NUMERICAL ANALYSIS OF ASYMMETRIC SEPTAL HYPERTHROPIC CARDIOMIOPATHY

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Key Words: *Hypertrophic cardiomyopathy, Electrical activity, Numerical model, Human torso.*

Ischemia is a term that indicates the existence of an imbalance between the amount of blood rich in oxygen that arrives in a certain organ and the need of that organ for nutrients. Cardiac ischemia (myocardial ischemia) refers to the occurrence of insufficient or, even completely absent, flow of blood and nutrients through the heart muscle. Hypertrophic cardiomyopathy (HCM) is a congenital or acquired disorder of the heart muscle, which is clinically manifested by symmetrical or asymmetric hypertrophy of the left and/or right ventricle in the absence of any other cause of hypertrophy.

By applying modern technological achievements, it is possible to simulate hypertrophic cardiomyopathy and study the process of ischemia. In this paper, we have developed a computer three-dimensional bidomenic model of the electrical activity of the whole heart built into the torso. The sinoatrial node has spontaneous activation triggers, including a specialized conduction system with heterogeneous morphologies of action potential throughout the heart. Heart model geometry included seven different regions. Monodomain model of modified FitzHugh-Nagumo model of the cardiac cell was used.

The patient's real ECG with asymmetric septal hyperthropic cardiomiopathy was the input parameter of the numerical simulation and the results of the electrical potential of the torso as well as the transmembrane potential of the heart were presented.

Acknowledgments: This work is supported by the SILICOFCM project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 777204. The research was also funded by Serbian Ministry of Education, Science, and Technological Development, grants [451-03-9/2021-14/200378 (Institute for Information Technologies, University of Kragujevac)] and [451-03-9/2021-14/200107 (Faculty of Engineering, University of Kragujevac)].

REFERENCES

[1] S. Sovilj, R. Magjarević. N. Lovell, S. Dokos, A simplified 3D model of whole heart electrical activity and 12-lead ECG generation. *Computational and Mathematical Methods in Medicine*, doi:10.1155/2013/134208, 2013.

[2] A. J. Pullan, M. L. Buist, and L. K. Cheng, Mathematically Modelling the Electrical Activity of the Heart-From Cell To Body Surface and Back Again. *World Scientific*, 2005.

[3] C. A. Gibbons Kroeker, S. Adeeb, J. V. Tyberg, and N. G. Shrive, A 2D FE model of the heart demonstrates the role of the pericardium in ventricular deformation. *American Journal of Physiology*, Vol. **291**, no. 5, pp. H2229–H2236, 2006.

[4] Y. Wang, and .Y Rudy, Application of the method of fundamental solutions to potential-based inverse electrocardiography. *Annals of biomedical engineering*, Vol. **34**, 8, pp. 1272–1288, 2006.

[5] M. Wilhelms, O. Dossel, G. Seemann, In silico investigation of electrically silent acute cardiac ischemia in the human ventricles. *IEEE Trans Biomed Eng*, Vol. **58**, pp. 2961–2964, 2011.