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Secondary flow in a curved artery model with Newtonian and non-Newtonian blood-analog fluids[1] MOHAMMAD REZA NAJJARI, MICHAEL W PLESNIAK, George Washington University — Steady and pulsatile flows of Newtonian and non-Newtonian fluids through a 180°-curved pipe were investigated using particle image velocimetry (PIV). The experiment was inspired by physiological pulsatile flow through large curved arteries, with a carotid artery flow rate imposed. Sodium iodide (NaI) and sodium thiocyanate (NaSCN) were added to the working fluids to match the refractive index (RI) of the test section to eliminate optical distortion. Rheological measurements revealed that adding NaI or NaSCN changes the viscoelastic properties of non-Newtonian solutions and reduces their shear-thinning property. Measured centerline velocity profiles in the upstream straight pipe agreed well with an analytical solution. In the pulsatile case, secondary flow structures, i.e. deformed-Dean, Dean, Wall and Lyne vortices, were observed in various cross sections along the curved pipe. Vortical structures at each cross section were detected using the d_2 vortex identification method. Circulation analysis was performed on each vortex separately during the systolic deceleration phase, and showed that vortices split and rejoin. Secondary flow structures in steady flows were found to be morphologically similar to those in pulsatile flows for sufficiently high Dean number.

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