Myocardial T1 measurement: comparison of modified Look-Locker inversion recovery (MOLLI) and TI scout

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Introduction: Most T_1 quantification techniques are based on measuring the longitudinal magnetization at different time intervals TI after an inversion or saturation pulse. The magnitude of the longitudinal magnetization as a function of TI is then fitted to a monoexponential recovery function. Different cardiac MR acquisition sequences have been used to obtain myocardial T_1 values within a breath hold. The multipoint approach, as first described by Look and Locker (1), samples the relaxation curve multiple times after an initial preparation pulse. This technique, also named TI scout, has been shown theoretically to be highly efficient, and has been widely used for estimation of the optimal TI in the assessment of myocardial delayed enhancement. The other technique, MOdified Look-Locker Inversion-recovery (MOLLI), proposed by Messroghli et al. (2) allows a rapid and highly reproducible T_1 mapping of the heart with high levels of intra and inter-observer agreement. Even though each technique claims its own merit and reliability, the post-contrast myocardial T_1 value is confounded by various factors that inhibit comparison of myocardial T_1 data between patients. In this work, we compared myocardial T_1 values derived from both MOLLI and TI scout techniques in the post gadolinium (Gd) delayed enhancement experiments at 3.0T environment.

Materials and Methods: All cardiac MRI studies were performed using Siemens 3.0T MR scanner. Sixteen patient participants underwent cardiac MRI study with inform consent. Gadolinium (Gd) dose (Magnevist; Bayer) of 0.15mmol/kg was administrated as a bolus and single slice T_1 determinations at the mid-ventricle short-axis view using short MOLLI (shMOLLI, 8 images within 11 heartbeats) was performed between 5 to 9 minutes post-Gd injection and followed immediately by TI scout imaging. Protocol for MOLLI was TR/TE=3.9/1.11ms, flip angle=50^o, matrix=256x126, FOV=38x38cm, slice thick.=10mm. The same view was obtained with TI scout (TrueFisp acquisition): TR/TE =2.5/1.19 ms, flip angle=50°, matrix size=192×94, FOV=38×38cm, slice thick.=10mm, 30-45 phases. All images were processed off-line using MASS research software. Region of interest was manually drawn from the same area in septum at all images (MOLLI)/phases (TI scout) in each sequence. The Levenberg-Marquardt algorithm was used to perform a three-parameter non-linear fit to both MOLLI and TI scout data. Paired student t-test was used to compare the T_1 values measured from both sequences (p-value of <0.05 for statistically significance).

Results: The representative curve fitting in each technique is shown in Figure 1. Figure 2 demonstrates strong correlation between T_1 values measured by MOLLI and TI scout sequences (r2=0.83, p<0.01). In general, TI scout measured T_1 values were slightly higher than those of from MOLLI: mean T_1 values by MOLLI and TI scout were 460±69ms (range 374-645ms) and 462±78ms (range 370-687ms), respectively (p=0.8). Based on the report of MOLLI techniques performed on normal volunteers (3) at a dose of 0.15 mmol/kg, average T_1 change between 6 to 10 minutes post-contrast was ~8ms/minutes. TI scout was performed at 1.97±1.02 (range 0.5-3.5) minutes after MOLLI acquisition in our setting, the difference between the two methods (2ms of T_1) is within experimental error.

Discussions: Our results indicated that T_1 measurement using MOLLI is reproducible with TI scout. This evaluation addresses an important issue in which comparison between myocardial T_1 derived from different techniques, MOLLI and TI scout, could be possible provided other conditions that affect T_1 values such as Gd type/dose and timing remain the same.

References: 1. Look DC, Locker DR. Rev Sci Instrum 1970;41:250–251. 2. Messroghli DR et al. Magn Reson Med. 2004;52:141–146. 3. Messroghli DR et al. Radiology. 2006;238:1004-1012.

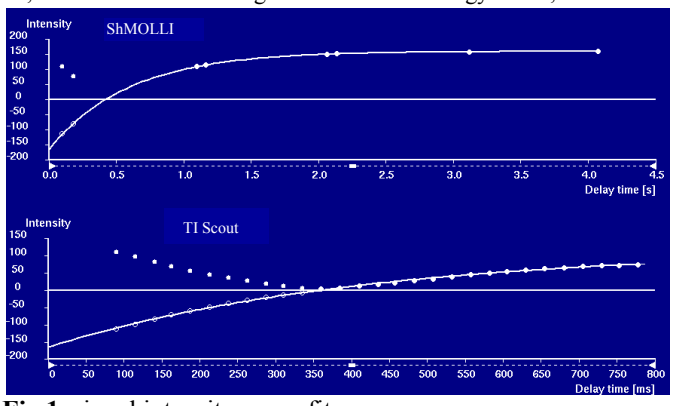

Fig.1. signal intensity curve fit.

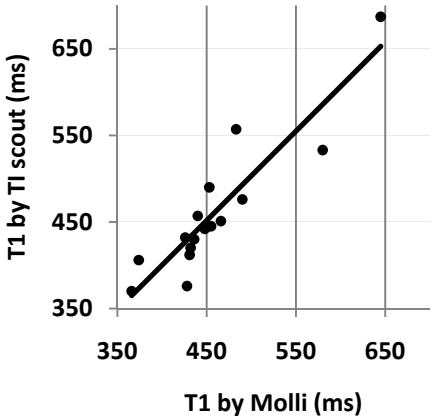

Fig.2. TI scout measured T_1 values correlated well to those of MOLLI.