Mice Learning After 30 Minutes Exposure

Abstract

The aim of this experimental study was to investigate the effect of extremely low frequency (50 Hz, 8 mT) electromagnetic fields on earning in mice. The learning was evaluated with passive avoidance learning and after each learning session, an animal in experimental group was exposed to an 8mT, 50Hz electromagnetic field for 30 minutes. The results showed that exposure to a 50 Hz, 8mT electromagnetic field for 30 minutes after the animal's learning has devastating effects on avoidance learning in mice ($p<0.05$).

Mini Review

Volume 3 Issue 2 - 2017

Elham Foroozandeh*

Department of Psychology, Islamic Azad University, Iran

***Corresponding author:** Elham Foroozandeh, Department of Psychology, Islamic Azad University, Iran, Email: elham_for@yahoo.com

Received: April 14, 2016 | **Published:** May 15, 2017

Introduction

Recent studies in Behavioral and psychological fields have shown that exposure to electromagnetic fields (EMFs) can change human cognitive functions and behaviors of animals [1,2]. For instance it is reported that neither short term (7 days), Nor long term exposure to 25-50Hz fields did not make a change in motor activity, but 50 Hz field exposure will decrease recognition of new arm of the Y maze [3]. It is suggested that EMFs can make changes in calcium ion homeostasis in neuronal tissues and it was found that exposure to extremely low frequency EMFs increased Ca ions levels in Hippocampal regions cells [4]. In this study the effect of extremely low frequency (50 Hz, 8 mT) electromagnetic fields on learning in male mice was examined.

Method

Adult male mice (25-30 g) were housed five per cage in a room with natural light cycle and constant temperature (24±2C). Food and water were available ad libitum. All procedures were conducted in agreement with the National Institutes of Health Guide for care and use of laboratory animals. In this study, to measure learning or acquisition of information, mice were evaluated with inhibitory (passive) avoidance task. Passive avoidance learning box is a wooden box with dimensions (30*30*40cm) and the floor of the 29 steel bars, the diameter of 0.3 cm. Bars are away from each other 1 cm. A wooden platform (4 * 4 * 4cm) is placed in the middle floor of the box. By an electric shock (1 Hz, 0.5 seconds, and 50 V, DC) can be controlled irritating situation (Grass S44-Quincy, Massachusetts.USA). In the learning stage, the animal was gently placed on the small wooden platform in the middle of box. Animal's natural tendency to coming down from the platform, make it to move in space of larger wooden box immediately. A 15 seconds electric shock was given as soon as animal came down from the platform and placed on the floor of the box. So despite his natural tendency, mice learn to stay on platform. After 24 hours and in test session, avoidance learning with step-down latency was calculated [5] (Hiramatsu, Sasaki & Kameyama (1995). Electromagnetic field was applied in a room adjacent to that used for behavioral experiments. A sinusoidal magnetic field was created using a round coil electromagnet made from a 1000 turned copper wire (0.50 mm). The electromagnet was supplied with a sinusoidal waveform signal generator (GFG-8019G, Good Will instrument Co.). Then amplifier output droved to coil, producing an ELF of 8 mT at the center of the coil. The desired intensity ELF (8 mT) calibrated using a Gauss meters (K72106-9-WALKER, USA) at the center of the coil. The heat generated by coil dissipated due to good ventilation in exposure area. The electrical apparatuses and exposure system adjusted on the laboratory non-metallic table and the temperature inside coil, using a fan and aluminum water was kept at constant temperature (24±2 C) during learning tests. Animals were selected at random and two groups were used: male sham-exposed (N= 10), male exposed to 8 mT (N=10), after each learning session, an animal in experimental group was exposed to 8mT, 50Hz electromagnetic field for 30 minutes. The animals in sham-exposed control group were placed in coil for 30 minutes too but there was not any electromagnetic field. After 24h, step-down latency for each animal was measured and recorded as passive avoidance learning.

Finding

As it can be seen in (Table 1) compared the control and experimental group (10 mice in each group) in the learning session was not significant (U Mann-Whitney = 24.50, $p <0.052$). The analysis of test session (passive avoidance learning index) data showed that the step-down latency in groups which mice exposed to electromagnetic Tesla 8 mT (50 Hz) were significantly lower than control groups. Comparison of experimental and control mice indicated significant differences between two groups (U Mann-Whitney = 22.00, $p <.035$).

Table 1: comparison of experimental and control groups' rank in learning and test sessions.

Session	Group	N	Mean Of Ranks	Mann–Whitney U Test	P Value
Learning session	Experimental group	10	7.95	24.50	0.052
	Control group	10	13.05		
Test session	Experimental group	10	7.70	22.00	0.035
	Control group	10	13.30		

Discussion

According the finding it can be concluded that exposure to ELFs may impair the learning process in mice. So animal's learning will not be used and animal's step-down latency and avoiding the shock reduces in test session. It is well-known that the differences between step-down latency on the platform in learning and test sessions are an index of the rate of learning.

This result is in line with Jadidi et al [6]. It is suggested that brain cholinergic system plays a crucial role in learning and on the other hand exposure to EMFs decreased activities of cholinergic system in the frontal cortex and hippocampus, both regions are involved in memory processing [7,8]. Thus, one possibility is that the impairment of cognition processing can result from decrement in transmission of cholinergic system. In this study the effect of gender was not controlled. Also the p value in learning session that shows the difference between two groups was near to an statistical difference. So the findings and statistics should be interpreted with caution.

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Citation: Foroozandeh E (2017) Mice Learning After 30 Minutes Exposure. MOJ Toxicol 3(2): 00048. DOI: 10.15406/mojt.2017.03.00048