Abstract Submitted for the DFD07 Meeting of The American Physical Society

Shock formation and nonlinear dispersion in a microvascular network¹ OLIVER JENSEN, RARES POP, SARAH WATERS, GILES RICHARDSON, University of Nottingham, UK — Temporal and spatial fluctuations in capillary blood flow are a common feature of microvascular networks. Among many possible causes of instability, previous authors have suggested that the nonlinear rheological properties of capillary blood flow (notably the Farhaeus effect, the Farhaeus-Lindqvist effect and the phase separation effect at bifurcations) may be sufficient to generate temporal fluctuations even in very simple networks. We have simulated blood flow driven by a fixed pressure drop through a simple arcade network using coupled hyperbolic PDEs that incorporate empirical descriptions of these rheological effects; we solved these PDEs using a characteristic-based method. Our computations indicate that, under physiological conditions, there is a unique steady solution in an arcade network which is linearly stable and that plasma skimming suppresses the oscillatory decay of perturbations. In addition, we find that nonlinear perturbations to this flow develop shocks via the Farhaeus effect, providing a novel mechanism for nonlinear dispersion in microvascular networks.

¹Supported by EPSRC grant GR/T19605/01

Oliver Jensen University of Nottingham, UK

Date submitted: 03 Aug 2007

Electronic form version 1.4