Quantitative *in vivo* characterisation of aortic banding in the mouse using high-resolution MRI

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Introduction: Transverse aortic constriction (TAC) in the mouse is a commonly used surgical model of cardiac hypertrophy and subsequent failure. However, there is considerable variability in the extent of hypertrophy possibly caused by variability in the constriction of the aorta. Thus, the aim of this project was to establish a high-resolution MRI protocol to quantitatively characterize aortic arch stenosis in the mouse.

Methods: Four C57Bl/6 male mice (≈19 g) were anaesthetised with isoflurane, intubated, and a trans-sternal thoracotomy performed. The transverse aorta was constricted with a 7/0 polypropylene suture tied around a 27G needle. These animals were subjected to MRI – together with three matched controls – two days after surgery. High-resolution, ECG-triggered and respiration-gated MRI was performed on an MR-system that comprised an 11.7T vertical magnet with a shielded gradient system (548 mT/m, risetime 160 µs) (Magnex Scientific, Oxon, UK), a Bruker Avance console (Bruker Medical, Ettlingen, Germany) and a 28 mm quadrature driven birdcage coil (Rapid Biomedical, Würzburg, Germany). Raw data were acquired using a segmented 3D GE sequence (5 mm slice thickness, FOV 25.6×25.6×6.4 mm, matrix size of 384×144×96, α=15°, TE=1.58 ms, TR=2 RR intervals≈240 ms, NAE=2) and isotropically zerofilled by a factor of two and filtered before FFT. 3D reconstruction of the aortic arch and quantitative measurement was done using Amira™ 2.3.

Results: Figure 1 shows data from a control (a-c) and from a banded mouse (d-f). In the left column (a,d) MR images through the aortic arch are shown with a voxel size of 33×89×33 µm. The middle column (b,e) shows a 3D reconstruction and the right column (c,f) the orthogonal intersection of the respective arch. The reduction in the cross-sectional area after banding is clearly visible (Fig. 1f compared to Fig 1c). Fig. 2 shows an example for a cross-sectional volume obtained from slicing the aortic arch of a normal (filled symbols) and a banded mouse (open symbols) in coronal direction. The mean cross-sectional volume of normal mouse aorta as measured between the right brachiocephalic artery and the left common carotid artery was $(193 \pm 25)\cdot10^{-3}$ mm^3 (n=3) compared to $(32.4 \pm 6.7)\cdot10^{-3}$ mm^3 (n=4) of the aortic stenosis. Preliminary data showed that variability in the cross-sectional area of the stenosis after TAC in mice may explain the variability in hypertrophic response.

Fig.1:

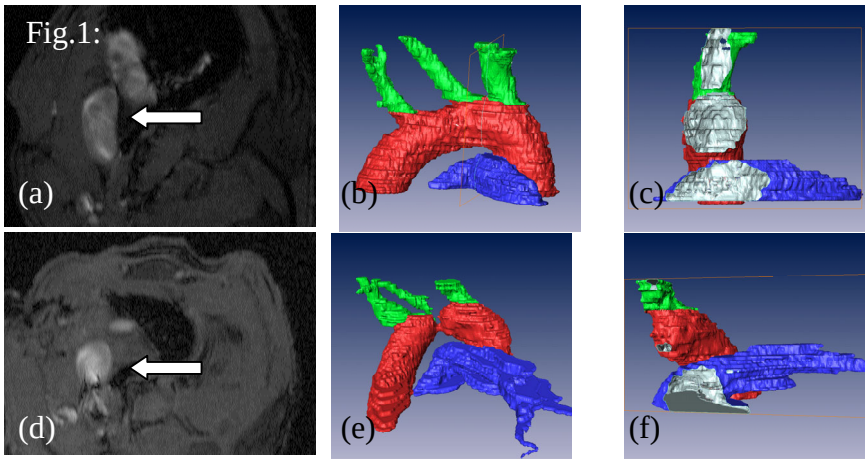
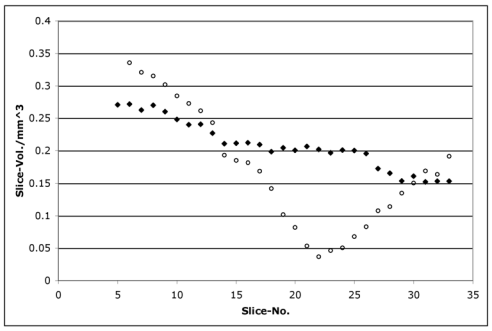


Fig. 2:



Discussion & Conclusion: Our work now shows that high-resolution MRI can be used to accurately visualize and quantify aortic arch stenosis after banding in mice *in vivo*. This technique will be of particular value in genetically modified mice to control for the effect of the extent of banding on the hypertrophic response. Work is in progress to correlate the cross-sectional volume to cardiac functional parameters.

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