

大鼠初级传入纤维与脊髓背角神经元间的动作电序列的突触传递

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外周感觉神经元通过动作电位序列对信号进行编码, 这些动作电位序列经过突触传递最终到达脑部。但是各种脉冲序列如何通过神经元之间的化学突触进行传递依然是一个悬而未决的问题。研究了初级传入A δ 纤维与背角神经元之间各种动作电位序列的突触传递过程。用于刺激的规则、周期、随机脉冲序列由短簇脉冲或单个脉冲构成。定义“事件”(event)为峰峰间期(interspike interval)小于或等于规定阈值的最长动作电位串, 然后从脉冲序列中提取事件间期(interevent interval, IEI)。用时间-IEI图与回归映射的方法分析IEI序列, 结果表明在突触后输出脉冲序列中可以检测到突触前脉冲序列的主要时间结构特征, 特别是在短簇脉冲作为刺激单位时。通过计算输入与输出脉冲序列的互信息, 发现短簇脉冲可以更可靠地跨突触传递由输入序列携带的神经信息。这些结果表明外周输入脉冲序列的主要时间结构特征可以跨突触传递, 在突触传递神经信息的过程中短簇脉冲更为有效。这一研究在从突触传递角度探索神经信息编码方面迈出了一步。

SYNAPTIC TRANSMISSION OF VARIOUS SPIKE TRAINS BETWEEN PRIMARY AFFERENT FIBER AND SPINAL DORSAL HORN NEURON IN THE RAT

Peripheral sensory neurons encode continuous, time-varying signals into spike trains, which are finally relayed to the brain through synaptic transmission. But how various types of spike trains are transmitted across chemical synapses between neurons is still an open question. Here the synaptic transmission of various spike trains between primary A δ afferent fiber and spinal dorsal horn neuron was investigated. Regular, periodic and stochastic stimulus trains were composed of either brief bursts or single pulses. "Events" were defined as the longest sequences of spikes with all interspike intervals less than or equal to a certain threshold and the interevent intervals (IEIs) were extracted from spike trains. The IEI analysis by time-IEI graphs and return maps showed that the main temporal structure of presynaptic input trains could be detected in postsynaptic output trains, especially under brief-burst stimulation. By calculating the mutual information between input and output trains, it was found that brief bursts could more reliably transmit the information carried by input trains across synapses. These results suggested that the main temporal characters of peripheral input trains can be transmitted across synapses, and that brief-burst firing is more effective during synapse transmission of neural information. The present research takes a step forward to exploring the mystery of neural coding from the aspect of synaptic transmission.

关键词