

# 实验性神经起步点产生的整数倍簇放电节律

古华光、李莉、杨明浩、刘志强、任维  
航天医学工程研究所

随机Hindmarsh-Rose模型中产生簇(bursting)放电节律是神经放电中存在随机自共振的一个重要理论证据,但是,该簇放电节律在实验中一直没有被发现。在实验性神经起步点细胞外 $[Ca^{2+}]_o$ 低于周期1节律的 $[Ca^{2+}]_o$ 时,发现了一种簇放电节律。其簇簇间期(inter-burst intervals, IBIs)呈现出与随机自共振引起的整数倍峰放电(integer multiple spiking)节律的峰峰间期类似的整数倍特征。随机Hindmarsh-Rose模型中产生的簇(bursting)放电节律也表现出类似的特征。结果验证了随机自共振簇放电的存在性,揭示该簇放电节律的统计特征。此外,该簇放电节律的参数区间以及其与整数倍峰放电节律的区别被揭示,簇放电节律的 $[Ca^{2+}]_o$ 低于峰放电节律的 $[Ca^{2+}]_o$ 。

## INTEGER MULTIPLE BURSTING GENERATED IN AN EXPERIMENTAL NEURAL PACEMAKER

The stochastic bursting generated in stochastic Hindmarsh-Rose model was an evidence for the existence of autonomous stochastic resonance (ASR) in neural systems. Unfortunately, it has not been observed in the experiment. Stochastic bursting pattern was found in the experiment on an experimental neural pacemaker perfused with solution whose extra-cellular calcium concentration ( $[Ca^{2+}]_o$ ) was lower than that of period 1 spiking. The inter-burst intervals (IBIs) of the stochastic bursting exhibited multi-mode and were approximately integer multiples of a basic IBI, similar to those of the ISIs of the integer multiple spiking caused by coherence resonance. The stochastic bursting generated in stochastic Hindmarsh-Rose model exhibited similar characteristics. The results verified the existence of the stochastic bursting caused by autonomous stochastic mechanism and revealed its statistical characteristics. In addition, the parameter region of the stochastic bursting and its distinction to the integer multiple spiking were identified. The integer multiple bursting was generated in the parameter region where  $[Ca^{2+}]_o$  was lower than that of the integer multiple spiking.

### 关键词

整数倍(Integer multiple); 簇放电(Bursting); 随机自共振(Autonomous stochastic resonance); 神经起步点(Neural pacemaker); 簇簇间期(Inter-burst interval); 峰峰间期(Interspike interval)