

Computational Simulation Of Blood Flow In Stenosed Arterial Bifurcation Under Body Acceleration

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Abstract

Human body gains acceleration while doing activities such as walking, running, flying and other physical works. It is believed that human can sustain only up to a certain limit of acceleration. Extreme exposure to acceleration can cause serious health problem. Stenosis is a localized narrowing of blood vessel. The arterial bifurcation is one of common sites of occurrence of stenosis. The presence of stenosis will disturb the normal blood flow pattern and ultimately lead to dangerous vascular diseases. Realizing the physiological importance of body acceleration, researches [1-5] have been done to observe the influence of body acceleration on blood flow in arteries.

Motivated from previous studies, the present work developed a computational model of pulsatile blood flow through a bifurcation of artery with stenosis subjects to external body acceleration. The blood is treated as a Newtonian fluid. The flow is modelled as an incompressible and laminar flow passing through a bifurcated channel with an asymmetric obstruction representing a stenosis (see Figure 1). To construct the geometry, the built-in geometry tools in COMSOL Multiphysics 5.0 is used. Simulations are conducted in Fluid Flow physics interface, using the time-dependent, laminar flow setting.

Previous studies have shown that body acceleration enhances the velocity and flow rate, and reduces resistance to flow [2, 3, 5]. The results were displayed in the form of graphs. It is expected that the solutions of the current simulations reach qualitative agreement with those results. To support analyses and discussions of the effects of the localization of stenosis and body acceleration on the flow pattern, results are visualized in the form of velocity profiles, streamlines and pressure contour.

Reference

1. S. Chakravarty and A. K. Sannigrahi, "A nonlinear mathematical model of blood flow in a constricted artery experiencing body acceleration", *Mathematical and Computer Modelling*, vol. 29, pp. 9-25 (1999).
2. P. Nagarani, and G. Sarojamma, "Effect of body acceleration on pulsatile flow of Casson fluid through a mild stenosed artery", *Korea-Australia Rheology Journal*, vol. 20, pp. 189-196 (2008).
3. D. S. Sankar and U. Lee, "Nonlinear mathematical analysis for blood flow in a constricted artery under periodic body acceleration", *Communications in Nonlinear Science and Numerical Simulation.*, vol. 16, pp. 4390-4402 (2011).

4. D. S. Sankar and A. K. Nagar, "Nonlinear fluid models for biofluid flow in constricted blood vessels under body accelerations: A comparative study", *Journal of Applied Mathematics*, vol. 2012, Article ID 950323, doi:10.1155/2012/950323

5. H. T. Amira et al., "Effects of body acceleration on the blood flow through irregular stenosis", UMT 11th International Annual Symposium on Sustainability Science and Management, 2012.

Figures used in the abstract

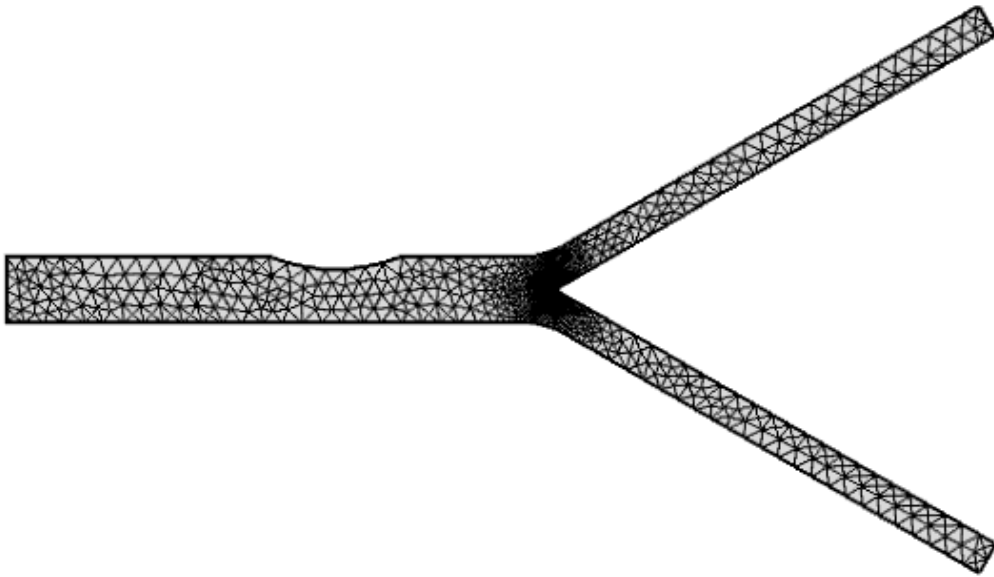


Figure 1: The geometry of arterial bifurcation model