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A COMPARATIVE STUDY TO ASSESS THE BEHAVIORAL CHANGES BETWEEN THE SLEEP DEPRIVATION AND NOISE STRESS INDUCED MICE

Suresh K	Dept. of Physiology, Meenakshi Medical College and Research Institute, Kanchipuram,
Suganya K	Dept. of Physiology, Meenakshi Medical College and Research Institute, Kanchipuram,
Kayalvizhi E	Dept. of Physiology, Meenakshi Medical College and Research Institute, Kanchipuram,
Chandrasekar M	Dept. of Physiology, Meenakshi Medical College and Research Institute, Kanchipuram,

ABSTRACT Humans are exposed to a number of stressors in the daily routine life and among them noise and sleep deprivation is the most encountered stressor. This two stressor an associated with disorders like anxiety and depression which are functional major disorders we see daily. The aim of this study was to compare the behavioral changes between sleep deprived and noise stress induced mice. 18 swiss albino mice weighing 20-25gms were taken in this study and they were divided into three groups with six mice in each group (Group I- control, Group II- noise stressed mice and Group III - Sleep deprived mice). Immediately after sleep deprivation for about 96 hrs for four consecutive days and noise stress with 200 Hz's 120 db, 30 min/day for 12 consecutive days, the mice were exposed to behavioral analysis. In our study, there was a significant decrease in behavior parameters in both noise stressed and sleep deprived mice, but it was highly significant in the sleep deprivation group. Our findings reveals that sleep deprivation reduces locomotor activity with altered behaviors suggest that sleep deprivation is potent stressor than noise stress.

KEYWORDS : Sleep deprivation, Noise stress and Flower pot technique.

INTRODUCTION:

Stress is an unavoidable phenomenon that affects the body systems at various levels. Among the most widespread encountered stressor is noise and sleep deprivation which affects all living beings throughout the world. Noise pollution can be defined as unwanted sound that can cause ear problems, disturbing the relaxation, or even permanent deafness. Noise is stressful stimulus which induces stress in both animals and humans and disrupts the activity or balance of life. [1] As a stressor, noise has a greater influence on the human body. Previous studies have shown that living in a noisy environment can cause annoyance and aggression, hypertension, high stress levels, hearing loss, sleep disturbances, work efficiency, performance, and communication ability and other harmful effects. [2] The brain, the key organ that interprets and responds to potential stressors, recognizes the sound levels and discriminates the stress levels. It reacts within split seconds to help the body adjust to this stressful situation by releasing hormones. [3] Earlier studies on exposure to noise stress showed that increase of stress hormone (corticosterone) levels are associated with behavioral disorders.

Sleep is essential physiological process necessary for the maintains of homeostasis, autonomic functions, neuroendocrine, immune systems, memory consolidation, spatial learning and restoration of neural tissue. [4] Increase of sleep deprivation in the modern society due to rapid changes in life style alters sleep waking pattern which results to anxiety like behavior, impaired motor activity, behavioral irritability, poor performance, hormonal and neurochemical alterations. [5] Sleep deprivation also results an increase in plasma glucocorticoids in both humans and rodents which is further causes increase in stress levels and neuro-degeneration over a period of time. [6]

Research in sleep deprivation and noise stress are limited and there is no literature comparing sleep deprivation and noise induced behavioral changes in rodents. Therefore the aim of present study was to investigate and explore behavioral changes in both noise stress and sleep deprived mice.

MATERIAL AND METHODS:

This study was done in the Department of Physiology, Meenakshi Medical College and Research Institute, Kanchipuram. Male Swiss albino mice weighing 25-30 gms body weight were used for the study. 18 animals were taken in this study and they were divided in to three groups with six mice in each group, Group I- control (6), Group II- noise stressed mice (6) and Group III-Sleep deprived mice (6). The mice were sleep deprived for 96 hours by using the inverted flowerpot technique. Mice were placed on a circular platform of diameter 3 cm in the center of a small water tub surrounded by water up to 1 cm below the surface of the platform. This setup prevents mice to sleep because the decrease in muscle tone during sleep makes the animal fall into the water, which wakes up the animal. [7] Noise stress was induced by sine wave using a function generator in a fabricated noise stress chamber. Mice were kept in chamber for 30 min of duration, 200hzs, 120db for 14 consecutive days. [8] Behavioral analysis was done by using open field and elevated plus maze apparatus.

Open field test

The open field test measured the behavioral activity such as locomotor activity and exploratory behavior. To monitor the behavioral response, the animal were taken out from their home cages and placed in the central square of open field (one at a time). Numbers of ambulation -central and peripheral, rearing, grooming and immobilization time were counted for 3 min. [9]

Elevated plus maze test

The elevated plus maze assessed the anxiety like behavior changes in laboratory animals. To monitor this activity, mice were

individually placed in the open arm and the following parameters like transfer latency, time spent in open arm, time spent in closed arm and number of crossings were recorded for 5 minutes.[10]

Statistical Analysis

Statistical significance was evaluated by one-way analysis of variance (ANOVA) using SPSS 20. P < 0.05 was considered significant.

Parameter	Group I Mean ± SME	Group II Mean ± SME	P-Valve	Group III Mean ± SEM	P-Valve
Transfer latency(sec)	14.1 ± 2.2	21.3 ± 5.2	0.234	109 ± 29	.009*
Time spent in close arm(sec)	101 ± 11	126 ± 18	.286	157 ± 18	0.030*
Time spent in open arm(sec)	97 ± 6.8	48.1 ± 8.9	0.002*	32.5 ± 8.1	.000*
No of crossings(no)	12.5 ± 1.7	6.1 ± 1.1	0.014*	5.0 ± 0.6	.002*

RESULTS:

Table I: Effect of noise and sleep deprivation on Behavior of animals in elevated plus maze.

(Values are mean ± SE, *= p value < 0.05 significant).

Table II: Effect of noise and sleep deprivation on Behavior of animals in open field maze.

Parameter	Group I Mean ± SME	Group II Mean ± SME	P-Valve	Group III Mean ± SEM	P-Valve
No. Of Central squares	21 ± 1.9	10 ± 1.2	.001*	5.6 ± 1.6	.000*
No. Of peripheral sqaures	92 ± 5.3	71 ± 9.7	.092	46 ± 10.7	.004*
Rearing	17 ± 3.7	9 ± 2.0	.088	4.5 ± 1.4	.010*
Grooming	19 ± 5.3	8 ± 4.0	.135	8 ± 2.4	.093
Immobilization time	7 ± 2.8	17 ± 4.9	.100	48 ± 5.3	.007*

(Values are mean ± SE, *= p value < 0.05 significant).

The mice subjected to noise stress and sleep deprivation showed behavioral alterations with increased Transfer latency, closed arm time, and decrease in Open arm time and numbe not significant. (Table-I)

The mice subjected to noise stress and sleep deprivation showed behavioral alterations with decrease in No. of ambulation (central and peripheral) rearing, grooming with increase in immobilization time then controls in open field apparatus. The sleep deprived group showed highly significant decreasing in ambulation (central and peripheral), rearing with increase in immobilization time then a noise stress group, which is not significant. (Table II).

DISCUSSION:

Sleep deprivation and noise stress is considered as a risk factor for development of several health consequences. Sleep deprivation leads to various behavioral disturbances involving motor activity, anxiety level, memory and metabolic functions related to anabolic hormones and also the exposure of noise stress induced the exhaustion, annoyance, decreased muscle movements and mood changes. In our study, mice was subjected to sleep deprivation and noise stress showed behavioral alterations in both groups compare the controls, but the mice subjected to sleep deprivation showed highly significant then noise stress induced mice.

In sleep deprived group, the behavioral parameters in elevated plus maze was highly significant with an increase of transfer's latency, closed arm time and a highly significant decrease of open arm time with no of crossings. According to Gopalakrishnan et al., (2004) this could be due to increase in GABA, which is one of the important neurotransmitters mediating inhibitory postsynaptic potentials. The GABAergic system has a definite role on anxiety and related behavior, since 30-50 % of all synapses are GABAergic in CNS (Ramananthan et al,.2002). This might be due to oxidative damage in discrete areas of brain and there was a link between the oxidative damage and GABAeric system this could be explain the changes in behavioral parameters in sleep deprived mice. The behavioral changes also could be increased corticosterone levels due to positive feedback of HPA axis, D2 dopamine receptors and monoamine system.. (Rocio et al,. 2016).

In open field apparatus, the locomotor behavior was significantly decreased with increased immobilization time in sleep deprivation. This could be due to decrease in Dopamine, a major neurotransmitter involved in movement and locomotion Cenci et al, (2007). Oades et al,. (1986) reported that dopamine increases the locomotion in rodents. According to Jolanta orzeł et al,. (2010) this could be due to increased CRH on striatum, limbic and hypophysis with increase of ACTH and nor adrenalin this may cause the behavioral abnormalities in sleep deprivated mice.

CONCLUSION: In the present study, we found that mice exposed to noise stress and sleep deprivation showed alteration in the locomotion and behavior than the controls and our study also substantiate that a sleep deprivation is potent stressor than noise stress by behavioral analysis. Our further studies will be aimed at analyzing the biochemical changes in sleep deprived and noise stress induced mice.

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