Modeling the effect of different locations of carotid atherosclerosis on hemodynamics parameters

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ABSTRACT

Carotid atherosclerosis is a potentially fatal diseases caused by plaques buildup in arteries that deliver blood to the brain. Over the years, this pathological condition particularly the stenosis size severity has been studied, and computational fluid dynamics has played an essential role in investigating the blood flow behavior. However, the study on the effect of stenosis location especially at the area of bifurcation is still lacking. This study aims to investigate which stenosis location would cause higher risk factor and high flow disturbance to the blood flow. The area susceptible for atherosclerosis is usually at the carotid bifurcation where common carotid artery (CCA) is bifurcated into internal carotid artery (ICA) and external carotid artery (ECA). The computational simulations were performed using idealized geometry of carotid artery with different locations of stenoses. Type I, II and III stenoses were grouped according to the most common type and location stenosis. The results show that the Type I geometry with stenosis extended toward the ICA had higher possibility for the atherosclerosis plaque to grow. Velocity profiles and low wall shear stress contours predicted more complex helical and recirculation blood flow at post-stenotic region of Type I as compared to the other two. The findings indicate that atherosclerosis plaque in the ICA could provide higher risk to the patient and immediate medical treatment shall be required.

KEYWORDS

Atherosclerosis; Computational fluid dynamics; Location of stenosis

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