Effects of Noise Pollution on Thyroid Function in Rat

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***Abstract*---**Studies show that there is association between noise pollution and physiological functions in body. The main aim of this study was to determine the effects of noise pollution on thyroid function in male rats. In our study male Wistar rats were randomly divided into control, and groups exposed to 1 h/day, 3h/day, and 6h/day noise pollution of 5 rats in each. After 8 weeks, the animals were killed and blood samples were obtained using cardiac puncture method. Serum T3 and T4 levels were measured using radioimmunoassay method. Data were statistically analyzed and compared between groups (ANOVA). The results indicated that serum T3 and T4 level decreased in rats exposed to noise pollution compared to control rats. Our findings show that noise pollution can reduce throid function may leading to hypothyroidism.

Keywords*----Noise Pollution, T3, T4, Rat*

I. Introduction

NOISE pollution or noise disturbance is defined as the unwanted sound which is released into the environment and it disturbs the human being and cause an adverse effect on the mental and psychological well being and is also the most important source of environmental annoyance [1], [2].noise pollution is almost entirely human generated, whether by machine sources or amplified sound of human creation, for example transportation systems, motor vehicles, aircraft and trains [3]. There is general agreement that exposure to sound levels less than 70 dB does not produce hearing damage, regardless of the duration of exposure and There is also general agreement that exposure for more than 8 hours to sound levels in excess of 85 dB is potentially hazardous [4]. As with being under long-term environmental noise exposure, we have hormones and specifically stress hormone dysregulations as well as increases of established endogenous risk factors of ischaemic heart diseases have been observed so we can have hypertension, vasoconstriction and other cardiovascular impacts [5] - [7] and also the studies show that the other environmental pollution, including air, water, chemicals pollution and etc, can alter hormones gene expression, specifically steroid hormones[8], [9].

The thyroid hormones, triiodothyronine (T3) and its prohormone, thyroxine (T4), are tyrosine-based hormones produced by the thyroid gland that are primarily responsible for regulation of metabolism. The major form of thyroid hormone in the blood is thyroxine (T4), which has a longer half-life than T3 [10]. The thyroid hormones have marked effects on the growth, development, and metabolic function of virtually all organ systems and tissues of human beings and other higher organisms [11], [12]. For example they affect protein synthesis, help regulate long bone growth (synergy with growth hormone) and neural maturation, and increase the body's sensitivity to catecholamines (such as adrenaline) by permissiveness. The thyroid hormones are essential to proper development and differentiation of all cells of the human body [13]. In the 1960s Tata and co-workers showed that thyroid hormone administration increased the rate of RNA synthesis in rat liver suggesting that L-T3 and L-T4 might act by controlling gene expression [14], [15]. Research over the past decade using intact animals and cultured cells has provided compelling evidence that the thyroid hormones exert their effects in various cells and tissues by stimulating the accumulation of mRNAs which code for specific proteins [16]. The purpose of the present study was to determine effects of noise pollution on thyroid function in Rat.

II. Material and Methods

A. Animals

Adult Wistar rats weighting 200±30g were purchased and raised in our colony from an original stock of Pasteur institute (Tehran, Iran).The temperature was at 23±-2 ^{0}C and animals kept under a schedule of 12h light:12h darkness (light on at: 08: 00 a.m.) with free access to water and standard laboratory chow. Care was taken to examine the animals for general pathological symptoms. Food was withheld for 12-14h before death. This study was performed according to ethical guidelines relating to working with laboratory animals.

B. Protocol of Study

Male Wistar rats were randomly divided into control animals, and rats exposed to noise pollution for 1h/day, 3h/day, and 6h/day. For induction of noise pollution, recorded traffic noise was used. After 8 weeks, the animals were killed and blood samples were obtained using cardiac puncture method. Serum T3 and T4 levels were measured using radioimmunoassay method. All animal experiments were carried out in accordance with the guidelines of Institutional Animal Ethics Committee.

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C. Statistical Analysis

Statistical significance was evaluated by one-way analysis of variance (ANOVA) using SPSS 19. Significance was measured using Fisher's least significant for the exact P values and significant differences are noted in the results. Differences with P<0.05 were considered significant

III. Results

Table I and figure I show serum levels of T3 and T4 in male rats.

TABLE I
THE SERUM T3 AND T4 LEVEL IN CONTROL AND RATS EXPOSED TO NOISE POLLUTION FOR 1H/DAY, 3H/DAY, AND 6H/DAY.

HORMONE / GROUP	T3(Mean±SEM) (ng/ml)	P	T4(Mean±SEM) (ng/ml)	P
Control	161.14±5.95		11.17±1.71	
1h/day	117.00±5.47	<0.001	7.80±1.22	<0.05
3h/day	119.00±3.61	<0.001	6.99±0.49	<0.01
6h/day	105.43±3.24	<0.001	7.13±0.61	<0.01

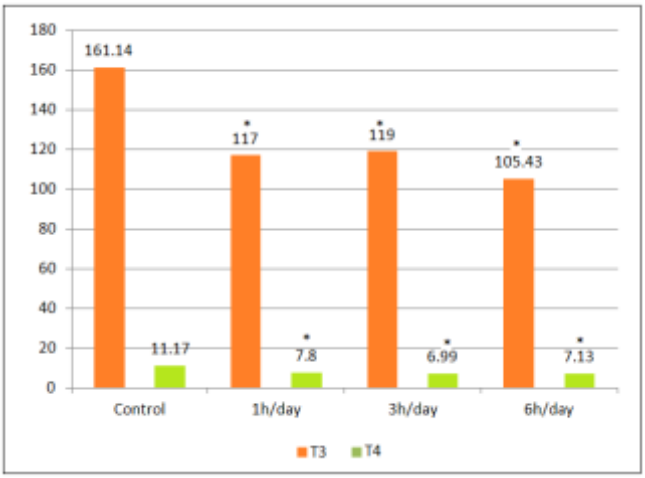

Fig. 1 The serum T3 and T4 level in control and rats exposed to noise pollution for 1h/day, 3h/day, and 6h/day. * indicates significant differencve compared to control group.

Our results showed that serum T3 levels decreased in rats exposed noise pollution compared to control rats (P<0.001). The more exposure time applied to noise pollution, the more decrease in serum T3 was also observed. Serum T4 also decreased in rats exposed to noise pollution for 1h/day, 3h/day and 6h/day compared to control animals (P<0.05, P<0.01 and P<0.01, respectively).

IV. Discussion

Our study indicated that noise pollution results in reduced serum T3 and T4 levels, indicating reducing of throid gland function. The natural environment is composed of various potentially hostile stressors. It is a basic requirement of life that the cells of an organism must be maintained within closely defined physiological limits [18],[19]. The maintenance of a constant interior mileu results from physiological and behavioural homeostatic adaptations. The physiological regulation of homeostatis is achieved by complex endocrine interactions, principally by the hormones secreted from the adrenal glands [17],[19]. Load sounds, intense light, immobilization, anxiety, force the abnormal secretion levels of stress hormones [20]. In each case the mechanism by which secretion of these hormones change is neurohomoral and is mediated through the central nervous system [21],[24]. Physical stressors such as noise generate highly reactive oxygen species overwhelm the endogenous antioxidant defense of the body and damage cellular macro molecular structures [22],[23]. Researchers have shown that thyroid hormones play a crucial role in inducing the generation of general stressors. And variations in the levels of thyroid hormones *in vivo* have been considered as one of the main physiological modulators of cellular oxidative [23],[24].Looking into overall literature, the objective of the present investigation was to evaluate the possible relationship between the noise stress and thyroid hormones level.

V. Conclusion

We have shown that exposure to noise pollution can bring about decreased serum T3 and T4 levels may leading to hypothyroidism.

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