MultiContrast Delayed Enhancement (MCODE) Improves Interpretation of Cardiac MRI Delayed Enhancement: A Clinical Validation Study

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Introduction: Myocardial infarction as documented by late gadolinium delayed enhancement (LGE) has been shown to have prognostic significance [1]. Atypical patterns of delayed enhancement within cardiomyopathic processes such as hypertrophic cardiomyopathy are also thought to be associated with arrhythmias [2], and any form of myocardial delayed enhancement may portend a poor prognosis. Multicontrast delayed enhancement (MCODE) [3] is a technique that has been useful in discriminating subendocardial myocardial infarction from blood pool by simultaneously providing a T2-weighted image in addition to the standard delayed enhancement image, thus allowing distinction between true enhanced myocardium and blood pool. In this clinical validation study, our goal was to assess whether the T2 data acquired during an MCODE acquisition adds diagnostic value to the usual T1 data seen in delayed enhancement.

Materials and Methods: Imaging was performed on either a 1.5 T Siemens Espree or Avanto scanner. Approximately eight minutes after administration of 0.15 mmol/kg gadolinium-DTPA, a stack of short-axis and three standard long axis images were acquired using a gradient recalled echo phase sensitive inversion recovery sequence. Based upon the initial standard LGE images, all patients who had overt abnormal delayed enhancement and those patients who had a remaining question of whether or not there was a region of delayed enhancement had select slice locations imaged with gradient recalled echo-MCODE (GRE-MCODE). Typical imaging parameters included a matrix of 256 x 119, slice thickness 6 mm, TI 300 msec, TE 2.47 msec , BW 201 Hz/pixel, readout flip angle 25^0 for the T1-weighted IR image, and 15^0 for the T2-weighted image approximately 10-15 minutes after the administrationof 0.15 mmol/kg of Gadolinium-DTPA. The LGE T1-weighted images were first read in a blinded fashion and scored as to whether or not there was overt delayed enhancement and categorized as normal, MI, or atypical. The studies were then re-read incorporating the T2 data and re-scored as to whether or not the additional T2 information was able to give a confirmation of the true diagnosis.

Results: All 48 patients had diagnostic quality MCODE images. Thirty-nine of the 48 patients were male (mean age 57.3 ± 11.4 years). After the LGE T1 analysis only, there were 19 cases with remaining questions that were all resolved by addition of the T2 data. The final analysis of the cases included five normal studies (questions related to issues of whether or not a bright region was blood pool versus delayed enhancement), 32 myocardial infarctions, and 11 atypical patterns. See Figures 1 and 2 for two patient examples.
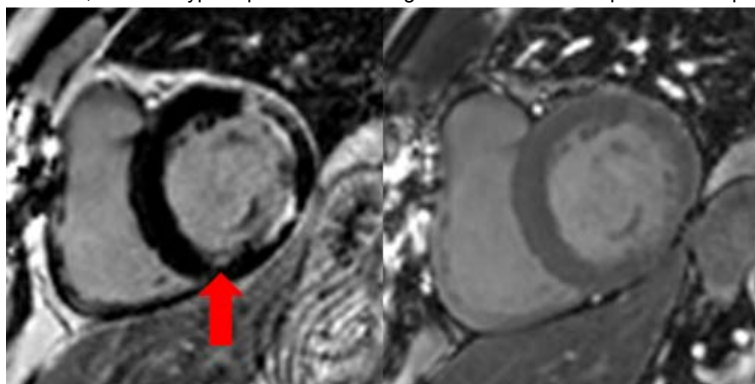

Fig.1 On the left panel, an overt anterolateral and inferolateral MI are visible on the T1 image. The homogenous T2 image on the right panel confirms that what originally appeared to be a small crevice on the T1 image (red arrow) is actually additional subendocardial MI within the inferior wall. The T2 image shows that what appears on the T1 image to be blood pool is in fact within a region of myocardium.
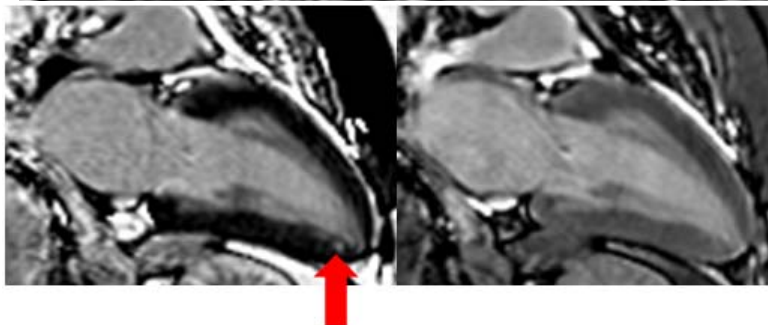

Fig.2. On the left panel, a focal region of possible delayed enhancement versus blood pool is observed on the LGE T1 image. The right panel with the T2 image demonstrates that the focal region is within an area of myocardium, consistent with a focus of atypical delayed enhancement.

Discussion: MCODE is useful in many common scenarios including: differentiating an endocardial crevice of blood from endocardial fibrosis/infarction, better assessment of the transmural extent of infarction, and sometimes for differentiating fat from myocardium. Our study demonstrates that in over one-third of cases of abnormal delayed enhancement and cases of questionable delayed enhancement, the T2 data acquired in the GRE-MCODE sequence adds diagnostic value to the final interpretation above that of the data obtained in a T1 image alone.

References: [1] Kwong R., et al, Circulation 2006;113:2733-43. [2] Adabag A., et al, JACC 2008;51:1369-74. [3] Kellman P., et al, J Magn Reson Imaging 2005;22:605-13.