Department of
Biomedical Engineering
UNIVERSITY OF WISCONSIN-MADISON

Spring 2018 Seminar Series

Great arteries lost & found:

Predictive growth and remodeling of congenital heart defects

Kerem Pekkan, Ph.D.
Assoc. Professor of Engineering
Koç University, Istanbul

Embryonic pharyngeal aortic arches (AA) are bilaterally paired transient vessels that form the great arteries of adult circulation. Proper regression and remodeling of the six left and right AA are critical as their abnormalities result in complex congenital heart defects (CHD).

Here, for the first time in literature, I will discuss the recovery potential of embryonic arterial microstructure and AA lumen (following a fetal surgical intervention) that alters the mechanical loading is studied in a chick embryo CHD model. Time-lapsed mechanosensitive gene expression levels of major molecular pathways (30 genes) and immunohistochemistry patterns of key vascular constituents are compared with the computational growth and remodeling (G&R) simulations. The three-dimensional predictive G&R algorithm is implemented in FeBio as an extension of our earlier functional optimization-based growth framework. Developing AA's are adequately represented as a micro-meso scale jell-like material with a mean wall thickness of ~70 μm. Material properties are obtained through optical coherence tomography guided servo-null dynamic pressure and micropipette aspiration measurements performed at a key stage during embryonic development (Stages 18, 21 and 24). Translation of this approach to CHD patients may one day eliminate the need of complex three-staged open-heart surgeries, typically needed to reconstruct a functional circulation system.

ABOUT the SPEAKER

Dr. Kerem Pekkan was trained at Middle East Technical University, Purdue University and Georgia Institute of Technology School of Biomedical Engineering and led his research laboratory at Carnegie Mellon University as an Associate Professor before joining Koc University. His studies contributed to the physiological understanding of pediatric cardiovascular surgeries and helped establishing the new research field of embryonic cardiovascular mechanics. He has over 80 peer-reviewed publications and holds five US patents. His research is sponsored through American Heart Association, National Science Foundation CAREER program and recently through the most prestigious awards of Europe: European Research Council (ERC) Consolidator and European Molecular Biology (EMBO) grants. He has also received the Prof. Dr.-Ing. Helmut Reul Young Investigator award for his work on novel cardiovascular devices. Dr.Pekkan is currently working on a book titled "Hemodynamic cardiovascular surgical planning - a practical toolkit with open source tools"

Monday, February 26, 2018
12 PM in Tong Auditorium (1003 Engineering Centers)