Cerebral blood flow dynamics

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A monoexponential model characterizing cerebral blood flow velocity dynamics at the onset of exercise may mask dynamic responses by the cerebrovasculature countering large fluctuations of middle cerebral artery blood velocity (MCAv) and cerebral perfusion pressure (CPP) oscillations. Therefore, the purpose of this study was to determine whether the use of a monoexponential model attributes initial fluctuations of MCAv at the start of exercise as a time delay (TD). Twenty-three adults (10 women, 23.9 ± 3.3 yrs; 23.7 ± 2.4 kg/m2) completed 2 min of rest followed by 3 mins of recumbent cycling at 50 W. MCAv, CPP, and Cerebrovascular Conductance index (CVCi), calculated as CVCi = MCAv/MAP × 100 mmHg, were collected, a lowpass filter (0.2 Hz) was applied, and averaged into 3-second bins. MCAv data were then fit to a monoexponential model [ΔMCAv(t) = Amp(1 - e-(t-TD)/τ)]. TD, tau (τ), and mean response time (MRT = TD + τ) were obtained from the model. Subjects exhibited a TD of 20.2 ± 18.1 s. TD was directly correlated with MCAv nadir (MCAvN), r = -0.560, p = 0.007, which occurred at similar times (16.5 ± 15.3 vs. 20.2 ± 18.1 s, p = 0.967). Regressions indicated CPP as the strongest predictor of MCAvN (R2a = 0.36). Fluctuations in MCAv were masked using a monoexponential model. To adequately understand cerebrovascular mechanisms during the transition from rest to exercise, CPP and CVCi must also be analyzed. A concurrent drop in cerebral perfusion pressure and middle cerebral artery blood velocity at the start of exercise forces the cerebrovasculature to respond to maintain cerebral blood flow. The use of a monoexponential model characterizes this initial phase as a time delay and masks this large important response [1].

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Ashley J, Shelley J, Song J, Sun J, Larson RD, Larson DJ, Berkowitz A, Yabluchanskiy A, Kellawan JM. Cerebral blood flow dynamics: Is there more to the story at exercise onset? Physiol Rep. 2023 Jun;11(11):e15735. doi: 10.14814/phy2.15735. PMID: 37287070.