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Coupling 1D Navier Stokes equation with autoregulation lumped parameter networks for accurate cerebral blood flow modeling JAIYOUNG RYU, University of California, Berkeley, XIAO HU, University of California, San Francisco, SHAWN C. SHADDEN, University of California, Berkeley — The cerebral circulation is unique in its ability to maintain blood flow to the brain under widely varying physiologic conditions. Incorporating this autoregulatory response is critical to cerebral blood flow modeling, as well as investigations into pathological conditions. We discuss a one-dimensional nonlinear model of blood flow in the cerebral arteries that includes coupling of autoregulatory lumped parameter networks. The model is tested to reproduce a common clinical test to assess autoregulatory function - the carotid artery compression test. The change in the flow velocity at the middle cerebral artery (MCA) during carotid compression and release demonstrated strong agreement with published measurements. The model is then used to investigate vasospasm of the MCA, a common clinical concern following subarachnoid hemorrhage. Vasospasm was modeled by prescribing vessel area reduction in the middle portion of the MCA. Our model showed similar increases in velocity for moderate vasospasms, however, for serious vasospasm ($\sim$ 90% area reduction), the blood flow velocity demonstrated decrease due to blood flow rerouting. This demonstrates a potentially important phenomenon, which otherwise would lead to false-negative decisions on clinical vasospasm if not properly anticipated.

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