Differences in blood T1-value between right and left ventricles on 4-chamber view contrast-enhanced Look-Locker CMR

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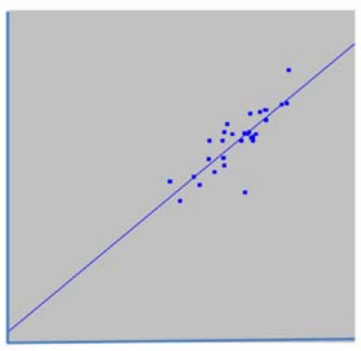
Target audiences physicists, radiologists, cardiologists, radiologic technologists

Introduction Late gadolinium enhancement CMR is useful for diagnosis and risk stratification for many types of myocardial diseases. Because of its binary results based on the contrast between the normal myocardium and scar, this CMR technique cannot evaluate interstitial myocardial fibrosis associated with heart failure or cardiomyopathies. T1-value of the blood as well as that of the myocardium is measured to detect the myocardial fibrosis and to calculate extracellular volume fraction in the myocardium. However, the location of measuring the blood T1 value has not been confirmed because of concern about flow artifact, gadolinium distribution, or cardiac motion. The purpose of this study was to evaluate the difference in the blood T1 value between the right and left ventricles (RV and LV) on 4-chamber view Look-Locker CMR and assess its relation with intraventricular turbulence and cardiac function.

Methods *Patients:* 30 patients with various myocardial diseases were enrolled. Their LV ejection fraction (LVEF) ranged between 15.8 and 81.4%, with the mean of 51.5% (SD, 15.9). The duration of cardiac cycle (RR) was 1012 ± 219 ms (570 - 1644 ms).
CMR: A 1.5 T unit with a 5-element phased-array coil was used. Look-Locker CMR was performed using a multiphase 2D inversion-recovery gradient-echo echo-planar imaging (EPI) at a single midventricular slice in the 4-chamber view. This imaging started 10 minutes after a 0.15 mmol/kg gadolinium injection, with the imaging parameters as follows: TR, 7.9 ms; TE, 3.9 ms; flip angle, 10 degrees; in-plane resolution, 3.3 x 2.8 mm^2; slice thickness, 12 mm; EPI factor, 7; trigger delay, 3.9 - 4.4 ms; and cardiac phase 45 - 50.
Image analysis: ROIs including > 10 pixels were placed on the RV and LV cavities. Blood T1-values were calculated based on the signal intensity and delay time on the Look-Locker images. Difference in the blood T1 value between the RV and LV was assessed. The difference was compared in the patients between with and without mitral or aortic regurgitation, which could induce the intraventricular turbulence. The relationship between the difference in the myocardial T1 value between RV and LV and the LVEF or RR was also assessed.

Results There were no significant difference in the blood T1 value after contrast between the RV (292.4 ± 36.3 ms) and LV (287.8 ± 30.7 ms). The blood T1 value correlated between the RV and LV (P < 0.01; r = 0.83, Figure). The presence of valvular regurgitation did not affect the LV blood T1 value. No correlation was found between the difference in the myocardial T1 value between RV and LV and LVEF or RR.



Discussion This study suggests that the blood T1 value can be measured both in the LV and RV using 4-chamber view Look-Locker CMR after contrast. Despite of valvular dysfunction, multi-phase data acquisition of Look-Locker CMR may minimize the effect of turbulence for measurement of the blood T1 value. In addition, the 4-chamber view may suppress the flow artifact because this imaging plane is parallel to the flow crossing between the LV cavity and left atrium or aorta.
Conclusion The 4-chamber view contrast-enhanced Look-Locker CMR allows for the blood T1 measurement both in the LV and RV cavities, and the T1 value is not affected by valvular regurgitation, LVEF, and RR.

References 1. Look DC, Locker DR. Rev Sci Instrum 1970; 41: 250-1. 2. Deichmann R. MRM 1999; 42: 206-209.

Figure: The blood T1 of the LV correlated with that of the RV
(P < 0.01, r = 0.83; LV T1 = 0.7 x RVT1 + 82.2)