Spatial learning in men undergoing alcohol detoxification

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HIGHLIGHTS

- Ethanol addiction affects cognitive capabilities.
- Spatial learning responses in alcoholic men
- The virtual Morris maze as a useful tool for addiction investigation in humans

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ABSTRACT

Alcohol dependence is a major public health problem worldwide. Brain and behavioral disruptions including changes in cognitive abilities are common features of alcohol addiction. Thus, the present study was aimed to investigate spatial learning and memory in 29 alcoholic men undergoing alcohol detoxification by using a virtual Morris maze task. As age-matched controls we recruited 29 men among occasional drinkers without history of alcohol dependence and/or alcohol related diseases and with a negative blood alcohol level at the time of testing.

We found that the responses to the virtual Morris maze are impaired in men undergoing alcohol detoxification. Notably they showed increased latencies in the first movement during the trials, increased latencies in retrieving the hidden platform and increased latencies in reaching the visible platform. These findings were associated with reduced swimming time in the target quadrant of the pool where the platform had been during the 4 hidden platform trials of the learning phase compared to controls. Such increasing latency responses may suggest motor control, attentional and motivational deficits due to alcohol detoxification.

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1. Introduction

Chronic alcohol consumption is known to induce brain damage associated with cognitive impairments in animal models and humans [11, 27, 43, 54]. Substantial animal data exist demonstrating that chronic alcohol exposure leads to hippocampal neurodegeneration via the disruption of brain cell proliferation, survival and maturation [26]. Early human studies reported visuospatial and visuoperceptual deficits in detoxified alcoholics by using different tests such as the Rey–Osterrieth complex figure [5, 52] and the WAIS Block Design [28]. However very limited data are available concerning spatial cognition changes in alcoholics.

Spatial cognition is a basic brain function with the goal to understand space by identifying and using important object-to-self and object-to-object spatial relations and concerns the acquisition, organization and revision of knowledge about spatial environments [38]. In the mammalian brain the parietal neocortex, the parahippocampal cortex and the hippocampus synergistically play a key role in the fine tuning of spatial memory regulation [2, 24]. Heavy alcohol consumption has been associated with changes across several domains of cognition [34, 36], with executive functioning and memory domains being the most vulnerable to disruptions by alcohol [35, 37].

Binge drinking in young adults (approximately 21 years) is considered to be associated with deficits in cognitive functions linked to the dorsolateral prefrontal cortex, as well as modifications in memory functions, associated with the temporal lobe [41]. Adolescents examined after a period of three weeks of abstinence revealed a lower verbal learning and poorer visual reproduction [9]. In 3-week abstinence adult alcoholics, impairments were observed on word recall [42]. In long-