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Effects of the Fractional Order on Nanoparticles in Blood Flow through the Stenosed Artery

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Abstract : In this paper, based on the applications of nanoparticle, the blood flow along with nanoparticles through stenosed artery is studied. The blood is acted by periodic body acceleration, an oscillating pressure gradient and an external magnetic field. The mathematical formulation is based on Caputo-Fabrizio fractional derivative without singular kernel. The model of ordinary blood, corresponding to time-derivatives of integer order, is obtained as a limiting case. Analytical solutions of the blood velocity and temperature distribution are obtained by means of the Hankel and Laplace transforms. Effects of the order of Caputo-Fabrizio time-fractional derivatives and three different nanoparticles i.e. Fe3O4, TiO4 and Cu are studied. The results highlights that, models with fractional derivatives bring significant differences compared to the ordinary model. It is observed that the addition of Fe3O4 nanoparticle reduced the resistance impedance of the blood flow and temperature distribution through bell shape stenosed arteries as compared to TiO4 and Cu nanoparticles. On entering in the stenosed area, blood temperature increases slightly, but, increases considerably and reaches its maximum value in the stenosis throat. The shears stress has variation from a constant in the area without stenosis and higher in the layers located far to the longitudinal axis of the artery. This fact can be an important for some clinical applications in therapeutic procedures.

Keywords : nanoparticles, blood flow, stenosed artery, mathematical models
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