

Blood T1 value measurement in the left and right ventricles and aorta using postcontrast Look-Locker MR imaging at 1.5 T and 3.0 T: influence of location, heart rate, ejection fraction, and valvular regurgitation

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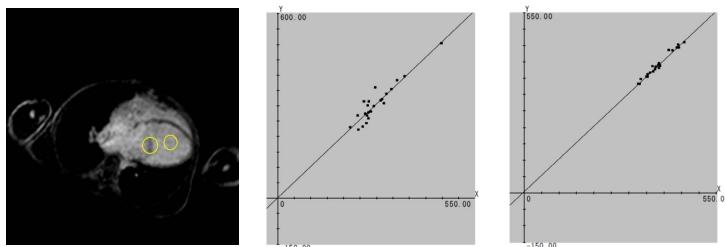
Target audience: radiologists and physicist who are interested in cardiac MR including T1 mapping

Purpose: T1 values of the myocardial and blood are measured to calculate extracellular volume of the myocardium, which correlates with the severity of fibrosis.^{1,2} The blood T1 value has been measured in the left or right ventricle (LV or RV), or the aorta. The effects of heart rate, cardiac function, and flow on the blood T1 value are concerned. The purpose of this study was to compare the blood T1 values between the LV and the RV or descending aorta at a 1.5 T and 3.0 T. The relationship between the blood T1 value of the LV and heart rate (HR), ejection fraction (EF), or intraventricular flow induced by valvular regurgitation was assessed.

Methods: 23 and 22 patients with various myocardial diseases underwent cardiac MRI using a 1.5 T and 3.0 T, respectively. The blood T1 value was measured using postcontrast Look-Locker imaging at the 4-chamber view. Regions-of-interest (ROIs), including 50-100 pixels, were placed on the LV and RV cavities and the descending aorta. The signal changes of ROIs were recorded every 5 phase. The signal changes of the blood at each delay time on Look-Locker MRI were fitted to a least square model, and thereafter the blood T1 value was calculated.³ In patients with intraventricular flow associated with valvular regurgitation, the ROIs were placed on the LV with and without flow at the corresponding cardiac phase (Fig. 1). HR was noted during Look-Locker imaging. EF was measured using cine MRI. First, we evaluated correlation and agreement of the blood T1 values between the LV and RV or the aorta. Correlation between the blood T1 value of the LV and the HR and EF was evaluated. The LV blood T1 values were compared when ROIs were placed on the jet and when they were not.

Results: High correlation and substantial agreement were observed between the blood T1 value of the LV and that of the RV or the aorta at 1.5 T and 3.0 T ($P < 0.01$; $r \geq 0.93$ for all; Figs. 2, 3). At 1.5 T, however, the difference in the blood T1 was slightly greater between the LV and the aorta (-6.8 ± 22.7 ms) than that between the LV and the RV (-4.1 ± 14.1 ms). There were no correlation between the blood T1 value of the LV and the HR or EF at 1.5 T and 3.0 T. The intraventricular flow decreased the LV blood signal in 5 patients at 1.5 T and in 2 patients at 3.0 T, but the blood T1 values did not change significantly.

Discussion: The present results indicate that ROI can be placed on the LV, RV, or the descending aorta to measure the blood T1 value at both 1.5 T and 3.0 T. The 4 chamber view plane, multi-phase data acquisition, and T1 shortening due to Gd injection may minimize the effect of flow as well as that of EF or HR on the blood T1 value in the LV, while the aortic flow might affect the blood T1 value slightly at 1.5T.



Conclusion: Blood T1 value can be measured at both LV and RV cavities using postcontrast Look-Locker MRI without concern about HR, EF, and intraventricular flow associated with valvular regurgitation at 1.5 T and 3.0 T.

References: 1.Ugander M. Extracellular volume imaging by magnetic resonance imaging provides insights into overt and sub-clinical myocardial pathology. Eur Heart J 2012; 33: 1268-78. 2. Choi EY. Correlation with blood T1 is essential when measuring post-contrast myocardial T1 value in patients with acute myocardial infarction. JCMR 2013; 15: 11. 3. Deichmann R. Fast T1 mapping on a whole-body scanner. MRM 1999; 42: 206-9

Figures 1) ROIs were placed blood with and without flow. 2, 3) High correlation of the blood between the LV and RV at 1.5 T and 3.0 T