Breath-hold whole-heart coronary MR angiography (CMRA) by 2D-parallel acquisition compared with respiration-gated CMRA using a multi-element body coil

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Introduction

It is often the case that limited number of MR sites can be furnished with a dedicated cardiac coil. On the other hand, phased-array coils that covers wide body areas is now widely available in clinical practice. Although they are designed for general purpose of body imaging and not dedicated for cardiac imaging, they consist of tens of coil elements and have the capability to conduct 2D-parallel imaging to reduce acquisition time [1, 2], within a single breath-hold (BH), for example [3]. Such capability may facilitate MR usage for the coronary examination. Hence, the aim of this study was to evaluate the image quality of breath-hold (BH) CMRA in comparison with respiration-gated (RG) CMRA using a multi-element body coil with maximum usage of the parallel imaging capability.

Materials and Methods

We studied 14 healthy subjects (10males, 23±3years old) for coronary arteries. MR imaging was performed on a 1.5T scanner (Vantage powered by ATLAS, Toshiba Medical Systems, Japan) equipped with a whole body phased array coil system and 16-channel receivers. The elements were arranged four-by-four at both front and back. The CMRA was acquired with ECG-gated 3D-SSFP in two conditions of BH and RG with adaptive correction of the diaphragmatic motion. In-plane resolutions were 1.3x1.5-1.9x1.5 mm for RG and 1.3x1.5-2.2x2.5mm for BH. The parallel imaging was applied with in phase direction by factor 2 for RG and in phase direction by factor 2.5 and in slice direction by factor 2 for BH. The CMRA quality was assessed with a five-point scale (0 - 4) in segment-wise separately by two radiologists.

Results

The average scan times were 11 min 51 seconds for RG-CMRA and 34.2 seconds for BH-CMRA. The average scores were #1(3.9, 2.9), #2(3.6, 2.9), #3(2.5, 1.6), #4(1.0, 0.36), #5(3.7, 2.4), #6(3.5, 2.2), #7(3.1, 2.1), #8(2.1, 1.1), #9(2.3, 1.2), #10(0.93, 0.57), #11(3.5, 2.1), #12(1.9, 0.86), #13(2.6, 1.6), #14(1.8, 0.71), #15(0.21, 0.07) for segment-number(RG-CMRA score, BH-CMRA score). Except for the terminal segments #10 and #15, there were statistically significant deterioration in all segments in BH-CMRA (P < 0.05) with reduction of average score by 0.93 (Fig 1). In BH-CMRA, however, proximal segments (#1-2, #5-7, #11) showed average scores over 2, which was considered usable for clinical evaluation, as is represented by Fig 2.

Conclusion

The introduction of multiple array coils enables 2D-parallel imaging and it enabled breath-hold whole-heart coronary imaging. Although the attainable quality is limited, BH-CMRA is feasible and easily implemented as an adjunct for the routine MR examination of the heart.

References

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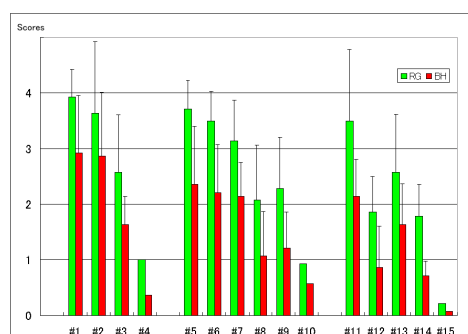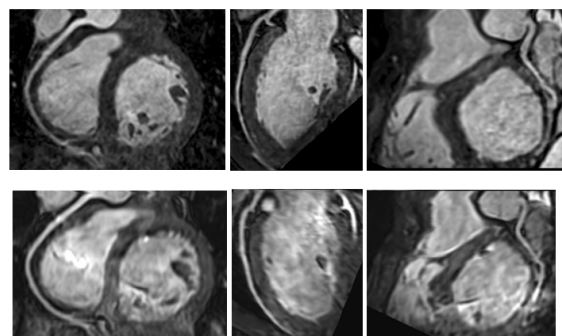
Fig 1. The average scores for each segment.

Fig 2. Sample images of the coronary artery
(upper row: RG-CMRA, lower row: BH-CMRA)