3T SENSE navigator coronary MRA: targeted volume vs whole heart acquisitions

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Introduction: Coronary MRA at 3 Tesla provides high SNR (1), enabling parallel imaging for accelerated scanning (2). The free breathing navigator technology allows acquisition of coronary arteries at high resolution in a large volume. Recently, the approach of whole heart coronary MRA has been investigated for the advantages of easy scan setup, high SNR, and 3D reformatting freedom (3,4). Preliminary experiences suggest that the scan time for the navigator whole heart coronary MRA is too long, degrading image quality. Accordingly, this study we evaluate the whole heart (WH) SENSE acquisition of coronary MRA at 3T by comparing with the targeted volume (TV) acquisition in a cohort of patients.

Methods: Twenty subjects (5 females 15 males, aged 23-71) were recruited for this coronary MRA study. Imaging was performed on a 3.0T scanner (Achieva, Philips) equipped with a gradient of 80 mT/m max strength and 200mT/m/ms slew rate and a 6 channel cardiac coil. A 40 mm thick volume was acquired for the targeted volume (TV) scan, and a 140 mm thick volume for the whole heart (WH) scan. The TV scans were prescribed from three points in RCA or LAD+LM, and the WH scan was prescribed axially. Other imaging parameters for WH and TV acquisitions were identical: 3D fast gradient echo, partial Fourier, TR/TE = 7.0/1.59 ms, flip angle =25^0, NEX =1, SENSE factor R =2, bandwidth =200 Hz/pixel, FOV =320x320 mm, acquisition voxel size = .8x1.1x1.5mm^3, reconstructed voxel size = 0.63x0.62x0.75mm^3, navigator gating window =5mm with real time adaptation to respiratory drifts.

Table 1. Summary of targeted volume (TV) vs whole heart (WH) scans. Length and diameter are measured in mm.

Left coronary arteries					
	efficiency	length	diameter	sharpness	quality
TV	53±7%	84±14	2.9±.3	43±15%	.35
WH	50±8%	84±15	3.0±.3	34±13%	(mean)
p	.05	.45	.13	**.009**	**<.05**
Right coronary artery					
	efficiency	length	diameter	sharpness	quality
TV	49±12%	111±31	3.0±.4	44±13%	.75
WH	50±8%	104±24	3.2±.3	36±9%	(mean)
p	.25	.07	.06	**.02**	**<.005**

Image data were analyzed for measuring coronary artery length, diameter and sharpness, and their differences were assessed with t-test. Reformatted coronary images of TV and WH acquisitions were also compared side by side and scored by an experienced reader according to scales: 2 (markedly better), 1(moderately better), 0 (same), -1 (moderately worse), -2 (markedly worse), and the score differences were assessed with Wilcoxon test.

Results: Imaging was successfully performed in all subjects. The left circumflex artery was not consistently captured in the RCA targeted volume and was excluded from data analysis. Table 1 summarizes the imaging results. Both TV and WH scans were completed with similar navigator efficiency (sum of the 2 TV scan times (~3 min each) ~ 60% of the WH scan time (~11min)), and they depicted coronary arteries in similar length and diameters. However, the TV scan provided sharper images ($p \leq .02$) and better overall image quality score ($p \leq .05$).

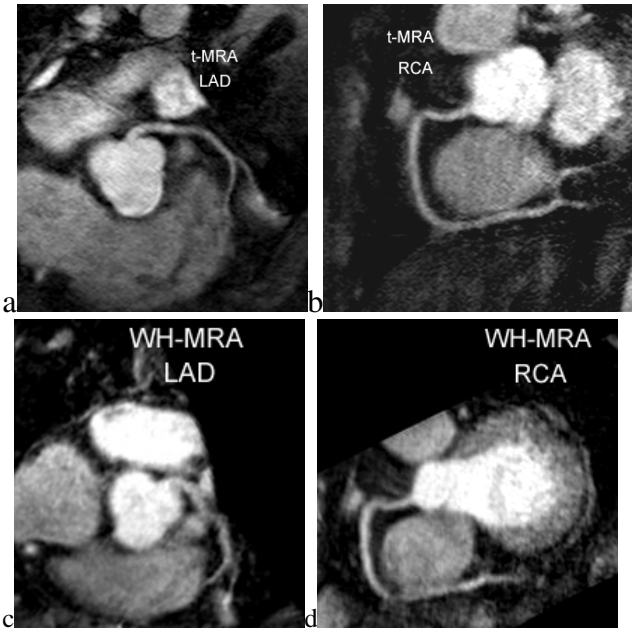

Figure 1. a&b) targeted volume scan for LAD and RCA. c&d) corresponding whole heart scan.

An example case of LAD and RCA images from a 71 yr female patient is illustrated in Fig.1. The LAD is markedly better and the RCA is moderately better in the TV scan than in the WH scan.

Discussion: Our results demonstrate that the targeted volume (TV) approach provides sharper coronary images than the whole heart (WH) approach. This observation is consistent with recent preliminary reports on evaluating the WH approach at 1.5T (5,6). The main causes for degradation of coronary sharpness in the WH acquisition may include effects of irregular motion during the long scan time not measured by the navigator echo, asynchronous right and left coronary motion, and poor shimming in a large volume. These issues need to be addressed in order to derive benefit from the advantages of the WH acquisition.

Parallel imaging was used in this study, making it difficult to measure SNR, and visually the WH images have higher SNR than the TV images. The incomplete inclusion of the left circumflex artery in the TV scan of RCA may be overcome with an additional TV scan, leading to a total scan time close to the WH scan but with sharper image quality.

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