Multi-centre validation of the Magnetic Resonance T2* technique for segmental and global quantification of myocardial iron

V. Positano[1], A. Ramazzotti[1], A. Pepe[1], G. Rossi[1], C. Salvatori[2], A. Meloni[1], D. De Marchi[1], B. Favilli[1], L. Natale[3], E. Cracolici[4], G. Restaino[5], G. Valeri[6], A. Luciani[7], L. Landini[1], and M. Lombardi[1]

[1]MRI Laboratory, "G Monasterio" Foundation and Institute of Clinical Physiology, Pisa, Italy, [2]MRI Laboratory, "G Monasterio" Foundation and Institute of Clinical Physiology, Italy, [3]Policlinico Gemelli, Roma, Italy, [4]Policlinico "P. Giaccone", Palermo, Italy, [5]Università Cattolica del Sacro Cuore, Campobasso, Italy, [6]Ospedali Riuniti di Ancona, Ancona, Italy, [7]Az. Ospedaliera "G. Garibaldi", Catania, Italy

Introduction: Multislice multiecho T2* approach has been recently validated as a technique for global and segmental assessment of myocardial iron overload [1]. However, the transferability of this technique among different MRI sites is unknown. In this study, the transferability of multislice multiecho approach was assessed among six MRI sites.

Materials and methods: Multiecho T2* sequences were installed at six MRI sites, equipped with 1.5T GE Signa/Excite scanners. Five healthy subjects (n=30) were scanned at each site; five thalassemia major (TM) patients were scanned locally and at the reference site (n=25) within one month. For the quantification of myocardial iron overload, three parallel short-axis views of the left ventricle were obtained using T2* GRE multiecho sequence at nine different echo times (2.0 to 20.3 ms, echo spacing 2.26 ms). Each slice was acquired in a single end-expiratory breath-hold. T2* images were analysed using a previously validated software [2] able to provide assessment of global and segmental T2* values using a standardized 16-segments model [3]. Mid-ventricular T2* value was evaluated as the mean of T2* values in the mid-antero- and inferoseptal segments.

Results: On healthy subjects heart global T2* values ranged from 27 to 47 ms (mean 36±5.0) and mid-ventricular septum T2* values ranged from 23 to 49 ms (mean 39±7.3). Segmental T2* values ranged from 20 to 60 ms (mean 36.2±4.0). The analysis of variance (ANOVA), applied to the global heart and the segmental T2* values showed non significant differences among the population samples. All T2*values of the 16 myocardial segments obtained from the images acquired from healthy subjects at all sites were ≥ 20 ms, the common used lower limit of normal threshold in T2* iron overload assessment.
In TM patients, the T2* values of global heart and of the mid-ventricular septum ranged from severe iron loading to normal (5 to 49 ms, mean 24 ms; and 4 to 52 ms, mean 26 ms respectively. There was high correlation between the T2* values calculated from images obtained at the reference site and at the other five MRI sites concerning the global heart ($p<0.001$, $r=0.97$) and the mid-ventricular septum ($p<0.001$, $r= 0.94$). Figure 1.a shows the relationship between global T2* measurements at reference and local sites. Correlation coefficient and CoV for the 16 segmental T2* values ranged from 0.80 to 0.96 and from 0.28 to 0.10 respectively. Figure 1.b depicts the mean difference between reference and local T2* values evaluated on the 16 LV segments.

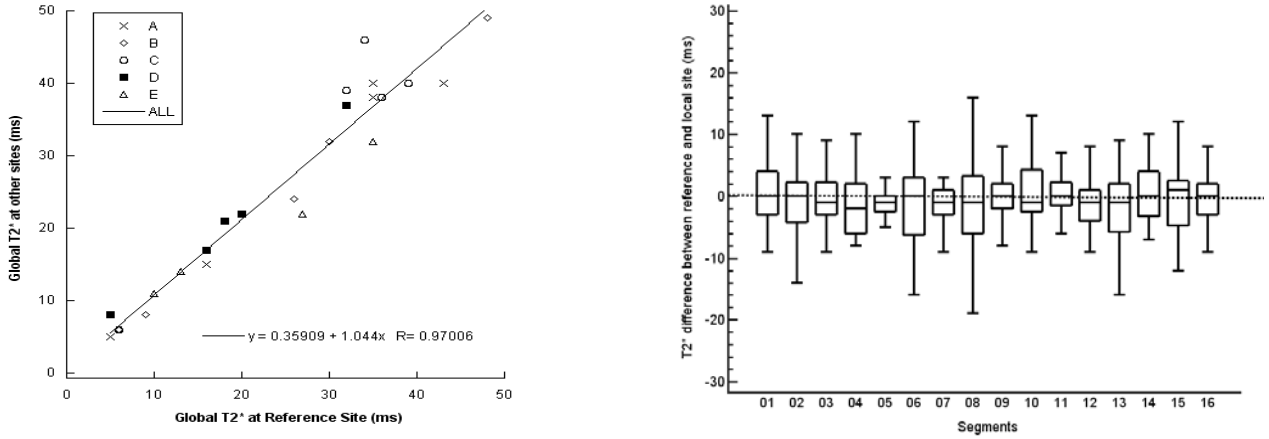

Figure 1: Comparison between global (left, a) and segmental (right, b) T2 measurement at reference and local sites.*

Discussion and Conclusions: Few studies are available about the transferability and standardization of the T2*technique among different MRI sites [4,5,6]. These studies were limited to the investigation of the mid-ventricular septum and mainly exploited a multi breath hold, single echo technique. The availability of multislice multiecho T2* technique had recently permitted to extend the methodology to global 3D analyses of the left ventricle. This study assessed the transferability of the 3D approach among different MRI sites. The T2* MRI assessment of iron overload by the multislice multiecho T2* technique seems to be a reliable and reproducible technique, useful to give information on global and segmental cardiac iron overload, although the extension of the validation procedure to multiple scanner vendors would be desirable.

References: [1] Pepe A et al. JMRI 2006;23(5):662-668. [2] Positano V et al. NMR Biomed 2007;20(6):578-90. [3] Cerqueira MD et al. Circulation 2002 ;105:539-542. [4] Westwood MA et al. JMRI 2003 ;18 :616-620. [5] Westwood MA et al. Int J Cardiovasc Imaging 2005;21:531-538. [6] Tanner MA et al. Heamatologica 2006 ;91 :1388-1391.