

Stress myocardial perfusion MRI at 3.0T with improved spatial and temporal resolutions by using B1-insensitive water-suppression and k-t SENSE acceleration.

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Background: High spatial resolution and temporal resolution are required for the accurate assessment of myocardial ischemia using stress perfusion MRI. A recent study demonstrated the feasibility of k-tSENSE accelerated high-spatial-resolution perfusion MR imaging at 3.0 T, by using conventional saturation pulse and acquiring dynamic images every two R-R intervals [1]. One of the limitations of perfusion MRI at 3.0T is insufficient magnetization saturation due to increased B1 inhomogeneities. The purpose of this study was to obtain high spatial resolution stress myocardial perfusion MR images covering the entire left ventricle at every heart beat by using k-t SENSE and 3.0T MR imager. In order to obtain B1-insensitive uniform suppression, WET pulse was employed for saturation recovery preparation in this study.

Materials and Methods: Thirty-four patients with suspected coronary artery disease were studied. High spatial resolution (<2mm) first-pass contrast enhanced MR images were obtained at rest and during stress by using a 3.0T MR imager (Achieva) and k-t SENSE acceleration factor of 8. Saturation recovery TFE images were acquired with TR/TE of 3.7ms/1.9ms, FOV=410mm, matrix=320x320, slice thickness of 8mm and saturation preparation delay of 80ms. WET pulse was used to obtain uniform 90 degree saturation in the increased B1 inhomogeneities at 3.0T. Three short-axis slices of the left ventricle were imaged at every heart beat. Two observers determined the image quality score (1:poor - 4:excellent) and recorded the presence or absence of respiratory artifacts and endocardial dark-banding artifacts using a 16-segment model. X-ray coronary angiography was performed in 15 patients within 2 weeks from stress perfusion MRI.

Results: All studies were successfully completed. High quality stress and rest perfusion MR images were obtained with the averaged image quality score of 3.8 ± 0.4 . Uniform saturation was achieved in the entire imaging field with WET pulse. In addition, 3T perfusion MRI with WET pulse was found to be arrhythmia insensitive when compared with conventional saturation pulse. Endocardial dark-banding artifacts were observed in 17 (3.1%) of 544 segments. However, there were no cases in which dark-banding artifacts influenced the diagnosis. Respiratory artifacts were found in 11 (2.0%) of 544 segments. The sensitivity, specificity, positive and negative predictive values and accuracy of stress perfusion MRI were 91.6%(11/12), 93.9%(31/33), 84.6%(11/13), 96.8%(31/32) and 93.3%(42/45) for predicting significant coronary artery disease on X-ray angiograms.

Conclusions: Perfusion MRI with high spatial resolution can be acquired at every heart beat by using a 3.0 T MR imager and k-t SENSE acceleration. Uniform saturation in the imaging field can be achieved with WET pulse, which also reduces variation of the signal intensity caused by arrhythmia. Perfusion MRI at 3.0T using k-t SENSE and WET pulse allows for an accurate detection of myocardial ischemia in patients with significant coronary artery disease.

Reference: 1. Plein S. Radiology 2008;249:493

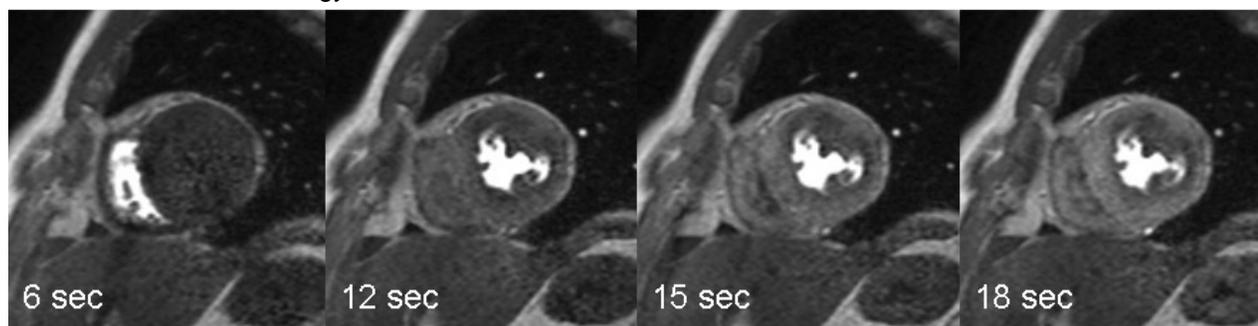


Figure 1. Stress myocardial perfusion MRI acquired with 3T MR imager and k-t SENSE in a patient with triple-vessel coronary artery disease. WET pulse was used to obtain uniform saturation in the imaging field.