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Computational Fluid Dynamics Simulation and Comparison of Flow through Mechanical Heart Valve Using Newtonian and Non-Newtonian Fluid

Authors : D. Šedivý, S. Fialová

Abstract : The main purpose of this study is to show differences between the numerical solution of the flow through the artificial heart valve using Newtonian or non-Newtonian fluid. The simulation was carried out by a commercial computational fluid dynamics (CFD) package based on finite-volume method. An aortic bileaflet heart valve (Sorin Bicarbon) was used as a pattern for model of real heart valve replacement. Computed tomography (CT) was used to gain the accurate parameters of the valve. Data from CT were transferred in the commercial 3D designer, where the model for CFD was made. Carreau rheology model was applied as non-Newtonian fluid. Physiological data of cardiac cycle were used as boundary conditions. Outputs were taken the leaflets excursion from opening to closure and the fluid dynamics through the valve. This study also includes experimental measurement of pressure fields in ambience of valve for verification numerical outputs. Results put in evidence a favorable comparison between the computational solutions of flow through the mechanical heart valve using Newtonian and non-Newtonian fluid.

Keywords : computational modeling, dynamic mesh, mechanical heart valve, non-Newtonian fluid
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