学报简介

第二军医大学学报 ISSN 0258-879X CN 31-1001/R

ACADEMIC JOURNAL OF SECOND MILITARY MEDICAL UNIVERSITY

董惠1, 李彬1, 郭芳2, 郭会彩2, 王永利2*, 李春岩1*. Na+, K+ ATP酶在大鼠皮质神经元缺氧性损伤中的作用[J]. 第二军医大学学报, 2008, 29(2):0171-0176

Na+, K+ ATP酶在大鼠皮质神经元缺氧性损伤中的作用 点此下载全文

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基金项目:

DOI: 10.3724/SP.J.1008.2008.00171

摘要:

目的:探讨缺氧对Na+, K+ ATP酶活性的影响, 以及高亲和力Na+, K+ ATP酶和低亲和力Na+, K+ ATP酶在缺氧损伤中的不同作用。方法:通过切换低氧灌流液模拟大鼠脑片和原代培养的皮质神经元缺氧环境, 以脑片膜片钳全细胞模式记录Na+, K+ ATP酶电流和膜电流, 以可视化动缘探测系统测定培养的皮质神经元内钙离子浓度(\[Ca2+\]i), 观察缺氧4 min时脑片皮质神经元Na+, K+ ATP酶电流的变化, 以及缺氧2、4、6、8和10 min时在有、无哇巴因(Na+, K+ ATP酶阻断剂)存在情况下皮质神经元膜电流密度和\[Ca2+\]i的变化。结果:缺氧4 min总Na+, K+ ATP酶电流密度(0.160±0.046 pA/pF)较缺氧前(0.265±0.068 pA/pF)显著降低(P<0.01), 但10 min缺氧可时间依赖性显著升高皮质神经元的膜电流密度(r=0.980 3, P<0.01)和\[Ca2+\]i(r=0.973 4, P<0.01);10 μmol/L哇巴因可通过抑制低亲和力Na+, K+ ATP酶进一步增强此种缺氧所致的膜电流密度和\[Ca2+\]i增大作用(P<0.05或0.01), 但10 nmol/L哇巴因则通过抑制高亲和力Na+, K+ ATP酶显著降低缺氧对二者的增大作用(P<0.05或0.01)。结论:Na+, K+ ATP酶活性改变参与了皮质神经元的缺氧性损伤, 其中高亲和力Na+, K+ ATP酶与皮质神经元缺氧性损伤保护作用有关, 而低亲和力Na+, K+ ATP酶则与其缺氧性损伤有关。

关键词: Na+ K+ ATP酶 缺氧 神经元 钙信号 膜片钳术

Role of sodium pump Na+ K+ ATPase in hypoxic injury of cortical neurons in rats Download Fulltext

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Fund Project:

Abstract:

Objective: To investigate the effect of hypoxia on the activity of Na+ K+ ATPase (Na pump) and to understand the distinct functions of high and low affinity Na pump during hypoxia of cortical neurons. Methods: Hypoxic condition was mimicked by perfusing cortical slices or culturing cortical neurons with low oxygen solution. Sodium pump current and membrane current of neurons from cortical slices were measured by patch clamp technique in the whole cell mode and the intracellular Ca2+ concentration (\[Ca2+\]i) in cultured cortical neurons was examined by video based motion edge detection system. Changes of Na pump current induced by hypoxia were also examined 4 min after hypoxia in the neurons of cortical slices. Changes of membrane current and \[Ca2+\]i were determined 0, 2, 4, 6, 8 and 10 min after hypoxia with or without Ouabain (Oua, inhibitor of sodium pump). Results: Total sodium pump current were significantly decreased 4 min after hypoxia (\[0.265±0.068\] pA/pF vs \[0.160±0.046\] pA/pF, P<0.01). Membrane current and \[Ca2+\]i were increased in a time dependent manner 10 min after hypoxia (r=0.9803 and r=0.9734, P< 0.01). The effect of hypoxia on membrane current was abolished by tetrodotoxin (TTX, 1 μmol/L, a blocker of sodium channel). Oua at 10 μmol/L significantly promoted the hypoxia induced increase of membrane current and \[Ca2+\]i through inhibiting low affinity sodium pump (P<0.05 or 0.01), and Oua at 10 nmol/L significantly depressed the increase of membrane current and \[Ca2+\]i through inhibiting high affinity sodium pump (P<0.05 or 0.01). Conclusion: Change of sodium pump activity is involved in hypoxic injury in rat cortical neurons. High affinity sodium pump is related to the protection of hypoxic injury and low affinity sodium pump is related to the hypoxic injury.

Keywords: Na+ K+ ATPase hypoxia neuron calcium signaling patch clamp techniques

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