Magnetic Resonance Imaging of the Heart and Vasculature at 3 Tesla: Novel Strategies for the Diagnosis and Risk Stratification of Cardiovascular Disease

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**Purpose:** (1) To study the effects of field strength and parallel imaging on image contrast and the interstudy reproducibility of right and left ventricular (RV and LV) measurements using steady-state free precession (SSFP) cardiac magnetic resonance; (2) to explore the impact of 3T parallel imaging techniques on the assessment and reproducibility of black-blood aortic atherosclerosis imaging; and (3) to evaluate the feasibility of coronary sinus flow imaging by 3T spiral velocity-encoded cine (VEC) MR imaging in overweight women with risk factors for cardiovascular disease

**Materials and Methods:** To evaluate cardiac measurements and aortic atherosclerosis by cardiac magnetic resonance, thirty-two subjects (20 normal, 12 cardiac patients) underwent SSFP cine short-axis imaging and black-blood abdominal aortic imaging: two studies at 1.5T, one study at 3T, and another study at 3T with parallel imaging (SENSE). Contrast-to-noise ratios (CNR) were compared between techniques.

To evaluate the feasibility of coronary sinus flow MR imaging, ten women (age 38 years ± 10) with a mean BMI of 33 kg/m2 ± 8 were studied. Coronary sinus flow was measured at baseline and in response to cold pressor stress. Changes in right coronary artery flow were also measured before and after stress using VEC MRI.

**Results:** Cardiac MRI: 3T SENSE imaging reduced cardiac imaging time from 8 ± 2 min to 3 ± 1 min (P<0.001). A significant gain in LV CNR was detected between 1.5T and 3T with SENSE (43.8 ± 6.5 vs 48.4 ± 7.4, P=0.01), but no significant gain was detected in RV CNR. The reproducibility of LV and RV measurements between two 1.5T studies was not significantly different from the reproducibility between a 1.5T study and a 3T study with SENSE.

Aortic MRI: Image quality scores were comparable between 1.5-T and 3-T with SENSE (4.0 ± 0.6 vs 4.2 ± 0.6, P = 0.21). Bland-Altman reproducibility for MWT was -0.03 mm ± 0.15 (1.5-T vs 1.5-T) and -0.01 mm ± 0.18 (1.5-T vs 3-T with SENSE), P = 0.83. Detection of the presence of absence of plaque was comparable.

Coronary Sinus Flow Imaging: A significant 24% increase in coronary sinus volume flow was observed from baseline to peak cold pressor stress (141 ± 34 ml/min vs. 184 ± 42 ml/min, p = 0.02). Similar increases in RCA flow velocity were observed (15.3 ± 5 cm/sec vs. 23.2 ± 7 cm/sec, P < 0.01).

**Conclusions:** (1) SSFP cardiac MR imaging and black-blood aortic MR imaging are reproducible techniques. (2) Parallel imaging at 3T permits shorter scan time compared to conventional 1.5-T imaging with comparable measurements of cardiac structure and function, as well as aortic atherosclerosis. (3) Coronary sinus spiral velocity-encoded MRI at 3T is a feasible technique for measuring changes in coronary flow in asymptomatic overweight and obese women with risk factors for cardiovascular disease.