Improved Clinical Performance of A New Myocardial Adenosine Stress Perfusion Technique with SW-CG-HYPR at 3.0T: A Comparison to Conventional IR-Turbo-FLASH Perfusion MRI and X-Ray Angiography in Patients with Suspected Coronary Artery Disease

H. Ma[1], L. Ge[2], J. An[3], D. Chen[2], L. Jin[4], X. Bi[5], R. Jerecic[4], K. Li[1], and D. Li[2,6]
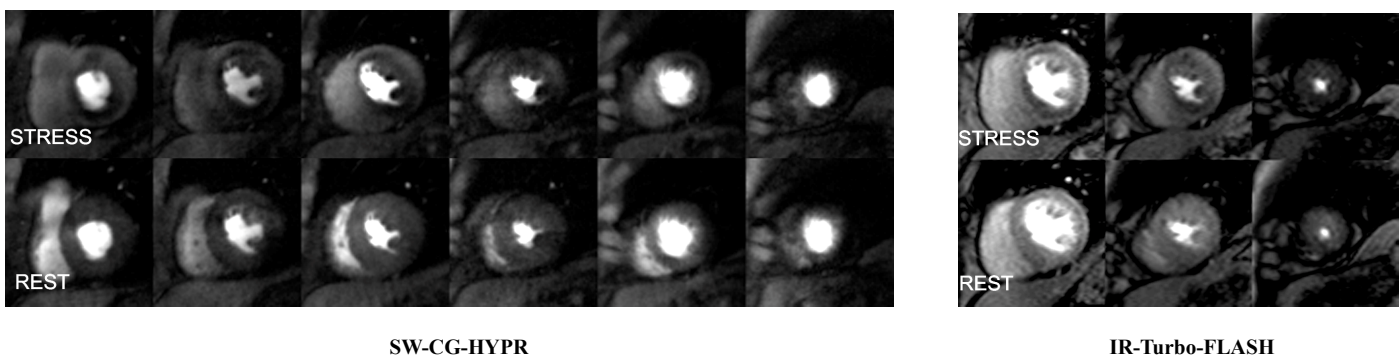
[1]Xuanwu Hospital, Capital Medical University, Beijing, Beijing, China, People's Republic of, [2]Northwestern University, [3]Siemens Healthcare, MR Collaboration NE Asia, Siemens Mindit Magnetic Resonance, [4]Siemens Healthcare, MR Collaboration NE Asia, Siemens Limited China, [5]Siemens Healthcare, Cardiovascular MR R&D, USA, [6]Cedars-Sinai Medical Center and UCLA

Introduction: Conventional myocardial perfusion MRI is limited by the low spatial coverage (3 to 4 slices), temporal and spatial resolution, signal-to-noise ratio, and cardiac motion-related image artifacts. A sliding-window (SW) conjugate-gradient (CG) highly constrained back-projection reconstruction (HYPR) (SW-CG-HYPR) technique has been developed for time-resolved myocardial perfusion imaging (1-2). Using this method, the acquisition time per cardiac cycle can be reduced dramatically, allowing increased spatial coverage (whole left ventricular coverage), temporal and spatial resolution and SNR, and reduced motion artifacts compared with the conventional IR-Turbo-FLASH sequence. The purpose of this study was to prospectively determine the feasibility and diagnostic accuracy of myocardial adenosine stress perfusion MRI with SW-CG-HYPR at 3.0T in patients with suspected CAD.

Methods: Thirty consecutive patients (17 men, 13 women; age range, 39–74 years; mean age, 55 years ± 19) with suspected CAD who were scheduled for coronary angiography underwent myocardial adenosine stress perfusion MRI with both SW-CG-HYPR and IR-Turbo-FLASH sequences at 3.0T. Perfusion defects were interpreted visually by 2 blinded observers and were correlated to x-ray angiographic stenoses ≥ 50%. Receiver-operating characteristic (ROC) curve analysis was used to compare the diagnostic performance of the two imaging techniques.

Results: The prevalence of CAD was 60%. Compared with IR-Turbo-FLASH perfusion imaging method, SW-CG-HYPR method produced better left ventricular (LV) coverage (whole LV vs. only 3 slices). In the per-patient analysis, perfusion imaging with SW-CG-HYPR provided a higher sensitivity (94% vs. 89%), specificity (83% vs. 75%) and diagnostic accuracy (90% vs. 83%) for the detection of CAD compared with IR-Turbo-FLASH. In the per-vessel analysis, the diagnostic performance of SW-CG-HYPR perfusion imaging was significantly greater than that of IR-Turbo-FLASH perfusion imaging for the overall detection of CAD (area under ROC curve: 0.96 ± 0.02 vs. 0.90 ± 0.03, respectively; $p < 0.05$).

Conclusions: Myocardial adenosine stress perfusion MRI with SW-CG-HYPR at 3.0T is feasible in patients with suspected CAD, allowing whole LV coverage with higher diagnostic accuracy compared with conventional IR-Turbo-FLASH perfusion MRI.

SW-CG-HYPR   **IR-Turbo-FLASH**

An example of the superiority of myocardial perfusion MRI with SW-CG-HYPR at 3.0T for the detection of CAD compared with IR-Turbo-FLASH in a 58-year-old man. Perfusion imaging with SW-CG-HYPR detects perfusion defects in the basal anterior, septal, inferior and lateral segments, mid anterior, septal, and inferior segments, and apical septal, inferior, and lateral segments, corresponding to three-vessel stenoses. The two middle slices were combined to yield mid-cavity slice. Perfusion imaging with IR-Turbo-FLASH demonstrates perfusion defects in only the basal anterior, septal, and inferior segments and mid anterior, septal, and inferior segments, corresponding to significant stenoses in the left anterior descending and right coronary arteries, and it fails to identify a perfusion defect relating to significant stenosis in the left circumflex coronary artery. Coronary angiograms show three-vessel stenoses.

References

1. Ge L, et al. Magn Reson Med 2009;62:835-839.

2. Ge L, et al. Magn Reson Med 2010; 64:1148-1154.