

Quantitative myocardial T2 measurement for systemic sarcoidosis with cardiac involvement: initial results

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Introduction: Sarcoidosis is a systemic disease with a predilection for pulmonary involvement. The incidence of cardiac involvement on autopsy can be up to 40% while involvement based on clinical findings is only 5-10%. Cardiac involvement is a major risk factor for sudden death in these patients due to damage in the cardiac conduction system and associated ventricular arrhythmias [1-3]. Late-gadolinium-enhancement (LGE) MRI provides improved sensitivity in the detection of cardiac involvement in systemic sarcoidosis [4-5], especially with the application of a multi-contrast late-enhancement (MCLE) MRI technique [6]. However, the LGE foci are not specific for cardiac sarcoidosis. In pathology, various features are noted including tight, non-necrotizing, and epithelioid granulomas, giant cells with Schaumann bodies of calcified proteins or asteroid bodies, and patchy fibrosis [3]. We hypothesize that quantitative T2 measurements with MRI may yield new insights for the assessment of cardiac lesions in systemic sarcoidosis.

Materials and Methods: The institutional research ethics board approved the study protocol and informed consent was obtained in all subjects. Twenty-five patients with confirmed sarcoidosis (males 16 and females 9, average ages of 50.4±11.5 years old) were enrolled and examined on a 1.5T GE Signa HDx system. ECG gating and an eight-channel phased-array cardiac coil were used for data acquisition. First, a 3-plane localizer and a short-axis oblique (SAO) SSFP stack of slices covering the left and right ventricle (LV and RV) were acquired, then a pre-contrast quantitative T2 measurement using a T2 preparation (n=16) or multiple spin echo (MSE, n=9) pulse sequence was performed with 2 to 4 echo times (the first two TEs were approximately 3.2 ms and 49.8 ms). Post-contrast LGE-MRI techniques using IR-FGRE and MCLE covering the LV with the same localization as T2 measurement were performed 10-20 minutes after a double-dose intravenous bolus injection of Gd-DTPA (0.2 mmol/kg of Magnevist). For IR-FGRE, the inversion time (TI) varied from 200 to 300 ms, depending on the null point of healthy myocardium. For MCLE, a segmented SSFP readout was used following an inversion pulse, providing 20 cardiac-phase-resolved images at varying effective TIs [6]. The in-plane resolution was 1.5x1.5 mm and the through-plane resolution was 8 mm for both LGE-MRI and T2 measurement. Image analysis of ventricular function, LGE determination and quantitative T2 calculation of mid-LV myocardium in patients with or without LGE and in regions corresponding to focal LGE were performed on a GE advantage workstation or using commercial software CMR⁴² (Circle Cardiovascular Imaging, Calgary).

Results: The LV functional parameters in twenty-five subjects were within the normal range while the RV function was decreased (LVEF vs. RVEF: 62.1±8.7% vs. 46.7±7.0%, p<0.0001; LVESV vs. RVESV: 47.9±26.5 ml vs. 69.9±24.8 ml, p<0.0001; LVEDV vs. RVEDV: 122.1±36.3 ml vs. 129.2±37.2 ml, p=0.11; LVSV vs. RVSV: 74.1±15.6 ml vs. 59.3±16.9 ml, p<0.0001). Eight of twenty-five subjects (32%) were identified by LGE-MRI to have cardiac involvement that included abnormal patchy or multiple focal hyper-enhancement patterns in LV free wall, papillary muscle or inter-ventricular septum. In this study the LV systolic function was preserved in sarcoid patients with cardiac involvement (n=8, LVEF=61.8±11.2%, LVESV=50.0±44.6 ml, LVEDV=129.9±59.5 ml, LVSV=74.9±16.1 ml). For pre-contrast quantitative T2 measurements at mid-LV level, there is no significant difference in T2 averaged over the myocardium between the LGE negative (n=17) and LGE positive group (n=8) (LGE negative vs. LGE positive: 53.1±2.3 ms vs. 53.5±1.6 ms, p=0.64). However, a significant decreased T2 measurement was observed in the regions corresponding to focal positive LGE (n=8), compared to the LGE negative group (n=17) (focal positive LGE regions vs. LGE negative group: 41.0±2.9 ms vs. 53.1±2.3 ms, p<0.00001, Figure 1). This decreased T2 measurement in cardiac sarcoid lesions may reflect the relaxation effect from the mixture of patchy fibrosis or clusters of giant cells with Schaumann or asteroid bodies. This is different from myocardial infarction in which T2 measurement might be elevated up to 7 months after the acute event [7].

Conclusions: LGE-MRI can detect cardiac involvement in sarcoidosis. A decreased T2 measurement from cardiac sarcoid lesions may reflect the true pathological features of certain sarcoid lesions with Schaumann bodies of calcified proteins. This suggests that MRI T2 measurement techniques may have a role in the detection of cardiac sarcoidosis and for monitoring therapy of the condition.

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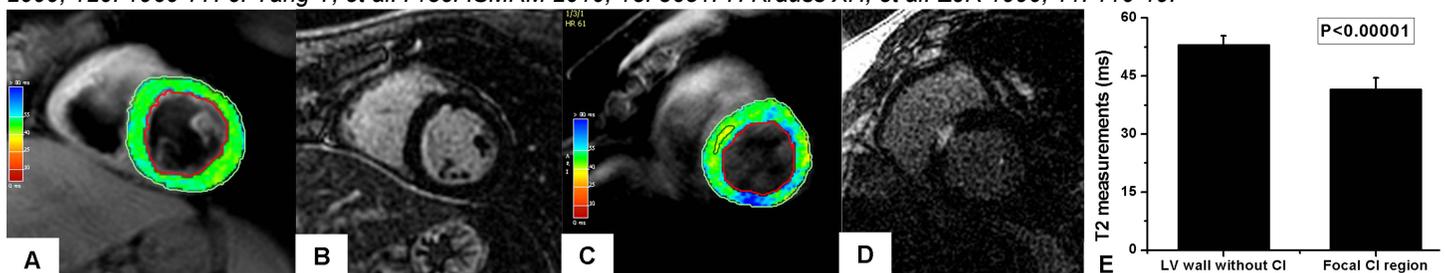


Figure 1. Quantitative pre-contrast T2 measurements in sarcoidosis. A. T2 measurement of 51.5 ms on mid-LV wall in a patient without cardiac involvement (CI), B (same patient as A): No focal or diffuse LGE area observed; C. Decreased T2 measurement of 40.6 ms in focal CI region, D (same patient as C): Focal positive LGE area in interventricular septum observed; E. Significant T2 difference seen between patients without CI (n=17) measured on mid-LV myocardium and patients with CI (n=8) on focal CI region.