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POSTER PRESENTATION **Open Access**

A fully automatic algorithm for assessing T2* and its certainty value for accurate cardiac and liver iron load determination

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Background

Quantification of myocardial and liver iron load has become a mainstay of guiding therapy in thalassaemia patients. However, current quantification methods are user dependent for data-point exclusion before curve fitting, and do not report the T2* certainty. Recently, an automatic inline maximum likelihood estimate (MLE) method with k-space Rician noise correction was validated against the reference standard manual truncation method. We now present a vendor-independent offline tool for fully automatic post processing and T2* quantification with certainty estimates, tested in computer simulations and patients with iron overload.

Methods

A new hybrid method was implemented in Segment (http://segment.heiberg.se), combining exponential fitting and residual-weighting. The only user dependency is drawing the ROI for evaluation.

Hybrid method: One of three fitting algorithms is applied based on an initial automated T2* estimation. If this estimate is shorter than the first echo time (TE_1), an exponential model is used with offset correction and certainty residual-weighting; if the estimate is longer than $3\times TE_1$, a pure exponential model residual-weighted to certainty of pixels is used; and if the estimate falls in-between TE1 and $3\times TE_1$, a linear interpolation of the two methods is applied. Possible bias for large T2* values (>>maximum TE) is compensated for by using the magnitude of the fit residual error. Certainty estimates of T2* are calculated based on size of the fit residual error. For low T2* value certainty estimates the TEs are also taken into account.

Simulations: Computer phantoms were generated for T2*=0.5-40 ms with varying Rician noise. For each T2* and noise level 200 computer phantoms were created for calculation of T2* certainty.

Patient study: Nine iron overload patients (5 male; median age 12, range 1.4-39 years) were scanned at 1.5T for cardiac and liver iron load using 2 multi-gradient echo sequences. All parameters were identical (voxel = 2 × 2 × 10 mm, matrix = 256, 10 echoes, FA = 20°, BW = 833 Hz, SENSE = 2) except for TE (cardiac: $TE_1/\Delta TE$ 2.5/2.3 ms; liver: $TE_1/\Delta TE$ 0.8/1.6 ms). The new hybrid method and the MLE method were applied in the cardiac septum and liver, respectively.

Results

Results of computer phantom experiments are shown in Figure 1. In patients, bias ± SD between Segment and MLE were -0.28±0.41 ms (-1.16 ± 1.68%; Figure 2).

Conclusions

Accurate iron-load T2* is provided by the proposed fully automatic method, comparable with the MLE method over a wide range. In addition to previous algorithms, the new hybrid algorithm reports a certainty estimate for T2*.

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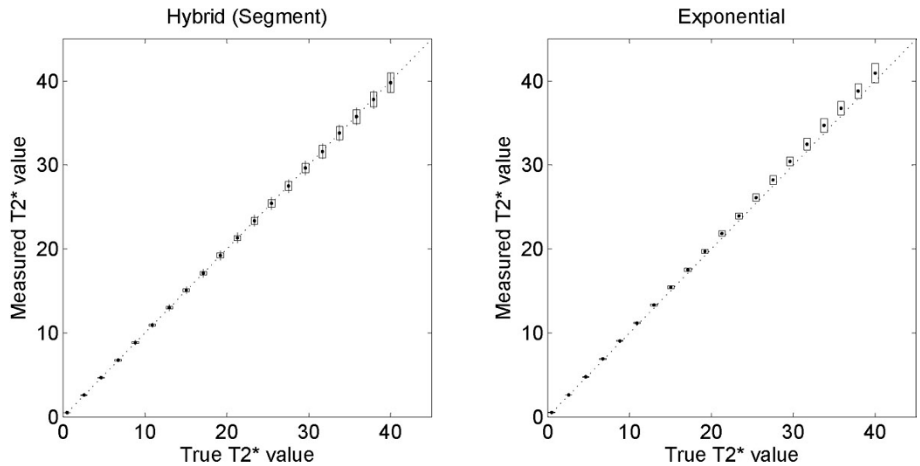

Figure 1 Hybrid method (left) and standard fitting (right) both agree well with the theoretical T2* values from computer simulation phantoms. Boxes indicate measured uncertainty and vertical lines indicate calculated uncertainty (Hybrid method only). Note the trend of overestimating the true T2* value with increasing T2* for the commonly used exponential fitting method (right).

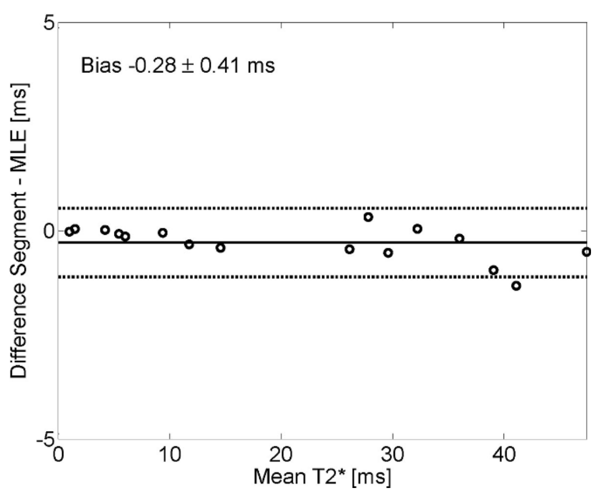

Figure 2 In patients, segment and MLE are comparable over a wide range of T2* values.

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