Effects of Darkness Stress on Thyroid Function

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Abstract—Studies have shown that alteration in photoperiod influences secretion of many hormones. The aim of this study was to investigate the effects of long periods of darkness as a type of stress on serum levels of T3 and T4 in male rats. In this laboratory experimental study, male Wistar rats were randomly divided to control group, and groups exposed to 1 or 9 h/day of 6 rats in each group. The subjects were artificially exposed to darkness. After 8 weeks, blood samples were collected using cardiac puncture method and following serum collection, the levels of T3 and T4 were measured by radioimmunoassay. The data were statically analyzed using ANOVA. The results of the present study show that there was not significant differences in serum levels of T3 and T4 in control and rats exposed to darkness for 1 h/day compared with control animals. However, serum levels of T3 and T4 were significantly decreased in rats exposed to darkness for 9 h/day compared with control group (P<0.05). The findings suggest that prolonged periods of darkness can reduce thyroid activity and serum levels of thyroid hormone, according to which, it is suggested that darkness can be considered as a probable factor in hypothyroidism occurrence.

Keywords— Darkness, T3, T4, Testosterone, Rat.

I. INTRODUCTION

The thyroid hormones, triiodothyronine (T3) and thyroxine (T4) are tyrosine-based hormones produced by the thyroid gland that are primarily responsible for regulation of metabolism[1], [2]. Thyroid-stimulating hormone (also known as TSH or thyrotropin) is a hormone that stimulates the thyroid gland to produce thyroxine (T4), and then triiodothyronine (T3) which stimulates the metabolism of almost every tissue in the body [3]. Stress of different kinds including darkness stress influence many functions of body such as endocrine system [4]-[8] and immune system [9]. In fact, many hormonal changes can be occurred during stress [10]. Studies show that changes in photoperiodic cycles have effects on hormonal secretion of rats exposed to stress [11] and also thyroid gland function [12]-[18].

The aim of this study was to investigate the effects of long periods of darkness as a type of stress on serum levels of T3 and T4 in male rats.

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 °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.

B. Protocol of Study

In this laboratory experimental study, male Wistar rats were randomly divided to control group, and groups exposed to 1 or 9 h/day of 6 rats in each group. The subjects were artificially exposed to darkness. After 8 weeks, blood samples were collected using cardiac puncture method and following serum collection, the levels of T3 and T4 were measured by radioimmunoassay. All animal experiments were carried out in accordance with the guidelines of Institutional Animals Ethics Committee.

C. Statistical Analysis

All values are presented as mean ± S.E.M. 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 shows serum levels of T3 and T4 in male rats.

<table>
<thead>
<tr>
<th>Group</th>
<th>T3 (IU/L)</th>
<th>T4 (IU/L)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>135.6±2.56</td>
<td>5.53±0.3</td>
<td></td>
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</tbody>
</table>
| 1h/day darkness| 129.0±10.09| 4.99±0.99 | N.S.
| 9h/day darkness| 113.3±13.53| 4.13±0.07 | P<0.05

The data are indicated as mean ± SEM. P values are expressed in comparison with control group. N.S. represents non significant difference.

The results of the present study show that there was not significant differences in serum levels of T3 and T4 in rats exposed to darkness for 1 h/day compared with control animals. However, serum levels of T3 and T4 were...
significantly decreased in rats exposed to darkness for 9 h/day compared with control group \( (P<0.05) \).

IV. DISCUSSION

Our study indicated that serum T3 and T4 levels did not significantly change in rats exposed to darkness for 1h/day compared with control rats but significantly decreased in groups exposed for 9h/day compared to control animals. Studies show the effects of light and darkness on TSH level [17], [18]. Although there are reports showing that some stressors do not influence TSH level [19], several findings show that stress can suppress pituitary gland, in turn may inhibit TSH secretion [20]. In accordance with our finding, the studies indicate the effect of photoperiodism on pineal-thyroid-gonadal axis [21]. In effect, the stimulation of thyroid gland is mediated via neuroendocrine reflexes from the hypothalamus, which increases thyrotropin-releasing hormone secretion and consequent thyroid hormone release [22], [23]. So, it is conceivable that prolonged darkness can affect on hypothalamus, by which influence thyroid gland secretion.

V. CONCLUSION

The findings suggest that prolonged periods of darkness can reduce thyroid activity and serum levels of thyroid hormone, according to which, it is suggested that darkness can be considered as a probable factor in hypothyroidism occurrence.

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REFERENCES


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