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ON THE SIMULATION OF STEADY AND OSCILLATORY BLOOD FLOW IN A TUBE USING A NEW NON-HOMOGENEOUS CONSTITUTIVE MODEL

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Abstract

Realistic simulations of blood flow in smaller vessels (such as the arterioles) require that wall effects be adequately taken into account in the constitutive modelling. As in arterial flow, red cell aggregates typically vary in size depending upon the local flow conditions. However, in smaller tubes the number density of erythrocytes can no longer be considered constant. Furthermore, the cells typically migrate away from vessel walls leaving a cell-depleted region there.

In the first part of our talk new results for steady non-homogeneous tube flows will demonstrate the decrease in the apparent viscosity of blood and the dynamic (tube) hematocrit that are observed when the tube radius is reduced: respectively, the Fahraeus-Lindqvist (1931) and Fahraeus (1929) effects. Comparisons are made with results from the experimental literature and demonstrate that our predictions are in close conformity with the available data.

In the second part of the presentation, we will use our non-homogeneous blood model to simulate blood undergoing oscillatory flow and, in particular, examine the behaviour of the in phase and phase quadrature components of the pressure gradient as the volume flow rate amplitude is varied. Excellent agreement is found with experimental data for a tube of radius 430 microns. An improvement in the predictions compared to those of an earlier homogeneous model [J. Fang and R. G. Owens, Numerical simulations of pulsatile blood flow using a new constitutive model, Biorheology **43** (2006) 637–660] is evidenced. We also seek to relate the macroscopic

blood behaviour in different size tubes and at two different angular frequencies to the aggregate properties such as the average aggregate size and the cell number density.

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