Tri-hybrid nanofluid flow through stenotic artery

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1. INTRODUCTION & OBJECTIVE

Due to modern lifestyle, risk of heart attack is increasing rapidly. One of the many causes of this disease is hardening and contraction of the walls of blood vessels. In the language of medical science it is called as arterial stenosis. Stenosis affects flow of blood to different organs that may cause to defect in many organs like kidney, heart and also increases chances of high blood pressure. Young[1] was the first author who proposed an idea about the boundary asymmetry that can be a cause of development and progress of atrial disease. Blood-mediated nanoparticle delivery is the trendiest and fastest growing area in the evolution of pharmaceuticals and diagnostics. Sarwar et.al.[2] achieved computational solution of flow of blood mixed with nanoparticle in stenotic artery. Sahoo[4] studied the various shaped nanoparticle-based trihybrid nanofluid. Adun et.al. [5] presented synthesis, stability and thermophysical properties of trihybrid nanofluids. Ismail et.al.[3] investigated thermal instability of blood- based Tri-hybrid Casson nanofluid with thermal radiation saturated porous medium with four different types of enclosure.

The purpose of this research work is to investigate the flow of blood mixed with Tri-hybrid nanoparticles (Cu, Ag, Fe) of three different shapes passing through stenotic artery. The coupled navier stroke equations along with boundary condition are converted into ordinary differential equation using appropriate similarity transportation and diminished to non-dimensional form by using boundary layer approximation. Effect of all flow parameters over velocity and temperature profile are shown using Matlab -BVP4C.

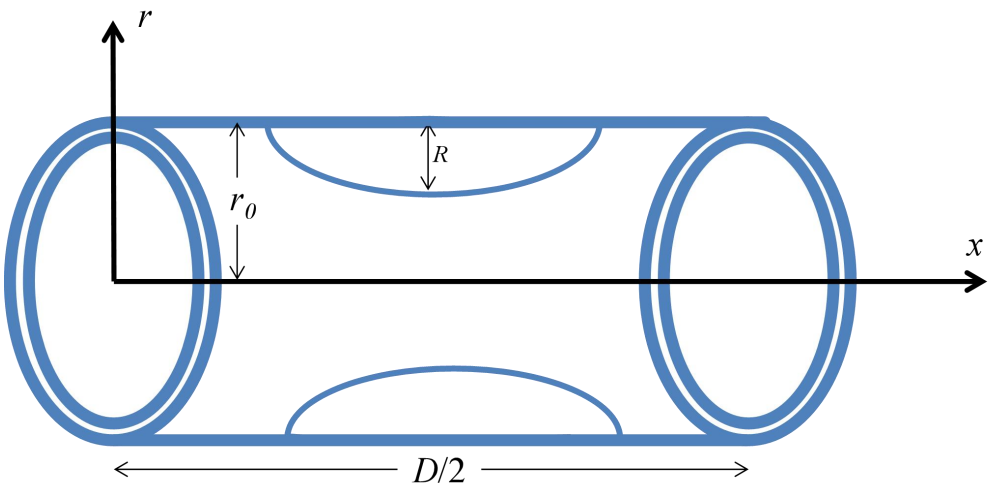

Fig. 1: Schematic diagram of stenosed artery

The two-dimensional incompressible flow of blood which is Newtonian fluid through stenotic artery of length $\frac{D}{2}$ is considered. The stenoised region is of cosine shape with maximum height λ. The radius of artery is $R(x)$ and unblocked area has width $2r_0$. The profile for stenosed region is defined as

$$R(x) = \left.\begin{matrix} r_0 - \frac{\lambda}{2}\left(1+\cos\left(\frac{4\pi x}{D}\right)\right), \\ r_o, \quad \text{otherwise} \end{matrix}\right\}, -\frac{D}{4} < x < \frac{D}{4} \qquad (1)$$

The governing equations for the Newtonian nanofluid are expressed as follows

$$\frac{\partial(ru)}{\partial x} + \frac{\partial(rv)}{\partial r} = 0 \qquad (2)$$

$$u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial x} = \frac{\mu_{thnf}}{\rho_{thnf}}\frac{\partial}{r\partial r}\left(r\frac{\partial u}{dr}\right) \qquad (3)$$

$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial r} = \frac{k_{thnf}}{(\rho C_P)_{thnf}}\frac{\partial}{r\partial r}\left(r\frac{\partial T}{\partial r}\right) \qquad (4)$$

Together with boundary conditions

$$\left.\begin{matrix} u{=}0, v{=}0 \text{ and } T{=}T_1 \text{ at } r{=}R(x) \\ \frac{\partial u}{\partial r}{=}0, \ \frac{\partial T}{\partial r}{=}0 \text{ at } r{=}0 \end{matrix}\right\} \qquad (5)$$

Equation (2), (3), (4) along with boundary condition (5) is converted into ordinary differential equation and nondimensionalised using appropriate similarity transformation. Then computational solution achieved using MATLAB-BVP4c.

2. RESULTS & HEIGHTLIGHTS

We examined the effect of tri hybrid nanofluid (spherical shaped Cu, platelet shaped Ag, cylindrical shaped Fe) in blood through stenotic artery. Initial one-phase hybrid nano-liquid has been extended to a ternary hybrid nanofluid. It is reported that due to amplification in the curvature parameter, the velocity profile increases which can make the flow of blood smoother and risk of heart attack can be lowered. Also magnification of the curvature parameter leads to improved temperature profile which has a positive effect on the patient health. By changing different flow parameters, we can alter the velocity and temperature of blood which will help in patient health and diagonisis.

REFRENCES

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