An automatic method for myocardial T2* curve fitting in thalassemia patients with severe iron overload

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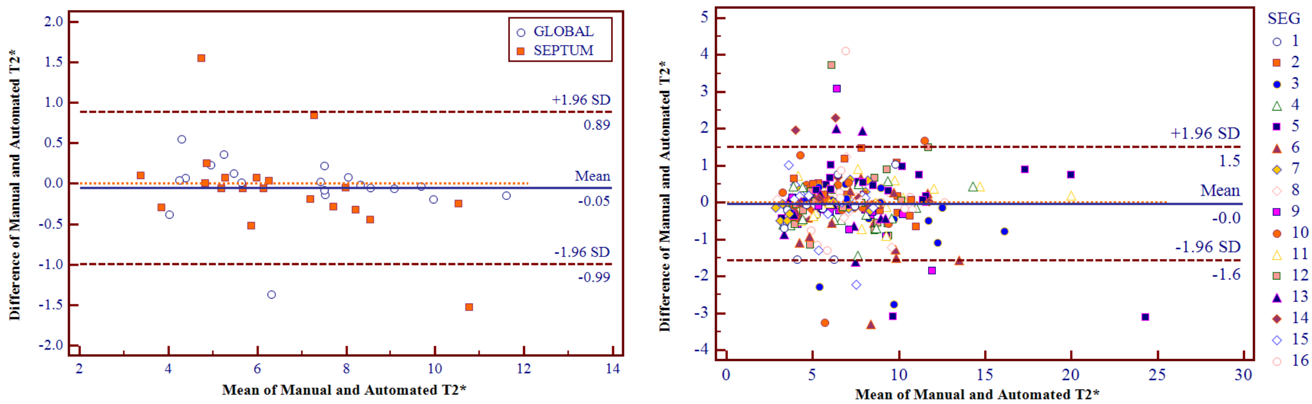
Introduction. Myocardial iron overload assessment by multislice multiecho T2* technique is used in the clinical management of thalassemia major (TM) patients [1]. Signal decay curves are extracted from the 16 left ventricular (LV) segments and the fitting of these curves to a mono-exponential model provides the corresponding T2* values [2]. In patients with severe cardiac iron overload, where signal will decay quickly becoming comparable to image noise, manual truncation of signal decay curves excluding later echo times (TEs) is adopted [2,3]. In this study an automatic truncation method avoiding the variability associated with the manual selection of the truncation point was introduced and validated.

Materials and methods. Twenty patients (13 males, age 33±7 years) enrolled in the MIOT Network [4] and diagnosed for severe iron overload (T2*<10 ms) were considered. Using a previously validated software the segmental T2* values were evaluated by the standard methodology (i.e. manual truncation).
Images were independently analysed by the developed automated approach. The percentage fitting error e was computed as the root mean square error (MRSE) between the signal decay curve and the mono-exponential model normalized to the mean value of the signal (S).

$$e = 100\frac{MRSE}{\overline{S}} = \frac{\sqrt{\sum_{i=1}^{N_{TE}}(S_i - M_i)^2}}{\sum_{i=1}^{N_{TE}} S_i}$$

where N_{TE} was the number of acquired echoes, S_i and M_i the values of the MR signal and the model at the i-th TE, respectively. If e was > 5%, the algorithm cut-off the last TE and performed again the fitting. The procedure was iterated until e become <5% or the number of TEs become equal to three. To assess the inter-operator variability, the dataset was processed by a second operator.

Results. The Coefficient of Variability (CoV) for inter-observer variability was 6.82±4.01%. The CoV between automated and manual analysis was 6.15±3.92 %, not significantly different from inter-observer variability (P=0.332). No significant difference was detected between mid-septum and global T2* values evaluated with manual and automated procedure (P=0.26 and P=0.91, respectively). The mean fitting error was not significantly different in manual and automated analysis (4.10±2.11 vs. 4.52±2.12, P=0.53). In segmental analysis, no significant differences were found between manual and automatic procedure (P>0.01 for all segments). Figure 1 shows the Bland-Altmann plots for global heart and mid-ventricular septum T2* measurements (a) and for segmental T2* values (b).



a *Figure 1.* **b**

Conclusion. Truncation of signal decay curve needed to compensate for low signal in later echoes in patients with severe iron overload can be effectively automatized avoiding operator induced variability.

References. [1] Pepe A et al. JMRI 2006;23(5):662-668. [2] Positano V et al. NMR Biomed 2009;22(7):707-715. [3] He T et al. MRM 2008;60(5):1082-1089. [4] Ramazzotti A et al. JMRI 2009;30(1):62-68.