Clinical Feasibility of Whole Heart Coronary MRA using a Navigator-gated 3D bTFE Sequence

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Introduction: Three dimensional coronary MRA has been acquired with a targeted double-oblique volume acquisition, which necessitates repeated 3D scans to cover the entire coronary arteries. Whole heart coronary MRA using a navigator-gated 3D balanced-TFE sequence has recently been introduced as a method that can provide visualization of all three major coronary arteries within a single 3D scan [1]. However, it is not clear whether this can be achieved in the majority of patients in a clinical setting. The purposes of this study were to obtain whole heart 3D coronary MRA by using optimized acquisition parameters and a new-generation CV MR imager equipped with an improved gradient system, to determine the feasibility of whole heart 3D coronary MRA in clinical patients, and to evaluate the values of Soap-Bubble reconstruction and 3D volume rendering (VR) for demonstrating coronary arteries.

Methods: Twenty-one patients without occlusion in the major coronary arteries were evaluated. MR images were acquired with a 1.5T CV MR imager (Intera CV with Nova-dual gradient; Philips Medical Systems). After acquiring coronal scout images to determine the heart position, bTFE axial cine images (50 phases) were obtained to determine the interval of minimal coronary arterial motion. High resolution navigator-gated 3D bTFE images encompassing the entire heart were acquired during this interval to minimize blurring, by using TR/TE of 4.6/2.3ms, TFE factor of 30, SENSE factor of 2, FOV of 280x280x135mm, acquisition matrices of 256x256x90, reconstruction matrices of 512x512x180, reconstructed voxel size of 0.42x0.42x0.75mm. The vessel length and image quality (4-point grading scale ranging from 0=unreadable to 3=excellent) of the major coronary arteries were evaluated by using Soap-bubble reconstruction and 3D VR.

Results: Acquisition of whole heart 3D MRA was completed in all patients, with the averaged imaging time of 18.0 ± 5.3 min. In 18 of 21 subjects (86%), excellent 3D MR angiographic images were obtained for the entire coronary tree. In the remaining 3 patients, visualization of the distal LAD and LCX were suboptimal due to irregular breathing patterns. High quality coronary MR angiographic images were demonstrated with both 3D volume rendering (Figure 1) and Soap-Bubble reconstruction (Figure 2). The length of LAD visualized was significantly longer on 3D VR images than on Soap-Bubble images(Table 1). However, the left main coronary artery and proximal RCA were more easily displayed with a Soap-Bubble tool.

Conclusions: Whole heart coronary MRA with a navigator-gated 3D-bTFE can provide reliable 3D visualization of the entire coronary arteries in a clinical setting. A Soap-Bubble tool allows rapid delineation of the proximal coronary arteries, while 3D volume rendering is useful for visualizing distal coronary arteries.

Reference: Weber OM, et al. Magn Reson Med (in press).

Table 1. Length of the coronary artery visualized on whole heart 3D coronary MRA

	3D volume rendering	Soap bubble tool	p
Right coronary artery	12.9±3.4cm	11.9±2.6cm	0.1
LAD artery	12.5±4.5cm	10.4±2.5cm	<.05
LCX artery	7.8±3.6cm	7.2±2.4cm	0.31

Fig. 1. 3D Volume Rendering

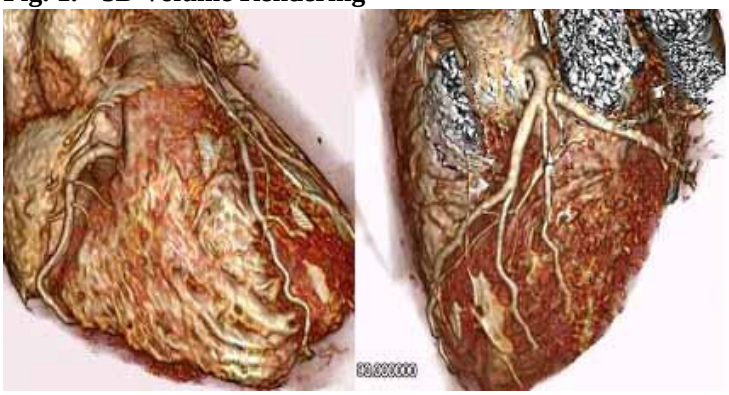

Fig. 2. Soap-Bubble Tool