Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

On the flow through the normal fetal aortic arc at late gestation
KEREM PEKKAN, PAYMON NOURPARVAR, SRINIVASU YERNENI, LAKSHMI DASI, DIANE DE ZELICOURT, Georgia Institute of Technology, MARK FOGEL, Childrens Hospital of Philadelphia, AJIT YOGANATHAN, Georgia Institute of Technology — During the fetal stage, the aortic arc is a complex junction of great vessels (right and left ventricular outflow tracks (RVOT, LVOT), pulmonary arteries (PA), ductus, head-neck vessels, decending aorta (Dao)) delicately distributing the oxygenated blood flow to the lungs and the body -preferential to the brain. Experimental and computational studies are performed in idealized models of the fetal aorta to understand and visualize the unsteady hemodynamics. Unsteady in vitro flow, generated by two peristaltic pumps (RVOT and LVOT) is visualized with two colored dyes and a red laser in a rigid glass model with physiological diameters. Helical flow patterns at the PA's and ductal shunting to the Dao are visualized. Computational fluid dynamics of the same geometry is modeled using the commercial code Fidap with porous boundary conditions representing systemic and pulmonary resistances ($\sim$400000 tetrahedral elements). Combined (RVOT+LVOT) average flow rates ranging from 1.9 to 2.1-L/min for 34 to 38-weeks gestation were simulated with the Reynolds and Womersly numbers (Dao) of 500 and 8. Computational results are compared qualitatively with the flow visualizations at this target flow condition. Understanding fetal hemodynamics is critical for congenital heart defects, tissue engineering, fetal cardiac MRI and surgeries.

Kerem Pekkan
Georgia Institute of Technology

Date submitted: 05 Aug 2006 Electronic form version 1.4