SIMULATION OF VESSEL STRESS AND SECONDARY FLOWS FOR BLOOD FLOWS THROUGH A REALISTIC AORTA WITH THREE BRANCHES

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Abstract

Blood secondary flows and vessel wall shear stress distributions in a human aortic arch have been predicted numerically for a Reynolds number of 4700 at entrance. The simulation geometry was derived from a three-dimensional reconstruction of a series of two-dimensional slices obtained in vivo. Numerical results demonstrate wall stresses were highly dynamic, but were generally high along the outer wall in the vicinity of the branches and low along the inner wall, particularly in the descending thoracic aorta. The maximum wall stress distribution is presented on the aortic arch in the systole. Extensive secondary flow motion was observed in the aorta, and the structure of these secondary flows was influenced considerably by the presence of the branches. Within the aorta, it is observed that clockwise secondary flow recirculation, also seen in the MRA scan data, appears in the downstream of aortic arch in the late systole and turn out to be a pair of counter-clockwise vortex in the downstream of the arch in the early diastole.

Keyword：Aorta; Newtonian flows; Secondary flow; Wall Stress.