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Dispersion as a waste clearance mechanism in pressure-driven flow through open penetrating perivascular spaces[1] DANIEL E. TROYETSKY, University of Rochester, JEFFREY TITHOF, University of Minnesota, University of Rochester, JOHN H. THOMAS, DOUGLAS H. KELLEY, University of Rochester — Determining the relative contributions of advection and diffusion in transporting metabolic waste products in perivascular spaces (PVSs) is an important step in understanding the brain's system for removal of these waste products, failure of which may lead to neurological diseases such as Alzheimer's. Experiments have measured flow properties in PVSs around pial (surface) arteries through the use of tracer particles, but little is known about flows in the PVSs around arteries that penetrate deeper into the brain. Some recent publications have claimed that a purely oscillatory flow will lead to transport that is substantially faster than diffusion in these spaces, precluding any need for bulk flow. We evaluate the plausibility of these claims by utilizing analytical solutions and numerical simulations based on physically relevant parameters to quantify the transport of a solute (amyloid-beta) in a penetrating PVS. Specifically, we examine solute transport in steady and unsteady Poiseuille flows in an open (not porous) concentric circular annulus. We find that a purely oscillatory flow only weakly enhances dispersion and does not produce significant transport, whereas a steady (bulk) component of flow, even if slow, is much more effective as a clearance mechanism.

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