Assessment of Aortic Valve Area in Aortic Stenosis – Comparison of Fast Low Angle Shot and Steady-State Free Precession Sequences

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Introduction: The severity of aortic valve stenosis can be assessed using different non-invasive techniques like transthoracic and transesophageal echocardiography as well as invasive pressure measurements during cardiac catheterisation. Recently, it has been demonstrated that velocity-encoded cardiac magnetic resonance allows measurements of pressure gradients, velocity-time integrals and valve dimensions that correlate with Doppler ultrasound as the standard of reference[1]. However, flow measurements are difficult to perform and post processing of these data is time consuming. Therefore planimetry of the aortic valve area may be an attractive alternative. The aim of this study was to assess aortic valve areas in aortic stenosis by MR using two different MR sequences (steady state free precession (SSFP) and gradient-echo fast low-angle shot (FLASH)) in comparision to transesophageal echocardiography (TEE).

Methods: 27 patients with known aortic stenosis were imaged with MR and echocardiography. MR imaging was performed on a 1.5 T MR scanner (Magnetom Sonata, Siemens, Erlangen, Germany) using a cine SSFP sequence (TR = 2.9 ms, TE = 1.3 ms, FA = 65°, slice thickness = 5 mm, temporal resolution = 19 ms, spatial resolution = 1.3 mm x 1.3 mm) and a cine FLASH sequence (TR = 8 ms, TE = 3.3 ms, FA = 20°, slice thickness = 5 mm, temporal resolution = 33 ms, spatial resolution = 1.9 mm x 1.3 mm). The imaging plane for planimetry was perpendicular to the aortic root (Figure 1). Planimetry was performed in cross-sectional images in systole by a radiologist blinded to the results of the TEE.

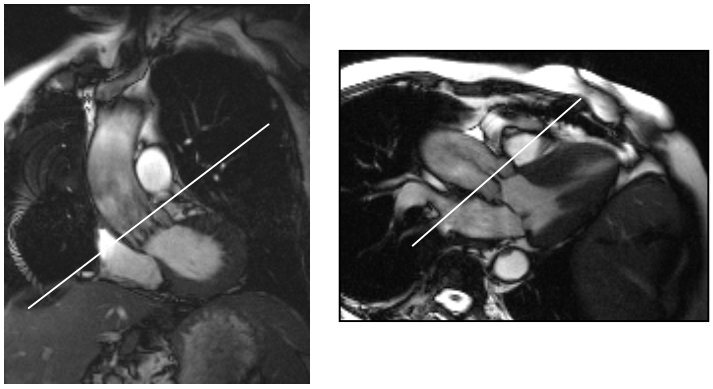

Figure 1: The imaging plane for planimetry was perpendicular to the aortic root.

Results: MR planimetry could be performed in all patients. The valve leaflets could be delineated more clearly on SSFP images, particularly in severely calcified valves (Figure 2). Mean aortic valve area measured by TEE was 0.97 mm², 1.00 mm² for SSFP and 1.25 mm² based on FLASH images. Good correlation was found between aortic valve areas measured on SSPF images and by TEE. The mean difference between the valve areas assessed based on SSFP and TEE images was 0.15 ± 0.13 cm² (FLASH vs. TEE: 0.29 ± 0.17 cm²). Bland-Altman plots demonstrated that measurements using FLASH images overestimate the aortic valve area compared to TEE.

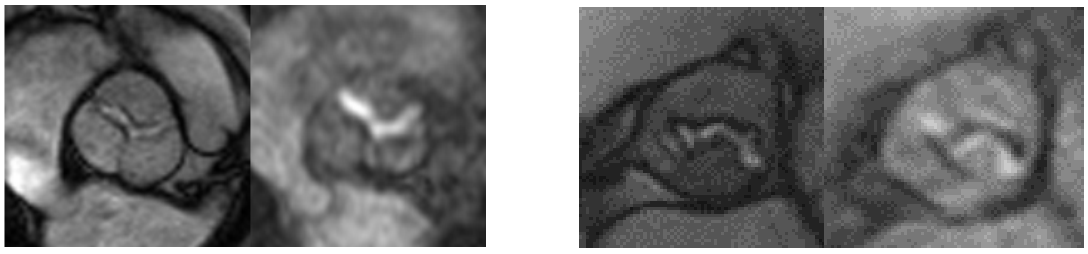

Figure 2: Cross-sectional images of the aortic valve acquired by SSFP (left) and FLASH sequence (right).

Conclusion: MR planimetry of aortic valve areas is feasible using SSFP and FLASH sequences. Measurements of the aortic valve area based on SSPF images correlate better with TEE compared to FLASH images. The higher spatial and temporal resolution as well as the improved image contrast must be considered as major advantages of the SSFP images.

1. Caruthers SD, Lin SJ, Brown P, Watkins MP, Williams TA, Lehr KA, Wickline SA. Practical value of cardiac magnetic resonance imaging for clinical quantification of aortic valve stenosis: comparison with echocardiography. *Circulation*. 2003;108:2236-43.