ICCB
2019

VIII International Conference on
Computational Bioengineering
4-6 September 2019, Belgrade, Serbia

ICCB 2019
Proceedings

8th International Conference on Computational Bioengineering

September 4-6, Belgrade, Serbia

ICCB 2019

Proceedings

8th International Conference on Computational Bioengineering

September 4-6, Belgrade, Serbia

proteoglycans. The problems can become extremely challenging in the case of ascending thoracic aortic aneurysms (ATAA) evolution due to the simulateneous and region specific evolution of geometry, material properties, and hemodynamic loads. Therefore, in this work, we fully coupled a continuum finite-element CMT-based G&R model of arterial wall with CFD analyses to study the effects of the different hemodynamic metrics, such as helicity, WSS, time averaged WSS (TAWSS), oscillatory shear index (OSI) or RRT, on aortic G\&R. Two novelties can be highlighted in our work: application of CMT-based models to patient-specific geometries and integration of layer-specific properties (media and adventitia). The model is applied on 8 patients including 3 healthy patients and 5 suffering from unbounded dilatation of the ATAA.

Keywords: Ascending Thoracic Aortic Aneurysm, CFD, relative residence time, Growth and Remodeling

Acknowledgement: The authors are grateful to the European Research Council for grant ERC-2014-CoG BIOLOCHANICS.

T.3.1.4 – *Numerical simulations of blood flow patterns in the patient-specific left ventricle model with dynamic valves* - Fei Xu[1*], Sasa Kenjeres[1]

[1] Delft University of Technology, Van der Maasweg 9, 2629 HZ Delft, The Netherlands.

e-mail: f.xu-1@tudelft.nl, s.kenjeres@tudelft

**corresponding author*

Abstract:

The left ventricle is one of the chambers in the human heart. It is connected with the aorta by the aortic valve and the left atrium by the mitral valve. The left ventricle is responsible for pumping the blood through the aortic valve into aorta and then to the whole body. Hence it is the most important heart chamber. Besides, in the left ventricle the blood flow has the most complex pattern and pressure variation during cardiac cycles.
With series of images from measurements (MRI and PIV) and the RBF (radial basis functions) method, a cost-effective image (CT and/or MRI) based numerical simulation technique has been developed for the blood flow simulation in realistic patient-specific ventricles.
The numerically calculated velocity components and the vortex structure have been compared with available PIV as well as MRI measurements at characteristic time instants during a cardiac cycle. Obtained results are in a good agreement with experimental data. Furthermore, the vorticity as well as the velocity components have been compared between different simulation approaches (i.e. Direct Numerical, Large Eddy and Detached Eddy Simulation; DNS, LES and DES respectively) at specific locations. Additionally, the energy spectra of the velocity time series at characteristic monitoring locations within the left ventricle have been analyzed to identify the turbulent/laminar regions in the flow field.
In conclusion, the obtained results provided detailed insights into energetics of the instantaneous flow features of the left ventricle model. The presented method can be applied for future analysis with the patient-specific geometries.

Keywords: Computational fluid dynamics (CFD), left ventricle, vortex structure, Direct Numerical Simulation (DNS), Large Eddy Simulation (LES), Detached Eddy Simulation (DES)

T.3.1.5 – *Effect of hip implant surface modification on shear stress distribution* - Aleksandra Vulović[1,2,3*], Nenad Filipović[1,2,3]

[1] Faculty of Engineering, University of Kragujevac, Sestre Janjić 6, 34000 Kragujevac, Serbia

e-mail: aleksandra.vulovic@kg.ac.rs, fica@kg.ac.rs

[2] Bioengineering Research and Development Center (BioIRC), Prvoslava Stojanovića 6, 34000 Kragujevac, Serbia

[3] Steinbeis Advanced Risk Technologies Institute doo Kragujevac, Kneza Milosa 25, Kragujevac, Serbia
*corresponding author

Abstract:

Hip replacement surgery is one of the most common procedures in the world. Annually, more than 1 million hip replacement surgeries are performed worldwide, while it is anticipated that this number will double in the next decade. After the damaged or worn out hip joint is replaced with the artificial hip joint, bone healing process starts. In order to ensure the long and proper function of the artificial joint, the connection between the bone and the inserted implant should be as strong as possible. However, if the established connection is not strong enough, the implant starts to loosen. Experimental studies have indicated that implants with a rough surface form a stronger connection with a bone. The goal of this paper was to numerically analyze different spherical shapes on the implant surface. The results obtained numerically are considered to be a very helpful addition to the experimental studies. Numerical analysis of the implant surfaces has been performed using the Finite Element Method. The obtained results include distribution of the shear stress on the implant surface. This type of stress is important for this study because in order to promote bone ingrowth, the shear stress should be minimized. Our study considered the interaction between cortical bone and implant with rough surface. Material properties and boundary conditions were adapted from literature.

Keywords: hip implant, implant surface, finite element analysis

Acknowledgement: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 760921 - PANBioRA. This article reflects only the author's view. The Commission is not responsible for any use that may be made of the information it contains. The research has also been carried out with the support of the Ministry of Education, Science and Technological Development, Republic of Serbia with projects III41007 and OI174028.

Publisher: University of Kragujevac, Kragujevac, Serbia

Co-publisher: Bioengineering Research and Development Centre BioIRC doo Kragujevac

Published by: Dr. Nenad Filipović, rector

Editor: Dr. Nenad Filipović

Tehnical assistant: Đorđe Dimitrijević

Print: Grafo Ink doo Kragujevac

Impression: 100 copies

2019

CIP - Каталогизација у публикацији - Народна библиотека Србије, Београд

004:57+61(048)

INTERNATIONAL Conference on Computational Bioengineering (8 ; 2019 ; Beograd)
ICCB 2019 Proceedings / 8th International Conference on Computational Bioengineering, September 4-6, Belgrade, Serbia ; [editor Nenad Filipović]. - Kragujevac : University of Kragujevac : Bioengineering Reserach and Development Centre BioIRC, 2019 (Kragujevac : Grafo Ink). - 94 str. : portreti ; 30 cm

Tiraž 100.

ISBN 978-86-81037-75-1 (UK)

а) Биомедицина - Примена рачунара - Апстракти

COBISS.SR-ID 278926348