PATIENT-SPECIFIC SIMULATION OF RIGHT VENTRICLE OUTFLOW TRACT CONDUIT BALLOON ANGIOPLASTY USING CARDIAC MRI-DERIVED 3D VIRTUAL MODELS TO ASSESS THE RISK OF CORONARY ARTERY COMPRESSION DURING TRANSCATHETER PULMONARY VALVE REPLACEMENT

Poster Contributions
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Background: Transcatheter pulmonary valve replacement (TPVR) with the Melody™ valve is frequently considered in patients with right ventricular outflow tract (RVOT) conduit obstruction. TPVR carries a risk of coronary artery (CA) compression. This risk is evaluated by CA angiography and simultaneous balloon dilation prior to TPVR. No MRI or CT based predictors exist to assess this risk. We hypothesized that finite element (FE) balloon dilation simulations on patient-specific virtual models (VM) generated using MRI data could predict CA compression during TPVR.

Methods: All patients who underwent pre-catheterization MRI and attempted TPVR at our institution from 06/13 to 06/14 were included (n=3). 3D VM were created from MRI data, using Mimics, 3-Matic and Meshmixer software. A FE simulation of balloon conduit angioplasty was implemented retrospectively in ABAQUS for each of the VM. Balloon expansion was modeled as rigid body dilation using linear elastic constitutive model to a dimension equal to 100% of the original RVOT conduit diameter.

Results: The FE balloon simulation accurately predicted the presence (III) or absence (I, II) of CA compression in all 3 patients (Figure 1). 3D VM were also successful in delineating the CA origin and course in relation to the RVOT conduit in all cases.

Conclusion: FE-simulation of conduit balloon angioplasty using MRI derived 3D VM offers a potential method for predicting the likelihood of CA compression in TPVR candidates and may improve patient selection.