

VARIATION IN THE HISTOLOGY OF NERVE CELLS OF ALBINO RATS EXPOSED TO HIGH DECIBEL NOISE POLLUTION.

Zoology

Varsha V. Andhare Associate Professor, Department of Zoology, The Institute of Science, 15, Madam Cama Road, Mumbai 400032.

Nisha Velayudhan Research student, Zoology Department, The Institute of Science, 15, Madam Cama Road, Fort, Mumbai 400032.

ABSTRACT

Industrial revolution has created noise pollution which is an unavoidable change of the development. It has serious and significant implications on the human health. Continuous exposure of one such critical noise i.e. traffic noise unfolds the stress hazards on humans. When a set of albino rats were exposed to traffic noise pollution on regular basis for a stipulated period of time, showed an array of behaviour like increased anxiety and hyperactivity especially fighting tendency. When the neuronal histology of these rats was studied, they showed neuropathy of the nerve cells of the rats that were exposed to high decibel traffic noise. This is a major health concern as hippocampus in the brain also exhibits neuropathy leading to serious health conditions like Alzheimer's disease in future.

KEYWORDS

Noise, stress, anxiety, Alzheimer

Introduction:

Today stress is a major health issue in the urban population. It was never meant to be a health hazard but, for protecting animals from critical situations. Stress can be triggered by any aspect which is unfavourable for the organism. Thus sound which is unpleasant which is categorized as noise can act as a major stressor. The possibility of the noise pollution to be a serious stressor in urban population is still not given importance because still noise limits are not strictly followed which is clear from the Municipal decibel charts during different festivals^(4,9)

During stress conditions the body responds to release of corticosteroid hormone. This hormone basically shows attachment on the hippocampus region of the brain. The hippocampus is the part of the brain which contributes to the new memory formation centre and it also, helps in spatial navigation.^(7,8)

Corticosteroid hormones are released by the adrenal gland. It is released from the Zona fasciculata section of the adrenal cortex as a result of stress condition. These hormones then triggers an alarm in the body for fight or flight situations. In both the situations the brain gets active to react to the situation and the activation could be through the hippocampal attachment of the cortisol hormone to create a fresh memory as well as for flight conditions for spatial navigation.⁽⁶⁾ This alarm system could have been useful if it was for situations which are commendably significant but, in today's conditions this alarm is triggered due to undue stress from psychological trauma of unhealthy competition, various types of diseases, etc. This list should also contain noise pollution as public stress but which is largely being ignored.^(1,2)

The stress thus caused by noise pollution shows histological variation in the structure of the nerves cells of the rats exposed to high decibel noise pollution. The histological sections of these rats showed structural distortion in the nerve cells.

Methodology:

The experimentation included 14 albino rats as subjects. After the albino rats were incurred they were quarantined separately for 10 days in a quiet place with low decibel sound (below 60 decibel). Then these rats were segregated into two groups –control and test with weight of each animal between 200 gms to 250 gms.

The control group continued to stay with same surrounding with sound below 60 dB. The test group rats were exposed daily for 30 mins to noise pollution recordings obtained from traffic sites which were between 90 to 100 dB. This noise exposure was given to the test group rats for a period of 10 days.

After 10 days all the test as well as control group rats were scarified by euthanizing them. The brain of all the rats were removed, fixed in bovine and stained for permanent slide preparation to study the

structural variation of the nerve cells. The slides were stained using H and E staining technique to study the disruption of the cells. These variations due to high decibel noise exposure were compared with the control animals kept in silent zone (below 60 decibel).

Observations and Results:

The nerve cells of the test showed clear evidences of disturbance in the normal structure. The cell shape and the nerve fibre axon wrapped by oligodendrocytes displayed distortion in the test slide; they displayed irregular shape whereas in the control rat nerve structures had smooth and neatly wrapped nerve fibres by oligodendrocytes. Such disruptive cell structure evidently showed disruptive functioning. It is a known fact that high decibel noise pollution causes stress^(1,2). This stress triggers disruption and distortion of the axonal protection i.e. oligodendrocytes⁽²⁾. This excessive disruption would be the result of excessive GC attachments in the brain due to continuous stress condition in the body⁽⁷⁾.

GC attachments specifically show attachment in the Hippocampus region of the brain is evidential due to the HPA axis of the endocrine system of the body^(6,8). When the body has continuous exploitation due to stress it affects the wear and tear of the nerves in the brain which is evidently seen in these slides of the rats stressed with high decibel noise pollution.

Fig.1. H&E stained control rat brain (Hippocampus region of the brain) pointing to an oligodendrocyte

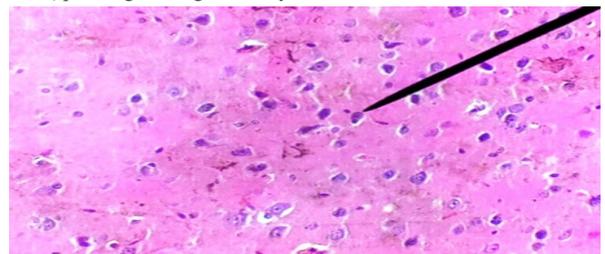
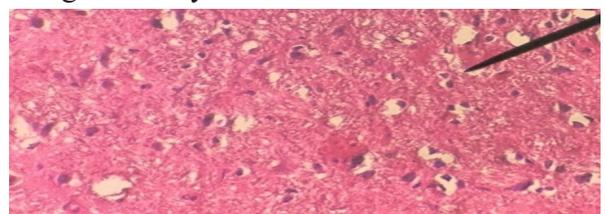


Fig.2. H&E stained test rat brain (Hippocampus region of the brain) pointing to an oligodendrocyte



Discussion:

The healthy nerve cells with oligodendrocytes are compromised due to stress exposed to them which causes the dendrites atrophy this physiology has been observed when we study the neuropathology of stress. ⁽²⁾The present study in which the test rats exposed to noise pollution showed variation in the nerve cell i.e. the myelin sheath which consists of compacted spirally wrapped layers of oligodendrocytes in the hippocampus, similar to the observation by Lisa J. Phillips, Patrick D. McGorry, Belinda Garner .et .al. which states that the onset of psychotic disorders maybe associated with higher rates of stress and changes to hippocampus. ⁽⁶⁾The present study also revealed that the cell continuously exposed to noise pollution results in excessive wear and tear of the nerve cell causing the oligodendrocytes to shrink which was similarly observed in the study conducted by Hideo Uno, Ross Tarara, et.al. on primates at a primate care centre in Kenya on ulcerated monkeys during where the ulcers were the stress indicators. ⁽³⁾

In conclusion it can be stated that noise pollution is a matter of concern with respect to public health. The noise pollution could be the reason behind the rising rate of anxiety related health issues. ⁽²⁾This can also, be co-related to psychological well being of all the individuals in a society because "A healthy mind can give rise to a healthy society". ^(4,5)

Conclusion:

The stress interferes with the wear and tear of the nerves which forms the functional unit of the brain. This study reveals the fact that the nerve cells compromise with continuous exposure of high decibel noise which indirectly destroys the signalling pathways of the brain .i.e. the axon. Schwann cells act as axons insulator. When these cells get disrupted they cause loss of signalling patterns and slowly deplete the functional areas of the brain. It can be concluded that long term and regular exposure to high decibel noise pollution can lead to serious illness like Alzheimer's disease in future.

Acknowledgement

The authors would like to thank the Former Head of Department, Zoology, The Institute of Science

References:

1. McEwen, B.S. (2000).The neurobiology of stress: from serendipity to clinical relevance. *Brain Research*, 886, 172-189.
2. Lucassen, P.J, Pruessner, J., Sousa, N., Almeida, O.F.X., Van Dam, .A.M., Rajkowska, J., · Swaab & D.F, Czeh, B. (2014). Neuropathology of stress. *Acta Neuropathol*, 127,109–135.
3. Uno, H., Tarara, .R., Else, J.G., Suleman, .M.A., Sapolsky, .R.M. (1989). Hippocampal Damage Associated with Prolonged and Fatal Stress in Primates. *The Journal of Neuroscience*, 9(5), 1705-1711.
4. Jamir, L., Nongkynrih, .B., Gupta, .S.K. (2014). Community noise pollution in urban India: Need for public health action. *Indian Journal of Community Medicine*, 39(1), 8-12.
5. Turner, J.G., Parrish, J.L., Hughes, L.F., Toth, .L.A., Caspary, D.M. (2005). Hearing in Laboratory Animals: Strain Differences and Non-auditory Effects of Noise. *National Institute of Health*, 55(1), 12-23.
6. Phillips, L.J., McGorry, .P.D., Garner, .B., Thompson, .K.N., Pantelis, .K., Wood, .S.J., Berger, G. (2006). Stress, the hippocampus and the hypothalamic-pituitary-adrenal axis: implications for the development of psychotic disorders. *Australian and New Zealand Journal of Psychiatry*, 40, 725–741.
7. Spiers, J.G., Chen, H-J.C., Sernia, .C., Lavidis, .N.A. (2015). Activation of the hypothalamic-pituitary-adrenal stress axis induces cellular oxidative stress. *Frontiers of Neuroscience*, 8(456),
8. Kim, J.J., Diamond, .D.M., (2002). The stressed hippocampus, synaptic plasticity and lost memories. *Nature Reviews/ Neuroscience*, 3, 453-462.
9. Passchier-Vermeer, .W., Passchier, .W.F. (2000). Noise Exposure and Public Health. *Environmental health perspectives*, 108(1), 123-131.
10. Copenhaver, .W.M., Bunge, .R.P., Bunge, .M.B. (1971). *Bailey's Textbook of Histology*. Germany