Numerical Simulations of Blood Flows in the Left Atrium LUCY
ZHANG, Rensselaer Polytechnic Institute — A novel numerical technique of solving
complex fluid-structure interactions for biomedical applications is introduced. The
method is validated through rigorous convergence and accuracy tests. In this study,
the technique is specifically used to study blood flows in the left atrium, one of the
four chambers in the heart. Stable solutions are obtained at physiologic Reynolds
numbers by applying pulmonary venous inflow, mitral valve outflow and appropriate
constitutive equations to closely mimic the behaviors of biomaterials. Atrial con-
ntraction is also implemented as a time-dependent boundary condition to realistically
describe the atrial wall muscle movements, thus producing accurate interactions with
the surrounding blood. From our study, the transmitral velocity, filling/emptying
velocity ratio, durations and strengths of vortices are captured numerically for sinus
rhythms (healthy heart beat) and they compare quite well with reported clinical
studies. The solution technique can be further used to study heart diseases such as
the atrial fibrillation, thrombus formation in the chamber and their corresponding
effects in blood flows.

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Date submitted: 04 Aug 2008