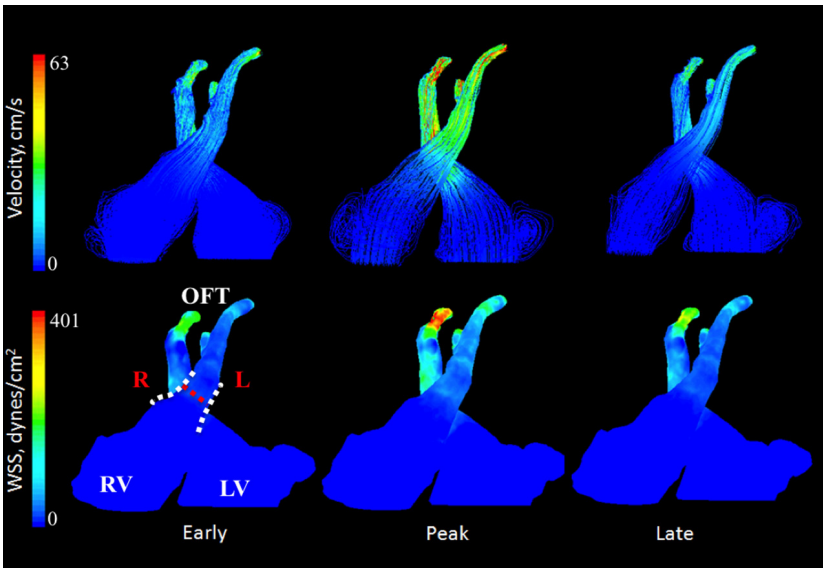
EMBRYONIC HEART RESEARCH

By *ANSYS Advantage* Staff

Researchers in Cornell's Department of Biomedical Engineering are generating a better understanding of the role played by hemodynamic forces in sculpting the embryonic heart and its valves. Hemodynamic forces — the stresses exerted by fluid flow — guide the development of the heart in human embryos; disruptions in these forces are a major cause of congenital heart defects. Understanding these mechanisms would be valuable in addressing congenital heart defects responsible for 10 percent to 30 percent of pre-term fetal deaths. But the very small, tortuous and rapidly changing anatomy of the embryonic heart has made it difficult to quantify these forces, which is crucial to the development of better treatments for congenital heart defects.



Hemodynamic environment in embryonic heart

A Cornell research team used various imaging methods and ANSYS Fluent CFD software to quantify the hemodynamic environment within the developing outflow tract of the embryonic chick heart that evolves toward the aortic and pulmonary valves. Hemodynamic factors such as blood pressure and wall shear stress are possible regulators of cardiac development; these factors can be modulated with microsurgical interventions. Evaluating locally hemodynamic values, such as wall shear stress, within complex 3-D anatomies is a true challenge: Imaging provides only coarse measurements. "We used CFD to provide accurate estimates for local hemodynamic metrics," says Jonathan Butcher, associate professor in the Department of Biomedical Engineering at Cornell. "We confirmed that changes in local flow patterns preceded and correlated with key morphogenetic events such as valve formation; this suggests that hemodynamics may be an important stimulator for cardiac development, since slight variations in normal hemodynamics may lead to heart defects."

CFD provided accurate estimates for local hemodynamic metrics.

Learning Experience
ANSYS and Cornell University have developed a unique collaboration that has flourished for well over a decade, helping to extend Cornell's reputation as one of the world's leading research institutions. ANSYS software is used by students and teachers in the classroom as well as by project teams and researchers to solve challenging mechanical and fluid-flow problems.

Reference
Bharadwaj, K.N.; Spitz, C.; Shekhar, A.; Yalcin, H.C.; Butcher, J.T. Computational Fluid Dynamics of Developing Avian Outflow Tract Heart Valves. *Annals of Biomedical Engineering,* **2012**, Vol. 40, Issue 10, pp. 2212–27.