

GABA receptor potential in early life on cognitive performance of sleep-deprived adult male rats

Abstract:

Background: Neurotransmitters function as integral components in the complex communication network of the central and peripheral nervous system. Changes in the functioning of the GABAergic system can affect sleep behavior and cognitive functions.

Aim: Considering the effects and role of GABA in early life on neuronal growth and development, and considering the important role of these receptors in regulating the sleep-wake cycle, an attempt has been made in this study to investigate the effects of using GABA A receptor antagonists in the early stages of life on cognitive functions in sleep-deprived male rats.

Materials and Methods: In this study, four groups of 10 male neonatal infants were selected from mothers. The first group was the control group (receiving DMSO), the second group received bicuculline (300 µg/kg on days 7, 9, and 11), the third group was sleep-deprived, and the fourth group received bicuculline and was sleep-deprived. Various behavioral tests, including the open field test and elevated plus maze (EPM), were performed to assess stress in mice. The cognitive effects of blocking GABA receptors in sleep-deprived mice were evaluated using Y-maze and the Morris water maze tests. Then, after anesthetizing the animals, the prefrontal cortex of the rats was dissected to measure the antioxidant factors and oxidative stress after the induction of sleep deprivation.

Results: The findings showed that the inhibition of GABA receptors by bicuculline in early life resulted in a reduction of anxiety-like behaviors in sleep-deprived animals. Inhibiting GABA receptors by bicuculline in early life significantly reduced anxiety-like behaviors in the bi+sd group compared to the sd group ($p < 0.05$). Sleep

deprivation led to a decrease in short-term spatial learning and memory, while the inhibition of GABA receptors in early life prevented the decline in learning and spatial memory in sleep-deprived animals. The results of the present study also demonstrated that early life blockade of GABA receptors and sleep deprivation did not have a significant effect on the percentage of alternation in the Y-maze. Inhibition of GABA receptors by bicuculline in early life increased antioxidant factors (SOD and GPx) and a decrease in MDA levels in the prefrontal cortex of sleep-deprived mice.

Conclusion: The results of the present study showed that according to the open field test, the maze plus the high form of inhibition of GABA receptors in early life prevent the anxiety-like behaviors of rats in adulthood. Inhibition of GABA receptors by bicuculline in early life improved spatial learning and memory in sleep-deprived rats using Morris water maze test. Inhibition of GABA receptors by bicuculline in early life had no effect on the alternation percentage according to the y-maze test. Our study emphasized the role of inhibition of GABA receptors by bicuculline in reducing oxidative stress caused by sleep deprivation through increasing antioxidant factors (SOD and GPx) and decreasing MDA in the prefrontal cortex of sleep deprived rats.

Keywords: Anxiety-like behaviors, Cognitive functions, Bicuculline, Sleep deprivation