

ABSTRACT

Peristaltic Transport of a Newtonian Fluid in Finite Length Tubes

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The transport of an incompressible Newtonian fluid driven by peristaltic waves in a tube of finite length, in which the flow is symmetric about the axis of the tube, is studied. Considering the solutions of the governing equations as an asymptotic series with perturbation parameter, the wave number k , and truncating this series at the first order corrective term, the expressions for transverse and axial velocities, pressure, shear stress at the wall and volume flow rate are obtained. The inertial effects of the flow are included in the study, which were neglected in previous studies and the order of the error obtained in these solutions is reduced to k^2 . The effects of wave number on local characteristics and global pumping performance are analyzed. The wave types considered in this analysis are multiple non-integral numbers of waves, integral number of waves and a single wave within the tube. These results are also compared with the limiting case $k = 0$. We observed that the pressure distribution is affected by the wave type. The time averaged volume flow is only slightly affected by non-integral waves and is independent of axial position in the case of multiple train waves. However, for a single wave, the time averaged volume flow is dependent on the position with a reflux flow at the inlet even in co-pumping condition. Due to the wave number, we observed a transformation of the flow parameters which becomes more apparent with a reduction of the occlusion.

Keywords: Andre' Alexander Small; peristaltic transport; finite length tube.