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Highly accelerated single breath-hold non-contrast thoracic MRA: evaluation in a clinical population

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Background

Gadolinium enhanced MRA (Gd-MRA) is commonly used in clinical practice for evaluation of the thoracic aorta. Electrocardiographic (ECG) gating is required for accurate aortic root assessment, but decreases scanning efficiency. We evaluate the performance of a highly accelerated, breath-hold 3D ECG-gated non-contrast enhanced steady state free precession MRA technique (NC-MRA) in a clinical population, compared with ECG-gated Gd-MRA.

Methods

30 patients (22 male, mean age 53.4 years) with known or suspected thoracic aortic pathology were imaged with NC-MRA followed by Gd-MRA at 1.5T following informed consent. Images were anonymized and reviewed by 2 readers for aortic pathology. Diagnostic confidence, image quality and artifacts were evaluated on a 5-point Likert scale (1=worst, 5=best), with image quality and artifacts evaluated segmentally in 10 vascular segments, including the sinuses of Valsalva and coronary artery origins. Aortic dimensions were measured in 7 aortic segments. Diagnostic confidence, image quality and artefact scores were evaluated with the Wilcoxon signed rank test. Paired Student t-test and Bland-Altman analysis were used for comparison of aortic dimensions.

Results

All patients successfully completed NC-MRA and Gd-MRA (Figure 1). NC-MRA vascular pathology findings were concordant with Gd-MRA in 29/30 (96.7%) and 28/30 (93.3%) of patients for Readers 1 and 2 respectively with high diagnostic confidence (mean 4.35 ±0.77), not significantly different from Gd-MRA (4.38 ±0.64), p=0.74. Image quality and artefact scores were comparable with Gd-MRA in the majority of vascular segments. Differences were observed at the ascending aorta, where NC-MRA image quality (3.80±0.88) was inferior to Gd-MRA (4.13±0.73), and at the coronary artery origins, where NC-MRA was considered superior for the left main (3.38±1.47 versus Gd-MRA 2.78±1.21) and the right coronary (3.55±1.40 versus 2.32±1.16) arteries, $p<0.05$ for both comparisons. Aortic dimensions were comparable, with only one significant difference observed at the ascending aorta, where mean NC-MRA dimension (4.05±0.76 cm) was less than 1 mm smaller than Gd-MRA (4.12±0.70), p=0.043.

Conclusions

Breath-hold non-contrast enhanced MRA of the thoracic aorta yields good image quality, comparable to ECG-gated gadolinium-enhanced MRA, with high accuracy for aortic dimensions and pathology. It can be considered an alternative to gadolinium-enhanced MRA in patients with relative contra-indications to gadolinium contrast or problematic venous access.

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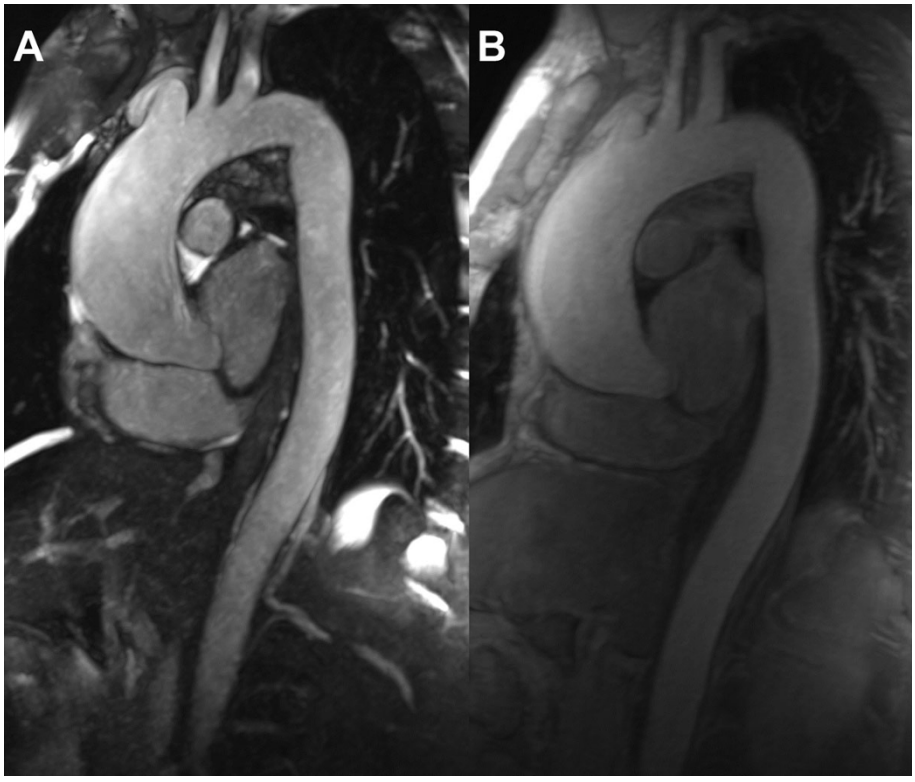

Figure 1 A) Non-contrast and B) gadolinium-enhanced MRA thin MIP images of a 42-year-old male with history of bicuspid aortic valve. The ascending aorta is aneurysmal, measuring up to 4.6cm, and is well depicted with the non-contrast MRA technique.

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