(*Blicca bjoerkna*), лангуст (*Jasus edwardsii*), омар (*Nephrops norvegicus*), таракан (*Periplaneta americana*), саранча (*Schistocerca gregaria*), морской котик (*Arctocephalus gazella*), кролик (*Sylvilagus aquaticus*), землеройка (*Cinereus ohioensis*), крыса (*Millardia meltada*), коза (*Capra hircus*), черепаха (*Chrysemys picta*), змея (*Spalerosophis cliffordi*), бухарник шерстистый (*Holcus lanatus*), крыжовник (Actinidia chinensis). Обнаружено, что значения коэффициента *a* для большинства рассмотренных видов находятся в диапазоне от 1 до 2.5. Исключения представляют насекомые и растения, значения коэффициента *a* для которых превышают отмеченный диапазон. Таким образом, несмотря на существенную разнородность и существенно различный временной и массовый масштаб, в котором происходит рост изучаемых систем, столь близкое совпадение значений даёт повод полагать о существовании некоторой универсальности растущих неравновесных систем.

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TRANSMURAL HETEROGENEITY IN THE MECHANICAL AND ELECTRICAL PROPERTIES OF CARDIOMYOCYTES. EXPERIMENTAL STUDY AND MODELING

Vasilyeva A.D.[1,2*], Solovyova O.E.[1,2], Iribe G.[3]

[1)] Ural Federal University, Yekaterinburg, Russia
[2)] Institute of immunology and physiology Ural Branch Russian Academy of Science, Yekaterinburg, Russia
[3)] Okayama University, Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama, Japan
*E-mail: a.vasilyeva@iip.uran.ru

Ventricular cardiomyocyte function is known to vary depending on the spatial location of cells in the ventricular wall, in particular, from sub-endocardial (ENDO) to sub-epicardial (EPI) layers. This intra-myocardial heterogeneity attributes to the normal heart and may increase significantly in pathology, providing substrates for arrhythmia and contractile dysfunctions [1]. Although phenomenon of cardiac heterogeneity is commonly agreed, its role in the mechanical and electrical function of myocardium and the bilateral relationships between the electrical and mechanical activity remain largely under appreciated. Mathematical modeling is a unique tool to predict consequences of myocardium heterogeneity on the cellular, tissue, and organ levels.

Recently we have developed a mathematical model of the electrical and mechanical activity of cariomyocytes from ENDO and EPI layers of the left ventricular (LV)

wall of guinea pig. These ENDO and EPI models reproduce action potential generation, membrane ionic currents and flows, calcium-dependent mechanisms of cell contraction and force generation for each of cellular subtype. Consistent with the experimental data, the EPI model produces significantly shorter AP, faster Ca^{2+} transient and faster contractions with smaller time to peak contraction and rate constant of relaxation in both heavy-loaded isometric and low-loaded isotonic modes of contractions, as compared to the ENDO model [2, 3]

However we found insufficient number of studies focused on the heterogeneity of cellular mechanics and underlying mechanisms of excitation-contraction coupling. To fill the gap and validate our models, we start with carrying out experiments on isolated myocytes to obtain input and/or output parameters required for improving and verifying the above integrative models of regional LV cardiomyocyte function. Experiments on isolated cardiomyocytes are performed at Okayama University, Japan, with using an original experimental set-up [4]. The mechanical measurements allow one to analyze the dynamical force-length loops during cell contractions and to derive a set of mechanical characteristics: end-diastolic and end-systoilic force-length relations, elastance, force – velocity, work and power relations, temporal and velocity characteristics of contraction (time to peak force or shortening, maximal velocity of contraction and relaxation, etc), indexes of load-dependent relaxation of the cells etc.

There is a very few data in literature on such cellular mechanical characteristics especially obtained in the cells from different myocardial regions. This data will help to develop adequate mathematical models of the ENDO and EPI ventricular cells which then will be used in more complex tissue models and help to discovering new phenomena in heterogeneous myocardium.

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