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Oral presentation

Effect of improving spatial or temporal resolution with k-t SENSE acceleration in first pass CMR myocardial perfusion imaging

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Introduction

First pass cardiac magnetic resonance (CMR) myocardial perfusion imaging (MPI) requires the acquisition of large amounts of image data in a short time. Acceleration techniques like *k-t* SENSE exploit spatiotemporal correlations to speed up data acquisition. In myocardial perfusion CMR *k-t* SENSE has been used to improve spatial resolution, temporal resolution or slice coverage with improvements of endocardial dark rim artefacts reported. To date, there has been no direct comparison between these strategies.

Purpose

To compare the effect of investing the speed-up afforded by *k-t* SENSE acceleration in spatial or temporal resolution.

Methods

Adenosine stress and rest MPI was performed using a 1.5 T Philips Intera system. Ten healthy volunteers were scanned on four occasions using a different saturation recovery gradient echo perfusion sequence at each visit (Table 1). The order of sequence utilisation varied for each volunteer.

Image analysis was performed on the middle slice. Image quality was scored 0-3 (0-poor, 3-excellent) and breathing artefacts noted by two readers in consensus. Dark rim artefact was assessed by: thickness (using electronic callipers), duration (frame count) and extent (area of artefact measured by contouring and expressed as a percentage of myocardial area). Friedman Test and repeated measures Analysis of Variance Testing (with Bonferroni correction for pairwise comparisons) were used to compare non-parametric and parametric data respectively.

Results

Image quality at stress did not significantly differ between the sequences (table 2). At rest, the *k-t* Hybrid sequence showed highest quality. Rim artefact thickness was similar using REFERENCE and *k-t* Fast sequences but significantly lower using *k-t* High and *k-t* Hybrid sequences. Rim artefact extent was significantly higher for REFERENCE images, similar for *k-t* Fast and *k-t* Hybrid images and significantly lower for *k-t* High images. Although four-way comparison suggested a difference at rest, rim artefact duration did not differ between sequences by pairwise analysis at stress or rest. Breathing artefacts occurred in 57% of stress and 17% of rest *k-t* SENSE studies. No breathing artefacts were seen with REFERENCE data.

Conclusion

Although spatial and temporal resolution both influence the thickness and extent of dark rim artefact, maximising spatial resolution by *k-t* SENSE acceleration produces the greatest reduction in these parameters. This may lead to fewer false positive results using CMR MPI in a clinical setting. *k-t* SENSE remains sensitive to respiratory artefacts.

Table 1: Pulse sequence characteristics. (* assuming 340 mm field of view)

Sequence Name	REFERENCE	*k-t* High	*k-t* Fast	*k-t* Hybrid
Acceleration Method	SENSE	*k-t* SENSE	*k-t* SENSE	*k-t* SENSE
Acceleration Factor	2	8	8	8
Training Profiles	-	11	11	11
Number of slices	3	3	3	3
Acquisition Matrix	128	256	128	192
Acquired Voxel Dimensions (mm)*	2.66 × 2.66 × 10	1.33 × 1.33 × 10	2.66 × 2.76 × 10	1.77 × 1.82 × 10
Image Acquisition Time Per Slice (ms)	119	117	64	109

Table 2: Image quality and dark rim artefact results.

		REFERENCE	*k-t* High	*k-t* Fast	*k-t* Hybrid	P value
Mean Image Quality Score	Stress	1.7	1.6	1.7	1.9	0.590
	Rest	2	2.1	1.9	2.4	0.015
Mean Rim Thickness (mm)	Stress	3.4	1.1	3.0	1.8	<0.001
	Rest	3.4	1.3	2.7	2.2	<0.001
Mean Rim Extent (%)	Stress	16.1	2.2	6.0	4.6	<0.001
	Rest	14.5	1.7	5.0	4.7	<0.001
Mean Rim Duration (frames)	Stress	11	7	11	10	0.07
	Rest	13	9	11	13	0.008