Effects of the Material Properties on Hemodynamic Parameters of the Coronary Arteries

Xiu qing Qian*, Yan Wang, Zhilun Zhou and Zhicheng Liu

Beijing, Beijing, China

Atherosclerosis is a kind of multifactorial disease in which conditions such as high cholesterol level, high blood pressure. The purpose of this paper is to research the effect of materials properties of vascular wall and blood on the hemodynamic parameters of the coronary artery. Firstly, the three dimensional model of coronary artery with geometry branches is reconstructed based on the clinical detection of CT images of coronary angiography of a healthy person using the software Mimics. Then, the model is transferred to finite element software. The mechanical property of vascular wall is simplified as the linear elasticity and the flow of blood is taken as transient flow of incompressible Newtonian fluid. Spring elements connected the vascular wall are used to simulate the effect of elasticity of the heart muscle. Finally, a series of solid-fluid coupled analysis are performed to study the effects induced by variations of elastic modulus of the vascular wall and the viscosity of blood. Take the solutions of the second cardiac cycle as the results by comparing the results of different cardiac cycle. The results show that the velocity reaches the maximum value during the cardiac diastole. There are low velocity fields of the blood flow, the bigger value of the deformation and equivalent stress of the vascular wall at the curve part of the blood vessel and neighborhood of the branches. The blood velocity decreases with the decrease of the elastic modulus of the vascular wall and the blood velocity is highest when taking the vascular wall as rigid body. Therefore the deformation effect of the vascular wall should be considered. The low velocity field of the blood flow will become larger with the increase of the viscosity of blood. It can be deduced that while the viscosity of blood increases, atherosclerosis is easily coming on.