HÜSEYİN ÇAĞATAY YALÇIN
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Curriculum Vitae

ACADEMIC and RESEARCH APPOINTMENTS / EDUCATION

06/2016 – ongoing, Assistant Professor of Research, Biomedical Research Center, Qatar University, Doha QATAR.

02/2010 – 06/2016, Senior Scientist, Qatar Cardiovascular Research Center (QCRC), Qatar Foundation, Doha, QATAR.

09/2010 – 02/2015, Assistant Professor, Dogus University, Mechanical Engineering Dept., TURKEY.

06/2008 – 09/2010 Postdoctoral Researcher, Cornell University**,** Dept. of Biomedical Engineering, USA. Postdoc Advisor: Prof. Jonathan Butcher (Cardiovascular Developmental Bioengineering Lab. www.butcherlab.com). Research Topic: in-vivo investigation of congenital heart defects. Techniques include ultrasonography, micro-CT, confocal and two-photon imaging, femtosecond pulsed laser photoablation, computational fluid dynamics modeling via MIMICS and ANSYS, RT-PCR and immunohistochemistry.

08/2001 – 08/2007 M.S. and Ph.D. in Mechanical Engineering, Bioengineering Program, Lehigh University, Phd Advisor: Prof. Samir Ghadiali. Thesis title: Influence of hydrodynamic stresses, cellular mechanics and environmental conditions on epithelial cell injury during airway reopening. Techniques include oscillating optical tweezers based cell mechanical property measurements, in-vitro shear stress experimentation, and computational fluid dynamics modeling via COMSOL.

08/1996 – 06/2001 B.S. in Mechanical Engineering**,** Middle East Technical University**,** TURKEY

Current Research Focus

Investigation of embryonic development of congenital heart defects (CHDs): For this purpose, clinically relevant heart defects are generated on embryonic animal hearts. Two main animal models utilized are embryonic chick and zebrafish. Chick cardiogenesis is suitable for surgical interference whereas zebrafish cardiogenesis is suitable for genetic interference. Echocardiography and time lapse microscopy are used to assess heart function. Light sheet microscopy, confocal microscopy and micro-CT imaging are used to study morphology in animal hearts whereas gene/protein screeining techniques are utilized to study biological mechanisms. Computational fluid dynamics (CFD) models are generated to simulate blood flow through animal hearts to characterize hemodynamics environment. In parallel clinical studies in collaboration with Hamad Hospital, prenetal patients having CHDs are identified and patient specific-CFD models are generated for the defected hearts to investigate clinical development of CHDs. Therefore, with a variety of animal and clinical studies, the purpose here is to reveal mechano-biological mechanisms contributing to development of CHDs. This information is critical for future rescue strategies for CHDs.

Investigation of the development of calcific aortic valve diseaese (CAVD): For this purpose, bioreactor systems (strain and shear stress setups) are used to expose aortic valve cells to forces seen in natural mechanical environment inside the heart. Subsequent cell calcification under clinically relevant conditions are investigated. Cellular mechanics for the calcified tissue is studied via atomic force microscopy. A variety of biological agents are also tested in their efficiency to minimize calcification in these systems. In parallel studies, CAVD patients are identified and CFD models are generated for the defected hearts to investigate clinical development of the disease. These CFD models are based on fluid-structure approach to simulate the motion of the valve leaflets. Therefore, with a variety of in-vitro and clinical studies, the purpose here is to reveal mechano-biological mechanisms that contribute to CAVD. This information is critical for future therapies for CAVD.

Development of tissue engineered and mechanical aortic valves: Here, artificial aortic valve geometries are designed to have superior ability to interact with the blood flow so that the hemodynamics disturbance

is minimal. For this purpose, fluid-structure interaction approach based CFD models are generated to guide the our tissue engineering collaborators. The manufactured valves are tested in a pulse duplicator system for further flow analysis.

Research Keywords

congenital heart defects, mechanobiology, hemodynamics, shear stress, strain, embryonic chick, zebrafish, echocardiography, confocal microscopy, light sheet microscopy, two-photon imaging, femtosecond pulsed laser photoablation, micro-CT, computational fluid dynamics, fluid-structure interaction, ANSYS, MIMICS, COMSOL, calcific aortic valve disease, atherosclerosis, bioreactor, atomic force microscopy, optical tweezers, artificial aortic heart valve

RESEARCH PROJECTS

Qatar National Research Fund - National Priorities Research Program (NPRP). Co-Lead Principal Investigator for the project entitled as "Mechano-biological Development of Congenital Heart Defects" (NPRP8-2466-3-540). Project Duration is 2016 – 2019 and project budget is 809,000 $. Project is currently on hold due to dissociation of QCRC.

Turkish Science Foundation - The Support Program for Scientific and Technological Research Projects (1001). Principal Investigator for the project entitled as "Development of Accurate Computational Diagnosis Techniques for Aortic Valve Disease". Project duration is 2013-2015 and project budget is 91,000 $.

European Union FP7 Marie Curie Career Integration Grants (CIG). Principal Investigator for the project entitled as "Mechanical Regulation of Congenital Heart Defects". Project duration is 2011-2015 and project budget is 100,000 €.

Turkish Science Foundation - National Young Researchers Career Development Program (3501). Principal Investigator for the project entitled as "Experimental and Computational Investigation of Influence of Heart Outflow Tract Constrictions on Abnormal Embryonic Heart Development". Project duration is 2012-2015 and project budget is 141,000 $.

AWARDS

Turkish Academy of Sciences, 2013 Recipient of Young Scientist Award

INTERNATIONAL RESEARCH COLLABORATIONS

Bilateral Research Co-operation Agreement with Prof. Jonathan Butcher, Cardiovascular Developmental Bioengineering Laboratory at Biomedical Engineering Department of **Cornell University,** USA (www.butcherlab.com), on generating in vivo and computational models of congenital heart defects.

Bilateral Research Co-operation Agreement with Dr. Bassil Akra, Laboratory for Tissue Engineering at the Department of Cardiac Surgery of **Klinikum der Universität München,** Germany (http://www.herzklinik-muenchen.de/en/home/) , on generating computational models of flows through heart valve scaffolds, xenografts and homografts.

TEACHING FOCUS

Courses taught previously:

- *Principles of Biomedical Engineering*: In this course, engineering students are introduced with the specific engineering applications in medicine. Topics include modeling of physiological systems, biofluid mechanics, biomechanics, bioimaging, bioinstrumentation, genetic engineering, biomaterials, tissue engineering and artificial organs. The contents of this course can be tailored according to the needs and interests of the students at the institution. Research projects of the departmental faculty can be explained as novel examples
- *Fundamentals of Fluid Mechanics:* Fundamental laws governing fluid mechanics is explained with scientific and industrial examples

- *Fundamenatls of Heat Transfer:* Fundamental laws governing heat transfer is explained with scientific and industrial examples

Additional basic engineering subjects that can be taught:

- *Thermodynamics*
- *Statics*
- *Dynamics*
- *Strength of Materials*

Specialized courses that can be taught:

- *Computational Biofluid Mechanics*: This course will present the application of fluid mechanics principles to major human organ systems exposed to fluid flow. Topics include circulatory biofluid mechanics, synovial fluid in joints and respiratory biofluid mechanics. After the introduction of theoretical concepts, current computational modeling and simulation techniques for biological fluid flows will be explained, supported by the findings from my research.
- *Cell and Tissue Biomechanics:* This course will apply the methods of continuum mechanics to biomechanical phenomena over a range of length scales. The focus will be on the structure/function relationships and mechanical properties of cells, tissues and organs in terms of elasticity and viscoelasticity. A special emphasis will be given to theoretical and experimental aspects of novel mechanical measurement techniques of biological structures: optical tweezers and AFM based cell rheology measurement, and uniaxial and biaxial stretch measurements of tissue.
- *Biostructural Mechanics Laboratory:* This course will teach students basic concepts of bioengineering through experimental designs and procedures. The experiments will involve cells, tissues and laboratory animals. The techniques and setups will be readily available from my research and. The topics will include advanced techniques in microscopy, micromanipulation and directed migration of cells, rheological measurements of cells, in-vitro flow experiments, and strain experiments. Additionally, well established experimental techniques to change heart function will be performed on small lab animals and heart function will be assessed afterwards via echocardiography and time-lapse microscopy.
- *Modeling of Human Physiological Systems:* Course will focus on applying techniques of engineering analysis to quantify function of human physiological systems focusing on cardiovascular, respiratory, musculoskeletal, and renal systems. Course will also have lab hours in which students will make physiological measurements on their own bodies using Biopac Science Lab Systems to quantify body function. Measurement techniques include electrocardiography (ECG), blood pressures measurement, lung tidal volume measurement, electromyography (EMG), Electroencephalography (EEG), and doppler ultrasonography.

THESIS SUPERVISION EXPERIENCE

- PhD advisor for Armin Amindari from Istanbul Technical University, Turkey, with dissertation title "Investigation of cardiovascular blood flows using fluid solid interaction approaches"
- Advisor for numerous graduation projects for undergraduate mechanical engineering students at Dogus University, Turkey

INDUSTRY EXPERIENCE

- 2011 – 2013 Hemosoft Incorporated Company, Ankara, Turkey. Worked as a scientific consultant for the TUBITAK-TEYDEB funded (1,000,000€ total budget) project entitled as "Developing New Generation Disposable Bioreactor Systems to Grow Therapeutic 3-

Dimensional Cultures". Duties included generating computational models to characterize flow environments inside bioreactor systems.

- 2007 – 2008 JM Hyde Consulting, USA. Worked as a research engineer to design and validate bioreactor systems for vaccine production for Merck and Sanofi Pasteur.

PUBLICATIONS

See google scholar page for publications info (312 total citations)

http://scholar.google.com.tr/citations?hl=en&user=QtMeO8wAAAAJ

1. http://www.ncbi.nlm.nih.gov/pubmed/25416845

   S. E. Lindsey, P. G. Menon, W. J. Kowalski, A. Shekhar, **H. C. Yalcin,** N. Nishimura, C. B. Schaffer, J. T. Butcher and K. Pekkan (2015), "Growth and Remodeling after Early Aortic Arch Occlusion", *Biomechanics and Modeling in Mechanobiology*, Aug 14(4): 735-751.

2. http://www.ncbi.nlm.nih.gov/pubmed/26725196

   R.A. Gould, **H.C. Yalcin**, J.L. MacKay, S. Kumar, and J.T. Butcher (2016), "Cyclic Mechanical Loading Is Essential for Rac1-Mediated Elongation and Remodeling of the Embryonic Mitral Valve", *Current Biology*, Jan 11;26(1):27-37

3. http://www.ncbi.nlm.nih.gov/pubmed/25169937

   H. C. **Yalcin** (2014) **,** "Femtosecond Laser Photoablation of Vitelline Vessels of Avian Embryos as a Technique to Study Embryonic Vascular Remodeling", *Journal of Experimental Biology*, 239: 1644-1652.

4. http://www.ncbi.nlm.nih.gov/pubmed/25191277

   S. E. Lindsey, J. T. Butcher **and H. C**. **Yalcin** (2014) and, "Mechanical Regulation of Cardiac Development", *Frontiers in Physiology*, 5: Article 318

5. A. Amindari and **H.C. Yalcin,** "Numerical investigation of influence of leaflet calcification on aortic valve hemodynamics", in preparation.

6. A. Amindari, J.T Butcher, M. Yacoub and **H.C. Yalcin,** "Growth and hemodynamics after left and right atrial ligations on embryonic chick", in preparation.

7. S.I. Da'as, I.A. Mohamed, **H. C. Yalcin**, J. Yu, J. T. Butcher, J.A Suwaidi, and M.H. Yacoub, "Strategies to Normalize Zebrafish Specific Cardiac Phenotypes Resembling Different Human Myosin Binding Protein C3 Mutations Using RNA Approach", in preparation.

8. http://www.ncbi.nlm.nih.gov/pubmed/22535311

   K.N. Bharadwaj, C. Spitz, A. Shekhar, **H.C. Yalcin,** and J.T. Butcher (2012), "Computational Fluid Dynamics of Developing Avian Outflow Tract Heart Valves". *Annals of Biomedical Engineering*, Oct; 40(10):2212-27.

9. http://www.ncbi.nlm.nih.gov/pubmed/21761480

   A. L. Henning, M. X. Jiang, **H. C**. **Yalcin**, and J.T. Butcher (2011), "Quantitative Three-Dimensional Imaging of Live Avian Embryonic Morphogenesis Via Micro-computed Tomography", *Developmental Dynamics*, 240: 1949–1957.

10. http://www.ncbi.nlm.nih.gov/pubmed/21181939

H. C. Yalcin, A. Shekhar, T. C. McQuinn, and J. T. Butcher, (2011), "Hemodynamic Patterning of the Avian Atrioventricular Valve", *Developmental Dynamics*, 240:23–35.

11. http://www.ncbi.nlm.nih.gov/pubmed/20709864

H. C. Yalcin, A. Shekhar, N. Nishimura, A. A. Rane, C. B. Schaffer and J. T. Butcher, (2010), "Two-photon Microscopy Guided Femtosecond-laser Photoablation of Avian Cardiogenesis: Noninvasive Creation of Localized Heart Defects", *American Journal of Physiology – Heart and Circulatory Physiology*, 299 (5), H1728 – 35.

12. http://www.ncbi.nlm.nih.gov/pubmed/21048670

H. C. Yalcin, A. Shekhar, A. Shekhar, A. A. Rane, and J. T. Butcher, (2010), "An Ex-Ovo Chicken Embryo Culture System Suitable for Imaging and Microsurgery Applications", *Journal of Visualized Experiments*, 44, pii 2154.

13. http://www.ncbi.nlm.nih.gov/pubmed/19700641

H. C. Yalcin, K. M. Hallow, J. Wang, M. Wei, H. D. Ou-Yang, and S. Ghadiali (2009), "Influence of Cytoskeletal Structure and Mechanics on Epithelial Cell Injury during Cyclic Airway Reopening", *American Journal of Physiology – Lung Cell Molecular Physiology*, 297, L881 – L891.

14. http://www.ncbi.nlm.nih.gov/pubmed/18545572

M. Wei, A. Zaorski**, H. C. Yalcin**, J. Wang, S. Ghadiali, A Chiou, and H. D. Ou-Yang, (2008), " Study of Living Cell Micromechanical Properties by Oscillatory Optical Tweezers", *Optics Express*, 16(12), 8594-8603 .

15. http://www.ncbi.nlm.nih.gov/pubmed/19008489

H. L. Dailey, L. M. Ricles, **H. C. Yalcin**, and S. Ghadiali, (2008), "Image-Based Finite Element Modeling of Alveolar Epithelial Cell Deformation during Airway Reopening", *Journal of Applied Physiology*, 106, 221-232.

16. http://www.ncbi.nlm.nih.gov/pubmed/17673567

H. C. Yalcin, S. Perry, and S. Ghadiali, (2007), "Influence of Airway Diameter and Cell Confluence on Epithelial Cell Injury in an In Vitro Model of Airway Reopening", *Journal of Applied Physiology*, 2007 August: 103, 1796-1807.

17. http://www.sciencedirect.com/science/article/pii/S0045794906003889

H. L. Dailey, **H. C. Yalcin**, and S. Ghadiali, (2007), "Fluid-Structure Modeling of Flow-Induced Alveolar Epithelial Cell Deformation", *Computers and Structures*, 85, 1066-1071.

18. H. C. Yalcin. "Influence of hydrodynamic stresses, cellular mechanics and environmental conditions on epithelial cell injury during airway reopening", Ph.D. Dissertation, 2007, Bethlehem PA USA.

19. H. C. Yalcin. "Design and implementation of a laser driven micropump", M. S. Thesis, 2004, Bethlehem PA USA.

SELECTED CONFERENCE PRESENTATIONS

1. S.I. Da'as, I.A. Mohamed, **H. C. Yalcin**, J. Yu, J. T. Butcher, J.A Suwaidi, and M.H. Yacoub, "Strategies to Normalize Zebrafish Specific Cardiac Phenotypes Resembling Different Human

Myosin Binding Protein C3 Mutations Using RNA Approach". European Society of Cardiology Conference, London, England, Aug 2015.

2. R. Gould, **H. C. Yalcin**, J. MacKay, S. Kumar and J. T. Butcher. "Cyclic stretch orchestration of RhoA-Rac1 signaling axis is essential for embryonic valve remodeling". 6th Biennial Conference on Heart Valve Biology and Tissue Engineering, London, England, Nov 2014.
3. A. Amindari and **H. C. Yalcin**. "Numerical Assessment of Turbulent flow Downstream of Stenosed Aortic Valve with flexible leaflets using Fluid-Solid Interactions Approach". IEEE 14th International Conference on Bioinformatics and Bioengineering, Boca Raton, USA November 2014
4. A. Amindari and **H. C. Yalcin. "**Numerical Investigation of Influence of Leaflet Calcification on Aortic Valve Hemodynamics". 12th Internatıonal Conference on Numerical Analysis and Applied Mathematics, Rhodos, Greece, Sep 2014
5. **H. C. Yalcin,** R.A. Gould and J. T. Butcher. "Hemodynamic forces control ventricular and valvular growth independent of sidedness during embryonic development". Biomedical Engineering Society Conference, Seattle WA USA, September 2013.
6. **H. C. Yalcin.** "Influence of Blood Flow on Abnormal Heart Development". INOVITA Seminar, Institute of Biomedical Engineering, Boğaziçi University, October 16 2012.
7. **H. C. Yalcin** and J. T. Butcher**.** "Investıgation of Effects of Abnormal Hemodynamics on the Embryonic Development of Congenital Heart Defects". Biyomedikal Mühendisliği Ulusal Toplantısı, Boğaziçi University, October 3-5 2012
8. M. C. Özbek, A. B. Olcay and **H. C. Yalcin**, "2D Numerical Investigation of Leaflet Thickness and Leaflet's Young's Modulus on Aortic Stenosis". Biyomedikal Mühendisliği Ulusal Toplantısı, Boğaziçi University, October 3-5 2012
9. **H. C. Yalcin.** "Computational and Experimental Techniques to Study Congenital Heart Defects". A Short Course on Biomedical Engineering, KOC University, İstanbul, May 30 2012.
10. **H. C. Yalcin**, S Ajaeb and J. T. Butcher. "Regulation of Abnormal Atrioventricular Valve Development. 5th Biennial Conference on Heart Valve Biology and Tissue Engineering, Myconos Island, Greece, May 18-20 2012
11. **H. C. Yalcin**, and J. T. Butcher. "Hemodynamic Patterning of Normal and Abnormal Heart Development". American Association of Veterinary Anatomists Meeting, Cornell University, USA, August 8 2011
12. **H. C. Yalcin**, and J. T. Butcher. "Computational and Experimental Investigation of Embryonic Development of Congenital Heart Defects Using Chicken Embryos". Biyomedikal Mühendisliği Ulusal Toplantısı, Antalya, Turkey , October 13-16 2011
13. **H. C. Yalcin**, A. Shekhar, N. Nishimura, C. B. Schaffer and J. T. Butcher. "Congenital Heart Defects Models via Non-invasive Femtosecond-laser Photoablation of Embryonic Outflow Tract American Heart Association Annual Meeting at Chicago IL USA, November 2010.
14. **H. C. Yalcin**, A. Shekhar, K. Bharadwaj, and J. T. Butcher. "Hemodynamic Patterning of Avian Embryonic Valves." Biomedical Engineering Society Conference, Austin TX USA, October 2010.

15. **H. C. Yalcin**, A. Shekhar, N. Nishimura, C. B. Schaffer and J. T. Butcher. "Non-invasive Femtosecond-laser Photoablation of Embryonic Outflow Tract: Microsurgical Congenital Heart Defect Models", 4th Biennial Heart Valve Biology and Tissue Engineering Conference, Hilton Head Island, SC USA on March 2010.

16. **H. C. Yalcin**, A. Shekhar, N. Nishimura, C. B. Schaffer and J. T. Butcher **. "**A Noninvasive In Vivo Embryonic Valvular Defect Model via Femtosecond Laser Photoablation**,** Biomedical Engineering Society Conference, Pittsburgh PA USA, October 2009.

17. **H. C. Yalcin**, A. Shekhar, N. Nishimura, C. B. Schaffer and J. T. Butcher**.** "A Noninvasive Defect Model of Congenital Heart Disease via Pulsed Laser Photoablation", 5th Biennial Meeting of the Society of Heart Valve Disease, Berlin Germany, June 2009.

18. **H. C. Yalcin** and S. Ghadiali. "Effects of Inflammatory Mediators and Fluid Properties on Cellular Responses to Airway Reopening", Biomedical Engineering Society Conference, Chicago IL USA, October 2006.

19. **H. C. Yalcin** and S. Ghadiali**. "**Influence of Microchannel Geometry on Cellular Injury during Microbubble flows"**,** American Society of Mechanical Engineers Summer Bioengineering Conference, Amelia Island FL USA, June 2006.

20. **H. C. Yalcin**, J. Wang, S. Ghadiali and H. D. Ou-Yang. "Using Optical Tweezers to Study Cell Mechanics during Airway Reopening", American Physical Society March Meeting, Baltimore MD USA, March 2006.

21. **H. C. Yalcin**, S. D. Preite, and S. Ghadiali. "Influence of Cellular Morphology and Mechanics on Injury Patterns during Airway Reopening", Biomedical Engineering Society Conference, Baltimore MD USA, October 2005.