Modeling the impact of stenting of aortic coarctations upon left ventricular load

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Hemodynamic models of blood flow in the left ventricle (LV) and aorta are important tools for analyzing the mechanistic links between myocardial deformation and flow patterns in human hearts. Typically, computational fluid dynamics (CFD) models driven by image-based kinematic models are employed aiming to predict the acute response to an intervention. While such models have proven to be suitable for analyzing the hemodynamic status quo of a patient, they are of limited predictive power as they rely upon the tacit assumption that the kinematics of the heartbeat remains unaffected by the intervention. Electro-mechano-fluidic (EMF) models that capture the entire physics of ventricular electromechanics (EM) promise high potential to overcome this limitation. Such models render feasible the prediction of changes in essential parameters such as myocardial wall stresses and work rates, which are known to be key factors driving ventricular remodeling and disease progression and their potential reversal post-treatment.

In a recent study we built a cohort of twenty in silico electro-mechanical LV and aorta models of patients suffering from aortic valve disease (AVD) and/or aortic Coarctations (CoA). All models comprising electrophysiological, mechanical and circulatory components were parameterized for individual patients using comprehensive clinical datasets. These

validated EM models were fed into our recently developed in-house CFD solver.
In this talk we will present our general workflow together with first results on hemodynamics in the LV for some peronalized EM models.