Cardiac Magnetic Resonance Characterization of Myocarditis

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Background Gadolinium delayed enhancement is well validated in the detection of myocardial infarction. Delayed enhancement has also been reported in non-ischemic myocardial processes, including non-ischemic dilated cardiomyopathy, hypertrophic cardiomyopathy, infiltrative cardiomyopathy, and myocarditis. Interleukin-2 immunotherapy has been documented histologically to cause acute myocarditis. Relatively little data have been presented regarding the appearance of myocarditis using gadolinium enhanced inversion recovery delayed enhancement techniques.

Purpose Our primary goal was to compare the cardiac magnetic resonance (CMR) characteristics of a group of patients presenting with community acquired myocarditis to those of a group of patients with IL-2 myocarditis. A secondary goal was to characterize myocarditis evolution over time.

Methods **Study population:** We imaged seven patients without prior cardiac history with clinical suspicion of viral myocarditis. All of these patients presented with atypical chestpain syndromes, had abnormal troponin assays, and had no significant coronary artery disease on cardiac catheterization (6 of 6). One 40 year old male presented with an acute febrile illness, globally depressed LV function, had no cardiac risk factors, but did not undergo coronary angiography. We also imaged five patients without prior cardiac history who had recent interleukin-2 therapy and clinical suspicion for cardiac injury based on abnormal research protocol driven serial troponin assays. **Imaging:** Studies were performed on either a GE 1.5 T CV/i scanner or a Philips 1.5 T CV/i scanner, using a 4-element cardiac phased-array coil. Steady-state free precession cine MRI was performed in all patients. Gadolinium 0.2 mmol/kg was administered intravenously, and inversion recovery fast gradient recalled echo delayed enhancement (DE) imaging was performed 10-20 minutes later. Computer-assisted planimetry was used to calculate left ventricular volumes and ejection fractions. Follow-up studies were performed in 8 of the 12 patients.

Results The mean peak troponin level for the community acquired myocarditis group was 12 ± 8 ng/mL (0.9-18 ng/mL), and the mean peak troponin level for the IL-2 myocarditis group was 541 ± 209 ng/mL (404-852 ng/mL). Myocardial DE was observed in all 12 patients. There was no predilection for a specific coronary distribution, and in contrast to myocardial infarction, the subendocardium was spared in all cases. In the 7 patients with suspected viral myocarditis, the pattern of DE was either mid-wall (see Figure 1) or subepicardial. In the 5 IL-2 myocarditis patients, the pattern of DE primarily involved the mid-wall (see Figure 2). The average acute ejection fraction (EF) for the community acquired myocarditis group was $48 \pm 8\%$ (range 33-59%), and the average acute EF for the IL-2 myocarditis group was $50 \pm 9\%$ (range 40-59%). Four of the 7 community acquired myocarditis patients underwent follow-up imaging. Two of the four had complete resolution of the previously noted delayed enhancement abnormalities. In the community acquired myocarditis group, the average EF improved to 60 ± 4 % (range 55-64%). Four of 5 IL-2 myocarditis patients returned for follow-up and demonstrated minimal change on the repeat delayed enhancement studies or ejection fraction.

Conclusion The pattern of delayed enhancement in myocarditis occurs in a non-coronary distribution and spares the subendocardium. Follow-up data in the community acquired myocarditis patients suggests that there is an improvement in both the extent of delayed enhancement, as well as left ventricular systolic function. In contrast, the IL-2 myocarditis patients do not improve in either the extent of delayed enhancement or ejection fraction.

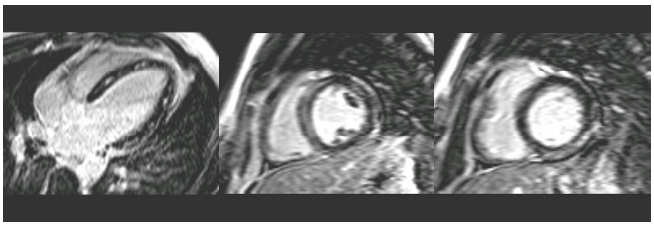

Figure 1. Delayed enhancement of a viral myocarditis patient.

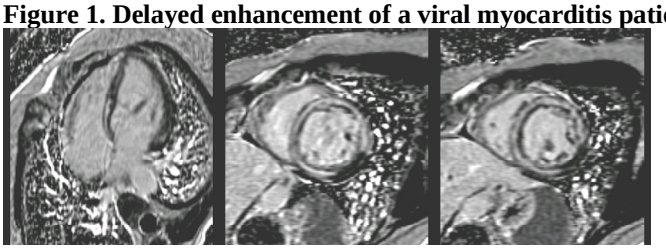

Figure 2. Delayed enhancement of an IL-2 myocarditis patient.

Table 1. CMR Characteristics of Myocarditis

	Pattern of DE	Mean EF (%)	Mean LVEDV (mL)	Presence of pericardial effusion
Community Acquired Myocarditis	Midwall or subepicardial	48 ± 8	190 ± 22	2 of 7
IL-2 Myocarditis	Midwall	50 ± 9	156 ± 39	5 of 5