



Research Article

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VESTIBULAR MODULATION OF THYROID FUNCTION IN FORCED COLD WATER SWIMMING STRESS INDUCED WISTAR ALBINO RATS

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ABSTRACT

The present study was undertaken to provide experimental evidence for vestibular modulation of thyroid function in cold water swimming stress induced wistar albino rats and to suggest further research to recommend vestibular stimulation as an intervention for thyroid disorders. 24 healthy, adult male albino rats of wistar strain were used in the present study. Rats were forced to swim in the plastic tubs (height: 60 cm, diameter: 40 cm) containing cold water, maintained at 10°C. Depth of the water in the plastic tub was 30 cm. The swimming session lasted for 45 minutes daily. The middle ear cavity was irrigated with hot (40 degree centigrade) or cold (15 degree centigrade) water through a polyethylene tube for 15 days. Our study provides preliminary evidence that vestibular stimulation can effectively prevent stress induced changes in body weight and thyroid hormones secretion. We recommend translational research in this area to elucidate the mechanism of vestibular modulation of thyroid hormones secretion.

KEY WORDS: Caloric vestibular stimulation, Cold water swimming stress, Thyroid hormones.

INTRODUCTION

Stress is the generalized, non-specific response of the body to any factor that overwhelms or threatens to overwhelm, the body's compensatory abilities to maintain homeostasis. Stress causes physiological changes, biochemical changes and behavioural changes in our body.^{1,2} Stress can cause thyroid autoimmunity.³ In laboratory animals forced swimming is most widely accepted for studying physiological variations in response to stress.¹ It was reported that rats could survive 80 hours in lukewarm water (36°C). Increase or decrease in the temperature of water influences the behaviour of the animal and changes the influence of glucocorticoids.^{4, 5} Stress modulates secretion of hormones and may lead to endocrine disorders. Stress increases secretion of glucocorticoids, growth hormone, prolactin and catecholamines. Increase in these hormones will help the individual to cope up with the stressful condition. However stress will decrease secretion of thyroid hormone and insulin. Both T₃, T₄ levels decreases in response to stress. Stress inhibits thyroid stimulating hormone through the action of glucocorticoids on the nervous system.⁶

Vestibular apparatus is known as membranous labyrinth and is enclosed in bony labyrinth of temporal bone. Vestibular apparatus consists of otolith organs and three semi circular canals. Vestibular stimulation relieves stress, pain, promotes sleep, improves cognition, immunity, balance food intake and also treats endocrine disorders.⁷⁻¹² Vestibular stimulation modulates thyroid

hormone secretion through its connections with paraventricular nucleus and arcuate nucleus.¹³ The present study was undertaken to provide experimental evidence for vestibular modulation of thyroid function in cold water swimming stress induced wistar albino rats and to suggest further research to recommend vestibular stimulation as an intervention for thyroid disorders.

MATERIALS AND METHODS

Animals: 24 healthy, adult male albino rats of wistar strain were used in the present study. Rats were housed under standard laboratory conditions with food and water provided ad libitum. Rats were randomly assigned into four groups.

Group A: (n=6) Control Group (Neither stress nor vestibular stimulation)

Group B: (n=6) Stress Group (Cold water swimming stress was given)

Group C: (n=6) Cold water swimming stress + cold water vestibular stimulation.

Group D: (n=6) Cold water swimming stress+ hot water vestibular stimulation.

Cold water swimming stress: Rats were forced to swim in the plastic tubs (height: 60 cm, diameter: 40 cm) containing cold water, maintained at 10°C. Depth of the water in the plastic tub was 30 cm. The swimming session lasted for 45 minutes daily. Experiments were done between 9 AM and 12 Noon to minimize the circadian variability.¹⁴

Caloric vestibular stimulation: The middle ear cavity was irrigated with hot (40 degree centigrade) or cold (15 degree centigrade) water through a polyethylene tube for 15 days.^{15, 16}

Study design: The present study is an experimental study. T₃, T₄, Cholesterol levels and body weight were recorded before and after vestibular stimulation by standard methods.

Data Analysis: Data was analyzed by SPSS 20.0. Statistical tests used are Two-way ANOVA and Bonferroni post tests.

Ethical Consideration

The present study was approved by institutional animal ethical committee of Little Flower Institute of Medical Science and Research Centre, Angamaly, No EC/2.

RESULTS

Body weight increased significantly followed by forced cold water swimming stress in stress only group on 7th day and 15th day. However no significant change was observed in body weight in cold and hot water vestibular stimulation groups. (Figure 1)

T₃ Levels decreased significantly in stress only group on 7th day followed by forced cold water swimming stress. However no significant change was observed in T₃ Levels in cold and hot water vestibular stimulation groups. (Figure 2)

T₄ Levels decreased significantly in stress only group on 7th day followed by forced cold water swimming stress. However no significant change was observed in T₄ Levels in cold and hot water vestibular stimulation groups. (Figure 3)

Cholesterol levels increased significantly followed by forced cold water swimming stress in stress only group on 1st, 7th and 15th days. However no significant change was observed in cholesterol levels in cold and hot water vestibular stimulation groups. (Figure 4)

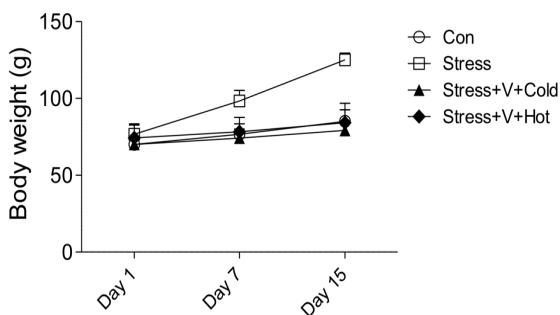


Figure 1: Body weight before and after vestibular stimulation

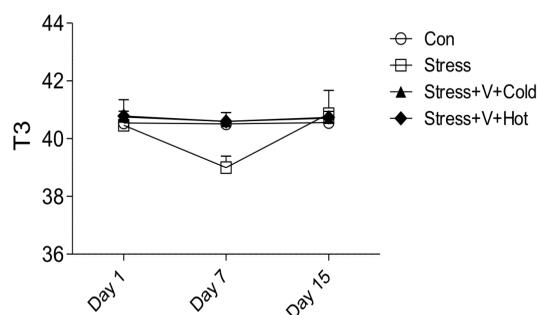


Figure 2: T₃ levels before and after vestibular stimulation

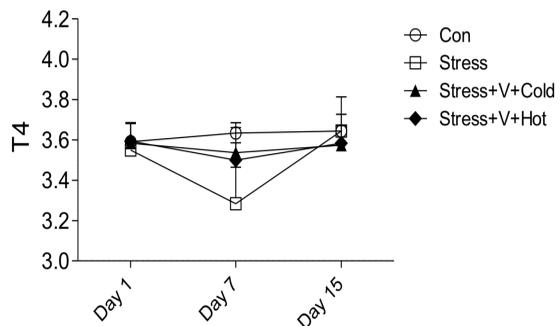


Figure 3: T₄ levels before and after vestibular stimulation

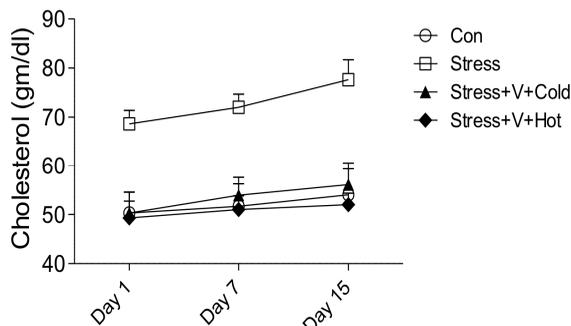


Figure 4: Cholesterol levels before and after vestibular stimulation

DISCUSSION

It was reported that body weight decreases significantly followed by cold water swimming stress,¹³ however we have observed increase in the body weight in response to stress. No significant change in body weight was observed in hot and cold water vestibular stimulation groups. This may be due to vestibular balance of food intake.⁶

It was reported that long term exposure to cold decreases T₃ and T₄ levels.¹⁶ Our study agree with these results as we have observed decrease in the T₃ and T₄ levels followed by forced cold water swimming stress. However vestibular stimulation by hot and cold water effectively prevented this stress induced fall in thyroid hormone secretion.

It was reported that total serum cholesterol decreased in response to forced cold water swimming stress.¹³ In the present study we have observed increase in cholesterol levels following exposure to stress. However vestibular stimulation by hot and cold water effectively prevented this stress induced rise in cholesterol levels.

CONCLUSION

Our study provides preliminary evidence that vestibular stimulation can effectively prevent stress induced changes in body weight and thyroid hormones secretion. We recommend translational research in this area to elucidate the mechanism of vestibular modulation of thyroid hormones secretion.

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