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Patient-Specific Simulations of Reactivity in Models of the Pulmonary Vasculature: A 3-D Numerical Study with Fluid-Structure Interaction KENDALL HUNTER, U Colorado HSC, YANHANG ZHANG, U CO Boulder, CRAIG LANNING, D. DUNBAR IVY, ROBIN SHANDAS, U CO HSC — Insight into the progression of pulmonary hypertension may be obtained from thorough study of vascular flow during reactivity testing, an invasive diagnostic procedure which can dramatically alter vascular hemodynamics. Diagnostic imaging methods, however, are limited in their ability to provide extensive data. Here we present detailed flow and wall deformation results from simulations of pulmonary arteries undergoing this procedure. Patient-specific 3-D geometric reconstructions of the first four branches of the pulmonary vasculature were obtained clinically and meshed for use with computational software. Transient simulations in normal and reactive states were obtained from four such models were completed with patient-specific velocity inlet conditions and flow impedance exit conditions. A microstructurally based orthotropic hyperelastic model that simulates pulmonary artery mechanics under normotensive and hypoxic hypertensive conditions treated wall constitutive changes due to pressure reactivity and arterial remodeling. Pressure gradients, velocity fields, arterial deformation, and complete topography of shear stress were obtained. These models provide richer detail of hemodynamics than can be obtained from current imaging techniques, and should allow maximum characterization of vascular function in the clinical situation.

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