Computational Science & Engineering

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On the flow of human blood in a tube

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Macdonald-Harrington Building, Room G1

Abstract

Human blood is a complex fluid consisting of a suspension in plasma of formed elements such as platelets, white blood cells and red blood cells. Of these cells, by far the greatest proportion (some 98%) consists of red blood cells. The rheology of blood is therefore primarily determined by the behaviour of the red blood cells at different shear rates. At low shear rates the red blood cells may agglomerate into long column-like structures called rouleaux, which are easily broken up as the shear rate increases. In addition, the number density of blood flowing in a tube is not constant: the cells typically migrate away from vessel walls leaving a cell-depleted region there.

In this talk we shall use a microstructure-based constitutive model that we have developed recently to investigate the steady and pulsatile flow of blood in a straight, rigid walled tube. Comparisons are made with the experimental results of Thurston [Microvascular Research 9 (1975) 145-157] for the pressure drop per unit length against volume flow rate and oscillatory flow rate amplitude. We may also have something to say about the decrease in the apparent viscosity of blood that is observed when the tube radius is reduced: the Fahraeus-Lindqvist effect.

In the presentation of the numerical and experimental results we discuss the microstructural properties of human blood that account for its fascinating rheological behaviour in this simple class of flows.