FIELD OF STUDY

Chemical Engineering

DISSERTATION TOPIC

"Study the Effect of Blood Rheology on Cholesterol Deposition through Mathematical Modeling"

EXAMINING COMMITTEE

Dr. Pedro E. Arce, Professor and Chair, Chemical Engineering Department

Dr. Robby Sanders, Assistant Professor, Chemical Engineering Department

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ABSTRACT

Atherosclerosis is an inflammatory disease that affects major arteries of the human vasculature. It is associated with hardened arteries in which plaque builds up, thus establishing an area of stenosis characterized by narrowing of the cross-sectional area for blood flow. Affecting millions of people worldwide, atherosclerosis is a serious medical condition that can lead to a variety of health complications and even death.

A contributing factor in the growth and development of stenosis is the rheological behavior of the blood. Though there are many computational studies addressing blood flow behavior in such systems, modeling that couples blood flow hemodynamics to the convective-diffusive transport of cholesterol inside the human arteries is limited. This may be due in part to the increased difficulty in dealing with the non-Newtonian behaviors of blood such as the effects of shear rate on blood viscosity.

In this work, a hydrodynamic analysis of the blood flow in an arterial stenosis domain in conjunction with convective-diffusive transport of LDL in stenosis domain of the artery is presented. Both Newtonian and Non-Newtonian Models of blood rheology are used to determine the blood velocity profile, effective diffusivity, effective mobility, and concentration profile of LDL inside a stenosis domain, and comparisons are made. When combined with equations describing cholesterol deposition, the results are fundamentally useful to predict cholesterol deposition in the artery via different fluid flow models. Also, the results of this analysis indicate that in addition to the common parameters such as stenosis size, blood flow rate, stenosis height, and blood viscosity, the latter is the most significant factor which has a substantial effect on the stenosis region. Ultimately, this work is a step forward towards the development of novel therapeutic and diagnostic approaches for atherosclerosis.

BIOGRAPHICAL SKETCH

Abbas Motamedi was born in Ghaemshahr, Iran. He received his B.S. in Mechanical Engineering from Azad University in 2009. He received his MSc in Chemical Engineering from Tennessee Technological University in 2014. His graduate research focuses on studying the effect of blood rheology on cholesterol deposition through mathematical modeling. During his PhD study, he has worked as an intern at Biogen Idec, Inc., and Alcon (a Novartis Company).

EDUCATION

Candidate PhD., Engineering - Chemical Engineering, Tennessee Technological University, Tennessee, Cookeville, USA (2018).

M.S., Engineering - Chemical Engineering, Tennessee Technological University, Tennessee, Cookeville, USA (2014).

B.S., Mechanical Engineering, Azad Sari University, Sari, Iran (2009).

College of Engineering

TENNESSEE TECH

The Department of

Chemical Engineering

Announces the Dissertation Defense

of

Abbas Motamedi

In Partial Fulfillment of the Requirements for the degree of

Doctor of Philosophy

Monday April 9th, 2018 at 3:00 p.m.

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1020 Stadium Drive

Tennessee Technology University

Cookeville, TN 38505