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Myocardial T1 mapping as a diagnostic tool in pediatric patients with a concern for cardiac disease

Cory V Noel[1*], Ramkumar Krishnamurthy[2], Rajesh Krishnamurthy[2]

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Background

Myocardial tissue characterization with both native T1 mapping and T1 mapping following gadolinium based contrast agents (T1 enhanced) has emerged as an important asset of CMR imaging [1]. However, there is only minimal experience in pediatrics [2]. Native T1 has shown to be a marker of myocardial edema, and may play a role in pathologic states such as myocarditis [3]. T1 enhanced mapping has shown to be a useful biomarker for disease sates with diffuse fibrosis, such as hypertrophic cardiomyopathy (HCM), and is comparable to myocardial biopsy [4].

Purpose: To examine the effectiveness of CMR myocardial characterization by native T1 and T1 enhanced mapping in a heterogenous group of pediatric patients with signs concerning for cardiomyopathy or myocarditis.

Methods

We reviewed our initial experience of an ongoing study with T1 mapping in 10 subjects (aged 15.4 ± 2.5 years). All patients underwent CMR due to signs suggestive of cardiac disease. Cohort included 4 patients with concern for myocarditis, 4 with concerns for HCM, and 2 with concern for myocardial ischemia. 3 of the acquisitions were made in 3T Acheiva^{TM}, remainder used 1.5T Ingenia^{TM} scanner (Philips Healthcare, Best Netherlands).

Acquisition Protocol: All clinically indicated MRI sequences were performed, including delayed enhanced phase sensitive inversion recovery sequence, after injection of contrast (Magnevist^{TM}). T1 mapping (modified Look Locker - MOLLI) sequence was performed prior to contrast injection and post contrast (15 minutes after contrast) injection. The MOLLI sequence had a bSSFP readout TR/TE/α = 3/1.5 ms/20°; A 5,5,3 inversion acquisition scheme was used, and acquisition time was 13 heart beats.

Data Analysis

The T1 was measured by manually drawing a region of interest at both the interventricular septum and the free wall after exporting the data to a custom made Matlab^{TM} program. Pixels with a zero value - representing a noisy T1 fit were ignored from the calculations.

Results

The native and enhanced T1 were calculated for all patients except 1 who had significant artifact in the free wall on the native T1 sequence. The 2 patients with concern for myocardial ischemia, and 1 patient with possible HCM were assessed on the 3T. As assessed on the 1.5T, the native T1 of the free wall in patients who were clinically treated for myocarditis (n = 3) was significantly higher than the native T1 in all other patients (n = 4), 1094 ± 38 ms vs. 986 ± 23 ms ($p < 0.05$). Likewise, the septal T1 enhanced of patients who were diagnosed with HCM (n = 3) was lower than the remaining patients (n = 4), 460 ± 16 ms vs. 533 ± 16 ms ($p < 0.05$).

Conclusions

Myocardial characterization may be an effective tool in pediatric patients with a potential diagnosis of cardiomyopathy or myocarditis. Within a heterogenous group of patients, the native T1 was able to distinguish myocarditis from other potential cardiac disorders, while the enhanced T1 was able to distinguish HCM.

Authors' details
[1]Pediatric Cardiology, Baylor College of Medicine, Houston, TX, USA.
[2]Radiology, Texas Children's Hospital, Houston, TX, USA.

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[1]Pediatric Cardiology, Baylor College of Medicine, Houston, TX, USA
Full list of author information is available at the end of the article

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