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#001-Header-BGRS

Cardiac Mechanics, Calcium Overload and Arrhythmogenesis

#002-Author-BGRS

A. Ivanov[1]*, O. Petrov[1, 2], L. Sidorov[3]

#003-Affiliation-BGRS

[1] *Institute of Cytology and Genetics SB RAS, Novosibirsk, Russia*
[2] *Institute of Immunology and Physiology UB RAS, Yekaterinburg, Russia*
[3] *Novosibirsk State University, Novosibirsk, Russia*
* *e-mail: ivanov@gmail.com*

#004-Key words-BGRS

Key words: calcium overload, rhythm disturbances, cardiac mechanics

#005-Normal_BGRS

Motivation and Aim: It is well-known that Ca^{2+} overload may cause cardiac
However, possible contribution of the mechanical factors to the arrhythmia
in Ca^{2+}-overloaded cardiomyocytes has been insufficiently addressed. Ear
developed a mathematical model of cardiomyocyte electro-mechanical fun
predicted a significant role of the intra- and extracellular mechanica
arrhythmogenesys. Model prediction was verified in experiments on papil
from the right ventricle of guinea pigs overloaded with calcium [2].
Methods and Algorithms: We utilized the cellular model to study ef
electromechanical coupling between cardiomyocytes in a 1D heterogen
strand formed of 90% of normal (N) cardiomyocytes and 10% of sub-
cardiomyocytes with decreased Na^{+}-K^{+} pump activity. Single SC-cardior
not demonstrate spontaneous activity during isometric contractions at a reference length.
Regular fiber twitches at the reference initial cell length were induced by 1 bps electrical
stimulation applied at an edge of the strand. Excitation spread along the tissue via
electro-diffusional cell coupling followed by cell contractions and force development in
the fiber.
Results: Mechanical interactions between N- and SC-cells in the tissue resulted in the
spontaneous activity emerged in the SC-zone between the regular stimuli. If the
excitation wave spread from SC- to N-region, the SC-cells developed delayed after-
depolarizations (DAD) that caused a slowly developing beat-to-beat decrease in the
force of fiber contraction. If the excitation spread in opposite direction, DAD in the SC-
cells induced reflected downward excitation waves capturing the normal region and
followed by extrasystoles in the whole fiber.
Conclusion: The results obtained in the model suggest that ectopic activity may emerge
in a sub-critical myocardial region, e.g. comprising cardiomyocytes with moderately
depressed N+-K+ pump, due to its mechanical interactions in the myocardial tissue.
Moreover, such ectopic zone may expand by capturing normal regions in myocardium
via the electro-mechanical coupling between cardiomyocytes.
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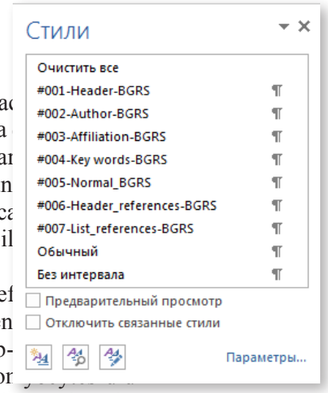

#006-Header_references-BGRS

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#007-List_references-BGRS

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