A study to assess the noise stress-induced changes on cognition in Wistar albino rats

Archana A

University of Madras, India

Background: In our modern lifestyle exposure to noise stress/ pollution not only affects the auditory system but rather extend to the central nervous system.

Objective: The aim of the study is to investigate the effect of acute noise stress on cognitive functions in male Wistar albino rats.

Methods: Adult albino rats were randomly divided into two groups. Each group contains six animals. Rats exposed to acute noise stress (100 dB/4 hour) were compared with control animal and assessed for cognition by using T-maze, hole board test, open field test, marble burying test and social interaction behavior.

Noise was produced by a loud speaker (15 W), installed at a distance of 30 cm above the cage, and driven by a white noise generator emitting all the frequencies in the range 0–20 kHz. A precision sound level meter was used to set the intensity of sound to 100 dB uniformly in the cage. During the experiment, the noise level peaked at 100 dB immediately after the generator was switched on and continued for 4 hr.

Results: The rats exposed to acute noise stress shown the significance ($p<0.05$) of behavioral alterations such as impaired learning and memory, memory retention, increased fear and anxiety, obsessive-compulsive behavior, social avoidance and decreased social interaction.

Glucocorticoids secreted during stressful episodes can readily cross the blood–brain barrier and act via both mineralocorticoid receptors and glucocorticoid receptors in limbic brain areas.It is well known that glucocorticoid and catecholamine effects on memory are mediated by the amygdala. Other than its effect on memory, it did not affect the time taken by the stress exposed rats to complete the task in eight arm maze compare to control and this is well supported by him shows stress and the stress hormone influence motor system function in rats. Rats with hippocampal lesions are impaired in learning the radial arm, the T maze Whishaw, proposed that the hippocampus is dedicated to monitoring cues generated by self-movement and that it is part of a directional system that provides information to an extrinsic location system. It is a fact that hippocampus provides negative feedback to the HPA axis and has an important role in key aspects of spatial and declarative memory. Corticosterone exerts a concentration-dependent biphasic influence, via selective activation of hippocampal mineralocorticoid and glucocorticoid receptor, on spatial memory.

The analysis of corticosterone metabolites and corticosterone in mice excreted into urine and feces of mice could offer such a non-invasive technique to assess adrenocortical function. The present study indicates that acute noise memories are affected in the early hours after stress and the effects are normalized by 24 hrs. This was associated with elevated corticosteroid. Y maze normally evaluates hippocampal dependent spatial memory by analyzing exploration of familiar or novel arm location. In Y maze the triad errors (abnormal arm entry sequence), latency period and time spent in each arm A, B, and C (novel arm) after an acute stressed rats shows significant increase in triad errors and delay in latency period only at 1 hr compare to control and there is no marked changes was observed at 4 hr and on 24 hrs. The stress induced arousal of autonomic sympathetic as well as increased corticosteroid level in the current study may be behind this change was observed and as the level of the stress hormones are normalized then the behavior also become normal. Glucocorticoid administration after memory retrieval impairs later recall. In contrast to memory consolidation, memory retrieval seems to be impaired by stress although this could also be interpreted as competitive encoding of new information, related to the stress exposure. This acute effect could not be ignored though it is restored to normal level as in normal life human beings are exposed the stress minute to minute. Continuous non-physiological increased level of stress hormones leads to an adverse effect During stress paradigms in animals, levels of glutamate and serotonin are increased in the hippocampus. Structural changes in the hippocampus associated with chronic stress in animals can be prevented by reducing corticosteroids levels through adrenalectomy. Animal data indicate that corticosteroids are associated with cognitive impairment, cellular changes, and even neuronal death in the hippocampus Memory is not a passive process in which the indiscriminately retain information from the environment. Variables such as context and prior experiences involve in filtering which information has to be retained and the accuracy with which that retention occurs. One important such filter is the emotional state. The amygdala is an essential component of the neural circuitry involved in emotional responses, in general, and in attaching emotional significance to learned stimuli.

During the acute noise stress exposure there might be an emotion disturbance also which may interfered with amygdala functions. Anatomically, the amygdala projects to several hippocampal regions providing various routes by which it may potentially influence hippocampal function. Evidence indicates that the amygdala is critically involved in mediating stress-related effects on behavior and modulating hippocampal function. An intact

amygdala is necessary for the expression of the modulatory effects of stress on hippocampal long term potentiation and memory. Since the corticosteroid elevation is short lived during acute stress the effect on the memory may be reversed in the study. Hence it may be inferred that simultaneous glucocorticoid and noradrenergic activation changes the patterns of brain activity in a way that may contribute to the differential effects of stress on different memory processes. Normally nature of stress effects on memory is critically timing dependent. As the acute effect the effects are short lived the restoration of memory process could be possible

Conclusion: The results report that acute noise stress affects the cognition, it became chronic may confer the increased risk of neurodegenerative disorders.

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