Improved myocardial T2* normal values at 1.5T and 3T

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Introduction

Quantitative T2* values can be calculated from multi echo- gradient echo sequences (ME-GRE). They are useful for estimation of myocardial iron content in patients with thalassaemia [1], haemochromatosis [2]. Normal myocardial T2* of values for 1.5T are already published as 52±16ms [3], which is a rather large margin. Susceptibility weighted images are not only prone to artefacts because of myocardial motion but also due to the vicinity of lung and large venous vessels [4]. Our goal was to set up an optimized protocol for the quantification of T2* and to establish normal values at 1.5T and 3.0T.

Material and Methods

An ECG gated, seven echo, 2D single-slice gradient-echo sequence with TEs corresponding to the (field dependent) first seven in-phase conditions was applied at three slice positions (basal, center, apical). A dark-blood prepulse suppressed motion artefacts from the left ventricular blood. The strong field inhomogeneities in the myocardium, which can reach 70-100Hz [1], will be less pronounced for thinner slices. By varying the slice thickness SNR, CNR and artefact strength were optimized. The artefacts were less pronounced in expirational breath-hold. The measurements were performed with 6 volunteers (5 male, 1 female, age 24-41, mean 30), both at 1.5T and 3T.

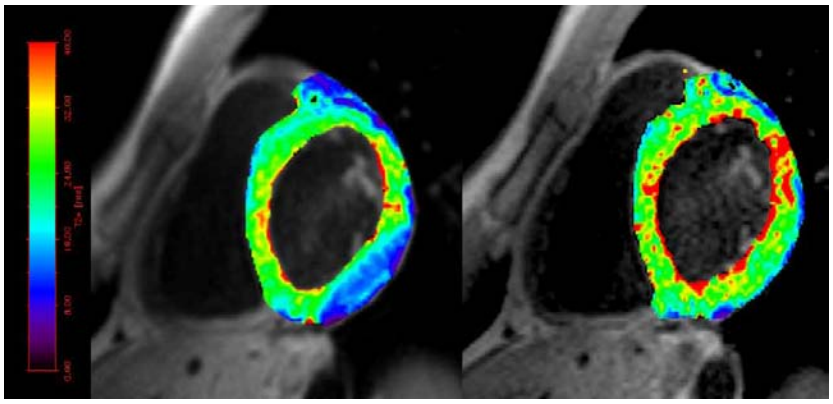

Fig 1: T2 maps of the human heart.* ***Left****: 8mm slice thickness. A susceptibility artefact from the posterior veines causes a severe shortening of T2*.* ***Right****: 4mm slice thickness. The T2* values are much more homogeneous.*

Results

An optimum slice thickness was found at 4mm for both 1.5T and 3T. While $T2^*$ artefacts would be further reduced by thinner slices, the darkblood pulse causes signal loss at 3mm slice thickness and below. A systematic variation of T2* within the myocardial regions (septum, anterior wall, posterior wall) was found due to different surrounding tissues while there was no systematic variation due to slice positioning (base, center ,apical). Therefore separate T2* normal values are given for the three region, which allows much more accurate mean values. The septum was mostly artefact free with typical T2* values of 35.2±1.3ms at 1.5T and 29.8±1.2ms at 3T. T2* of anterior wall was 32.2±2.7ms (1.5T) and 25.9±2.0ms (3T), whereas in the posterior wall values of 26.6±3.2ms (1.5T) and 20.2±2.4(3T) were extracted. All given T2*-values are weighted means and the errors are 95% t-quantiles calculated from weighted standard deviations of all volunteers, three slices each.

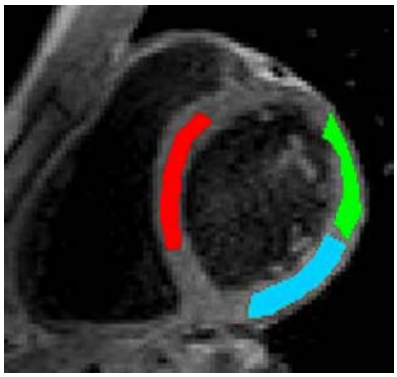

Fig 2: Example rois used for numerical evaluation: septum (red), anterior wall (green), posterior wall (blue).

Discussion

By selecting an optimized slice thickness of 4mm using a darkblood-pulse and expirational breath-hold the field inhomogeneity effects and common image artefacts could be reduced. The consistency of T2*-values between the three analysed myocardial areas were improved compared to the 8mm slice thickness. However, there still is a systematic variation of T2* between myocardial regions. The determination of separate T2* values for the three regions (septum, anterior wall, posterior wall) allowed more accurate myocardial T2* norm values. Further improvement could be achieved by applying a post-processing correction for field inhomogeneities [5], but that would require gap free multi-slice acquisitions with multiple breath-holds and much longer acquisition time.

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