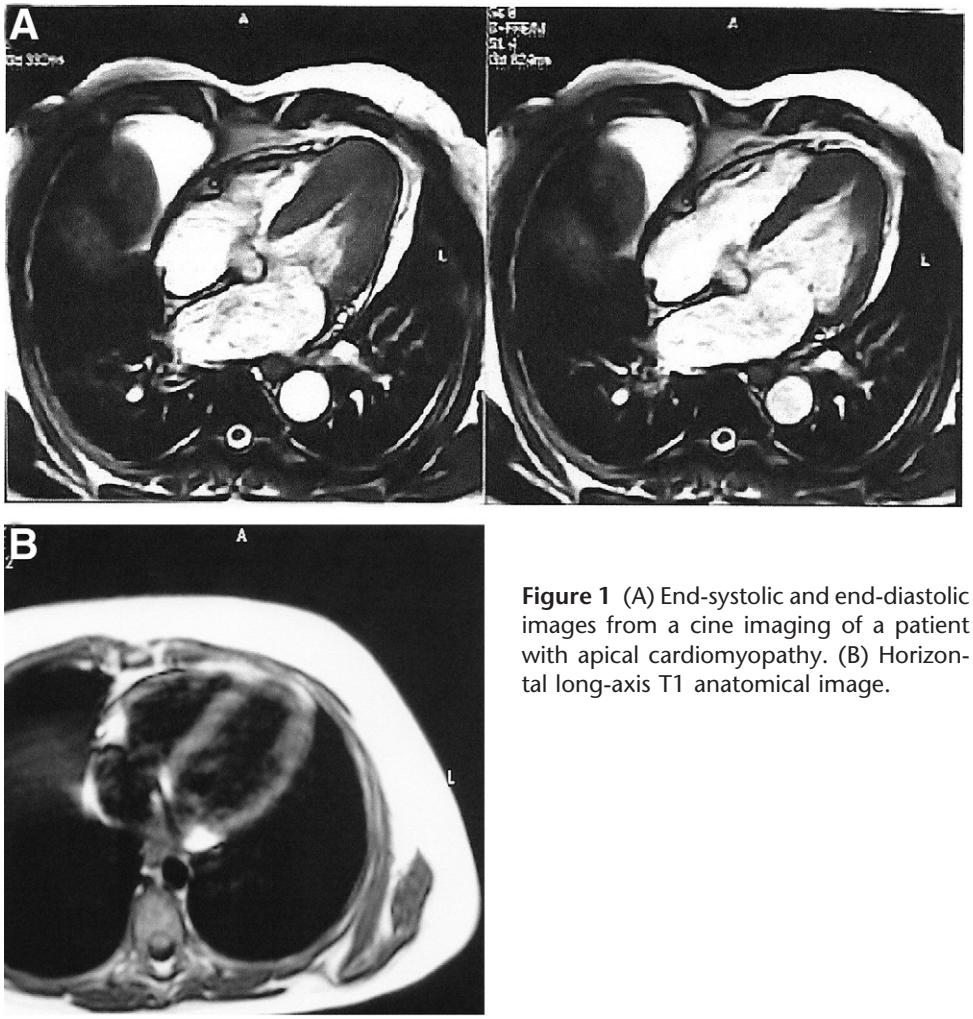

Figure 1 (A) End-systolic and end-diastolic images from a cine imaging of a patient with apical cardiomyopathy. (B) Horizontal long-axis T1 anatomical image.

form a cine loop (Fig. 1A) and spin-echo, which is more useful for anatomical imaging (Fig. 1B). Late gadolinium-enhanced images (LGE) taken 15 minutes after the use of paramagnetic contrast agent gadolinium allow the detection of myocardial fibrotic tissue (scar), which appears as a bright area in a background of nulled, black myocardium "bright is dead" (14) (Fig. 2A). By the use of bolus injection of gadolinium, noninvasive angiography of vessels can be also performed.

CMR APPLICATIONS OF SPECIAL INTEREST FOR RHEUMATOLOGY

Measurement of Volumes—Ejection Fraction

CMR measures ventricular volumes and ejection fraction noninvasively and without contrast agent. It is of great value for the assessment of the right ventricle, which is of special interest for rheumatic diseases and is not always adequately assessed by echocardiography. CMR provides 3-dimensional images of the heart, which is also feasible with 3-dimensional echocardiography. While CMR ejection fraction and volumes are more accurate and reproducible than other imaging techniques, there is a good correlation between CMR and these techniques (17). Echocardiography is still the every day, bedside tool for ventricular function evaluation, but there is a space for CMR, due to its high reproducibility, to follow individual patients with respect to changes in right and left ventricular volumes, mass, and function (dilated cardiomyopathy, valvular, congenital heart disease, right ventricular dysplasia, pulmonary hypertension, etc).

Although there are no comparative studies between CMR and Echo for Rheumatology at the moment, we know from the Cardiology literature that a) echocardiography is an operator-dependent technique and b) the excellent image quality, achieved by CMR, allows highly reproducible measurements of ventricular volumes and function. Repeated studies (performed by different operators) yield variabilities and 95% confidence intervals as follows: left ventricular end-diastolic volume: 4.2% (−1.26 to 9.6%); left ventricular end-systolic volume: 6.2% (−4.0 to 16.5%); left ventricular ejection fraction: 3.0% (−1.7 to 7.6%); left ventricular (LV) mass: 4.2% (−2.2 to 10.7%) (14). In a direct comparison of CMR