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# A Coaxial coupled model of cerebral flows: Blood and Cerebrospinal Fluid

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**Abstract (500 words max).** This study aimed to develop a one dimensional (1D) model to simulate the Cerebrospinal Fluid (CSF) flows in the cerebral sub-arachnoid spaces, and its coupling with the entire cerebral blood flow vascular network. The model consist in a network of coaxial tubes: the interior network represents the cerebral vasculature from the carotid and vertebral arteries to the sinuses and jugular veins (Zagzoule, 1986), and the coaxial exterior tubes the sub arachnoid spaces where the CSF flows. By integrating the mass and momentum flow conservation equations over the tubes cross-sections, we obtain a 1D coupled coaxial model of the blood and CSF flows. Our model takes into account the viscosity of the fluids (Cathalifaud, 2015), and assumes compliant boundary conditions for the coaxial compartment. Given the input pressure signal at the carotid and vertebral arteries, we therefore obtained an induced CSF flow, as shown in Figure 1. Results depends on the confinement of the coaxial compartment and the compliances of the boundary conditions, and well compared to measured CSF flows of the literature (between 2 and 5 $cm^3/s$). We also investigate the coupling effect of the CSF on the blood flows, especially on the cerebral autoregulation characteristic time. We show that it strongly depends on the confinement of the coaxial compartment.

**Keywords:** CSF flow, 1D model, cerebral blood flow, cerebral autoregulation

## References (2 max)

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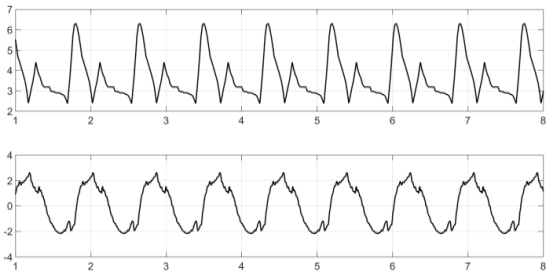

Fig. 1 (up) Flow rate in $cm^3/s$ in a carotid artery; (down) Induced LCS flow rate in $cm^3/s$

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