Myocardial T1 and extracellular volume fraction related to cardiac functional parameters in dilated cardiomyopathy: modified Look-Locker imaging study

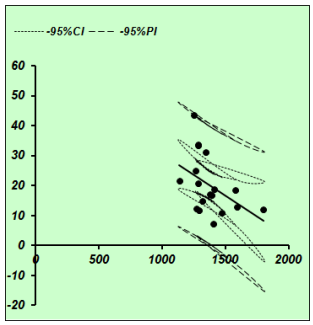
Masaki Tachi[1], Yasuo Amano[1], Minako Takeda[1], Yoshio Matsumura[1], Masashi Ogawa[1], Makoto Obara[2], Kuniya Asai[3], Keisuke Inui[3], and Shinichiro Kumita[1]

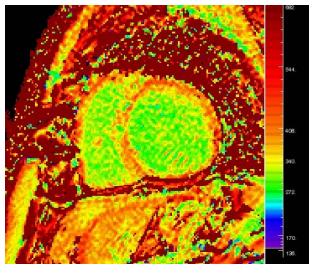
[1]Radiology, Nippon Medical School, Bunkyo-ku, Tokyo, Japan, [2]Philips Asia Pacific, Tokyo, Japan, [3]Cardiology, Nippon Medical School, Bunkyo-ku, Tokyo, Japan

Target audience: radiologists and cardiologists who are interested in myocardial T1 mapping

Purpose: Cardiac magnetic resonance (CMR) T1 mapping is a valuable tool for evaluating diffuse fibrosis of the myocardium associated with dilated cardiomyopathy (DCM).[1] The diffuse fibrosis is difficult to be identified by late gadolinium enhancement (LGE). Modified Look-Locker imaging (MOLLI) provides T1 mapping of the left ventricular myocardium and quantify the T1 value and extracellular volume fraction (ECV). However, the interval between Gd injection and MOLLI or the region measured, which may affect the correlation between T1 value or ECV and cardiac function, has not been established so far. The objective of this study was to determine the interval or region, by evaluating the correlation between pre- or post-contrast T1 value or ECV and the cardiac functions in patients with DCM.

Method: The 19 DCM patients underwent CMR using a 3.0 T. As cardiac functional parameters, we measured left ventricular ejection fraction (LVEF), end diastolic volume (EDV), end systolic volume (ESV), LV mass, and LV remodeling index (LVRI = LV mass / EDV) on cine MRI. MOLLI was performed before, and 10 and 30 minutes after 0.15 mmol/kg Gd injection at the basal, middle, apical levels. The left ventricle on T1 mapping was divided into 12 segments (4 segments x 3 levels), and wedge-shaped ROI was placed on each segment. We measured myocardial T1 values before, and 10 and 30 minutes after contrast. We calculated ECV from the pre-contrast T1 value and T1 values of 10 or 30 minutes post-contrast (i.e., ECV_{10} and ECV_{30}). Correlation between the T1 values or ECV and the cardiac functional parameters were assessed.





Results: Pre-contrast T1 value measured at the septum inversely correlated with LVEF ($P < 0.05$, $r = -0.49$; Fig. 1), and positively with EDV ($P < 0.01$; $r = 0.70$), ESV ($P < 0.01$; $r = 0.67$), and LV mass ($P < 0.01$; $r = 0.53$). T1 values 10 min after contrast at the septum correlated with EDV ($P < 0.01$; $r = 0.62$), ESV ($P < 0.05$; $r = 0.57$), and LVRI ($P < 0.05$; $r = 0.49$). There were significant correlations between ECV_{10} and EDV ($P < 0.01$; $r = 0.64$), ESV ($P < 0.01$; $r = 0.55$), and LV mass ($P < 0.05$; $r = 0.42$). T1 value 30 min after contrast and ECV_{30} correlated with only 1 or 2 functional parameters. T1 value 10 min after contrast in the entire left ventricle showed good correlations with EDV ($P < 0.05$; $r = 0.46$), ESV ($P < 0.05$; $r = 0.42$), and LVRI $P < 0.01$; $r = 0.54$). However, the other T1 values, ECV_{10} and ECV_{30} of the entire left ventricle correlated with only 1 or 2 functional parameters.

Discussion : Diffuse myocardial fibrosis related to cardiac dysfunction can be detected using pre-contrast MOLLI, probably because pre-contrast T1 value may reflect intracellular water contents and extracellular volume expansion.[2] Thus, it is possible to evaluate diffuse myocardial fibrosis in DCM patients who are contraindicated to Gd. ECV_{10} also reflect the severity of myocardial fibrosis. It may be practical to assess ECV_{10}, since LGE usually starts 10-15 min after contrast and the through-put is kept as well. However, ECV_{30} is not necessary for evaluating ECV related to cardiac function. The interventricular septum was the appropriate region for measuring the T1 and ECV probably the septum was free from artifacts (Fig. 2).[3]

Conclusion: T1 values evaluated by MOLLI can detect diffuse myocardial fibrosis even before contrast in DCM. ECV_{10} also correlated with cardiac functional parameters in DCM. The interventricular septum was the appropriate region for assessing the T1 and ECV related to cardiac functional parameters in DCM.

References: 1. Flett AS. Circulation 2010; 122: 138-144. 2. Puntmann VO. Circ Cardiovasc Imaging 2013; 6: 295-301. 3. Rogers T. JCMR 2013; 15: 78.

Figures: 1. Significant correlation between pre-contrast T1 and LVEF. 2. The septum is free from imaging artifacts.