

Myocardial Perfusion MRI at 3.0T with Sliding-Window Conjugate-Gradient HYPR for the Detection of Coronary Artery Disease

H. Ma¹, L. Ge², D. Xu¹, Q. Tang¹, H. Li¹, Y. Zhang¹, J. Liu¹, Q. Yang¹, J. An³, L. Jin⁴, R. Jerecic⁴, X. Du¹, K. Li¹, and D. Li²

¹Xuanwu Hospital, Capital Medical University, Beijing, China, People's Republic of, ²Radiology, Northwestern University, Chicago, IL, United States, ³Siemens Mindit Magnetic Resonance Ltd, Shenzhen, China, People's Republic of, ⁴Siemens Ltd, Healthcare Sector, China, People's Republic of

Introduction:

First-pass perfusion MRI is a promising technique for detecting ischemic heart disease. However, the diagnostic value of the method is limited by the low spatial coverage, resolution, SNR, and cardiac motion related image artifacts. A Sliding-Window Conjugate-Gradient HYPR (SW-CG-HYPR) technique has been developed for accelerated myocardial perfusion imaging. Using this method, the acquisition time per cardiac cycle can be reduced dramatically, which allows increased spatial coverage, resolution, and SNR, and reduced motion artifacts as compared to the conventional technique (1). The purpose of this study was to evaluate the feasibility and diagnostic accuracy of myocardial perfusion MRI at 3.0T with SW-CG-HYPR in suspected coronary artery disease (CAD).

Methods:

Ten patients with suspected CAD who were scheduled for a primary diagnostic invasive coronary angiography (CA) were scanned at 3.0T (MAGNETOM Tim Trio, Siemens). The images were acquired within a breath-hold, first at stress (140 $\mu\text{g}/\text{kg}/\text{min}$ intravenous adenosine), then at rest. 0.05 mmol/kg of contrast agent, followed by a 20-ml saline flush, was injected intravenously at a rate of 4 ml/s. An ECG-triggered gradient-echo sequence with radial k -space sampling was used for SW-CG-HYPR myocardial perfusion imaging with the following parameters: TR/TE/flip-angle = 2.92/1.67 ms/12°, FOV = 300×300 mm², matrix = 192×192, spatial resolution = 1.6×1.6×10 mm³, TI = 60 and 100 ms, and the number of slices = 6. 16 projections were acquired per heartbeat for each slice and image data for two slices was acquired following each saturation preparation pulse. Sliding composite images were reconstructed from k -space lines over 10 cardiac cycles. Contrast-enhanced time-resolved images were reconstructed after CG-HYPR processing. Image quality was evaluated using a subjective scale (1: poor – 4: excellent). Perfusion analysis of each myocardial segment (except for the apex) was performed using the 17-segment model recommended by the American Heart Association. Quantitative CA served as the reference standard. Significant coronary arterial stenosis was defined as a luminal diameter reduction of $\geq 50\%$.

Results:

The prevalence of CAD was 70% (7/10). All perfusion images were found to be visually interpretable for diagnosis with the average image quality score of 3.7 ± 0.5 . Endocardial dark rim artifacts were observed in 8 (5%) of 160 segments, but they didn't cause errors in diagnosis. Myocardial perfusion MRI at 3.0T with SW-CG-HYPR correctly identified and ruled out significant CAD in all the patients. Sensitivity, specificity, and diagnostic accuracy for the detection of coronary stenosis were 93.3% (14/15), 93.3% (14/15), and 93.3% (28/30), respectively. An example is shown in Fig. 1.

Conclusions:

Preliminary studies show that myocardial perfusion MRI at 3.0T with SW-CG-HYPR is feasible in a clinical population, and has high image quality and diagnostic accuracy in patients with suspected CAD.

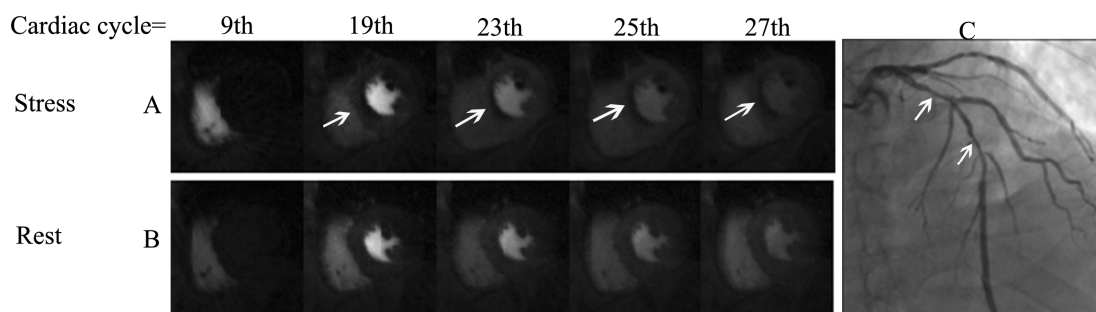


Fig. 1. Short-axis views of a patient with suspected CAD show an anteroseptal perfusion defect at A) stress and B) rest. Coronary angiography (C) shows significant stenoses in the proximal and mid LAD.

References:

1. Ge L, et. al. MRM, 62: 835-839, 2009.