生物物理学报(2003) 19(4), 388-394

PDF文档

神经起步点自发放电节律及节律转化的分岔规律

李莉*、古华光、杨明浩、刘志强、任维
航天医学工程研究所

在神经起步点的实验中观察到了复杂多样的神经放电（$[Ca^{2+}]_o$）节律模式，如周期簇放电、周期峰放电、混沌簇放电、混沌峰放电以及随机放电节律等。随着细胞外钙离子浓度的降低，神经放电节律从周期1簇放电，经过复杂的分岔过程（包括经倍周期分岔到混沌簇放电、混沌簇放电经激变到混沌峰放电、以及混沌峰放电经逆倍周期分岔到周期峰放电）转化为周期1峰放电。在神经放电理论模型———Chay模型中，调节与实验相关的参数（Ca^{2+}平衡电位），可以获得与实验相似的神经放电节律和节律转换规律。这表明复杂的神经放电节律之间存在着一定的分岔规律，它们是理解神经元信息编码的基础。

BIFURCATION SCENARIO RHYTHM IN THE FIRING PATTERN TRANSITION OF A NEURAL PACEMAKER

Abundant neural firing patterns were observed in the experimental neural pacemaker, such as periodic bursting, periodic spiking, chaotic bursting, chaotic spiking and stochastic rhythm. The neural firing rhythm changed from period 1 bursting to period 1 spiking via a complex bifurcation scenario, in which period-doubling bifurcation to chaotic bursting, chaotic bursting to chaotic spiking via crisis and chaotic spiking to period spiking via inverse period-doubling bifurcation were exhibited, when extracellar calcium concentration ($[Ca^{2+<>/sup}]_o$) was decreased. In the relevant theoretical neuronal model such as Chay model, neural firing patterns and firing pattern transition regularity similar to the experiment were observed when the physiological parameters was changed. The results not only showed the regularity of neural firing bifurcation scenario in real neuronal system, but also provided a theoretical foundation for the study of neural coding.

关键词

分岔(Bifurcation)； 神经元(Neuron)； 自发放电(Spontaneous discharge)； 倍周期分岔(Period-doubling bifurcation)； 混沌(Chaos)