生物物理学报(2004) 20(5), 363-370

PDF文档

心肌细胞团搏动整数倍节律的非线性动力学机制

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本文利用心肌细胞耦合模型研究实验观察到的心肌整数倍节律的动力学机理。确定性模型仿真揭示了心肌细胞团同步搏动加周期分岔的节律变化规律；随机模型仿真发现在加周期分岔序列中分岔点附近会出现整数倍节律，其中，0-1整数倍节律产生于从静息到周期1的Hopf分岔点附近，1-2整数倍节律产生于周期1和周期2极限环间的加周期分岔点附近；对系统相空间轨道的分析进一步揭示出整数倍节律由系统运动在相邻的两个轨道之间随机跃迁的机制形成。上述深入的理论分析结果不仅阐明了心肌整数倍节律的机理，并且揭示了各种整数倍节律与加周期分岔序列中相邻节律的内在联系，为重新认识心律变化的规律开辟了新的途径。

Nonlinear dynamic mechanisms of the integer multiple rhythms generated by cardiac myocytes

Coupled models of cardiac myocytes were used to investigate the mechanisms of the experimentally discovered integer multiple rhythms. Simulation in the deterministic model elucidated a rhythm transition process governed by a period adding bifurcation scenario. Simulation using the stochastic model further revealed that integer multiple rhythms occurred near each of the bifurcation points in the bifurcation scenario. The 0-1 integer multiple rhythm appeared near the Hopf bifurcation point, while the 1-2 integer multiple rhythm appeared near the period adding bifurcation point between two limit cycles. The analysis of the phase space trajectories clearly elucidated that the integer multiple rhythms were formed by a stochastic alternating of the system between two neighbouring orbits. Such theoretical analysis not only revealed the dynamic mechanism of the integer multiple rhythms, but also elucidated the relations of the integer multiple rhythms with other rhythm patterns within the context of a period adding bifurcation scenario. Our experimental and theoretical works created a new way for the study of the principles of the cardiac rhythm transitions.

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