Journal of Cardiovascular Magnetic Resonance

Poster presentation

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# Comparison between free-breathing true-fisp cine sequences: radial vs cartesian k-space reconstruction

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*from* 13th Annual SCMR Scientific Sessions
Phoenix, AZ, USA. 21-24 January 2010

Published: 21 January 2010

*Journal of Cardiovascular Magnetic Resonance* 2010, **12**(Suppl 1):P79 doi:10.1186/1532-429X-12-S1-P79

This abstract is available from: http://jcmr-online.com/content/12/S1/P79



## Introduction

Real-time cine imaging is a commonly used cardiac MR acquisition technique in patients who are unable to breath-hold or who have significant arrhythmia during their examination.

## Purpose

To compare cartesian versus radial k-space reconstruction in a free-breathing real-time true fast imaging with steady-state precession (true-FISP) sequence to quantify left ventricle (LV) and right ventricle (RV) volumes and ejection fraction (EF).

## Methods

Left and right ventricular volume and function studies were performed in 11 consecutive patients. Three different true-FISP sequences were acquired using a 1.5 T scanner: free-breathing single shot with radial k-space reconstruction, free-breathing single shot with Cartesian k-space reconstruction, and breath-hold (BH) segmented acquisition with Cartesian k-space reconstruction. For the radial and Cartesian sequences the temporal resolution was 77 ms and 79 ms, respectively, and for the segmented Cartesian acquisition the temporal resolution was 45 ms. Ventricular cavities were manually segmented at end-diastolic and end-systolic phases. The BH sequence was used as the reference standard, and a Bland-Altman analysis was performed to evaluate the free-breathing sequences.

## Results

With the BH sequence the mean ± SD LV EF was 51.5 ± 20% (range 22.3% - 73.6%), and the RV EF was 49.8 ± 21% (range 7.8% - 72.9%). With the free breathing Cartesian k-space reconstruction sequence the LV EF was 50.1 ± 24% (range 16.6% - 88%), and the RV EF was 45.1 ± 20% (range 11.6% - 70.5%). With the free-breathing radial k-space reconstruction sequence LV EF was 52.7 ± 21% (range 24.1% - 81%), and the RV EF was 45.7 ± 17% (range 14% - 72.6%). RV and LV end systolic (ES) and end diastolic (ED) Volumes (V) are reported in table 1.

Bland-Altman analysis between the BH and the free-breathing Cartesian k-space reconstruction demonstrated the measured bias for the LV EF was 2.4% and the 95% limits of agreement (LOA) were -12.6 to 17.4%, the bias for the RV EF was 7.9% and the 95% LOA were -15 to 30.7%; between the BH and the free-breathing radial k-space reconstruction the measured bias for the LV EF was -0.6% and the 95% LOA were -8 to 6.8%, the bias for the RV EF was 5.3% and the 95% LOA were -22.7 to 33.2%. Bland-Altman analysis for EDV and ESV of the RV and LV are shown in table 2.

## Conclusion

The free-breathing true-FISP with radial k-space reconstruction sequence produces LV and RV EF measurements which are more accurate compared to those obtained with free-breathing true-FISP with Cartesian reconstruction.

**Table 1: Right and Left Ventricles Volumes**

| | BH cartesian | Free Breathing cartesian | Free breathing radial |
|---|---|---|---|
| LV EDV | 167 ± 76 | 154 ± 60 | 165 ± 74 |
| LV ESV | 93 ± 68 | 88 ± 66 | 91 ± 71 |
| RV EDV | 154 ± 79 | 126 ± 59 | 132 ± 69 |
| RV ESV | 85 ± 66 | 76 ± 56 | 77 ± 56 |

**Table 2: Left and Right Ventricles end sistolic and end diastolic volumes Bland-Altman analysis**

| | | Bland-Altman Bias | LOA |
|---|---|---|---|
| LV EDV | BH Cartesian vs FB Cartesian | 8.9% | -42.3 to 60.1% |
| LV EDV | BH Cartesian vs FB Radial | -4% | -47.4 to 39.3% |
| LV ESV | BH Cartesian vs FB Cartesian | 0.4% | -23.7 to 22.8% |
| LV ESV | BH Cartesian vs FB Radial | -3.8% | -29 to 21.4% |
| RV EDV | BH Cartesian vs FB Cartesian | 27% | -18.1 to 72.1% |
| RV EDV | BH Cartesian vs FB Radial | 19.5% | -31.6 to 70.6% |
| RV ESV | BH Cartesian vs FB Cartesian | 4.4% | -26.5 to 35.3% |
| RV ESV | BH Cartesian vs FB Radial | 4.9% | -24.8 to 34.6% |