Metab Brain Dis. 2010 Sep;25(3):269-76. doi: 10.1007/s11011-010-9205-y. Epub 2010 Sep 14.

Choline-deprivation alters crucial brain enzyme activities in a rat model of diabetic encephalopathy.

Liapi C[1], Kyriakaki A, Zarros A, Galanopoulou P, Al-Humadi H, Dontas I, Voumvourakis K, Tsakiris S.

Abstract

Diabetic encephalopathy describes the moderate cognitive deficits, neurophysiological and structural central nervous system changes associated with untreated diabetes. It involves neurotoxic effects such as the generation of oxidative stress, the enhanced formation of advanced glycation end-products, as well as the disturbance of calcium homeostasis. Due to the direct connection of choline (Ch) with acetylcholine availability and signal transduction, a background of Ch-deficiency might be unfavorable for the pathology and subsequently for the treatment of several metabolic brain diseases, including that of diabetic encephalopathy. The aim of this study was to shed more light on the effects of adult-onset streptozotocin (STZ)-induced diabetes and/or Ch-deprivation on the activities of acetylcholinesterase (AChE) and two important adenosine triphosphatases, namely Na(+),K(+)-ATPase and Mg(2+)-ATPase. Male adult Wistar rats were divided into four main groups, as follows: control (C), diabetic (D), Ch-deprived (CD), and Ch-deprived diabetic (D+CD). Deprivation of Ch was provoked through the administration of Ch-deficient diet. Both the induction of diabetes and the beginning of dietary-mediated provoking of Ch-deprivation occurred at the same day, and rats were killed by decapitation after 30 days (1 month; groups C1, D1, CD1 and D1+CD1) and 60 days (2 months; groups C2, D2, CD2 and D2+CD2, respectively). The adult rat brain AChE activity was found to be significantly increased by both diabetes (+10%, $p < 0.001$ and +11%, $p < 0.01$) and Ch-deprivation (+19%, $p < 0.001$ and +14%, $p < 0.001$) when compared to the control group by the end of the first (C1) and the second month (C2), respectively. However, the Ch-deprived diabetic rats' brain AChE activity was significantly altered only after a 60-day period of exposure, resulting in a +27% increase (D2+CD2 vs. C2, $p < 0.001$). Although the only significant change recorded in the brain Na(+),K(+)-ATPase activity after the end of the first month is attributed to Ch-deprivation (+21%, $p < 0.05$, CD1 vs. C1), all groups of the second month exhibited a statistically significant decrease in brain Na(+),K(+)-ATPase activity (-24%, $p < 0.01$, D2 vs. C2; -21%, $p < 0.01$, CD2 vs. C2; -22%, $p < 0.01$, D2+CD2 vs. C2). As concerns Mg(2+)-ATPase, the enzyme's activity demonstrates no significant changes, with the sole exception of the D2+CD2 group (+21%, $p < 0.05$, D2+CD2 vs. C2). In addition, statistically significant time-dependent changes concerning the brain Mg(2+)-ATPase activity were recorded

within the diabetic ($p < 0.05$, D2 vs. D1) and the Ch-deprived ($p < 0.05$, CD2 vs. CD1) rat groups. Our data indicate that Ch-deprivation seems to be an undesirable background for the above-mentioned enzymatic activities under untreated diabetes, in a time-evolving way. Further studies on the issue should focus on a region-specific reevaluation of these crucial enzymes' activities as well as on the possible oxidative mechanisms involved.

PMID:20838865

DOI:10.1007/s11011-010-9205-y