Numerical analysis of 3D blood flow and common carotid artery hemodynamics in the carotid artery bifurcation without stenoses

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Abstract

Blood flow in common carotid artery (CCA) bifurcation without stenoses is studied on the basis of Navier-Stokes equations performing numerical simulations by a finite volume method and considering one wave period. Based on geometry reconstruction a mesh generation is done. The case studies are based on CCA bifurcation without stenoses presented in six characteristic time points of the pulse wave. The structures of the flow around the bifurcation are received. Using the numerical simulation the authors can trace the velocity distribution from common carotid artery (CCA) to the internal carotid artery (ICA) and external carotid artery (ECA). The axial velocity and wall shear stress (WSS) distribution and contours are presented considering characteristic time points. The recirculation zone around the bifurcation is the area of low wall shear stress (WSS). Thus this area is the most probable one for monocytes and platelet aggregation and thrombosis formation. The distribution of the WSS around the bifurcation allow a prediction of the probably sites of stenosis growth.

Keywords: 3D blood flow numerical analysis, carotid bifurcation, wall shear stress, whole blood viscosity