Breton et al. Journal of Cardiovascular Magnetic Resonance 2011, 13(Suppl 1):O107
http://jcmr-online.com/content/13/S1/O107

Journal of Cardiovascular Magnetic Resonance

ORAL PRESENTATION | Open Access

Rapid cardiac T1 mapping within two heartbeats

Elodie Breton*, Daniel Kim, Sohae Chung, Leon Axel

From 2011 SCMR/Euro CMR Joint Scientific Sessions
Nice, France. 3-6 February 2011

Introduction

Late gadolinium enhancement (LGE) imaging is an important CMR method than can detect salvageable myocardium after myocardial infarction [1-2]. Recently, T_2-weighted-imaging has gained a significant interest to assess myocardial edema [3]. However, clinical interpretation of T_2-weighted-imaging could be hindered by surface coil effects which yield non-uniform signals. Multi-point T_1 mapping approaches, such as Modified Look-Locker inversion recovery (MOLLI) [4], have been proposed to measure myocardial T_1, but, as a multiple heartbeat acquisition, it may be sensitive to cardiac motion and arrhythmia. We propose to develop a 2-second cardiac T_1 mapping pulse sequence for assessment of myocardial edema (pre-contrast) and infarction (post contrast) in patients with acute myocardial infarction.

Purpose

To develop and validate a cardiac T_1-mapping technique.

Methods

The proposed T_1-mapping acquisition consists of 2 TurboFLASH images with centric k-space ordering: proton density-weighted (PDw) image in the first heartbeat and saturation recovery (SR) T_1w acquisition in the second heartbeat. A robust non-selective saturation pulse [5] was used to achieve uniform saturation of magnetization. A long delay time=500ms was used to achieve adequate signal-to-noise ratio. The T_1w-image was normalized by the PDw image to correct for unknown equilibrium magnetization and receiver coil sensitivity. T_1 was calculated algebraically assuming an ideal saturation-recovery equation based on the Bloch equation [6]. Eight healthy volunteers (32±13y.o.) were imaged in a short-axis basal plane at 3T (Tim-Trio, Siemens) at baseline and 10 minutes following 0.05mmol/kg Gd-DTPA injection. All images were acquired in mid-diastole with appropriate trigger delay. Imaging parameters included: FOV=350mm×272mm, matrix=144×112, TE/TR=1.2/2.4ms, flip angle=10°, in-plane resolution=2.4mm×2.4mm, GRAPPA ~1.65, temporal resolution=162ms, and receiver bandwidth=990Hz/pix. For validation purposes, myocardial T_1 were compared to reference T_1 measurements using multi-point SR with TurboFLASH readout (~20s-breath-hold): 1 PDw-image, 12 T_1w-images with TD 100to600ms every 100ms, then 800to1800ms every 200ms. A nonlinear Levenberg-Marquardt algorithm was used to fit the normalized multi-point SR data. The proposed T_1-mapping method was also evaluated in a patient with arrhythmia, before and 20min after administrating 0.15mmol/kg Gd-DTPA.

Results

Myocardial T_1 measured using the proposed rapid method were linearly correlated with T_1 measured using the multi-point T_1 method (Fig. 1, slope=0.99,

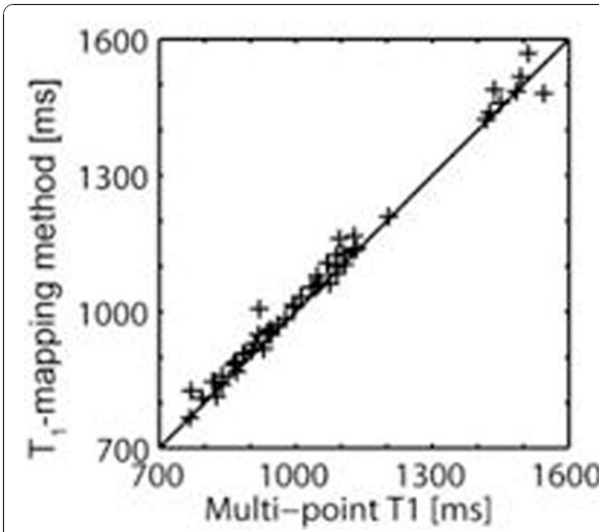

Figure 1 T_1 measured with the T_1-mapping method vs. multi-point SR T_1 measurements in the LV myocardium.

NYU Langone Medical Center, New York, NY, USA

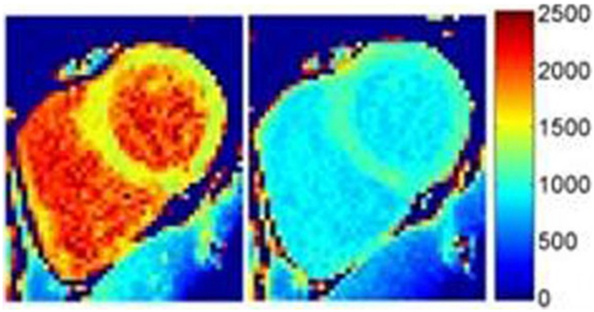

Figure 2 T_1-maps obtained in a volunteer before and 10 min after 0.05mmol/kg bolus injection.

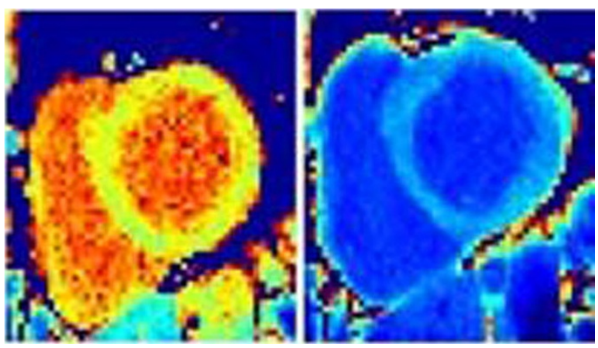

Figure 3 T_1-maps obtained in a patient with arrhythmias before and 10 min after 0.15mmol/kg slow injection.

bias=29ms, r=0.99, $P<10^{-5}$). Pre- and post-contrast T_1-maps obtained in a 52y.o.-volunteer and a 44y.o.-patient with arrhythmia are shown in Fig. 2-3, respectively (same T_1-scale).

Conclusion

The proposed T_1-mapping method is a fast pixel-wise T_1-mapping technique with insensitivity to cardiac motion and arrhythmia. Future work includes evaluation in patients with acute and chronic infarction.

Published: 2 February 2011

References

1. Kim RJ, *et al*: **NEJM.** 2000, **243**:1445-1453.
2. Kellman P, *et al*: **Magn Reson Med.** 2002, **47**:372-383.
3. Abdel-Aty H, *et al*: **Circulation.** 2004, **109**:2411-2416.
4. Messroghli DR, *et al*: **Magn Reson Med.** 2007, 34-40.
5. Kim D, *et al*: **Magn Reson Med.** 2009, **62**:1368-1378.
6. Cernicanue A, Axel L: **Acad Radiol.** 2006, **13**:686-693.

doi:10.1186/1532-429X-13-S1-O107
Cite this article as: Breton *et al.*: Rapid cardiac T1 mapping within two heartbeats. *Journal of Cardiovascular Magnetic Resonance* 2011 **13**(Suppl 1): O107.