Syrian Hamster Model of Postmenopausal Atherosclerosis as Assessed by Vascular MRI at 21.1 T


Introduction
The development of arterial plaques, known clinically as atherosclerosis, is at the root of a significant number of deaths related to heart attack and stroke. The risk for cardiovascular disease (CVD) drastically increases for women when they reach the age of menopause. Estrogen deficiency results in an unfavorable alteration in lipid profiles, which increases risk for atherosclerosis and CVD. This study builds upon an ongoing study to examine the anti-atherogenic effects of flaxseed in a hamster model of postmenopausal atherosclerosis. The focus is to examine in vivo identification of plaques in the cerebral arteries and aorta of ovariectomized (ovx) hamsters with endogenous contrast using high field, high resolution in vivo imaging at 21.1 T. Furthermore, the impacts of functional foods, such as flaxseed, on plaque development are investigated.

Experimental
Plaque formations in cerebral arteries and the aorta were investigated in and ex vivo by comparing control (sham), ovx and ovx with different concentrations of flaxseed diet during three timelines: baseline, 4 months after ovx and 8 months. Hamsters were put on flaxseed diet for 4 months at the 2nd time point. At each time point, hamsters were imaged on the 21.1-T, 105-mm bore magnet equipped with a Bruker Avance console and Mini0.7 gradients. Fast spin echo (FSE) images were acquired in two orientations: axial, covering the carotid and cerebral arteries to achieve a 133x133x500 μm resolution with TE/TR = 6.5/3000 ms, and coronal at 195x125x1000 μm resolution with TE/TR = 6.5/2500 ms. The diameter of the aorta was imaged at three places, rostral, dorsal and in between. Left and right vertebral aortas were measured dorsal to bifurcation, and the left and right carotid were measured in line with the 3rd cervical vertebra.

Results
Images A-C are from the three time points (baseline, 4 months and 8 months, respectively) of the sham group; no plaque formation was expected. Images D-F show the same time points for an ovx animal that did not receive flaxseed. White arrows indicate the basilar artery. There was no hyperintense signal associated with fat accumulation in the measured arteries in sham, ovx or flaxseed-treated animals. However, cardiac imaging performed at 8 months demonstrated different aortic diameters among the treatment groups. Histological data as well as high res images of ex vivo tissue are underway to confirm in vivo results.

Conclusion
Cerebral images of high field, high resolution in vivo images reveal no apparent, measurable occlusion in the basilar and vertebral aorta. This result agrees with results from Langheinrich et al 2007 [1], where Apo−/−/LDL−/− double knockout mice showed no atherosclerotic lesions of the cerebral arteries. Although this high field study demonstrated no apparent plaque formation in the basilar artery, alterations of the aorta and other systemic vascular are expected. In fact, the hypocholesterolemic effects of flaxseed did impact the deposition of atherosclerotic plaques in the aorta, as well as the overall body weight and general health of the ovx hamster, as demonstrated previously [2]. In summary, this application marks the first attempt to utilize high field MRI to image vascular events in both the cerebral and cardiac systems of a rodent model in vivo without the use of exogenous contrast enhancement.

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References