# Evaluation of aortic distensibility in wild type and ApoE-knock-out mice at 9.4 T.

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## Purpose

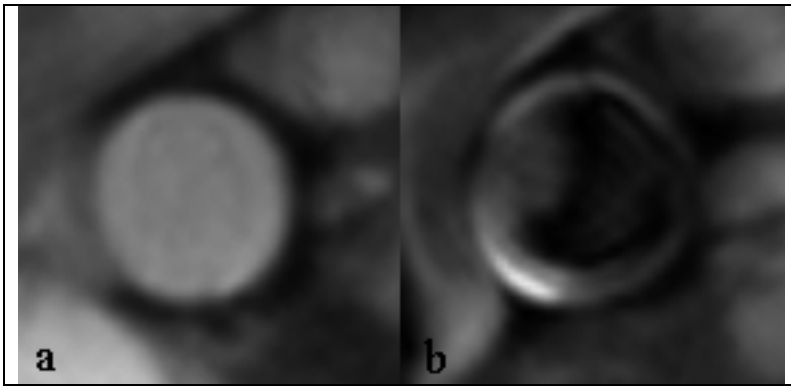
The aim of this study was to compare the aortic distensibility (AD) in wild type (C57/BL6) and cholesterol fed ApoE-knock-out mice (ApoE-/-), a model of atherosclerosis, by means of cine MRI at 9.4 Tesla.

## Material and Methods

C57/BL6 and ApoE-/- mice (n=6 per group) were evaluated using a horizontal bore 9.4 T MRI animal scanner (Bruker, Karlsruhe, Germany) with a dedicated 2x2 phased-array surface coil. All MRI experiments were performed during general anesthesia using a mixture of isoflurane (2%) and oxygene (98%) applied by a mask covering nose and mouth of the animals.
For cine imaging of the aorta a double-gated cine sequence (Intragate® Flash, TR/TE=8.9/2.1 ms, FA=10°, FOV=2x2 cm, matrix=384x384, slice thickness=1 mm) was acquired perpendicular to the ascending aorta. For assessment of cardiac function five consecutive short axis cine sequences were performed covering both ventricles (Intragate® Flash, TR/TE=42.8/1.8 ms, FA=10°, FOV=3x3cm, matrix=256x256, slice thickness= 1mm). AD was defined as the difference of the cross-sectional vessel area at endsystole (AES) and enddiastole (AED) (AD=AES-AED). Left ventricular enddiastolic (LVEDV) and endsystolic (LVESV) volume, stroke volume (SV) and ejection fraction (EF) were analyzed using an image processing software (Osirix). Student´s T-Test was used for statistical analysis ($p<0.05$).

## Results

ApoE-/- mice demonstrated a significantly lower AD (mean+/-SD: 0.42+/-0.07 $mm^2$) compared to C57/BL6 (0.651+/-0.1 $mm^2$, $p<0.001$). In addition, cross-sectional vessel areas at enddiastole were significantly larger in ApoE-/- animals as compared to C57/BL6 mice (ApoE-/-: 1.96+/-0.06 $mm^2$, C57BL6: 1.76+/-0.18 $mm^2$, p=0.016). LVEDVs of ApoE-/- mice were significantly smaller (ApoE-/-: 42.9+/-0.4 µl, C57/BL6: 55.5+/-1.6 µl, p=0.04) while there were no significant differences in SV between the two groups (ApoE-/-: 28.5+/-7.1 µl / C57/BL6: 30.4+/-1.6 µl, p=0.28). EF was significantly higher in ApoE-/- animals (66.4+/-2.7%) compared to the C57/BL6-group (54.4+/-1.8%, $p<0.001$).




Cine sequence acquired perpendicular to the ascending aorta during diastoly (a) and systole (b). Note that despite the small dimensions of the anatomical structures (diameter of the aorta in diastole was 1.7 mm) this sequence allows for a differentiation of the vessel wall / blood interface and thereby for a quantification of the cross-sectional vessel areas.

## Conclusion

The reduced aortic distensibility in this model of lipid-induced atherosclerosis may be evaluated in vivo with cine sequences, due to the high temporal and spatial resolution of ultra-highfield MRI at 9.4 T.
ApoE-/- mice demonstrate a significantly lower AD as compared to wild type C57/BL6 mice. As there is no significant difference in SV between the two groups these characteristics are most likely based on vascular changes. The increased enddiastolic cross-sectional vessel area of ApoE-/- animals may be interpreted as a combination of atherosclerotic outward remodeling and decreased elasticity of the vessel wall.
Ultra-highfield MRI at 9.4 T has the potential of intra-individual and long-term evaluation of the influence of drug therapies on the aortic distensibility of atherosclerotic mice.