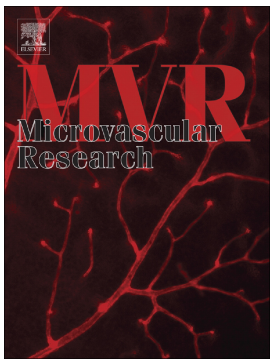

Study of microvascular non-Newtonian blood flow modulated by electroosmosis

Dharmendra Tripathi, Ashu Yadav, O. Anwar Bég, Rakesh Kumar

PII: S0026-2862(17)30234-0
DOI: https://doi.org/10.1016/j.mvr.2018.01.001
Reference: YMVRE 3752

To appear in: *Microvascular Research*

Received date: 3 November 2017
Revised date: 8 December 2017
Accepted date: 2 January 2018

Please cite this article as: Dharmendra Tripathi, Ashu Yadav, O. Anwar Bég, Rakesh Kumar , Study of microvascular non-Newtonian blood flow modulated by electroosmosis. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Ymvre(2017), https://doi.org/10.1016/j.mvr.2018.01.001

Ref: MVR_2017_187

Study of microvascular non-Newtonian blood flow modulated by electroosmosis

[*1]Dharmendra Tripathi, [1]Ashu Yadav, [2]O. Anwar Bég and [1]Rakesh Kumar

[1]Department of Mechanical Engineering, Manipal University Jaipur, Rajasthan-303007, India.

[2]Fluid Mechanics and Propulsion, Aeronautical and Mechanical Engineering, University of Salford, Newton Building, G77, The Crescent, Salford, M54WT, England, UK.

Corresponding author- email: dharmendra.tripathi@jaipur.manipal.edu

ABSTRACT

An analytical study of microvascular non-Newtonian blood flow is investigated in presence of electro-osmosis phenomenon. Blood is considered as a Bingham rheological aqueous ionic solutions. An externally applied static axial electrical field is imposed on the system. The Poisson-Boltzmann equation for electric potential distribution is implemented to accommodate the electrical double layer in the microvascular. With long wavelength, lubrication and Debye-Hückel approximations, the boundary value problem is rendered non-dimensional. Analytical solutions are derived for the axial velocity, volumetric flow rate, pressure gradient, volumetric flow rate, averaged volumetric flow rate along one time period, pressure rise along one wavelength and stream function. A plug width is featured in the solutions. Via symbolic software (Mathematica), graphical plots are generated for the influence of Bingham plug flow width parameter, electrical Debye length and Helmholtz-Smoluchowski velocity (maximum electro-osmotic velocity) on the key hydrodynamic variables. This study reveals that blood flow rate accelerates with decreasing the plug width (i.e. viscoplastic nature of fluids) and also with increasing the Debye length parameter.

Keywords: *Electroosmosis; Bingham plastic fluids; electric double layer; trapping; Blood flow; plug flow.*

Nomenclature

a	half width of the channel	u_e	Helmholtz-Smoluchowski velocity
c	wave velocity	u	axial velocity
D	diffusivity of the chemical species	v	transverse velocity
E_x	electrical field in axial directions	x	axial coordinate
E_y	electrical field in transverse directions	$\overline{z}_+$ & $\overline{z}_-$	valencies
h	transverse vibration of the wall	***Greek symbols***	
h_{pl}	width of the plug flow region	ϕ_i	Amplitude of the different