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Computational analysis of hemodynamic parameters in coronary arteries: Effects of stenosis and bifurcation angle

By

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Abstract

diseases (CVDs) are still becoming the number one cause of death around the world. Coronary artery disease (CAD) is one of the most prevalent types. It is exceedingly crucial to monitor hemodynamic parameters early and precisely in order to determine progresses to become more severe, particularly in regions where arteries bifurcated. This study employs computational fluid dynamics (CFD) simulations to investigate how stenosis and bifurcation angle influence blood flow in the coronary arteries. Seven idealized 3D models of coronary arteries have been developed to show various degrees of narrowing in the arteries. The Carreau model was used to model blood as a non-Newtonian fluid, and the Navier-Stokes equations were used to perform simulations across the cardiac cycle. Key hemodynamic variables like velocity, pressure, and wall shear stress (WSS) were extracted. Results demonstrate that areas with 85% stenosis had maximum velocity of 3.52 m/s, wall shear stress of 78 Pa, and pressures of up to 230 mmHg at time $t = 0.63$ s. These are high-risk areas for disease progression. These outcomes assist in understanding how the shape of arteries affects abnormal flow dynamics, which could help medical professionals find and treat CAD early on.

Keywords

Author Keywords: CVDs; Coronary artery bifurcation; CFD; Stenosis; Hemodynamic parameters

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