

POSTER PRESENTATION

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Free-breathing 3D phase-sensitive inversion recovery late gadolinium enhancement at 3.0 Tesla: reliability and image quality in ischemic and non-ischemic cardiomyopathy in comparison with multiple breath-hold 3D imaging

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Background

In both ischemic (ICM) and non-ischemic (NICM) cardiomyopathy late gadolinium enhancement (LGE) is an important cardiovascular magnetic resonance (CMR) technique. LGE CMR, traditionally performed in 2D during multiple breath-holds (MB), is challenging for vulnerable patients and subject to slice misregistration. Therefore, LGE CMR during free-breathing (FB) is more robust and enables to perform 3D acquisition, increase resolution and apply phase-sensitive inversion recovery (PSIR). We developed and clinically tested a high spatial resolution PSIR LGE sequence using a respiratory navigator in both ICM and NICM patients. Reliability and image quality were compared to a multiple breath-hold 3D approach (MB-3D).

Methods

Approval was waived by the institutional ethical committee. Between May 2012 and November 2013 FB-3D and MB-3D sequences were acquired in patients suspected of ICM and NICM. Data of 48 patients (36 men; mean age \pm standard deviation: 60.8 years \pm 10.9; 34 ICM) were retrospectively collected. LGE sequences were acquired using a 3.0 Tesla MR system. For both FB-3D (1.68 \times 1.68 \times 3.4 mm) and MB-3D (1.86 \times 2.8 \times 10 mm) a PSIR sequence was used. Multiplanar reformats with high resolution (FB-3D-HR; 0.91 mm isotropic voxels) and low resolution (FB-3D-LR; 1.86 \times 2.8 \times 10 mm) were constructed. LGE mass and image quality

(SNR, CNR and edge sharpness) were compared using the Friedman test, Wilcoxon signed rank test, spearman correlation and Bland-Altman analysis.

Results

34 ICM patients (23 chronic MI; 4 sub-acute MI; 7 acute MI) and 14 NICM were included (5 dilated cardiomyopathy; 4 hypertrophic cardiomyopathy; 3 peri/myocarditis; 2 other). In figures 1 and 2 3D reconstructions of two patients are shown. In the complete dataset of 48 patients, there were no significant differences between FB-3D-HR, FB-3D-LR and MB-3D datasets in terms of LGE mass (FB-3D-HR: (median [interquartile range]): 8.5 g [4.4-19.9]; FB-3D-LR: 10.7 g [4.5-22.9]; MB-3D: 9.8 g [5.1-19.8]; $p = 0.099$). LGE mass correlated well (FB-3D-HR vs MB-3D: $r=0.922$, $p=0.01$; FB-3D-LR vs MB-3D: $r=0.922$, $p=0.01$) with Bland Altman analysis indicating good agreement for FB-3D-HR vs MB-3D (mean difference \pm SD: 1.15 \pm 5.45 gram) and FB-3D-LR vs MB-3D (mean difference \pm SD: 0.00 \pm 5.47 gram). SNR was higher in both FB-3D-HR (median [interquartile range]: 244 [192-326], $p=0.001$) and FB-3D-LR (825 [498-1417], $P<0.001$) as compared to MB-3D (200 [146-263]). CNR was also higher in both FB-3D-HR (226 [164-277], $p<0.001$) and FB-3D-LR (691 [480-1086], $p<0.001$) as compared to MB-3D (216 [162-260]). Edge sharpness was 25% higher in FB-3D-HR as compared to MB-3D (0.21 [0.19-0.23] vs 0.17 [0.15-0.20], $p<0.001$).

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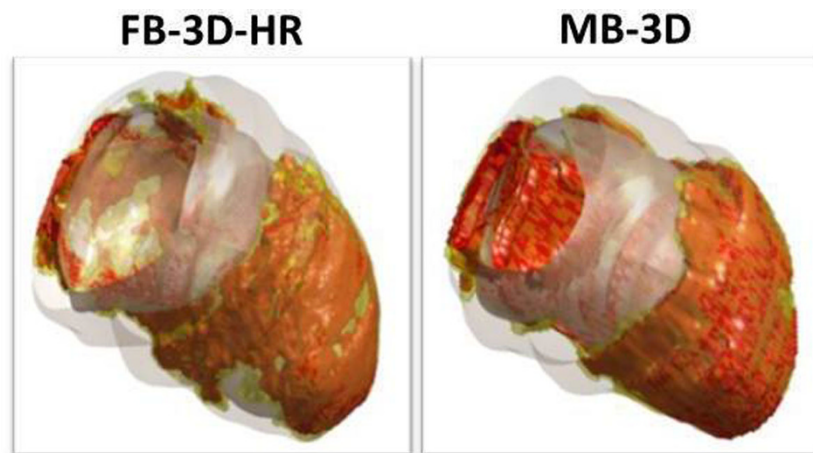


Figure 1 42-year old female patient a previous anterior myocardial infarction admitted under the suspicion of a sub-acute inferolateral infarction. CMR revealed large areas of LGE anterior and inferolateral. Also, a true apical thrombus was detected. 3D reconstructions of the entire left ventricle are displayed. Note the increased spatial resolution in the FB-3D-HR images with higher edge sharpness, apparent in for example areas with microvascular obstruction (anterior and lateral wall).

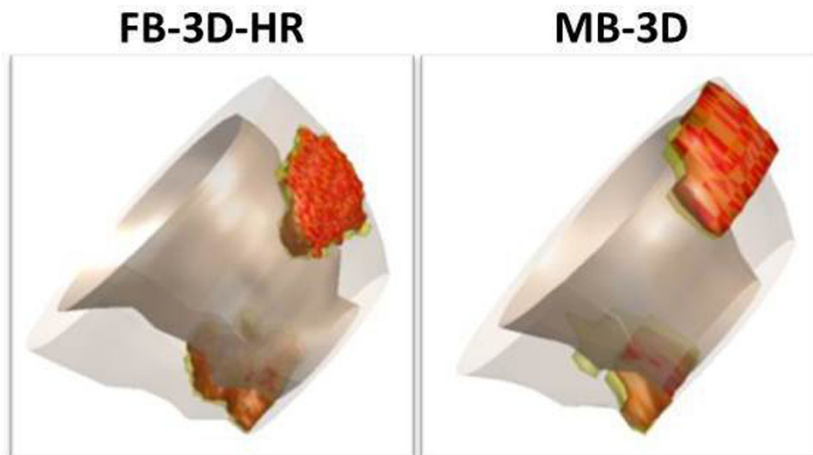


Figure 2 49-year old male patient admitted with thoracic pain related to breathing with elevated serum creatine kinase and troponine values. CMR reveals LGE in the epicardial apico-anterior wall and extending into the pericardium, and in the epicardial apico-inferior wall suggesting perimyocarditis. Appreciate the high contrast in the FB-3D images and sharp delineation of LGE areas in the FB-3D-HR 3D reconstruction.

Conclusions

Free-breathing 3D phase-sensitive inversion recovery LGE CMR enables reliable myocardial scar tissue assessment with significantly improved image quality as compared with multiple breath-hold 3D imaging in ischemic and non-ischemic cardiomyopathy.

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