



FMRC Fluid Mechanics Research Seminar Series

What is New in Cardiovascular Fluid Mechanics?

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Abstract: We will review the current advances in cardiovascular fluid mechanics followed by our own research on pediatric, embryonic cardiovascular mechanics and bio inspired fluid dynamics. One intriguing example is the emergence, and extinction of embryonic aortic arches as they form the mature brachiocephalic arteries, aortic arch and pulmonary arteries during fetal development. CV morphogenesis and adaptation are regulated by both genetic and epigenetic factors. Flow-driven loading plays a significant role in this dynamic multi-scale process, which is clinically described as the “flow-dependency” principle. In nature, there exist a great variety of circulation systems having peculiar hemodynamics and diverse energetic performance, due to arbitrary numbers and orientation of ventricles, auto-regulated shunts and exotic CV valve designs to address O₂ and nutrition transport. Hemodynamics of the pediatric stage will be presented through neonatal cardiopulmonary by-pass, systemic-to-pulmonary shunt and patient-specific venous confluence models that feature complex flow instability and unsteadiness. These studies are important for Pediatric Cardiology and Surgery, providing hemodynamic understanding of pediatric pulmonary/venous function, hepatic growth factor mixing and adult “failed” physiology, impacting patients with congenital heart defects.

Biography: Kerem Pekkan is a faculty member at Koc University Mechanical Engineering Department. He is trained at Middle East Technical University, Purdue University, Georgia Institute of Technology and led his independent research laboratory at Carnegie Mellon University as an Associate Professor. His studies span bio inspired fluid dynamics, embryonic biomechanics and cardiovascular fluid dynamics through particle image velocimetry and computational fluid dynamics. His team focuses pediatric cardiovascular engineering in order to improve the surgical outcome of congenital heart defects. Professor Pekkan authored over 70 peer-reviewed manuscripts and holds three US patents. He is the Associate Editor of Artificial Organs and BMES Cardiovascular Engineering and Technology journals. On 2013 he served as an organizer of the APS Division of Fluid Dynamics meeting. He is supported through US-NSF CAREER, AHA, NIH, TUBITAK and ERC awards.

