Blood Circulation Of Mathematical Model In Flexible-Gluey Fluid With The Influence Of Electromagnetic Force

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Abstract
We are dealing with the theoretical and mathematical analysis in this paper and the complex study of a human body is regularly exposed to an exceptionally productive gluey liquid with electromagnetic forces. Equations are solved by using the technique of finite Hankel transformation; reliable schemes of consistent blood progression as investigated by couple stress fluids. The variations of these amounts of blood fluid with various variables connected with the examined fluid flow. With the assistance of graphs, the effects of body acceleration on blood flow within the magnetic impacts are explored and discussed. The results of magnetic effects used to determine flow, which in certain cases of respiratory failure, etc, can be useful.

Keywords: Transformation technique of finite Hankel, blood circulation, viscous fluid, respiratory failure, electromagnetic force.

1. INTRODUCTION

Blood hemodynamics by blood flow in flexible-gluey fluid with electromagnetic force, because these models represent a significant risk to well-being and are an important reason for the modern world's mortality and undesirable future. An increasing enthusiasm for the development through cylinders of time-free non-Newtonian fluids with distinctive yield value as a result of their applications in biofluid materials. The hemodynamic though concentrating a sensible issue, the magnetic effects on blood circulation can not be neglected. Magnetostrictive applications have been identified as the perfect tool for fluid flow control. During the last few decades, the investigation of a stream along a vein has received a lot of consideration. The clinicians are attracted by scientific models of blood circulation through conduits, however in vivo examinations are troublesome, inefficient and restricted to effectively open passages. Thought experiment tests and numerical exhibits suggest appealing examination strategies. As indicated by the specific size of the phenomenon to the examined, in ordinary life, numerous accelerated confounding influences are essential, including working a jack hammer, riding a vehicle, entering and falling off and unexpected body developments during sports exercises. Kumar et al. (2005) explored a computer based system for stream in vein with permeable parameter and their applications. Kumar et al. (2007) found convective dissemination procedure of arteries within the effects of permeable parameter and their applications. Korenaga et al. (1998) studied biochemical factors, for example, quality articulation and egg whites transport in atherogenessis and plaque rupture. There appeared to enact by hemo-dynamic factors in wall shear stress. The idea of suction by tissues in the vessels has not been considered in these studies.

Whenever Kumar et al. (2008) examined mathematical model of blood vessel solidness and systolic hypertension and their applications. Ahmadi and Manvi (1971) established a general condition of movement for progression of a thick fluid through a permeable parameter. The magnetic effects of the fluid are in actuality a non-homogenous medium. For examination, it is conceivable to supplant it with a homogenous fluid, which has dynamical properties proportional

to the neighborhood midpoints of the first non-homogenous medium. In some neurotic circumstances, the appropriation of greasy cholesterol and supply route obstructing blood clumps in the lumen of the coronary artery can be considered as proportionate to an imaginary permeable medium. Das and Batra (1994) considered the progression of a Casson fluid in the passage area of a permeable cylinder with suction and infusion at the divider utilizing a changed force vitality fundamental technique. Pontrell (2004) found a multistage approach for displaying wave spread in a blood vessel portion. When examined fluid flow in a channel loaded up with a homogenous permeable medium. El-Shehawey (2000) established a temperamental progression of blood as an incompressible Newtonian liquid through a permeable medium affected by body acceleration. El-Shahed (2003) studied the pulsatile flow of Newtonian liquid through a stenosed permeable medium affected by periodic body acceleration.
In the investigation done on an object which may be valuable to the basic type of velocity and body acceleration articulation for the blood move through arteries in the permeable effects which may help individuals working in this field as well as help in Bio-physiological liquid elements and clinicians.

2. Mathematical Model

In this discussion, within the sight of body acceleration along the circular artery radius, we consider the movement of blood flow as an incompressible fluid and Flexible-Gluey fluid and also recognize the flow as removably symmetric with magnetization influences. The gradient with pressure is given by

$$-\frac{\partial p}{\partial z} = P_0 + P_1\cos(\omega t), \qquad t\geq 0 \tag{1}$$

$$G = a_0\cos(\omega_1 t + \phi) \qquad t\geq 0 \tag{2}$$

where P_0 the steady –state part of pressure gradient, P_1 the amplitude of the oscillatory part; $\omega=2\pi f$ and f the heart pulse frequency, a_0 the amplitude of body acceleration; $\omega_1=2\pi f_1$ and f_1 the body acceleration of blood flow, ϕ is the phase difference, z is the axial axis.

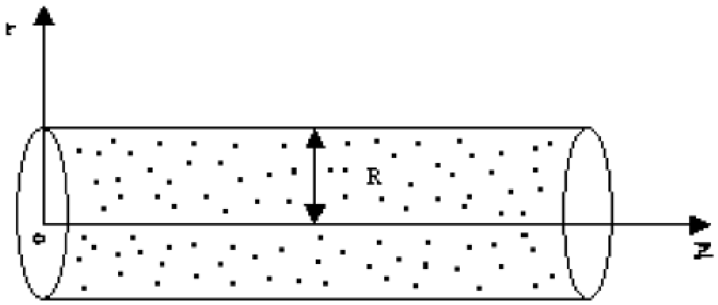

Figure 1: Geometric construction and dynamical structure of blood flow through artery.

The governing equations are as given below:

$$\rho\frac{\partial u}{\partial t} = P0 + P_1\cos\omega t + a_0\cos(\omega_1 t + \phi) + (\mu + \mu_1\frac{\partial}{\partial t})(\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r}) - Mu \tag{3}$$

where u(r,t) is velocity in axial direction , ρ and μ are the density and viscosity of blood, μ_1 is elastico-viscosity coefficient, σ is the electrical conductivity, M is Hartmann Number and r radial coordinate.

Consider the following dimensionless quantities are given below:

$$u^* = \frac{u}{\omega R}, \quad r^* = \frac{r}{R}, \quad A_0^* = \frac{R}{\mu\omega} A_0, \; A_1^* = \frac{R}{\mu\omega} A_1, \; z^* = \frac{z}{R}, \; t^* = t\omega$$

(4)

By solving them equation in (3) becomes

$$\alpha^2 \frac{\partial u}{\partial t} = P0 + P1\cos t + a0\cos(bt+\phi) + (1+\beta\frac{\partial}{\partial t})(\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r}) - Mu$$

(5)

Where $\beta = (\omega \mu_1 / R\mu)$ is dimensionless parameter of elastic-viscosity of the fluid $\alpha = R\sqrt{(\omega\rho/\mu)}$ is (Womersley parameter); $H = R\sqrt{(M/\mu)}$; H is the (Hartman number); $b = \left(\frac{\omega}{\omega_1}\right)$ and R is the radius of artery.

The initial and boundary conditions are:

$$u(r;0) = \frac{(P_0+P_1)}{H^2}(1 - \frac{I_0(H\,r)}{I_0(H)})$$

(6)

u (1;t) = 0

(7)

u (0;t); is finite

(8)

3. Numerical Procedure

By using Laplace transform equation (5) becomes

$$\alpha^2 s\bar{u} - \alpha^2 u(r;0) = \frac{P_0}{s} + \frac{P_1 s}{s^2+1} + \frac{a_o(s\cos\phi - b\sin\phi)}{s^2+b^2} + (\frac{\partial^2}{\partial r^2} + \frac{1}{r}\frac{\partial}{\partial r})[\bar{u} + \beta s\bar{u} - \beta u(r;0) - M$$

(9)

by usinging the finite Hankel transform on equation (9) & (7), we get

$$\bar{u}^*(\lambda_n, s) = \frac{J_1(\lambda_n)}{\lambda_n}\{\frac{P_o}{\lambda_n^2 + H^2}(\frac{1}{s} - \frac{1}{s+h})$$

$$+\frac{P_1(\lambda_n^2+H^2)}{(\lambda_n^2+H^2)^2(\alpha^2+\lambda_n^2\beta)^2}[\frac{-1}{s+h} + \frac{s}{S^2+1} + \frac{\alpha^2+\lambda_n^2\beta}{(\lambda_n^2+H^2)(s^2+1)}] +$$

$$\frac{a_0(\lambda_n^2+H^2)\cos\phi}{(\lambda_n^2+H^2)^2+(\alpha^2+\lambda^2\beta)b^2}[\frac{-1}{s+h} + \frac{s}{s^2+b^2} + \frac{(\alpha^2+\lambda_n^2\beta)b^2}{(\lambda_n^2+H^2)(s^2+b^2)}]$$

$$-\frac{a_0 b\sin\phi(\alpha^2+\lambda_n^2\beta)^2}{(\lambda_n^2+H^2)^2+b^2(\alpha^2+\lambda^2\beta)^2}[\frac{1}{s+h} - \frac{s}{s^2+b^2} + \frac{\lambda_n^2+H^2}{(s^2+b^2)(\alpha^2+\lambda_n^2\beta)}] + \frac{A_0+A_1}{(\lambda_n^2+H^2)}\frac{1}{(s+h)}\} - M, \quad (10)$$

where $h = \dfrac{\lambda_n^2 + H^2}{\alpha^2 + \lambda_n^2 \beta}$,

(11)

The Laplace and Hankel inversion transform of equation (10) gives the solution are as given below:

$$u(r;t) = 2\sum_{n=1}^{\infty} \frac{J_0(r\lambda_n)}{\lambda_n J_1(\lambda_n)} \left[\frac{A_0}{\lambda_n^2 + H^2} + \frac{A_1\left((\lambda_n^2 + H^2)\cos t + (\alpha^2 + \beta\lambda_n^2)\sin t\right)}{(\lambda_n^2 + H^2)^2 + (\alpha^2 + \beta\lambda_n^2)^2} \right] +$$

$$\frac{a_0(\lambda_n^2 + H^2)\cos(bt+\phi) + (\alpha^2 + \beta\lambda_n^2)\sin(bt+\phi)}{(\lambda_n^2 + H^2)^2 + b^2(\alpha^2 + \beta\lambda_n^2)^2}$$

$$+e^{-bt}\left[\begin{array}{l} \dfrac{A_0}{(\lambda_n^2 + H^2} + \dfrac{A_1(\lambda_n^2 + H^2)}{(\lambda_n^2 + H^2)^2 + (\alpha^2 + \beta\lambda_n^2)^2} - \dfrac{A_0 + A_1}{\lambda_n^2 + H^2} \\ + \dfrac{a_0(\lambda_n^2 + H^2)\cos(\phi) + (\alpha^2 + \beta\lambda_n^2)\sin(\phi)}{(\lambda_n^2 + H^2)^2 + b^2(\alpha^2 + \beta\lambda_n^2)^2} \end{array} \right] - M$$

(12)

The calculation of the flow rate Q is by

$$Q = 2\int_0^1 ru\,dr \,,$$

(13)

(14)

The fluid acceleration F is as given as:

$$F(r,t) = \frac{\partial u}{\partial t},$$

(15)

$$F(r;t) = 2\sum_{n=1}^{\infty} \frac{J_0(r\lambda_n)}{\lambda_n J_1(\lambda_n)} \left[\frac{A_0}{\lambda_n^2 + H^2} + \frac{A_1\left((\lambda_n^2 + H^2)\sin t - (\alpha^2 + \beta\lambda_n^2)\cos t\right)}{(\lambda_n^2 + H^2)^2 + (\alpha^2 + \beta\lambda_n^2)^2} \right] +$$

$$\frac{a_0(\lambda_n^2 + H^2)\cos(bt+\phi) + (\alpha^2 + \beta\lambda_n^2)\sin(bt+\phi)}{(\lambda_n^2 + H^2)^2 + b^2(\alpha^2 + \beta\lambda_n^2)^2}$$

$$-\frac{e^{-ht}}{h}\left[\begin{array}{l} \dfrac{A_0}{(\lambda_n^2 + H^2} + \dfrac{A_1(\lambda_n^2 + H^2)}{(\lambda_n^2 + H^2)^2 + (\alpha^2 + \beta\lambda_n^2)^2} - \dfrac{A_0 + A_1}{\lambda_n^2 + H^2} \\ + \dfrac{a_0(\lambda_n^2 + H^2)\cos(\phi) + (\alpha^2 + \beta\lambda_n^2)\sin(\phi)}{(\lambda_n^2 + H^2)^2 + b^2(\alpha^2 + \beta\lambda_n^2)^2} \end{array} \right] - M$$

(16)

4. Results

The role of viscosity parameter K and Hartmann number, excess of body acceleration on the gradient, is discussed and investigated in our scientific research. Table 2 illustrates that as the porousness of the permeable media K increases, the acceleration increases more as the velocity decreases as H grows. Figure 3 illustrate that the velocity profile improves as body acceleration increases.

The time estimates t and b establish a reduction in velocity (figures 4). Whereas the quickening of blood flow improves as permeable medium variable and body acceleration concentration rises and a comparative reverse pattern is seen in figures 5. Convince that this investigation have been assist in further investigations in the field of therapeutic research, the use of permeable implications for the treatment of certain cardiovascular diseases and also the effects of this investigation can be useful for the misanthropic flow pattern in blood vessels when greasy cholesterol plaques and blood clumps are obscured by passages.

5. CONCLUSION

In the current mathematical model, the blood flows under periodic body acceleration in the effect of electromagnetic field and the enticing impact of dynamic blood have been investigated. In the Hankel transform process, the velocity articulations were obtained. Likewise, the associated expression for flow rate, fluid increasing velocity and shear stress is received.

A reasonable knowledge of body acceleration associates with blood fluid increasing promote restorative use of controlled body to improve velocity. This method of destroying the effects of various types of impulses on various parts of the body is attractive.

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Figure 2. Variation of the velocity profile for M, H = 2, $A_0 = 1$, $A_1 = 4$, $a_0 = 3$,t = 0.5, b = 0.5, ϕ = 15 degree.

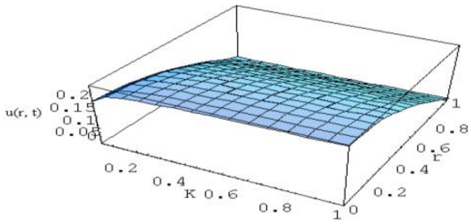

Figure 3. Variation of velocity profile and amplitude of body acceleration a0; H = 2 ,M = 1,A0 = 2,A1 = 4, , t = 0.5,

b= 0.5, ϕ = 15 degree.

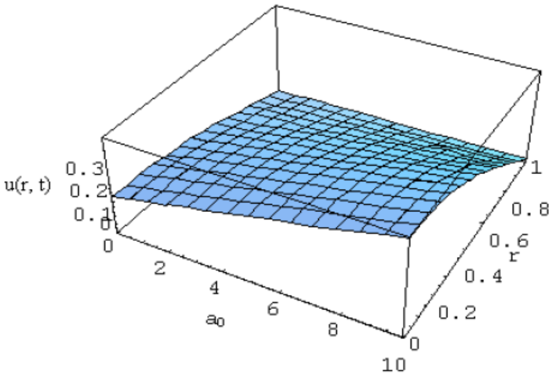

Figure 4 : Variation of the velocity profile for H = 2,M = 1,A0 = 2,A1 = 4, a0 = 3, , b = 0.5,

ϕ = 15 degree.

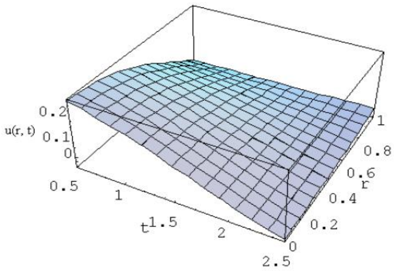

Figure 5: Variation of fluid acceleration for different values of permeability parameter K; H =2,A0 = 2,A1 = 4, a0 = 3,

t = 0.5, b = 0.5, ϕ = 15 degree.