

The Two-Way Street of Cardiovascular Biomechanics: Connecting Basic and Applied/Translational Research

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Abstract

Problems in cardiovascular biomechanics are characterized by complexity arising from the multi-scale structure (organ or tissue), the strongly non-linear nature of governing physics, and the clinical manifestation (etiology, patho-physiology, and clinical intervention). Biomechanics studies addressing such problems are therefore multi-faceted with the spectrum of investigations spanning basic to applied / translational research. Often the applied / translational research can lead to new basic areas of inquiry. This paradigm is illustrated with a specific example, namely heart valve disease. With regards to the “basic” biomechanics studies addressing heart valve disease, the focus is generally on developing a theory or some understanding that links specific traits of mechanics to disease. These studies could be on embryonic, pediatric, or adult models depending on the specific clinical manifestation. I will present two novel models developed in our laboratory involving (a) the embryonic zebrafish to study congenital heart defects at early stages of gestation; and (b) in-vitro model to study the initiation of calcific aortic valve disease. In these studies the emphasis is on engineering modeling of the biomechanical environment and piecing together the link to disease. With regards to “applied / translational” biomechanics studies addressing heart valve disease, the focus is generally on either engineering solutions such as device development, or developing a clinically relevant measure for diagnosis and clinical management. In this regard, I will present recent efforts in our laboratory focused on artificial heart valve engineering. In these studies the emphasis is on synergizing state-of-the-art biomaterials with biomechanical design as well as strategies to tackle the complex problem of minimally invasive heart valve therapy. I will briefly discuss strategies such as novel polymeric heart valves as well as heart valves with flow control technologies. Finally, with regards to the new “basic” studies emerging from “applied / translational” research, the problem of blood damage in turbulent flows will be discussed with theoretical implications.

Biography

Lakshmi Prasad Dasi is currently Assistant Professor at the Department of Mechanical Engineering, Colorado State University. He obtained his M.S and Ph.D. in Civil and Environmental Engineering from Georgia Tech in 2000, and 2004 respectively with a focus on turbulent mixing. His bachelor's degree is from Indian Institute of Technology, Mumbai. His research interests include biofluid mechanics, flow control in medical devices, and fluid turbulence.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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