J. Appl. Comput. Mech., 9(1) (2023) 274-293
DOI: 10.22055/jacm.2022.40984.3688

ISSN: 2383-4536
jacm.scu.ac.ir

Shahid Chamran University of Ahvaz

Journal of Applied and Computational Mechanics

Research Paper

Analytical Investigations for the Joint Impacts of Electro-osmotic and Some Relevant Parameters to Blood Flow in Mildly Stenosis Artery

Takia Ahmed J. Al-Griffi[1], Abdul-Sattar J. Al-Saif[2]

[1] Department of Mathematics, College of Education for Pure Science, Basrah University, Basrah, Basrah, 61001, Iraq, Email: takiaahmed44@yahoo.com
[2] Department of Mathematics, College of Education for Pure Science, Basrah University, Basrah, Basrah, 61001, Iraq, Email: sattaralsaif@yahoo.com

Received May 31 2022; Revised September 11 2022; Accepted for publication September 11 2022.
Corresponding author: T.A.J. Al-Griffi (takiaahmed44@yahoo.com)

Abstract. The joint impacts of electro-osmotic, variable viscosity, magnetic field, chemical reaction, and porosity on blood flow in the artery slant from the axis at an angle with mild stenosis are investigated using Yang transform homotopy perturbation method (YTHPM). The mathematical model, solved by Tripathi and Sharma, is developed by adding the effect of electro-osmosis. The results of axial velocity, concentration, temperature, and the wall shear stress for blood flow are studied in two cases, the absence and presence of electro-osmosis. The results illustrate that an increase in the electro-osmotic parameter and Helmholtz Smoluchowski velocity leads to velocity increases, while the temperature increases when the Joule heating increases with constant values of electro-osmotic parameter and Helmholtz Smoluchowski velocity. On the contrary, it is noted that the electro-osmotic on concentration has no significant effect. Moreover, the importance of applying electro-osmotic is exhibited through proper use and explaining that how it can benefit physicians during surgical operations. Furthermore, a contour plot is created to show the difference in the profile of velocity to the flow of blood when the magnetic field is increased and the altitude of stenosis takes the larger values. The results exhibit that YTHPM is effective in finding the analytical approximate solutions for Newtonian blood flow under the electro-osmotic parameter influence, with good convergence. In addition, the new solutions' graphs demonstrate the truthfulness, utility, and exigency of YTHPM which are in excellent agreement with the results of earlier investigations.

Keywords: Yang transform homotopy perturbation method (YTHPM), blood flow, mild stenosis arteries, electro-osmotic, variable viscosity, magnetic field and chemical reaction.

1. Introduction

The study of blood flow and its diseases has recently received great interest from scientists and researchers. This interest is due to the fact that the blood transports all the important substances, nutrients and oxygen to all parts of the human body trans arterioles and veins, and this in turn helps to regulate the human body temperature. Because the arteries play a great role in this transfer process, so the study of diseases that affect the arteries has received a great interest in recent times. One of the important diseases that infects the arteries and affects the process of blood flow is atherosclerosis, known as stenosis. This stenosis takes place when fatty substances are deposited on the inner wall of the arteries, which leads to a significant decrease in blood flow to the corresponding body organs, which results in disturbances in the blood circulation. Many scientists and researchers are looking to find solutions for studying the problems of blood flow in arteries that contain stenosis (one or multiple stenosis) by using different methods for different models of blood such as; Ali et al. [1] used finite difference method to study unsteady pulsatile blood flow through a tapered stenosis artery. Mandal et al. [2] applied a finite difference scheme to estimate the effect of externally body acceleration on the laminar pulsatile blood flow through an artery that has a stenosis. Chakravarty and Mandal [3] theoretically solved the nonlinear behavior of blood flow during a single cardiac cycle through an arterial segment with intervening stenosis when subjected to whole-body acceleration. Srivastava et al. [4] investigated the blood flow problem through constriction of the intervening arteries. Zaman et al. [5] analyzed the unstable pulsatile flow of blood through a tapered artery with stenosis. The Carreau model was used to capture the rheology of the blood flowing. At the same time, the study of arteries with stenosis that slants at an angle from the axis, also the impact of magnetic field on blood flow are currently receiving much attention; some of these studies are; Ikbal et al. [6] used finite difference scheme to solve the non-Newtonian blood flow through artery has stenosis in the presence of a transverse magnetic field. Varshney et al. [7] studied numerically the incompressible, non-Newtonian, fully developed, and laminar blood flow in an artery with multiple stenosis under the action of transverse magnetic field. Siddiqui and Geeta [8] utilized a perturbation scheme to study the characteristics of blood flow in slant

Published online: September 22 2022