

神经放电起步点对电场刺激反应的“临界敏感”现象

杨晶¹、段玉斌²、邢俊玲¹、胡三觉¹

1 第四军医大学神经科学研究所

2 第四军医大学生理学教研室

在大鼠坐骨神经慢性压迫模型的放电起步点上,记录单纤维放电的峰峰间期(ISIs)序列。在无钙条件下,ISIs序列进入加周期分岔过程后,通过调定灌流液乙二醇双四乙酸(Ethylene Glycol-bis(β -aminoethyl Ether)N, N, N', N'-Tetraacetic Acid, EGTA, 一种钙离子螯合剂)的浓度,使ISIs序列分别稳定于远离分岔点的周期阶段(称周期阶段)或邻近分岔点的阶段(称临界阶段),分析电场刺激反应与分岔动力学状态的关系。实验观察到,相同强度的电场刺激可使周期阶段和临界阶段的放电频率增加,但后者的增加幅度比前者显著,并伴有放电模式的转化。在周期阶段,随电场刺激强度增大,放电频率近似线性增加,放电模式不变;在临界阶段,当电场刺激达到一定强度时,放电频率增加的斜率显著增大,此时,放电模式也发生转化。结果提示邻近分岔点的临界阶段对电场刺激的反应较周期阶段敏感,称之为“临界敏感”现象。

“CRITICAL SENSITIVITY” PHENOMENA OF NEURAL FIRING PACEMAKER TO ELECTRICAL FIELD STIMULUS

Abstract: Interspike intervals (ISIs) sequence of discharge of single fiber was recorded from the neural firing pacemaker of chronic constriction of sciatic nerve in rat. Under calcium-free condition, the ISIs sequence entered into period-adding bifurcation, certain concentration of EGTA (a kind of calcium chelator) of the perfusion solution stabilized the firing pattern at period state which was far from a bifurcation or critical state which was near a bifurcation. Relationship between the response to electrical field stimulus and bifurcation dynamic state was analyzed. The following results were observed, the same intensity of electrical field stimulus induced a much more firing rate increase in the critical state than that in the period state, and in the critical state electrical field stimulus often resulted in a transition of firing pattern. In the period state, during increasing of the intensity of electrical field stimulus, firing rate increased in an approximately linear manner and there was no change of firing pattern. While in the critical state, firing rate increased obviously with the transition of firing pattern when the intensity of electrical field stimulus was high enough. It is concluded that the response to electrical field stimulus in the critical state, which is near a bifurcation, is more sensitive than that in the period state, this is named as “critical sensitivity” phenomena.

关键词

起步点(Pacemaker); 神经(Nerve); 放电(Firing); 分岔(Bifurcation); 电场刺激(Electrical field stimulus)