Analytical Survey on the Two-Fluid Blood Flow through Stenosed Artery with Permeable Wall

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Abstract

The womersley flow of blood through constricted arteries is analyzed by considering the blood as a two-fluid model with the suspension of all the erythrocytes within the core region as a non-Newtonian fluid and also the plasma within the peripheral layer as a Newtonian fluid. The non-Newtonian fluid within the core region of the artery is assumed as a Herschel-Bulkley fluid and Casson fluid. The perturbation technique is employed to resolve the ensuing system of non-linear partial differential equations. Expressions for numerous flow quantities are obtained for the two-fluid Casson model. In the present paper, there's associate analysis on the varied researches. It's determined that the plug core radius, pressure drop, wall shear stress and also the resistance to flow are considerably terribly low for the two-fluid Casson model than those of the two-fluid Herschel-Bulkley model. Hence, the two-fluid Casson model would be a lot of helpful than the two-fluid Herschel-Bulkley model to research the blood flow through constricted arteries.

Keywords: Artery, Blood, Mathematical modeling, Permeable wall.

References

1. Artery, From Wikipedia, the free encyclopedia, 2017. https://en.wikipedia.org/wiki/Artery
2. Bertazzo, S. et al. (2013), Nano-analytical electron microscopy reveals fundamental insights into human cardiovascular tissue calcification. Nature Materials 576-583.
3. Ellahia, R., Shafiq-Ur-Rahman, Nadeem, S. & Naturforsch, Z. (2013), Analytical Solutions of Unsteady Blood Flow of Jeffery Fluid Through Stenosed Arteries with Permeable Walls, 68a, 489-498. DOI: 10.5560/ZNA.2013-0032
4. Eldesoky, I. M., Kernel M. H. & Hussien, R. M., (2013), Numerical study of unsteady MHD pulsatile flow through porous medium in an artery using Generalized Differential Quadrature Method, International Journal of Materials, Mechanics and Manufacturing 1(2).
5. Eldesoky, I. M., (2014), Unsteady MHD pulsatile blood flow through porous medium in a stenotic channel with slip at the permeable walls subjected to time dependent velocity (injection/suction), Walailak Journal of Science and Technology 11(12).
6. Medhavi, A. (2013), Macroscopic two-phase blood flow through a stenosed artery with permeable wall, Applied Bionics and Biomechanics, vol. 10, no. 1, pp. 1-9. DOI: 10.3233/ABB-2012-0070
7. Misra J. C. & Shit, G. C., (2006), Blood flow through arteries in a pathological state: A theoretical study, Int. J. Engg. Sci. 44, 662–671.
8. Mandal, P. K., Chakravarty, S. and Mandal (2007), A Numerical study on the unsteady flow of non-Newtonian fluid through diffrerently shaped arterial stenosis, Int. J. Comput. Math. 84, 1059–1077.
9. Ponalagusamy, R., (2007), Blood flow through an artery with mild stenosis: A two layered model, different shapes of stenosis and slip velocity at the wall, J. Appl. Sci. 7(7), 1071–1077.
10. Politis, A. K., Stavropoulos, G. P., Christolis, M. N., Panagopoulos, F. G., Vlachos, N. S. & Markatos, N. C., (2008), Numerical modeling of simulated blood flow in idealized composite arterial coronary grafts: Transient flow, J. Biomechanics, 41(1), pp. 25-39.
11. Raza, T., Farzan, G., Siamak, H. & Kamran, G. (2016), Laminar-to-turbulence and relaminarization zones detection by simulation of low Reynolds number turbulent blood flow in large stenosed arteries, Bio-Medical Materials and Engineering, Vol. 27, no. 2-3, pp. 119-129, 2016. DOI: 10.3233/BME-161574
12. Stenosis, From Wikipedia, the free encyclopedia, 2017.https://en.wikipedia.org/wiki/Stenosis
13. Sankar, D. S. & Ismail, A. I. Md. (2009), Two-Fluid Mathematical Models for Blood Flow in Stenosed Arteries: A Comparative Study,Boundary Value Problems: 568657. DOI: 10.1155/2009/568657

14. Sankar, D. S. (2010), Pulsatile Flow of a Two-Fluid Model for Blood Flow through Arterial Stenosis, Mathematical Problems in Engineering, Volume 2010, Article ID 465835, 26 pages. http://dx.doi.org/10.1155/2010/465835

15. Sharan, M. & Popel, A. S., (2001), A two-phase model for flow of blood in narrow tubes with increased viscosity near the wall, Birheol, 38, 415-428.

16. Singh, A. K. & Singh, D. P. (2013), Effect of hematocrit on wall shear stress for blood flow through tapered artery, Applied Bionics and Biomechanics, vol. 10, no. 2,3, pp. 135-138. DOI: 10.3233/ABB-140080

17. Srivastav, R. K. & Srivastava, V. P., (2014), On two-fluid blood flow through stenosed artery with permeable wall, Applied Bionics and Biomechanics, vol. 11, no. 1,2, pp. 39-45. DOI: 10.3233/ABB-140091

18. Shit, G. C., Roy, M. & Sinha, A., (2014), Mathematical Modelling of Blood Flow through a Tapered Overlapping Stenosed Artery with Variable Viscosity, Applied Bionics and Biomechanics, Volume 11, Issue 4, Pages 185-195. http://dx.doi.org/10.3233/ABB-140102

19. Tripathi, D. (2013), Study of transient peristaltic heat flow through a finite porous channel, Mathematical and Computer Modelling: An International Journal archive,Volume 57 Issue 5-6, pp. 1270-1283. doi>10.1016/j.mcm.2012.10.030

20. Vardakis, J. C. et al., (2015), Investigating cerebral oedema using poroelasticity, Medical Engineering and Physics, pp. 1–10. http://dx.doi.org/10.1016/j.medengphy.2015.09.006