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研究论文

噪声对窦房结体系钠通道电导作用的计算机仿真研究

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摘要：

本文考虑神经系统的调节作用，利用张恒贵等人构建的兔子心脏窦房结-心房细胞体系的完整二维模型，将其改造为能模拟人体心脏起搏活动的在体模型，并通过计算机仿真模拟研究了环境噪声对心脏体系起搏活动的影响。模拟结果显示：一方面，利用该模型可以重现有生理缺陷的心脏体系异常搏动现象，例如老年化的心脏因细胞膜钠电流减少或部分心肌细胞死亡导致耦合强度减弱等，临床上均会导致心脏猝死现象；另一方面，更重要的是，可以通过引入适当的外界环境色噪声来消除这种死振，从而让心脏重新恢复正常搏动。同时，分析了调节色噪声参数对这种恢复作用的影响。另外还讨论了高斯白噪声的调控作用。模拟结果表明环境噪声在调控心脏窦房结起搏活动的过程中起着十分重要的调节作用，这个结果将有助于揭示临床医学上电击治疗心脏病的内在动力学机制，并为心脏复苏提供理论上的解释。

关键词： 噪声 死振 传导受阻 心脏猝死 心脏复苏

Computer Simulation of Noise Effect on the Sodium Channel Conductance in Sinoatrail Node System

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Abstract:

By using a two-dimensional model of rabbit SA node-atrial cell system which proposed by Zhang *et al*., and considering the nervous system regulation, the model can be modified to simulate the pacemaking activities of the human heart *in vivo*. The effects of environmental noise on the cardiac pacemaking behavior have been studied by computer simulation. Numerical results show, on the one hand, the phenomenon of abnormal rhythm in heart with physiological defect are reproduced by using this model, for example, once the membrane sodium current is reduced or coupling strength decreases due to the death of the myocardial cell in the aging heart, *etc*., this will induce the cardiac sudden death in clinical easily. On the other hand, more importantly, the oscillation death can be eliminated by introducing the appropriate external color noise, and the heart beat can be returned to normal beating. This recovery effects by regulating the colored noise parameters have been analyzed. In addition, the regulation of Gaussian white noise also been discussed. The simulation results exhibit that the environmental noise may play an important regulatory role in the process of regulation of cardiac pacemaker activity, the results will help to reveal the internal mechanism of remedy heart disease by electric shock in clinical, and provide a theoretical explanation on cardiac resuscitation.

Keywords: Noise Oscillation death Conduction block Sudden cardiac death Cardiac resuscitation

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