

睡眠2期脑电信号产生的生理机制模型仿真研究

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目前慢波睡眠生理机制研究已有的理论及动物实验结果显示,慢波睡眠中,皮层-丘脑系统神经元存在三种不同节律的振荡:慢振荡(<1 Hz)、 δ 振荡($1\sim 4$ Hz)和纺锤振荡($7\sim 14$ Hz)。这些神经元电活动在皮层水平广泛同步化,产生慢波睡眠脑电。提出了能分别产生这三种节律的三种神经元环路模型,并将之组合简化成一个七细胞环路模型。由这样的大量环路组成的网络模型在合适的突触连接参数范围内,能在皮层处产生人类慢波睡眠脑电2期的完整波形。这一结果说明了如何将动物实验观察到的睡眠生理机制的结果与人自然睡眠活动的脑电结果联系起来,并提示脑信息处理中由微观神经元群放电特征整合为脑的宏观功能状态的主要环节。

SIMULATION STUDY ON MODELS FOR MECHANISMS UNDERLYING EEG OF SLOW WAVE SLEEP STAGE 2

According to the recent physiological theories and the experiment results about slow wave sleep (SWS) mechanisms, it is thought that there exist three different rhythms in the neurons of cortex-thalamic system: slow oscillation (<1 Hz), delta oscillation ($1\sim 4$ Hz) and spindle oscillation ($7\sim 14$ Hz). The widespread synchronization of these neurons in cortex level will generate SWS electroencephalograms (EEGs). Three circuit models which can generate the three rhythms respectively are suggested; then they were combined and simplified into a seven-cell circuit model. Moreover the network model composed of many identical circuits can generate waveforms consistent with SWS EEG stage 2. The results reveal the concordance between the physiological experiments about sleep mechanisms and recordings from human natural sleep EEGs; also they enlighten us the chief courses of information processing in which the microscopic, electrical activities of neurons can be integrated into the macroscopic, functional states of human brain.

关键词

慢波睡眠脑电2期(Slow wave sleep EEG stage 2); 建模(Modeling); 神经元环路(Neuronal circuit); 脑整合机制(Integration mechanisms of human brain)