A GENERALIZED POWER-LAW MODEL OF BLOOD FLOW THROUGH TAPERED ARTERIES WITH AN OVERLAPPING STENOSIS

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To my beloved parents,

my awesome sisters,

and all family members—

Thank you for your support and unconditional love.
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ABSTRACT

A mathematical model of a generalized Power-law blood flow through a tapered artery with an overlapping stenosis is considered. The flow is assumed to be two-dimensional, unsteady, laminar, incompressible and axisymmetric. The artery is considered to be elastic and time-variant due to the pulsatile flow contributed by the pumping of heart. The continuity equation and momentum equation are derived in the cylindrical coordinate system. Then the radial coordinate transformation is used to transform the equations and boundary conditions in terms of radius of lumen before they are solved numerically using a finite difference scheme. Numerical results obtained show that the blood flow characteristics such as the velocity profiles, flow rate, resistance and wall shear stress are significantly affected by the taper angle of artery, severity of stenosis and time-variant nature of artery. As the taper angle increases, both axial velocity and flow rate increase, while resistive impedance and wall shear stress decrease. However, the radial velocity may increase or decrease with taper angle, depending on radial distance and time. In contrast, increasing the level of stenosis causes the axial velocity and flow rate to decrease, and resistance and wall shear stress to increase. As time progresses, the values of axial velocity, flow rate and resistance decrease during the first phase of cardiac cycle and increase during the second phase. Radial velocity and wall shear stress exhibit different behavior from other flow characteristics. The value of wall shear stress increases during the first phase and decreases during the second phase of cardiac cycle. The value of radial velocity decreases for all time.
ABSTRAK