“Unsteady and Three–Dimensional Simulation of Blood Flow in the Human Aortic Arch”

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755 Baldwin, 3:00 - 4:00 pm
Refreshments 2:30 pm in 743 Baldwin

ABSTRACT
Pulsatile 3-D blood flow in the human aortic arch and its three major branches has been studied numerically for a peak Reynolds number of 2500 and various frequency (or Womersley) parameters. The simulation geometry was derived from the 3-D reconstruction of a series of 2-D slices obtained in vivo using CAT scan imaging on a human aorta. A finite-volume formulation of the Navier-Stokes equations was used on a system of overset grids and the simulations were obtained using a projection method. Results demonstrate that the primary flow velocity is skewed towards the inner aortic wall in the ascending aorta, but this skewness shifts to the outer wall in the descending thoracic aorta. Within the arch branches, the flow velocities were skewed to the distal walls with flow reversal along the proximal walls. 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. Wall shear stress and wall pressure are examined within the aorta and within the branches. Comparison of numerical results with the localization of early atherosclerotic lesions broadly suggests preferential development of these lesions in regions of extrema (either maxima or minima) in wall shear stress and pressure.

BIOGRAPHICAL SKETCH
Dr. Harry A. Dwyer graduated with his Ph.D from Rutgers University and has been on the faculty of the University of California, Davis, since 1967. He has had a number of visiting appointments at various institutions, including those at Stanford University in 1971, University of California, Berkeley, in 1975 and ’76, Nagoya Institute of Technology in Japan in 2000, ONERA, and INRIA in France in 1982 and 1987, and Daimler-Benz Research Labs in Germany in 1996. He served as the Alexander Von Humboldt Professor, Technical University Munich, from 1992 to 1993. Dr. Dwyer also advises and consults numerous research institutions including the Aerospace Corporation, US Army Research Office, Sandia Laboratories, Los Alamos National Laboratories and Daimler-Benz Research Labs, Stuttgart, Germany. Dr. Dwyer was named the Cornell University Scholar in 1985. He is one of the pioneering members of the CFD community and was General Chair of the AIAA Computational Fluid Dynamics Meeting, Boston in 1983, and the 4th International Symposium on Computational Fluid Dynamics, University of California, Davis, 1991. Dr. Dwyer was General Chairman for the 5th Symposium on Overset Grid Solutions and Technology, Sept. 2000. In 1997, he was awarded the Best Paper of the Year by the AIAA Solid Rocket Technical Committee. Over the years, Dr. Dwyer has had many technical publications, invited keynote and plenary lectures and seminars, in the areas of flow simulation and emission control.

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