

T1 MAPPING AFTER ACUTE MYOCARDIAL INFARCTION: MULTIPHASE PHASE-SENSITIVE INVERSION-RECOVERY (MPPSIR) METHOD AS VALUABLE ALTERNATIVE TO THE MODIFIED LOOK-LOCKER INVERSION RECOVERY (MOLLI) METHOD

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Target audience Clinicians and scientists with interest in T1 mapping and/or detection of myocardial infarction.

Purpose Recently, there has been an increasing interest in the quantitative mapping of T1 values of the left ventricular myocardium, e.g. for the detection of myocardial infarct¹. Among the T1 mapping methods, the Modified Look-Locker Imaging (MOLLI) sequence² has found widespread acceptance due to its accuracy, speed, and spatial resolution. However, MOLLI is currently not commercially available in today's MR scanners, but needs special acquisition software. As the number of requests from clinical sites for a T1 mapping sequence has been rising, we adapted the routinely available Phase-Sensitive Inversion-Recovery (PSIR) sequence into a multi-phase PSIR (mpPSIR) acquisition scheme, which is capable of producing T1 maps without the need for programming³.

Methods Ten patients (mean age, 60.7±9.1 years; seven men) underwent an MRI study five to seven days after clinically confirmed myocardial infarction and appropriate therapy. The MR studies were performed at CNIC facilities on an Achieva 3T MR imager (Philips Healthcare) equipped with a 32-channel cardiac coil.

T1 mapping was performed using the mpPSIR and MOLLI methods before and 10 minutes after administration of a double dose of Gd-DTPA (0.2 mmol/kg; Magnevist, Bayer Healthcare). The two methods were applied within 1-2 minutes of each other. In the mpPSIR sequence, an inversion pulse was applied every other heart beat, followed by acquisition of 7 phases during diastole of both the first and second heart beat after inversion. Data acquisition consisted of a segmented gradient echo sequence with EPI readout (TFE factor=3, EPI factor=7, TR=13 ms, TE=5.8 ms, FA=12°). For a more extensive description of the method, see Ref. 3. In the MOLLI sequence, single shot SSFP images (TR=2.8 ms, TE=1.4ms, FA=35°) were acquired at different inversion times after an inversion pulse, which was applied once every 5 heart beats. Both sequences were acquired in 8-10 heart beats per slice during breathholds and provided equal spatial resolution (voxel size 2x2x8 mm³). Additionally, a late gadolinium enhanced (LGE) scan was performed 15 min after contrast agent administration. For all sequences, three short axis images of the left ventricle were acquired.

T1 maps were generated by pixel-wise fitting of the appropriate model curves to the signal intensities. Signal intensities in pre- and post-contrast images were determined in normal and infarcted myocardium, as determined by LGE imaging. Analysis of variance was performed using a repeated measure ANOVA with Tukey post-hoc test at a significance level of p<0.05.

Results Imaging was successful in all patients. There was an excellent correlation between the two methods (R²= 0.986, p<0.001) over the entire range of T1 values (Fig. 1). In comparison to MOLLI, the T1 values determined in mpPSIR images were higher by approximately 5%. As a secondary finding, both methods revealed differences in T1 values between normal and infarcted myocardium (Fig. 2). Before contrast agent administration, T1 of infarcted tissue was significantly longer than that of normal tissue (p<0.001 for both methods). Ten minutes after administration of contrast agent, T1 of infarcted tissue was significantly shorter than that of normal tissue when determined by mpPSIR (p<0.05). MOLLI demonstrated a similar, but non-significant difference post-Gd (0.05<p<0.1). There were no significant differences between mpPSIR and MOLLI.

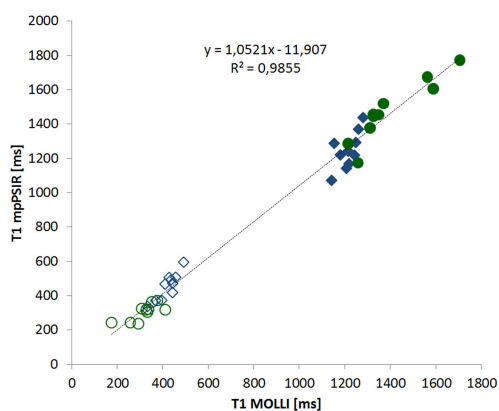
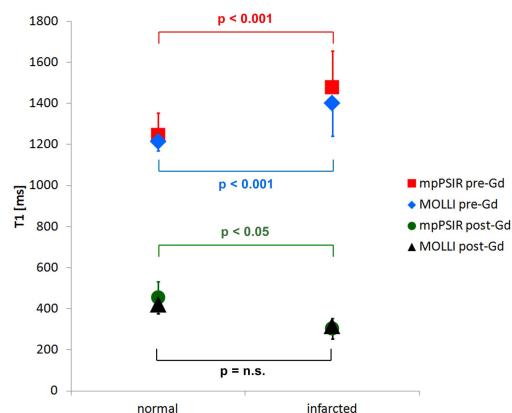


Fig. 1: T1 values determined by MOLLI vs mpPSIR before (filled symbols) and after (open symbols) Gd administration from normal (rhombi) and infarcted (circles) tissue.

Fig. 2: T1 values (mean +/- SD) determined by MOLLI and mpPSIR in normal and infarcted myocardial tissue, before and after Gd.



Discussion The mpPSIR method provides consistent T1 values for myocardial tissue. In comparison to MOLLI, it slightly overestimates the T1 values. mpPSIR provides more data points at short inversion times (7 vs. 2-3 of MOLLI), and thus promises more accuracy for shorter T1 times. On the other hand, the recovery time between two inversion pulses is shorter with mpPSIR (2RR vs. 5RR), which might have some effects for longer T1 times. Overall, both methods seem similarly suitable for the T1 mapping of the left ventricle.

Conclusion The mpPSIR method holds promise as an alternative to the MOLLI sequence. Both methods demonstrate differences in T1 values between normal and infarcted myocardium before and after administration of Gd-based contrast agent.

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References

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