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Effects of a protein glycocalyx in the hemodynamics of small blood vessels YIANNIS DIMAKOPOULOS, GEORGE DELIDAKIS, JOHN TSAMOPOULOS, Univ of Patras — Glycocalyx is a protein layer of approximate thickness 0.5μm that lines vessel walls. We study the effects this layer has on the blood flow inside arterioles and venules, where the relative size of the glycocalyx is significant. To properly describe phenomena that naturally occur in blood flow, such as the inhomogeneous distribution of red blood cells and their aggregation, we use an improved viscoelastic constitutive model. The glycocalyx layer is modeled as fixed porous media. Cells cannot penetrate inside it, since its hydraulic permeability is very low, and the flow inside this layer is described by the equations for a viscous fluid with an extra Brinkman term to account for the effects the porous medium has on the flow. The closed set of equations is solved using the Finite Element method, assuming steady-state with dependence only in the r-direction. Our results are favorably compared with the in vivo velocity profiles in venules of mice produced by Damiano et al., (2004) and the formation of cell-free layer near glycocalyx. Flow inside the glycocalyx layer is found to be severely attenuated due to the low hydraulic permeability, which can have interesting implications in the transport of various substances form the blood to the tissues or in the use of shear stresses as signals for the endothelial surface cells. Finally, we simulate the transient blood flow under pulsatile conditions.

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