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Real-time magnetic resonance cine imaging with sparse sampling and iterative reconstruction for ventricular measures: comparison with gold-standard segmented steady-state free precession

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Background

Segmented cine imaging with a steady-state free precession sequence (CINE-SSFP) is currently the gold standard technique for measuring ventricular volumes and mass. It requires multiple breath-holds to cover the entire ventricles, thus being prone to misalignment of consecutive slices, time consuming and dependent on breath-hold (BH) capability. Real-time cine avoids those limitations, however poor spatial and temporal resolution of conventional sequences have prevented its routine application. We sought to examine if a newly developed real-time sequence featuring sparse sampling and iterative reconstruction (CINE-RT), which is an investigational prototype, would yield similar results when compared with conventional CINE-SSFP in a group of healthy volunteers.

Methods

Stacks of short-axis cines were acquired covering both ventricles in a 1.5T system (MAGNETOM Aera, Siemens AG, Germany), using gold standard CINE-SSFP and CINE-RT. Acquisition parameters for CINE-SSFP were: voxel size 1.6x1.6x7.0mm, GRAPPA acceleration factor of 2, temporal resolution of 39 ms, retrospective gating, with an average of 8 heart beats per slice and 2 slices/BH. For CINE-RT: voxel size 1.6x1.6x7.0mm, sparse sampling net acceleration factor of 11.5, temporal resolution of 41 ms, prospective gating, real-time acquisition of 2 heart-beats/slice and all slices in one BH. Left and right ventricle contours were blindly drawn by an experienced observer at end diastole and systole to derive volumes and LV mass.

Table 1

	LV EDV			LV ESV			LV Mass			RV EDV			RV ESV		
	ml ± SD	r	bias ± SD	ml ± SD	r	bias ± SD	g ± SD	r	bias ± SD	ml ± SD	r	bias ± SD	ml ± SD	r	bias ± SD
CINE-SSFP	80.7 ± 24.6	-	-	33.9 ± 20.6	-	-	57.8 ± 15.4	-	-	65.3 ± 12.6	-	-	31.5 ± 7.8	-	-
CINE-RT	73.3 ± 21.8	0.95	7.5 ± 7.6	31.1 ± 19.9	0.97	2.8 ± 4.6	53.4 ± 11.9	0.90	4.4 ± 9.6	58.9 ± 11.6	0.90	6.4 ± 5.6	29.4 ± 8.4	0.82	2.1 ± 4.9

LV: left ventricle, RV: right ventricle, EDV: end-diastolic volume, ESV: end-systolic volume, SD: standard deviation, r: Pearson's correlation coefficient (vs. CINE-SSFP), bias: mean bias (vs. CINE-SSFP).

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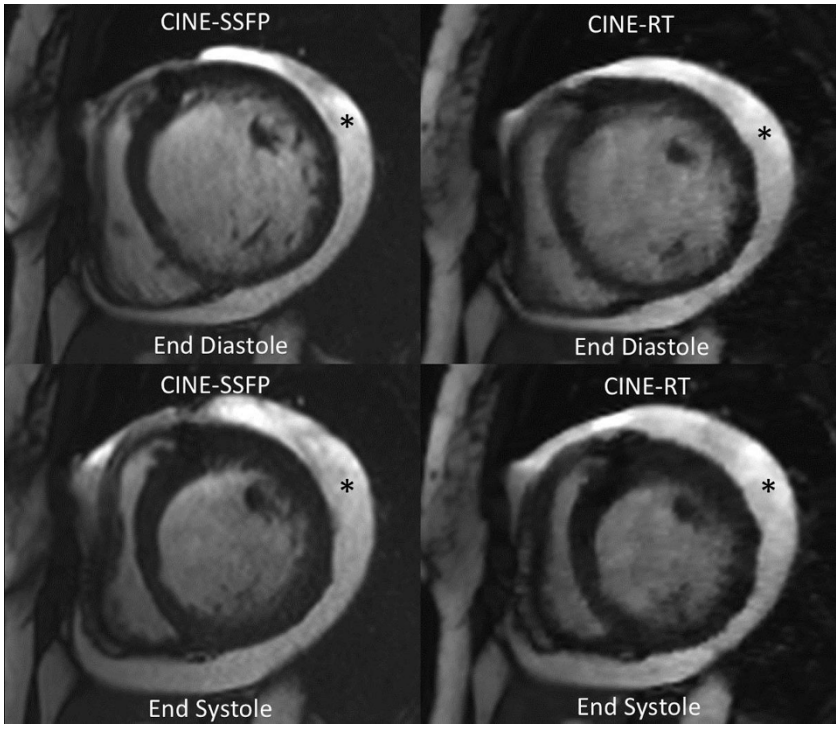

Figure 1 Patient with dilated cardiomyopathy and pericardial effusion (*) seen with CINE-SSFP and CINE-RT.

Results

Eight healthy volunteers (4 male; 35.2 ± 4.5 years) and twenty two patients (11 male; 44.5 ± 20.1 years) were examined in the same day. All subjects were in sinus rhythm and all images were considered to have diagnostic quality (figure). CINE-RT derived volumes and mass correlated with gold standard CINE-SSFP, with small biases. Table 1 summarizes all results and comparisons.

Conclusions

CINE-RT with sparse sampling and iterative reconstruction with 2 heart beats per slice achieved spatial and temporal resolutions equivalent to CINE-SSFP, yielding correlated measures of ventricular volumes and mass.

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Internal.

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