Novel MRI T2 Mapping for Improved Myocardial Tissue Characterisation

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Introduction: As part of our work on myocardial iron quantification we have developed an breath-hold fast spin echo (FSE) T2 technique with good reproducibility (1,2). This T2 technique, however, is based on region-of-interest (ROI) analysis. Although ROI analysis can increase signal to noise ratio (SNR), it may introduce errors to T2 measurement by averaging every pixel within the region. By contrast, pixel by pixel mapping is more attractive for tissue characterization but is limited by noise or artifacts particularly if the pixels are small and SNR is reduced. Although there has been considerable interest in providing T2 relaxometry pixel mapping of the heart, the achievement so far is limited mainly due to technical challenges.
In this study therefore, we were aiming at improving and extending the current FSE T2 technique to pixel by pixel mapping. The developed mapping method was tested on human subjects and preliminary results were presented.
Methods: With the improved T2 sequence, the echo-spacing was reduced to 3.6ms. The length of the echo train was 166ms with 50 echoes. The image resolution was increased by twofold giving rise to a matrix of 256x128. By using parallel imaging and partial Fourier technique, the images were acquired within a breath-hold.
Nine male athletes were studied on a 1.5T MRI scanner (Siemens Avanto) using a cardiac phased array coil and with ECG gating. Three short axis slices were imaged in left ventricle. T2 mapping was done using MRmap (http://www.cmr-berlin.org/forschung/mrmapengl/index.html). Pixel by pixel T2 values were compared across the whole myocardium for each mapping.
***Results*:** All the images were of good quality and the curves were well fitted. Figure 1 demonstrates an exemplary T2 mapping of a human heart (left) with a typical pixelwise exponential decay and curve fitting (right). Visually, the myocardium is homogeneous and remaining blood signals were clearly depicted near myocardial borders. Mean T2 value and standard deviations for each patient were shown in Table 1.

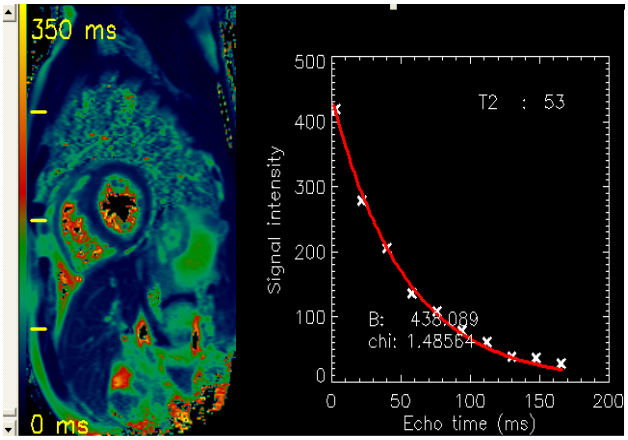

Figure 1. Left: T2 mapping of a human heart. Right: Example curve fitting pixel wise.

Patient	Mean T2 (TS)	Std
1	53.3	4.8
2	56.2	5.6
3	50.8	4.7
4	51.0	3.9
5	55.9	6.1
6	50.3	5.9
7	50.5	4.2
8	53.8	4.9
9	52.3	3.2

Table 1. Mean T2 values with standard deviation (n=9).

Acknowledgements:

This work is supported by British Heart Foundation (BHF). The first author is also supported by Wellcome Trust Value in People (VIP) Award.

Conclusions: Our preliminary results have shown that good quality T2 images can be acquired with improved resolution and that T2 mapping is feasible for myocardial tissue characterisation. There appears no significant T2 variation across the whole myocardium for these subjects studied. This study suggests T2 mapping may potentially be used for assessing regional disease variations across the myocardium.

References: 1. He T, et al. J Magn Reson Imaging. 2006; 24:580-585. 2. He T, et al. J Cardiovasc Magn Reson 2008; 10:11.