Investigation of mechanisms of regulation of electro-mechanical function of cardiomyocytes in the biomechanical model of myocardium

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We developed three-dimensional model of isolated myocardial muscular preparations that takes into account the coupling of excitation with contraction in the myocardium at the cellular and tissue levels. This model describes heart tissue using approaches and methods developed in continuum mechanics. In the model, electromechanical interactions and mechano-electric feedbacks are realized both at the micro level and at the macro level. We used non-linear partial differential equations describing the deformation of the cardiac tissue, and a detailed "Ekaterinburg-Oxford" (EO) cellular model of the electrical and mechanical activity of cardiomyocytes (Sulman et al., 2008).

Electrical and mechanical interactions between the cells in the wedge model, as well as intracellular mechano-electric feedback beat-to-beat affect the functional characteristics of coupled cardiomyocytes further, adjusting their electrical and mechanical heterogeneity to the activation timing. Model analysis suggests that cooperative mechanisms of myofilament calcium activation contribute essentially to the generation of cellular functional heterogeneity in contracting cardiac tissue.

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