Valvular Disease

Jens Bremerich

University Hospital Basel, Switzerland

Introduction: Echocardiography remains first line modality for imaging cardiac valves. In specific cases, however, Magnetic Resonance Imaging (MRI) can provide complementary information such as on perivalvular anatomy in abscesses or aneurysms or quantification of regurgitant fraction.

Methods: Magnetic Resonance Imaging of cardiac valves requires state of the art equipment such as a 1.5 or 3 Tesla magnet and a surface coil. Three principal sequences are required [1]: 1) Black blood, 2) cine steady state free precession (CineSSFP), and 3) phase contrast velocity encoded cine (VENCine). Black blood images are obtained by preparation of a fast spin echo sequences with a nonselective 180° pulse followed by a slice selective 180° pulse (double inversion recovery). Such preparation can be used for T1, T2, and PD weighted images. CineSSFP are used for assessment of valvular and myocardial motion. Temporal resolution is typically 50ms for a segmented breath hold sequence but may be further shortened by means of parallel imaging or non-breath hold sequences, if required. VENCine is an excellent tool for quantification of flow volume and velocity. It allows absolute quantification, since phase shift is proportional to the velocity of a moving spin in linear field gradients. Volume measurements are important to assess the regurgitant fraction of an incompetent valve, velocity measurement are used to assess degree of stenosis relying on the modified Bernoulli equation similarly to echocardiography.

Results: Aortic regurgitation is difficult to evaluate with Echocardiography but easily quantified on VENCine with excellent precision and reproducibility [2]. Therefore aortic regurgitation is an excellent indication for MRI. The regurgitant fraction is defined as Volumeantegrade/Volumeretrograde*100 [%]. Aortic stenosis, on the other hand, may also be quantified with MR by means of measuring the opening area on CineSSFP or by measuring peak velocity in the valve on VENCine and calculation with the modified Bernoulli equation ($\Delta P = 4 \times V_{\text{max}}^2$). Such quantification, however, is rather on approximation similar to echocardiography, thus providing only limited added value of MRI. CT on the other hand, can show quantification of the valve and the adjacent ascending aorta which is relevant for planning surgical repair. Mitral regurgitation, on the other hand, may be quantified by MRI but is currently not a routine application since scientific evidence is rather sparse [3]. Echocardiographic quantification relies predominantly on the extent of the regurgitant jet into the left atrium which is not a reliable sign on MRI, since extent of regurgitant jets depend on various parameters such as field strength and echo time. Pulmonary regurgitation can also be measured with MRI which is of outstanding relevance after surgical repair of the right ventricular outflow tract such as in patients with tetralogy of Fallot [4]. Moreover, MR can nicely depict the specific anatomy of the right ventricular outflow tract and pulmonary valve. Pulmonary stenosis, Tricuspid stenosis and regurgitation are no routine indications for MRI but are rather evaluated by echocardiography.

Conclusion: Aortic regurgitation is an excellent indication for MRI, since MRI provides – unlike Echocardiography - accurate and reproducible quantification. Aortic stenosis, Mitral
stenosis and regurgitation MRI may be used but does not provide added value as compared to echocardiography.

References:


