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Convective transport resistance in the vitreous humor ANITA PENKOVA, SATWINDAR SADHAL, KOMSAN RATANAKIJSUNTORN, University of Southern California, REX MOATS, YANG TANG, Children's Hospital Los Angeles, PATRICK HUGHES, MICHAEL ROBINSON, SUSAN LEE, Allergan, Inc
— It has been established by MRI visualization experiments that the convection of nanoparticles and large molecules with high rate of water flow in the vitreous humor will experience resistance, depending on the respective permeabilities of the injected solute. A set of experiments conducted with Gd-DTPA (Magnevist, Bayer AG, Leverkusen, Germany) and 30 nm gadolinium-based particles (Gado CELLTrack^{TM}, Biopal, Worcester, MA) as MRI contrast agents showed that the degree of convective transport in this Darcy-type porous medium varies between the two solutes. These experiments consisted of injecting a mixture of the two (a 30 μl solution of 2% Magnevist and 1% nanoparticles) at the middle of the vitreous of an ex vivo whole bovine eye and subjecting the vitreous to water flow rate of 100 μl/min. The water (0.9% saline solution) was injected at the top of the eye, and was allowed to drain through small slits cut at the bottom of the eyeball. After 50 minutes of pumping, MRI images showed that the water flow carried the Gd-DTPA farther than the nanoparticles, even though the two solutes, being mixed, were subjected to the same convective flow conditions. We find that the convected solute lags the water flow, depending on the solute permeability. The usual convection term needs to be adjusted to allow for the filtration effect on the larger particles in the form (1-σ)$\boldsymbol{u}\cdot\nabla c$ with important implications for the modeling of such systems.

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