DEVELOPMENT OF A MULTI-MODALITY IMAGING MODEL OF DYNAMIC MITRAL VALVE DYSFUNCTION

Poster Contributions
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Background: A robust, controlled in vitro model of mitral valve regurgitation (MR) would facilitate the exploration of MR repair techniques and provide a reference test environment for the validation of new imaging applications - including 3D Doppler and phase contrast CMR.

Methods: Design software, 3D printing technology, and non-magnetic materials were used to create a novel multi-modality imaging chamber incorporated into a pre-existing flow loop. Porcine mitral valves (MV) [annulus, leaflets, papillary muscles (PM) and chordae] were mounted onto a rigid saddle-shaped annular disk positioned between the ventricle and atrial chambers. MR was created by symmetric PM displacement (functional MR) or asymmetric displacement (MV prolapse). MR severity was tailored by adjusting PM position, trans-valvular pressure gradient and pump flow rate.

Results: A multimodality MV imaging chamber was created including: 1) left ventricle and outflow tract geometry; 2) physiologic ultrasound windows; 3) adjustable papillary muscle positioning system; and 4) a saddle-shaped annulus mounting disc. Controlled MR was achieved with 15, 30 and 50 ml/beat and quantitatively assessed by direct flow transducers, Color Doppler ultrasound, and PC-MRI.

Conclusions: A dynamic pulsatile model of functional MR and MV prolapse was created and evaluated using Doppler and Cardiac MRI techniques. This model can be used to examine novel cardiac imaging modalities and percutaneous repair technologies.