

描述肝细胞中两类不同特性钙离子浓度振荡

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细胞内第二信使钙离子通常以浓度振荡的方式转导多种生理学信息,影响细胞分化、成熟和凋亡等各种生理过程。肝细胞实验中看到在一定浓度范围的激动剂刺激下,细胞质钙离子浓度的变化可呈现出很不相同的图像。例如在脱羟肾上腺素刺激下,可出现简单的周期振荡,振荡频率随激动剂浓度的不同有变化;在腺苷三磷酸刺激下,随激动剂浓度从低到高,胞质钙离子浓度的变化可以从开始出现简单振荡,到形成复杂的多峰间歇振荡。肝细胞中钙离子浓度振荡的峰值多在500 nmol/L到800 nmol/L范围。给出一个四变量数学模型的改进形式,可以模拟肝细胞中钙离子浓度从简单振荡向复杂振荡的变化。数值计算给出与实验结果比较一致的振荡波形和振幅。

A MODEL DESCRIBING DIFFERENT KINDS OF OSCILLATIONS OF CYTOSOLIC CALCIUM IN HEPATOCYTES

As a second messenger, the intracellular calcium transfers biological message by concentration oscillations. The experiments on rat hepatocytes showed that intracellular calcium concentration has two very different forms of oscillations stimulated by different agonists. One consists of simple spikes with a high frequency, and the other consists of complex burstings with every bursting composed of multi-peaks of the concentration. The peak concentration is often limited under 500 nmol/L to 800 nmol/L for both kinds of oscillations. A four-variable dynamical model is constructed by combining different models and considering experimental facts published before. This model describes the change of the oscillations from simple spikes to complex bursting. Numerical simulations are in good accordance with experiments in both frequency and amplitude of Ca^{2+} oscillations. The dynamics of the system shows that the complexity of oscillations depends on the accelerate active G_{α} subunit and the forming of active PLC.

关键词

细胞信号系统(Cell signaling system); 钙离子浓度振荡(Cell calcium oscillations); 数学模型(Dynamical model)