Quantitative Assessment of Neurochemical Profiles in Rat Hippocampus after Short-Term Binge Ethanol Intoxication, Determined Using Ex vivo 1H High-Resolution NMR Spectroscopy

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Target audience: Neurologist, medical doctors, and clinicians interested in MRS of the brain.

Purpose: A number of studies have suggested that acute binge alcohol abuse can lead to a variety of brain disorders, such as loss of brain volume, neurological dysfunction, functional abnormalities, and neurochemical alterations. Previous studies have reported that the hippocampal region is especially vulnerable to the adverse effects of acute binge alcohol abuse. Therefore, the purpose of present study was to provide ex vivo evidence of changes in the neurochemical profiles of rat hippocampus after 4-day binge ethanol intoxication, using high-resolution 1H-NMR Spectroscopy.

Methods: 8-week-old male Wistar rats (n = 20) were divided into 2 groups [control (0.0 g/kg of ethanol; distilled water): n = 10, binge ethanol-exposed rats (1.5 g/kg of ethanol; 25% w/v ethanol solution): n = 10], were used in this study. The 10 rats in the binge ethanol group received an initial ethanol dose of 5.0 g/kg (30% w/v ethanol solution) via oral gavage, then received additional doses of 1.5 g/kg (25% w/v ethanol solution) every 8 h (at 10:00, 18:00, and 02:00) for 4 days. Oral gavage ethanol was administered according to body weight, using Majchrowicz binge alcohol protocol. Body weights of the rats in both control and binge alcohol groups were recorded daily for 5 days (including the pre-administration [Pre-admin.], body weights). After 4 days of oral gavage, all animals were sacrificed and brain tissues were harvested from the hippocampal region.

Results: The present study was conducted in rats using the Majchrowicz binge alcohol model for binge ethanol intoxication in order to observe the cerebral metabolite changes in the hippocampal region. We found significantly higher Glu/Cr and Glx/Cr ratios after binge ethanol intoxication, which may point to alterations in the glutamate-glutamine cycle, and reflect an alteration in glutamatergic turnover in the neuron-glial shuttle. On the basis of our findings and the results of previous studies, we suggest that significantly high Glu/Cr and Glx/Cr ratios may reflect the elevation of glutamate and glutamate-glutamine concentrations. Our findings suggest that the glutamate signals and the glutamate-glutamine cycle in the hippocampal region are particularly sensitive to binge ethanol consumption. Future studies using a combination of human patients and animal MRS investigations, as well as other neuroimaging approaches, are required to strengthen our findings and to validate the translational component in the binge alcohol intoxicated condition.

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