A comparative study of MOLLI and SHMOLLI T1 mapping at 3T in healthy controls

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Background: T1 mapping is a cardiovascular magnetic resonance (CMR) parametric imaging technique that permits assessment and quantification of myocardial tissue characteristics. Multiple techniques are used to measure T1 relaxation, including Modified Look Locker Inversion Recovery (MOLLI) and Shortened MOLLI (ShMOLLI). Currently, there is lack of consensus on the optimal CMR T1 mapping technique.

Objective: To compare the native T1 and extracellular volume (ECV) fraction values from the MOLLI and ShMOLLI T1 mapping CMR techniques.

Methods: 106 healthy subjects (56 female (53%), mean age 47±12 years), underwent CMR at a single centre, using a standard protocol which included cine imaging, the Siemens Myomaps MOLLI [5(3)3 scheme] T1 mapping, and T2 mapping, late gadolinium enhancement (LGE) and postcontrast T1 mapping on a 3T Siemens Skyra scanner. 65 subjects (36 female (55%), mean age 49±9 years) were scanned with an updated protocol that added ShMOLLI [5(1)1(1)1 scheme] T1 mapping to the standard protocol. Each subject had native T1 and T2 maps performed in the short axis view, with 3 parallel slices in the base, midventricular, and apical regions. T1 maps were repeated using the same slice positions 15 minutes after administration of Magnevist to calculate the ECV. Post-processing and analysis of images were performed in a dedicated core lab, using CVI42, independently by two experienced CMR readers, each with more than 2 years of CMR experience.

Results: Healthy volunteers included in the study had normal left ventricular (LV) volumes, function and mass (mean LV end diastolic volumes 144±30ml, ejection fraction 57±6%, and LV mass index 54±11g/m^2). Native T1 times measured by MOLLI were 1246±41, 1234±45 and 1229±51 ms in the basal, mid and apical slices, respectively, compared to native T1 times measured by ShMOLLI were 1142±47, 1126±52 and 1130±47ms in the basal, mid and apical slices, respectively. The MOLLI results were consistently higher and the difference between the MOLLI and ShMOLLI T1 times was significantly different for all slices (p<0.005). The mean ECV using MOLLI was 29±2% vs. 30±3% (p=0.11) using ShMOLLI. There was no LGE observed in all study subjects. The T2 relaxation times were 39.1±2.4, 38.8±2.4 and 40.0±2.9ms in the basal, mid and apical slices, respectively.

Conclusion: The MOLLI technique consistently overestimated T1 relaxation times by approximately 100ms (8%) compared with results from ShMOLLI. The ECV fraction for both techniques was not significantly different. These findings have significant implications for the interpretation of T1 values using different techniques for both clinical and research applications and highlights the need to better standardisation of T1 measures using different techniques.

Table 1. Myocardial function, T2, and native T1 values

		Mean ± SD
(n=106)	LVEDV (ml)	143.8 ± 30.1
	LVESV (ml)	62.7 ± 18.2
	LVSV (ml)	81.1 ± 16.8
	LVEF (%)	56.7 ± 6.2
	LV Mass (g)	101.6 ± 23.6
	LV Mass index (g/m^2)	54.1 ± 10.9
	T2 Base (ms)	39.1 ± 2.4
	T2 Mid (ms)	38.8 ± 2.4
	T2 Apex (ms)	40.0 ± 2.9
MOLLI Native (n=106)	T1 Base (ms)	1246 ± 41
	T1 Mid (ms)	1234 ± 45
	T1 Apex (ms)	1229 ± 51
	ECV (%)	29 ± 2
ShMOLLI Native (n=65)	T1 Base (ms)	1142 ± 47
	T1 Mid (ms)	1126 ± 52
	T1 Apex (ms)	1130 ± 47
	ECV (%)	30 ± 3