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Comprehensive characterization of experimental aortic valve stenosis by multiparametric MRI

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Background: Recently, we established an experimental model of moderate aortic valve stenosis (AS) aiming to mimic human disease progression closely. Functional and structural MRI of a mouse model in experimental aortic valve stenosis has not been accomplished so far.

Purpose: Here, we aimed at developing comprehensive MRI approach for simultaneous assessment of changes in valvular, left ventricular and aortic morphology and function.

Methods: Male 12-week-old wildtype mice (C57Bl/6) were subjected to wire injury of the aortic valve to induce aortic valve stenosis. High resolution MRI at 9.4T was used to monitor subsequent functional and structural changes in the aortic valve, the ascending aorta, the left ventricle and aortic flow patterns.

Results: MRI permits accurate planimetry of the orifice and the thickness of the aortic valve, allows a reliable three-dimensional mapping of transvalvular aortic flow, simultaneously depicts aortic regurgitation in 3D fashion and permits assessment of left ventricular changes due to AS. In our model we observed a reduced valve orifice and an increase in valve thickness. Homogenous flow pattern under control converted to heterogenous and turbulent flow with progression of AS associated with increased aortic strain, aortic wall and left ventricular wall thickness.

Conclusions: In a murine model of aortic valve stenosis MRI is capable to reliably display a three-dimensional transvalvular aortic flow profile with concomitant quantification of structural and functional changes in aortic valve, left ventricle, and ascending aorta. This comprehensive functional imaging at high resolution and distinct reproducibility offers for the first time serial assessment of disease progression in an experimental model of aortic valve stenosis.