# Seminars in Biotechnology BTEC 592 & BTEC 692

## "Cardiovascular Biology, Engineering and Devices"

**Thursday, April 1, 2021**
**14:30**

**Prof. Dr. Kerem Pekkan**
Koc University,
Mechanical Engineering Department

Dr. Kerem Pekkan is 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. He is working on biological fluid mechanics and cardiovascular mechanotransduction. His lab contributed to the physiological understanding of pediatric cardiovascular surgeries and embryonic cardiovascular mechanics. He has over 100 peer-reviewed publications and holds five international patents. His research is sponsored through American Heart Association, National Science Foundation CAREER program, European Research Council (ERC) Consolidator and European Molecular Biology (EMBO) and Tubitak Lead Investigator grants. He also received Prof. Dr.-Ing. Helmut Reul Young Investigator and Prof. Dr. Mustafa Parlar Science awards due to his work on novel cardiovascular devices targeting pediatric patients.

### Abstract

Interdisciplinary research activities that are centered on cardiovascular engineering, molecular biology and clinical sciences, targeting congenital diseases will be presented. The first part of the talk will cover, embryonic pharyngeal aortic arches (AA), which 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 complex congenital heart defects (CHD). Here, the recovery potential of embryonic arterial microstructure and AA lumen, following a model 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 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 software can predict developing AA's in the computer. Tissue 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. The lsecond part of the talk will cover the biofluid mechanics of blood-wetted cardiovascular devices incluiding novel mechanical heart pumps, blood cannulas and heart valves.