Numerical simulations of a 3D fluid-structure interaction model for blood flow in an atherosclerotic artery

Nader El Khatib
Department of Computer Science and Mathematics, Lebanese American University, Lebanon.
nader.elkhatib@lau.edu.lb

Oualid Kafi, Jorge Tiago and Adelia Sequeira
IST, Lisbon, Portugal.

Abstract

The inflammatory process of atherosclerosis leads to the formation of an atheromatous plaque in the intima of the blood vessel. The plaque rupture may result from the interaction between the blood and the plaque. In each cardiac cycle, blood interacts with the vessel, considered as a compliant nonlinear hyperelastic. A three dimensional idealized fluid-structure interaction (FSI) model is constructed to perform the blood-plaque and blood-vessel wall interaction studies. An absorbing boundary condition (BC) is imposed directly on the outflow in order to cope with the spurious reflexions due to the truncation of the computational domain. The difference between the Newtonian and non-Newtonian effects is highlighted. It is shown that the von Mises and wall shear stresses are significantly affected according to the rigidity of the wall. The numerical results have shown that the risk of plaque rupture is higher in the case of a moving wall, while in the case of a fixed wall the risk of progression of the atheromatous plaque is higher.

Keywords: atherosclerosis, fluid-structure interaction, blood flow, WSS.

References

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