Magnetic Resonance Imaging (MRI) Relaxometry: Assessment of reproducibility between Magnetic Resonance scanners at 1.5T

Qurain T Alshammari[1,2], Graham J Galloway[1], Mark W Strudwick[3,4], Wendy E Strugnell[5], and Christian Hamilton-Craig[1,6]

[1]Centre for Advanced Imaging, The University of Queensland, Brisbane, Queensland, Australia, [2]College of applied Medical Science, Hail, Saudi Arabia, [3]Dept of Medical Imaging and Radiation Science, Monash University, Melbourne, Australia, [4]School of Information Technology and Electrical engineering, The University of Queensland, Queensland, Australia, [5]The Richard Slaughter Centre of Excellence in Cardiac MRI, Prince Charles Hospital, Queensland, Australia, [6]University of Washington, Seattle, United States

Target Audience: Native T1 mapping is an important technique for quantitative analysis of myocardial substrate; this data is relevant to researchers and clinicians looking to apply native T1 mapping on different systems, and for repeat measures over time.

Purpose: Native T1 and T2* mapping has been reported to be sensitive to different myocardial pathologies such as diffuse fibrosis in hypertrophic and dilated cardiomyopathy (1) and iron overload in thalassemia (2). The purpose of the current study was to determine the inter-scanner, scan-rescan variability for myocardial relaxometry by Cardiac Magnetic Resonance (CMR) between different systems at 1.5T, and to compare results over time in healthy volunteers.

Methods: 10 healthy participants (mean age = 55.2±10 years) underwent CMR on two 1.5T systems (Siemens Avanto standard 60cm bore, and Siemens Aera widebore 70cm system). The time between first (Avanto) and second (Aera) MRI scans was three years and acquired by different operator. Myocardial T1 (using Modified Look-Locker Inversion 'MOLLI' 3,3,5 sequence) and T2* relaxation times were calculated from basal, midcavity and apical single short-axis slices. Myocardial maps were calculated offline using proprietary software (MRmap) using a standard AHA-16 segments model. The differences between relaxometry results were compared with paired *t* test and the method of Bland-Altman using SPSS (version 20, IBM). Scan/re-scan reproducibility was defined as the relative percent mean difference between repeat MRI scans.

Result: Left ventricular functional parameters (end-diastolic, end-systolic volumes, ejection fraction and mass) were similar and within normal ranges for both MRI scans. The T1 and T2* mapping result was similar between first and second scans (table 1) (figure 1) and operator independent. Overall, myocardial T1 and T2* showed a relatively small inter-variation between 1.5T scanners (3 ±0.6% and 1.4 ±0.5%), respectively.

	T1-MOLLI (Avanto)	T1-MOLLI (Aera)	T2* (Avanto)	T2* (Aera)
mean±SD	940 ±19	942 ±17	34.1 ±3.3	35.9 ±2.5
P-value	P>0.30		P>0.65	

Table 1: mean±SD (in Millisecond) of T1 and T2* mapping of both MRI scans.

Discussion and Conclusion: Native T1-MOLLI and T2* demonstrates high consistency and inter-study reproducibility in the normal individuals between MRI scanners. The values were stable over time, with no significant difference in T1 and T2* after 3 years in healthy volunteers. This implies CMR relaxometry should be comparable between centres, for follow-up in individual patients using different CMR scanners with different bore sizes within the same vendor at 1.5T. The finding that the result are also operator independent further demonstrates the robustness of T1 and T2* mapping.
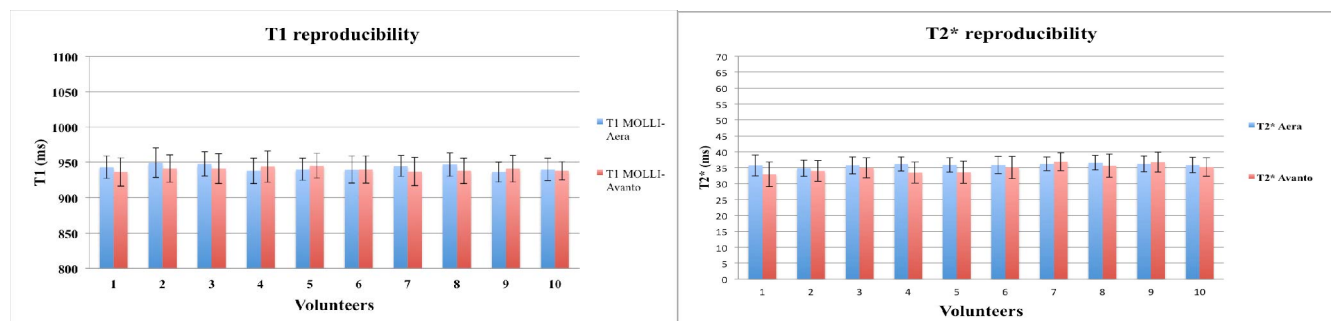

Figure 1: MOLLI T1 and T2* reproducibility with different scanners. Bar graph represents mean±standard error of T1 and T2* between two MRI scanners (Avanto and Aera 1.5T) at three years repetition between scans.

References: (1) Dass S, Suttie JJ, Piechnik SK, et al. Myocardial Tissue Characterization using Magnetic Resonance Non-Contrast T1 Mapping in Hypertrophic and Dilated Cardiomyopathy. Circ, Cardiovasc Imag, 2012. 5(6): 726-33. (2) Anderson LJ, Holden S, Davis B, et al. Cardiovascular T2-star (T2*) magnetic resonance for the early diagnosis of myocardial iron overload. European Heart Journal. 2001;22(23):2171-9.