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Hemodynamic Assessment of Compliance of Pre-Stressed Pulmonary Valve-Vasculature in Patient Specific Geometry Using an Inverse Algorithm ULLHAS HEBBAR, ANUP PAUL, RUPAK BANERJEE, School of Dynamic Systems, University of Cincinnati — Image based modeling is finding increasing relevance in assisting diagnosis of Pulmonary Valve-Vasculature Dysfunction (PVD) in congenital heart disease patients. This research presents compliant artery – blood interaction in a patient specific Pulmonary Artery (PA) model. This is an improvement over our previous numerical studies which assumed rigid walled arteries. The impedance of the arteries and the energy transfer from the Right Ventricle (RV) to PA is governed by compliance, which in turn is influenced by the level of pre-stress in the arteries. In order to evaluate the pre-stress, an inverse algorithm was developed using an in-house script written in MATLAB and Python, and implemented using the Finite Element Method (FEM). This analysis used a patient specific material model developed by our group, in conjunction with measured pressure (invasive) and velocity (non-invasive) values. The analysis was performed on an FEM solver, and preliminary results indicated that the Main PA (MPA) exhibited higher compliance as well as increased hysteresis over the cardiac cycle when compared with the Left PA (LPA). The computed compliance values for the MPA and LPA were 14% and 34% lesser than the corresponding measured values. Further, the computed pressure drop and flow waveforms were in close agreement with the measured values. In conclusion, compliant artery – blood interaction models of patient specific geometries can play an important role in hemodynamics based diagnosis of PVD.

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