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One-dimensional model for the intracranial pulse morphological analysis during hyperventilation and CO_2 inhalation tests JAIYOUNG RYU, University of California, Berkeley, XIAO HU, University of California, San Francisco, SHAWN C. SHADDEN, University of California, Berkeley — The brain's CO_2 reactivity mechanism is coupled with cerebral autoregulation and other unique features of cerebral hemodynamics. We developed a one-dimensional nonlinear model of blood flow in the cerebral arteries coupled to lumped parameter (LP) networks. The LP networks incorporate cerebral autoregulation, CO_2 reactivity, intracranial pressure, cerebrospinal fluid, and cortical collateral blood flow models. The model was used to evaluate hemodynamic variables (arterial deformation, blood velocity and pressure) in the cerebral vasculature during hyperventilation and CO_2 inhalation test. Tests were performed for various arterial blood pressure (ABP) representing normal and hypotensive conditions. The increase of the cerebral blood flow rates agreed well with the published measurements for various ABP measurements taken during clinical CO_2 reactivity tests. The changes in distal vasculature affected the reflected pulse wave energy, which caused the waveform morphological changes at the middle cerebral, common and internal carotid arteries. The pulse morphological analysis demonstrated agreement with previous clinical measurements for cerebral vasoconstriction and vasodilation.

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