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Effects of adult-onset choline deprivation on the activities of acetylcholinesterase, (Na+,K+)- and Mg2+-ATPase in crucial rat brain regions.

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Abstract

Choline (Ch) plays an important role in brain neurotransmission, while Ch-deprivation (CD) has been linked to various pathophysiological states. Prolonged ingestion of Ch-deficient diet (CDD) is known to produce CD causing a reduction of rat brain acetylcholine (ACh) levels, as well as memory and growth disorders. The aim of this study was to investigate the effect of a 2-month adult-onset CD on the activities of acetylcholinesterase (AChE), (Na+,K+)- and Mg2+-ATPase in crucial brain regions of male rats. Adult rats were divided into two groups (control and CD). The CD group was fed with CDD for 2-months. At the end of the second month, rats were sacrificed by decapitation and the brain regions were rapidly removed. Enzyme activities were measured spectrophotometrically in the homogenated frontal cortex, hippocampus, hypothalamus, cerebellum, and pons. In CD rats, AChE activity was found statistically significantly increased in the hippocampus and the cerebellum (+28%, P<0.001 and +46%, P<0.001, respectively, as compared to control), while it was found unaltered in the other three regions (frontal cortex, hypothalamus and pons). (Na+,K+)-ATPase activity was found increased by CD in the frontal cortex (+30%, P<0.001), decreased in both hippocampus and hypothalamus (-68%, P<0.001 and -51%, P<0.001, respectively), and unaltered in both cerebellum and pons. No statistically significant changes were observed in the activities of Mg2+-ATPase in the frontal cortex and the hypothalamus, while statistically significant increases were recorded in the hippocampus (+21%, P<0.01), the cerebellum (+85%, P<0.001) and the pons (+19%, P<0.05), as compared to control levels. Our data suggest that adult-onset CD can have significant effects on the examined brain parameters in the examined crucial brain regions, as well as that CD is a metabolic disorder towards which different and brain region specific neurophysiological responses seem to occur. Following a 2-month adult-onset CD, the activity of AChE was found to be increased in the hippocampus and the cerebellum and unaltered in the other three regions (frontal cortex, hypothalamus and pons), while Na+,K+-ATPase activity was found to be increased in the frontal cortex, decreased in both hippocampus and hypothalamus, and unaltered in both cerebellum and pons. Moreover, Mg2+-ATPase activity was found to be unaltered in the frontal cortex and the hypothalamus, and increased in the hippocampus, the cerebellum and the pons. The observed differentially affected activities of AChE, (Na+,K+)-ATPase and Mg2+-ATPase (induced by CD) could result in modulations of cholinergic neurotransmission, neural excitability, metabolic energy production, Mg2+ homeostasis and protein synthesis (that might have a variety of neurophysiological consequences depending on the brain region in which they seem to occur).

PMID: