Cardiovascular MR Imaging: Pushing the Limits - Part 2: Case-Based Studies in CMR

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Highlights
- Case based demonstration of valvular regurgitation and valvular stenosis
- Principle cardiac MR approaches to valvular heart disease

Title: Valvular Heart Disease
Target audience: – Clincians with intermediate skill level, Physicists with interest in clinical applications
OUTCOME/Objectives: – Audience will become familiar with the quantification of valvular pathology.
BACKGROUND: – Adequate function of cardiac valves ensure proper unidirectional/serial flow through the cardiac chambers and valvular disease may have deteriorating impact on cardiac function and thus on patients' morbidity and mortality. Failure to maintain a predefined single flow direction or failure to do so adequately results in either non-physiologic backward flow (regurgitation) or limitation of physiologic forward flow (stenosis). As a consequence stenosis may lead to pressure overload of cardiac chambers while regurgitation results in a cardiac chambers volume overload and proper therapy management requires adequate assessment of valvular disease and its potential sequelae.
METHODS: – Cardiac MR is focused on valvular morphology, valvular function, cardiac function or a combination thereof. Cine SSFP or spoiled GRE techniques are best suited for assessment of valvular morphology requiring high spatial & temporal resolution. The regurgitant volume and the regurgitant fraction of the atrio-ventricular (AV) valves (Mitral valve, Tricuspid valve) are either assessed by the stroke volume (SV) differences of both ventricles as assessed by cine SSFP or by the difference between the SV and the flow volume in the respective downstream great vessel (Pulmonary artery, Ascending aorta) as assessed by PC flow techniques. Regurgitations of the ventriculo-atrial (VA) valves (Aortic/Pulmonic valve) are typically assessed by employing PC flow measurements just at the level of distal of the leaking valve with consideration of the total antegrade flow volume which matches the respective ventricular SV (in the absence of additional regurgitation at the AV valve of the same ventricle) and the retrograde volume.
Assessment of valvular stenosis is typically focused on the VA valves and requires identification of the jets' highest velocity distal to the affected valve for estimation of the peak pressure gradient (mod. Bernoulli equation) or the application of thin sectioned SSFP cine parallel to the valvular plane under investigation for assessment of the minimum valve opening area using electronic calipers.
Detailed assessment of valvular morphology is not necessarily a focus of the application of cardiac MR in valvular heart disease, this slice cine SSFP though have proven to be useful in the assessment of especially the aortic valve. Cardiac MR is also of great help in the excact localization of stenosis in case questionable as MR can easily differentiate between valvular, subvalvular and supravalvular problems most often in the positions of the VA valves.
Beside the above mentioned application of cine SSFP for quantification of regurgitant volumes cardiac MR without doubt is the most accurate method to identify early identification of functional detoriation which may drive therapeutic decisions.
CONCLUSION: – While not being the immediate focus of cardiac MR imaging the modality adds valuable information to other modalities. It is considered the most accurate method for quantification for regurgitation and certainly also for the assessment of systolic ventricular function and volumes.
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