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Patient-Specific Computational Modeling of Cerebrovascular AVM-related Aneurysms[1] KIMBERLY A. STEVENS, School of Mechanical Engineering, Purdue University, AARON A. COHEN-GADOL, Goodman Campbell Brain and Spine, Department of Neurological Surgery, Indiana University School of Medicine, IVAN C. CHRISTOV, School of Mechanical Engineering, Purdue University, VITALIY L. RAYZ, Weldon School of Biomedical Engineering, Purdue University — An arteriovenous malformation (AVM) is a pathological condition where an abnormal tangle of vessels connects arteries to veins, bypassing the capillary bed. The decreased flow resistance can lead to increased flow in the vessels feeding the AVM, thought to be responsible for the pathogenesis of flow-related aneurysms. To investigate the relationship between AVMs and flow-related aneurysms, we created image-based computational fluid dynamic models of five flow-related cerebral aneurysms coupled with reduced-order lumped-parameter network models representing the AVMs. Vascular geometries for computational models are generated from CT data obtained from IU School of Medicine, and the blood flow within the geometry is computed using an open-source modeling platform, SimVascular. Once created, the model boundary conditions are modified to simulate AVM treatment and predict postoperative flow conditions. Calculated hemodynamic parameters known to influence arterial wall remodeling and intra-luminal thrombus deposition, such as the wall shear stress and oscillatory shear index, are compared between pre- and post-operative flow scenarios. Results indicate that hyperdynamic flow upstream of the AVM leads to elevated wall shear stress, which can be mitigated following AVM treatment.

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