BLACK-BLOOD PREPARATION VS. BRIGHT-BLOOD FOR MYOCARDIAL T_2P-SSFP – BASED T_2 QUANTIFICATION

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TARGET AUDIENCE: Researchers interested in myocardial tissue characterization who would like to address the validity of the results.

PURPOSE: Accuracy and reproducibility of myocardial T_2 measurements are important for characterization of myocardial tissue. Myocardial bright-blood techniques often suffer from noise, motion, and blood artifacts, whereas black-blood preparation provides more clearly defined endocardial borders and reduces artifacts from blood. Motion artifacts from the cardiac and respiratory motions can be minimized using the gradient-echo approaches with the shorter acquisition times. The superior performance of T_2-prepared steady-state free-precession (T_2p-SSFP) - based T_2 quantification in direct comparison to multi spin echo (MSE) techniques has been reported[1]. However shorter acquisition time causes increased noise level, thus the particular problem for myocardial T_2 quantification may be the low signal-to-noise ratio (SNR) in the later echo time (TE) images, and consequently noise bias which may complicate the T_2-decay curve fitting. Thus, different approaches have been adopted to model the myocardial T_2 decay.

In a previous study[2] we could show in phantom experiment that the offset model performs best in T_2 quantification as applied to T_2p-SSFP imaging technique without black-blood preparation, whereas monoexponential fit is not able to simultaneously capture the noise bias and the signal loss at a short TE leading to crucial T_2 overestimatation. He T. et al.[3] showed in myocardial T_2^* study in iron-overloaded thalassemia that for the bright-blood data monoexponential model gives rise to a pure T_2^* decay curve fitting and generally overestimates the measurements if all the data points are included, thus truncation model should be used, although the offset model fits the curve well in this situation, but appears to underestimate T_2^* values; whereas for the black-blood data simple monoexponential model generates a good fit and produces reproducible T_2^* values.

The purpose of this study was to investigate *in vivo* whether with the black-blood preparation applied to T_2p-SSFP imaging technique the T_2 could be modeled using a simple monoexponential fit or the offset model as decided previously by phantom study is the most appropriate model to use in both bright- and black-blood data.

METHODS: Myocardial T_2 study was carried out in 5 patients on a 1.5T clinical whole-body scanner (Philips Achieva) with a 32-element cardiac phased array coil. T_2-prepared experiments with 6 preparation times *TE* (0, 20, 35, 50, 65, 80 ms) and 4 refocusing pulses were performed consecutively within a single breathhold. All data were acquired during end diastole. T_2 preparation was performed every other cardiac cycle leading to overall scan duration of 12 RR intervals.

RESULTS: Figure 1 demonstrates representative bright- (a) and black-blood (d) images acquired at different TEs from an exemplary patient. Good blood suppression can be appreciated in the black-blood images; both bright- and black-blood images provide high contrast. Figure 2 shows one typical example of the decay curves of the bright- (a) and black-blood (b) data fitted with the monoexponential and offset models. It demonstrates that the monoexponential model does not fit well neither bright- nor black-blood data, whereas both datasets are well fitted with the offset model. Student's t-test shows that there is no significant difference for both models in evaluation of T_2 values from bright- or black-blood data ($p = 0.75$ for monoexponential and $p = 0.22$ for offset model).

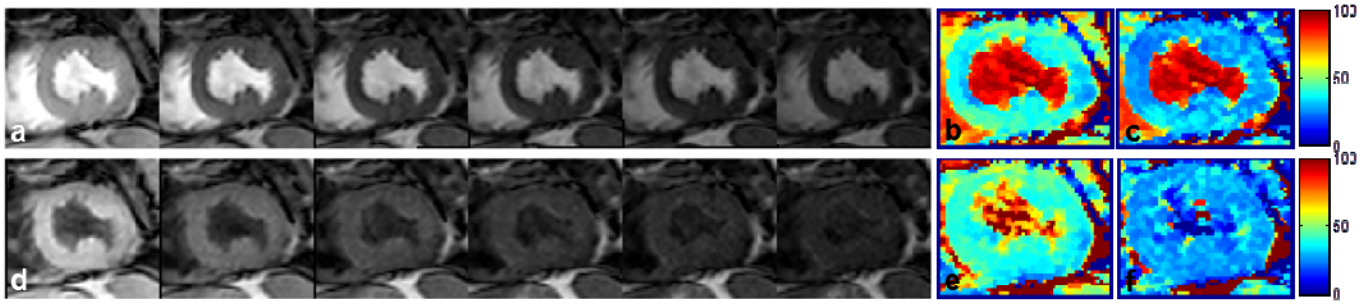

Figure 1. *Example of short-axis midventricular images of the bright- (a) and black-blood (d) data obtained from the same patient at TEs = 0, 20, 35, 50, 65, 80 ms respectively and correspondent T_2 maps derived from bright- and black-blood data with monoexponential (b, e) and offset (c, f) models correspondingly.*

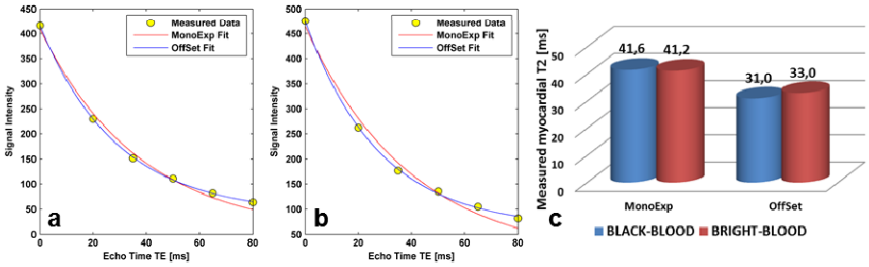

Figure 2. *Example of decay curves of the bright- (a) and black-blood (b) data from the same patient fitted with the monoexponential and offset models and comparison of the mean T_2 values (from 5 patients) obtained from bright- and black-blood data with monoexponential and offset models respectively (c).*

DISCUSSION & CONCLUSION: The preliminary results obtained from 5 patients showed that myocardial T_2 quantification based on T_2p-SSFP can be reproducible and accurate on both bright- and black-blood prepared data. The offset model appears to provide more robust T_2 decay curve fitting for myocardial T_2 mapping compared to the simple monoexponential model in both cases.

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