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A NEW KEY RELATIONSHIP BETWEEN NOISE POLLUTION, ACETYLCHOLINESTERASE AND HORMONAL SYSTEM

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ABSTRACT

Exposure to noise induce production of free radicals leading to increasing oxidative injury in whole body organs. This study involved ninety one workers aged (40.055 ± 11.56) years old, randomly selected from tow different gas electric stations compared with seventy apparently health persons as control group aged (38.366 ± 10.73) years old. Malondialdehyde MDA level, Triiodothyroid hormone T3 and Thyroxine hormone T4 were significantly (P≤0.05) higher in workers than that in the control, while Reduced glutathione GSH level and Acetylcholinesterase AChE activity were significantly (P≤0.05) lower in all groups of workers compared with control group, also Testosterone hormone level was significantly (P≤0.05) decreased in all groups of workers.

KEYWORDS: Noise pollution, Acetylcholinesterase, Testosterone, Malondialdehyde MDA, Thyroid hormone, Glutathione GSH.

INTRODUCTION

Noise is a powerful stress factor, disturbing, and uncomforting has great harmful effects on health that disturbs the human environment, physiological and psychological life of people, it is generated from human activities, especially in the developing countries. Its cause many health problems as hearing loss,[1] hypertension,[2] annoyance,[3] blood pressure increasing,[4] coronary heart disease,[5] and other harmful effects that induce oxidative stress. The harmful damage effect of noise increases production of free radicals that induce oxidative damage in whole body, also high levels of free radicals and ROS cause to harm bimolecules such lipids, proteins, and DNA,[6] leading to a variety of disorders like arthritis, diabetes, inflammation,

atherosclerosis, cancer, genotoxicity and neurological disorders such as Alzheimer's disease.[7]

Free radicals can attack all Biomolecular, especially the lipids, at which a free radical react with unsaturated fatty acids leading to lipid peroxidation process.[8] MDA is considering a major end product of lipid peroxidation and an indicator for damage of cell membrane, after formation many ROS products causing oxidative stress.[9] GSH plays a pivotal role in antioxidant defense in the maintenance of intracellular, redox status and antioxidant enzyme functions. It acts as a reducing agent and vital substrates for detoxification in the aqueous phase of the cell system.[10] Furthermore, GSH acts on regulation of immune function and maintenance of protein structure, function, and turnover.[11]

AChE is a key enzyme for the cholinergic transmission act on hydrolyzes the neurotransmitter acetylcholine Ach to acetate and choline, thus play a central role in the nervous system.[12]

Thyroid hormones (T3 and T4) are the primary regulators of human metabolism, growth, and stimulate protein synthesis. They secreted by the thyroid gland, it's one of the largest and most sensitive endocrine glands in the body these hormones stimulate oxidative respiration in most cells in the body and helping the body's basal metabolic rate.[13]

Testosterone is the main and important hormone for men, it's responsible for appear the secondary sexual characteristics. This hormone is the synthesis of cholesterol in leyding cells and secreted by the testis, it's responsible for the development and maintenance of masculine characteristics,[14] The aim of this study is to demonstrate the relationship between oxidative stress and hormonal system due to exposure to noise pollution.

1. EXPERIMENTAL METHODS

This study involved about ninty workers, aged (40.055 ± 11.56) years old, randomly selected from two different gas electric stations, while the control samples were collected from seventy apparently healthy persons aged (38.366 ± 10.73) years old.

Serum obtained by allowing blood samples to clot then centrifuged at 2000 xg for 10 minute, The blood samples of workers were classified to two classifyings, the first classifying was divided according to the location of worker from the sound source in the station, this classifying involved three groups, the first group (G_1L) is group A was far from the sound

source and the workers number in this group were thirty workers, The second group (G_2L) is group B was slightly near from the sound source and them number was twenty nine workers, the last group (G_3L) is group C which them number was thirty tow workers those were very near from the sound source.

The other classifying was involved three groups divided according to the time of working for worker in the station, the time of working of the first group (G_1TW) was between 2-8 years and the number of workers in this group was forty workers, the second group (G_1TW) have period time of working for the workers between 9-19 years and them numbers were twenty seven workers, the third and last group (G_1TW) involved twenty four workers with period time of working (19<) years.

Lipid peroxidation was estimated in serum based on the formation of thiobarbituric acid reactive substances (TBARS) as described in.[15]

Reduced Glutathione Level (GSH) was assayed by the method of.[16] 5,5`- Dithiobis (2-nitrobenzoic acid) (DTNB) is a disulfide chromogen that is readily reduced by sulfhydryl group of GSH to produce an intensely yellow Compound.While **AChE** activity was investigated as described in.[12]

Triiodothyroid (T3), Thyroxine (T4) and Testosterone Hormones were assayed by using Momobind ELISA kits (Monobind Inc, USA).

Statistical analysis was performed by Microsoft excel office 2010. The data as expressed as mean ± SD and statistical significance was set at ($P \leq 0.05$).

2. RESULTS

The present study demonstrated the influence of noise pollution on workers in gas electric stations compared with controls. Age, MDA, GSH, AChE, T3, T4 and Testosterone levels and controls were given in Table 1 that divided into three groups of workers according to time working in the station.

The significant rise in MDA levels, T3, T4 levels ($P \leq 0.05$), ($P \leq 0.05$), ($P \leq 0.05$) respectively for all workers group in classifying 1 and classifying 2 compared with the control group, and the increasing of MDA levels, T3, T4 levels dependent on the decreasing the distance between the working location of worker and the source of sound in the station for classifying

1, also increased with increasing period time of working years in the station in classifying 2, while the level of GSH, AChE activity and Testosterone level were significantly decreased (P≤0.05), (P≤0.05) and (P≤0.05) respectively for workers than control group as shown in Table 1.

Table 1: levels of MDA, GSH, AChE, T3, T4 and Testosterone levels of worker groups compared with control.

The group	N	MDA (µmole/L)	GSH (µmole/L)	AChE (U/L)	T3 (ng/ml)	T4 (µg/dL)	Testosterone (ng/ml)
*G_1L (A) far	30	1.78± 0.54	50.5 ± 14.1	41.818±10.5	1.028±0.22	6.229 ± 2.7	5.027 ± 1.15
*G_2L (B) slightly near	29	2.136±0.78	39.827 ± 11.8	34.863 ± 8.2	1.096±0.18	8.187 ±2.63	4.426 ± 2.48
*G_3L (C) near	32	2.586±0.78	32.968 ± 7.1	32.308±6.76	1.148±0.21	9.873 ± 2.4	4.069 ± 1.18
Control	70	0.6 ± 0.3	60.857 ± 9.5	63.244 ± 4.7	0.713±0.18	6.008 ±0.35	7.111 ± 4.1
**G_1TW (2-8) years	40	1.646 ± 0.5	49.625±15.1	41.921±9.13	0.915±0.22	6.789±2.73	4.853 ± 1.3
**G_2TW (9-19) years	24	2.401 ± 0.7	42.592±12.7	32.059 ± 4.5	1.054±0.18	9.149 ±2.55	4.459 ± 1.35
**G_3TW (19<) years	27	2.808 ± 0.6	38.333±14.4	31.54 ± 9	1.077±0.21	9.235 ±2.95	4.312 ± 2.55
Control	70	0.6 ± 0.3	60.857 ± 9.5	63.244 ± 4.7	0.713±0.18	6.008 ±0.35	7.111 ± 4.1

** (G_1L, G_2L, and G_3L) = groups of workers divided according to location of working (L= Location)*

*** (G_1TW, G_2TW, and G_3TW) = groups of workers divided according to time of working (TW= time of working in years.*

S=significant (p≤0.05).

3. DISCUSSION

Noise pollution is a silent killer, its induce ROS production leading to oxidative injury in all body tissues,[17] This study shows a significant raise in MDA levels for workers than the level of control, and this may be due to increase the generation of ROS caused by noise.[18] this result is an indication of oxidative stress in worker's serum. Also heavy exposure to noise and after the peroxidation process, polyunsaturated fatty acids and phospholipids in the cell membrane are destroyed and reduced in amount, this can lead to depletion of fatty acid in the

membrane might result in cellular destruction and impaired antioxidant defense system.[19] The decreasing of GSH levels is caused by exposure to noise lead to oxidative stress and increase production of free radicals and peroxides that oxidized thiol group of glutathione leading to decrease the GSH level,[20] also may be due to increased utilization of GSH for conjugation and participation of GSH as an antioxidant in terminating free radical production.[21] The reducing level of GSH for workers is a good indicator of increasing oxidative stress and free radical generation due to noise.

Inhibition of AchE activity due to oxidative stress causes a neurotoxicity in the brain.[22] Experimental study demonstrated that stress-induced changes in the central cholinergic system and reducing AchE activity,[23] Another study shows that the activity of AchE is reduced in conditions oxidative stress, and this reduction is due to overproduction of H_2O_2 which oxidized many amino acid residues such as methionine, tryptophan, and cysteine in structure of protein, which can severely affect the enzyme functions.[24] Additionally,[25] investigated that exposed to acute noise might cause a release of Ach from the cholinergic nerve terminals and its subsequent hydrolysis by AchE enzyme. In this work, The inhibition of AchE activity might be due to exposure to noise increase of free radical's production causing disappointing the oxidant and antioxidant equilibrium in the brain,[35] this lead to oxidative stress that reduced AchE function in the cholinergic system also alteration of AchE structure in the surface of the enzyme by the action of free radicals caused the reduction in enzyme activity.

The elevation levels of T3 and T4 due to many reasons, one of this reasons is that hydrogen peroxide was required by thyroid cells to oxidized iodine also in coupling two molecules of T2 to synthesis T4 hormones, thus the increasing level of total peroxides may cause increase synthesis of T4 hormone.[26] Also the raise secretion of thyroid hormone was increased production of ROS caused enhancement in oxidation phosphorylation caused by oxidative stress.[27] In addition, The hyper metabolic state of thyroid hormones is associated with increasing free radical generation, lipid peroxide levels,[28] consequence leading to hyperthyroidism and this accompanied by increasing oxygen utilization, and increased production of ROS in oxidative stress conditions.[29]

Decreasing the level of testosterone may be due to the increasing production of H_2O_2 induced cell damage in testis cause to decrease the testosterone biosynthesis leading to decrease the testosterone level.[30] Also oxidative stress induces increased glucocorticoid's secretion and

consequence circulation testosterone level is decreased via glucocorticoid receptors in leading cell.[31] Long exposure produces structural changes in testicular tissues and reduction of the sperm count, this is accompanied by the reduction the testosterone level.[32] In addition the decreasing of testosterone levels may be due to disturbance of normal spermatogensis, this suggests that hypothalamic cells which produce luteinizing hormone (LH), do not function correctly to the feedback when testosterone level is decreased. The appropriately to a decline in testosterone implies that exposure to noise has a central effect on the interaction between the nervous system and the endocrine system.

LH and FSH are important regulators of spermatogensis, LH enhances the transport of cholesterol into the mitochondria from the cytosol in interstitial cells of leyding.[31] But FSH stimulates spermatogenesis,[33] Previous studies showed that the low testosterone level was accompanied by LH and FSH levels,[34] therefore it can be concluded that decreasing testosterone levels due to noise leading to reduced sperm count also which may highlight the harmful effects on sperm motility.

4. CONCLUSION

Elevation of MDA, GPx and GR levels also decreasing of AChE activity may because of high production of free radicals caused by exposure to noise pollution

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