Comparing 3D-QALAS with MOLLI and Multi-Echo for in-vivo myocardial T1 and T2 quantification

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TARGET AUDIENCE

People interested in cardiac MRI, tissue characterization and quantitative MRI.

PURPOSE

Recently, a novel method has been developed for 3D interleaved T1 and T2 quantification of the entire myocardium within one single breath hold, 3D-QALAS (Kvernby et al, 2014). In this work we validate this method in-vivo by making a comparison with MOLLI-sequence for myocardial T1-mapping and multi-echo acquisitions for T2-mapping.

METHODS

The 3D-QALAS sequence is based on a 3D spoiled Turbo Field Echo sequence using inversion recovery with interleaved T2 preparation pulse. Quantification of both T1 and T2 in a volume of 13 slices covering the entire left ventricular myocardium with a resolution of $2.0 \times 2.0 \times 6.0$ mm was obtained during a single breath hold of 15 heartbeats with 3D-QALAS.

Healthy volunteers with no history of cardiovascular or pulmonary disease, underwent three 3D-QALAS scans in order to investigate the precision and accuracy of the method. Images were acquired in left ventricular short axis orientation.

For comparison, a 2D 3-3-5 MOLLI acquisition (Messroghli et al, 2004) was performed for myocardial T1 quantification and a 2D two-point multi-echo GraSE EPI sequence was used for quantification of T2. The 2D mid-ventricular short axis slices were acquired with a resolution of $2.0 \times 2.0 \times 10.0$ mm. T1 and T2 values were obtained from four ROIs positioned in different sections in a mid-ventricular short axis slice.

RESULTS

The in-vivo T1 and T2 relaxation time maps of 3D-QALAS showed good agreement with the MOLLI and Multi-Echo reference methods. Results from the different methods are shown for a typical healthy volunteer in Table 1. Associated images corresponding to the different relaxation time mapping methods are shown in Figure 1.

DISCUSSION AND CONCLUSION

Relaxation times measurements obtained with 3D-QALAS correspond well with data from existing 2D mapping methods and allows a fast acquisition that provides information about both T1 and T2, making the method clinically applicable to a broader spectrum of diseases.

REFERENCES

Kvernby et al, 3D-Qantification using an interleaved Look-Locker acquisition sequence with T2-prep pulse (3D-QALAS), SCMR 2014

Messroghli et al, Modified Look-Locker Inversion Recovery (MOLLI) for high-Resolution T1 Mapping of the Heart, MRM 2004

Table 1. In-vivo data from a typical healthy volunteer measured with 3D-QALAS, MOLLI and Multi-Echo. Relaxation time measurement in different sections of the myocardium, displayed as mean value and standard deviation from a specific ROI based on three repeated measurements.

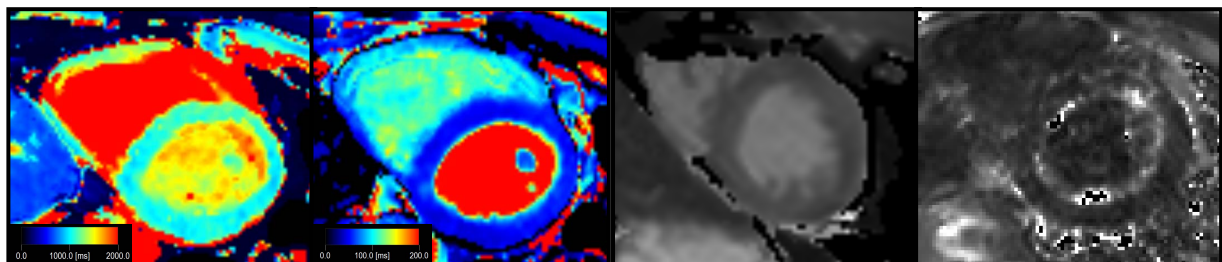| Case	Section	3D-QALAS T1	MOLLI	3D-QALAS T2	T2-ME
		T1 (ms)	T1 (ms)	T2 (ms)	T2 (ms)
Healthy	Septal	1117,8 ± 33,0	1123,0 ± 53,7	55,2 ± 3,3	50,1 ± 11,2
	Anterior	1066,6 ± 39,8	1095,7 ± 28,0	54,0 ± 2,2	49,1 ± 6,4
	Lateral	1052,3 ± 41,8	1050,3 ± 77,0	54,2 ± 3,0	48,8 ± 11,1
	Posterior	1047,0 ± 37,8	1060,7 ± 55,7	52,6 ± 7,2	50,6 ± 11,4
	Averages	**1070,9 ± 32,3**	**1082,4 ± 33,3**	**54,0 ± 1,0**	**49,7 ± 0,8**

Figure 1. Quantitative images of a healthy volunteer. From left to right: T1-map with 3D-QALAS, T2-map with 3D-QALAS, T1-map with MOLLI and T2-map with two-point Multi-Echo.