NON INVASIVE ASSESSMENT OF PLAQUE PROGRESSION IN APOE-/- MICE USING T2* WEIGHTED AND POSITIVE CONTRAST SGM-MRI


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Introduction
Macrophages have been identified as a contributor to plaque instability in atherosclerosis. Over the past several years macrophage MR imaging with iron oxide particles has been demonstrated in several animal models and in humans. The aim of this study was to noninvasively assess iron oxide uptake at different stages of plaque development in the innominate artery of apoE-/- mice [1] and to evaluate the effect of anti-inflammatory treatment.

Methods

The time course of plaque development in the innominate artery of male apoE knockout (-/-) mice was assessed. MRI of the innominate vessel wall of apoE-/- mice on a 3T Achieva MR scanner (Philips Medical Systems) was performed after 4, 8, and 12 weeks of high fat diet with and without statin treatment using a dedicated single loop small animal coil (c = 23mm) and a clinical gradient system (30mT/m, 200mT/m/ms). Time-of-flight (TOF) angiography (TR=43, TE=8.1, flip angle=60°, spatial resolution=0.2x0.2x0.5 mm) of the carotid arteries was performed for the visualization of the innominate artery and planning of the subsequent high resolution T2* weighted scan. Imaging parameters of the ECG triggered T2*-weighted 3D gradient echo sequence included flip angle=25°; FOV=16x16x8mm; matrix =176x176x20; TE=6.9ms and TR=21ms. At day 0 and day 1 animals were tail-vein injected with a 300 μg/kg dose of VSOP, and imaged on day 2. Negative contrast images were obtained from the T2* weighted 3D gradient echo acquisition. Furthermore complex (real/imaginary) image data was used to calculate a susceptibility gradient map (SGM). In particular, local field inhomogeneities are also created in the presence of iron oxide nanoparticles. Since susceptibility gradients result in a displacement of a higher local iron concentration is expected to induce a higher susceptibility gradient and thus a greater echo shift.

Results

Conclusions

In this study, we demonstrate the successful use of iron oxide particles for the non-invasive assessment of alterations in iron content in atherosclerotic plaque in an apoE-/- mouse model of progressive atherosclerosis. Molecular alterations in plaque composition with regard to macrophage content could be detected using iron oxide particles in combination with T2* weighted and SGM MRI. Anti-inflammatory treatment with statins resulted in a smaller SGM signal and smaller signal voids on T2* weighted images.