

POSTER PRESENTATION

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# Prospective heart tracking for respiratory motion compensation in whole-heart magnetic resonance angiography

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## Background

Electrocardiogram and respiratory navigator (NAV)-gated 3D whole-heart magnetic resonance angiography (MRA) acquired with an intravascular gadolinium-based contrast agent and a non-selective inversion recovery (IR) pulse to null the myocardial signal generates a high-resolution anatomic dataset allowing for a comprehensive evaluation of intra-cardiac, coronary, and vascular abnormalities [1]. In this technique, an additional IR pulse is also included to selectively restore the signal in the liver, and thus allow NAV tracking of the diaphragm (liver-lung interface). This selective IR pulse, however, excites the blood flowing from veins into the heart creating a bright inflow artifact that hinders image interpretation [2]. Therefore, we sought to develop a prospective respiratory-gating technique (Heart-NAV) that tracks the heart rather than the diaphragm position and eliminates the inflow artifact without compromising image quality.

## Methods

Schematics of the proposed Heart-NAV technique for non-contrast and contrast-enhanced MRA sequences are shown in Fig. 1A&1B. One of the startup pulses for MRA sequence is used to collect the centerline of k-space, and its 1-dimensional reconstruction is fed into the conventional-NAV signal analysis process to prospectively gate and track respiratory-induced heart displacement. To assess the efficacy of Heart-NAV in the correction of respiratory motion, 10 volunteers (7 females; age  $31 \pm 6$  years) underwent MRA acquisitions with conventional-NAV and Heart-NAV. For both acquisitions, imaging parameters were FOV  $\sim 386 \times 230 \times 120$  mm<sup>3</sup>, spatial

resolution 1.5 mm<sup>3</sup>;  $\alpha$ /TE/TR 90°/2.4/4.7 ms, bandwidth 0.54 kHz, SENSE factor of 2, acceptance window of 5 mm, and a 32-element phased-array coil. To compare their image quality, sharpness of the coronary arteries was subjectively graded by 2 clinicians and objectively measured (Soap Bubble tool). Subjective and objective measures were compared using a signed-rank test and paired student t-test, respectively. To evaluate the effect on image inflow artifact, 6 patients (4 males; ages 0.3-6 years) each underwent contrast-enhanced (0.03 mmol/kg of gadofosveset trisodium) IR MRA acquisitions with a conventional-NAV and with Heart-NAV.

## Results

All acquisitions were successfully completed. Images from 2 healthy subjects with the non-contrast MRA sequences are shown in Fig. 1C. The vessel sharpness and image quality were equivalent for conventional-NAV and Heart-NAV acquisitions but the imaging time of Heart-NAV was 10% shorter (Table 1). Fig. 1D displays images with contrast-enhanced MRA acquisitions from 2 patients. Inflow artifact was present with the conventional-NAV but not with Heart-NAV.

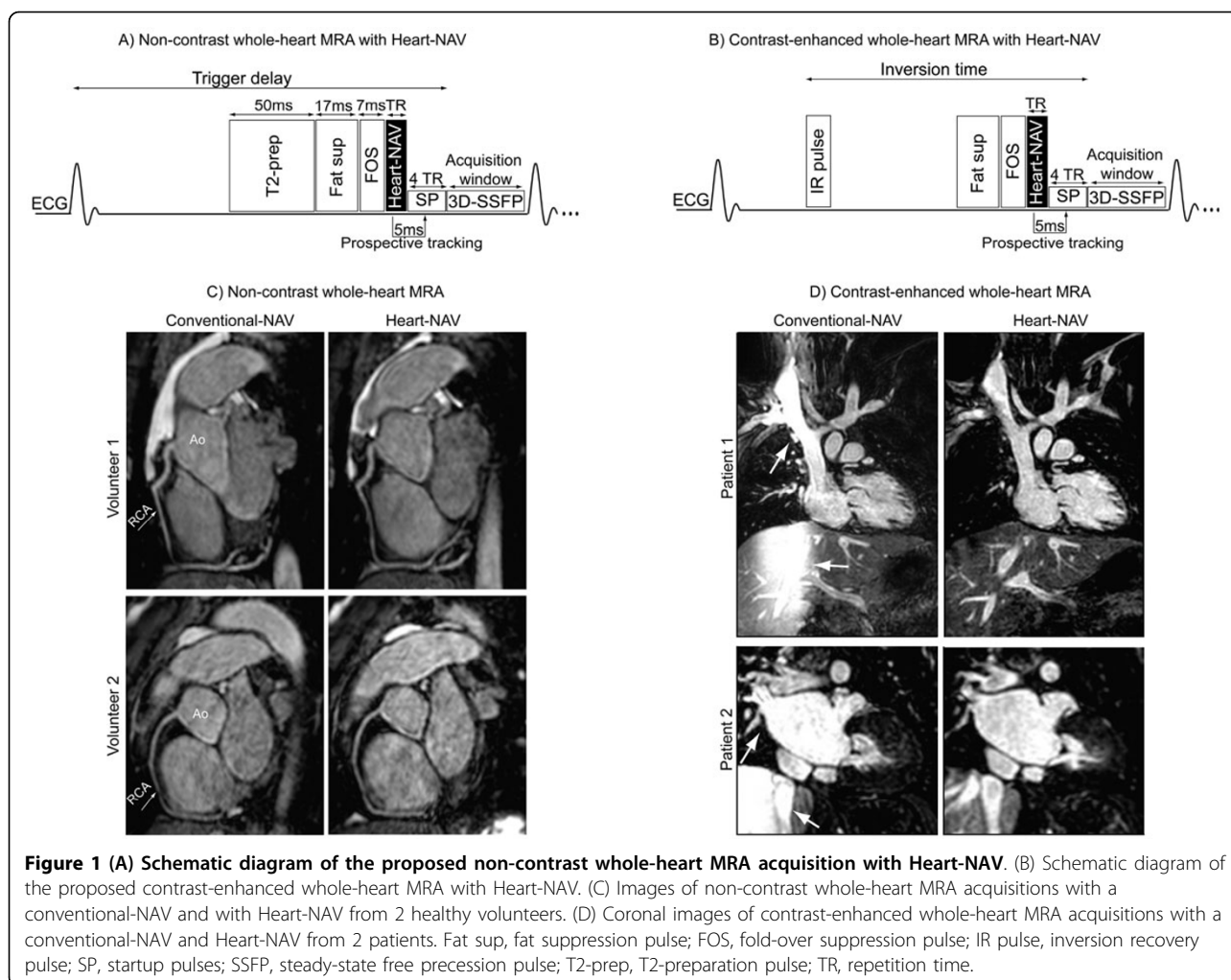
## Conclusions

Compared to a conventional-NAV, Heart-NAV achieved similar image quality for non-contrast whole-heart MRA, and eliminated inflow artifact in contrast-enhanced whole-heart MRA.

## Authors' details

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**Table 1 Comparison of conventional-NAV and Heart-NAV for non-contrast whole-heart MRA (n = 10).**

	Conventional-NAV	Heart-NAV	p-value
Scan time (min)	8.4 ± 2.2	7.5 ± 1.7	<0.01
RCA subjective sharpness	3.67 ± 0.49	3.77 ± 0.37	0.42
RCA objective sharpness	0.64 ± 0.04	0.67 ± 0.04	0.18
LAD subjective sharpness	3.55 ± 0.51	3.53 ± 0.46	0.91
LAD objective sharpness	0.61 ± 0.07	0.60 ± 0.07	0.62
LCX subjective sharpness	3.47 ± 0.55	3.43 ± 0.53	0.83
LCX objective sharpness	0.56 ± 0.07	0.56 ± 0.09	0.85

Values are mean ± standard deviation. Subjective sharpness: 1-poor to 4-excellent. Objective sharpness: 0-blurred to 1-sharp. LAD, left anterior descending coronary artery; LCX, left circumflex coronary artery; RCA, right coronary artery.

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