Pulsatile blood flow modeling with radially variable viscosity and magnetic nanoparticles through permeable multiple stenosed arteries under the influence of an applied external magnetic field

Anandasrinivasan S [a1] and R. Tamil Selvi [a]

[a] Department of Mathematics, National Institute of Technology Tiruchirappalli, Tiruchirappalli, Tamil Nadu, India

1. INTRODUCTION & OBJECTIVE

Coronary artery disease is the obstruction of coronary arteries due to plaque buildup on the inner arterial wall. It disrupts the blood flow through the passage and reduces the vital transmission of oxygen and nutrients to other parts of the body. Understanding the blood flow through the stenosed arteries is essential to treat it. This work focuses on understanding the interplay between the variable viscosity, magnetic nanoparticles, and external magnetic field inside the permeable multiple stenosed arteries, which is crucial for developing targeted drug delivery systems and therapeutic interventions to treat cardiovascular diseases. The present work analyzes the pulsatile two-fluid model of blood through permeable multiple stenosed arteries with effects of radially variable viscosity, magnetic nanoparticles, and an external magnetic field. In this study, blood in the core region is treated as Jeffrey fluid to capture its visco-elastic nature, and plasma in the peripheral region is considered Newtonian. Suitable non-dimensional variables are employed to simplify the governing equations. The Finite Difference scheme is applied to solve the coupled partial differential equations and the corresponding boundary conditions.

2. RESULTS & HIGHLIGHTS OF IMPORTANT POINTS

The effects of physiologically pertinent parameters such as Jeffrey parameter, Womersley parameter, Hartmann number, radially variable viscosity, hematocrit, Darcy number, slip parameter, concentration, and mass parameters on fluid and particle velocity are analyzed. The results reveal that fluid and particle velocity enhances when the Darcy number amplifies, while fluid and particle velocity decreases when the slip parameter increases. The shear stress at the wall amplifies when the slip parameter augments, whereas it reduces when the Darcy number enhances. Also, an increase in hematocrit amplifies the shear stress on the wall. The salient feature is that permeability in the arterial wall plays a predominant role in reducing the magnitude of wall shear stress.

Further, the flow rate and flow resistance are computed, and the effects of various parameters are investigated. Several developed mathematical models existing in the literature on blood

[1] Further author information: (Send correspondence to A.S.)

A.S.: E-mail: anandasrinivasans@gmail.com

R.T.: E-mail: tamil@nitt.edu, Address: Department of Mathematics, National Institute of Technology Tiruchirappalli, Tiruchirappalli, Tamil Nadu, India

flow have become a particular case of the present work by considering appropriate values of the parameters. The findings from this model have essential implications for understanding interactions between blood flow, magnetic nanoparticles, and permeability in the arterial wall. By elucidating the underlying mechanisms, these insights can inform the development of targeted drug delivery systems and therapeutic interventions for cardiovascular disease.

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