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EFFECT OF NON-NEWTONIAN BEHAVIOUR OF BLOOD AND STRUCTURAL ABNORMALITIES OF ARTERIAL WALL ON BLOOD FLOW IN CIRCLE OF WILLIS

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Fluid-Structure Interaction problems known as FSI problems have a variety of applications in scientific and engineering disciplines which involve interaction between fluid and structure. For most of FSI problems such as blood flow in deformable arteries there is no exact analytical solutions and experimental results are also limited. So, a numerical simulation would help to study the blood flow behavior for different medical issues in the vessels.
This work involves a study based on the numerical simulations of Circle of Willis in the human brain. Finite-Volume method is applied for the calculations by means of foam-extend-3.1. Using Fluid-Structure Interaction solver, blood flow is simulated through the vessels surrounded with different linear elastic structures. First layer is the wall around the arteries, which separates blood flow from the brain tissue and prevents blood leakage into the brain. The whole system is located inside the brain. Therefore, there would be also an interaction between the artery wall and its surrounding material. These two have different properties most notably the modulus of elasticity [1][2]. The effect of tissues surrounding the artery can be considered either using another structure material or using a damping factor for the artery wall. Through different reasons such as smoking, blood pressure, aging, etc. artery wall can thicken or narrow. This can change the blood flow pressure and flow rate in downstream of the Circle of Willis. Apart from this, the mentioned reasons can also lead to either stiffening or weakening of the artery wall. These phenomena in brain can increase the risk of stroke and lead to a medical emergency. So, the exact study of them can be helpful. The calculations are performed for blood as both Newtonian and non-Newtonian fluid and the results will be compared with each other. The simulations are mainly focused on Anterior Communicating Artery located on the upper part of Circle of Willis. Different cases of thickness and stiffness would be calculated and studied. At the end the result will be discussed. [3]

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