

Levels of thyroid hormones during stress

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Abstract

Different kinds of stress situations are known to change the concentration of a wide range of hormones in human beings. The secretion of thyroid hormones seems also to be influenced by various stress situations. Levels of thyroid hormones T3 and T4 were determined by radioimmunoassay before and after an artificially induced stress condition in a selected group of young adult men and women from the Garhwal region, India. Levels of T3 were significantly higher in men than in women during the period of stress. The levels of T4 were found to be similar in both the sexes. The results suggest that endocrine system of women reacts differently from that of men.

Keywords: iodine

Introduction

Iodine deficiency disorders represent a serious public health problem. Despite the worldwide application of successful iodine supplementation programmes over the last five decades, 54 countries and two billion of its people still have inadequate iodine nutrition (WHO 2004). Iodine is an essential micronutrient present (15-20 mg) almost exclusively in the thyroid gland of human body. It is an essential component of the thyroid hormones which are derivatives of the tyrosine bound covalently to iodine. The two principle thyroid hormones are Thyroxin (T4 or L-3,5,3,5'-tetraiodothyronine) and Triiodothyronine (T3 or L-3,5,3'-triiodothyronine. Several other iodinated molecules are generated that have little or no biological activity and are called "reverse T3" (3,3'5'-T3).

These hormones regulate metabolic processes in body cells and play a determining role in the growth and development of organs, especially that of brain. Under- and over-production of thyroid hormones, clinically referred to as hypothyroidism and hyperthyroidism, produce abnormalities in normal body functioning. Iodine deficiency, if severe enough to affect thyroid hormone synthesis during the early stages of body development, will result clinically in irreversible mental retardation. Its absence results in severe growth retardation which is associated with arrest of bone elongation as well as retarded bone maturation (WHO 2001). Therefore, to maintain a normal growth and developmental activity, a daily intake of 90, 120 and 150 µg iodine has been recommended for the age group of 0-59 months, 6-12 years, and for adults, respectively. The recommended value of iodine intake is 250 µg for pregnant and lactating women (WHO 2007, FAO 2004). When these conditions are not met in a given population, a large spectrum of iodine deficiency disorders occurs at all stages of growth and development i.e., from fetus to adult.

Thyrotropin, or thyroid stimulating hormone (TSH), a glycoprotein, acts on the receptors of thyroid gland to promote the synthesis and release of thyroid hormones T3 and T4: thyroid hormone controls TSH secretion by a negative feedback on the pituitary gland (Huszenicza *et al.* 2002, Guyot *et al.* 2007). Low thyroid hormones levels due to iodine deficiency or altered utilization of iodine can increase the secretion of TSH, serving as a basis for the diagnosis of thyroid dysfunction.

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Management of individuals with thyroid dysfunction is considered to be controversial because the body of scientific evidence available to guide clinical decision is limited (Col *et al.* 2004). Even different stress factors are known to change the levels of thyroid hormones. Exposure to cold has been associated with increase of TSH, while acute exposure to heat decreases serum T3 (Golstein *et al.* 1970, Epstein *et al.* 1979). Most other psychological stress conditions also tend to decrease the release of thyroid hormones (Kirkeby *et al.* 1984). The objective of this study was to measure the levels of total serum thyroxine, T4 and total serum triiodothyronine, T3 in the local population of the study area, and to investigate changes in concentration of T4 and T3 under the specific stress condition of teaching.

Materials & Methods

The chosen area, Garhwal, is situated in the Uttarakhand State of India (29° 26' to 31° 4' N and 78° to 88° E) in an iodine deficient goitre belt which passes through north-west Himalaya. The study sample consisted of 12-15 randomly selected graduate young adults of each sex who had no record of previous teaching experience. The women had normal menstruation. On the day of the test, two women had their menstruation and three were found to be in the early stages of pregnancy.

All were examined under the stress condition of teaching. Each was asked to teach three subjects to a group of 30 students belonging to class five (aged 9-10) in a nearby primary school for a duration of three hours. A schedule was set, and detailed instructions given. Within a time span of almost one month, four teaching sessions separated by an interval of at least five days were arranged. On each day, ca. 1.5 mL blood samples were taken immediately before (ca. 0700 h) and after (ca. 1100 h.) the teaching session, which lasted for about three hours.

Thyroid hormones were measured using the technique of radio immunoassay. This is the most widely accepted technique which is reliable, simple to perform and relatively inexpensive if numerous samples have to be performed in a batch. The disadvantages of this technique include the special handling and licensing required of radio-isotopes and the requirement that a multipoint standard curve be generated each time the test is performed (Golstein *et al.* 1970). Serum T3 and T4 radioimmunoassay was carried out using a kit supplied by Mumbai-based Bhabha Atomic Research Centre. Blood was collected with the help of the Pathology Department of nearby Base Hospital in Srikot, Srinagar Garhwal. Blood was collected into a heparinized tube, centrifuged and the serum separated. Aliquots of serum were stored at -20°C. Prior to radioimmunoassay the samples were allowed to come to room temperature.

Statistical analysis was conducted using Minitab statistical package, release 14 (Minitab Inc., State College, PA, USA). One-sample t-test and analysis of variance (ANOVA) was performed on the differences (before-after stress) of levels of T3 (total serum triiodothyronine) and T4 (total serum thyroxin)

Results

The levels of total serum T3 and T4 before and after stress did not exceed the normal range. However, this study showed some variations in T3 and T4 levels in males and females. The T3 levels of the men were significantly higher ($P < 0.001$) than those of women, whilst levels of T4 were similar in both sexes. T3 levels were significantly lower after teaching in men (Fig 1a) but not in women (Fig 2a). There were no differences in T4 levels in either sex (Fig 1b, 2b).

The reproductive state of women (pregnant, menstruating, not menstruating) made no difference to levels of either thyroid hormone.

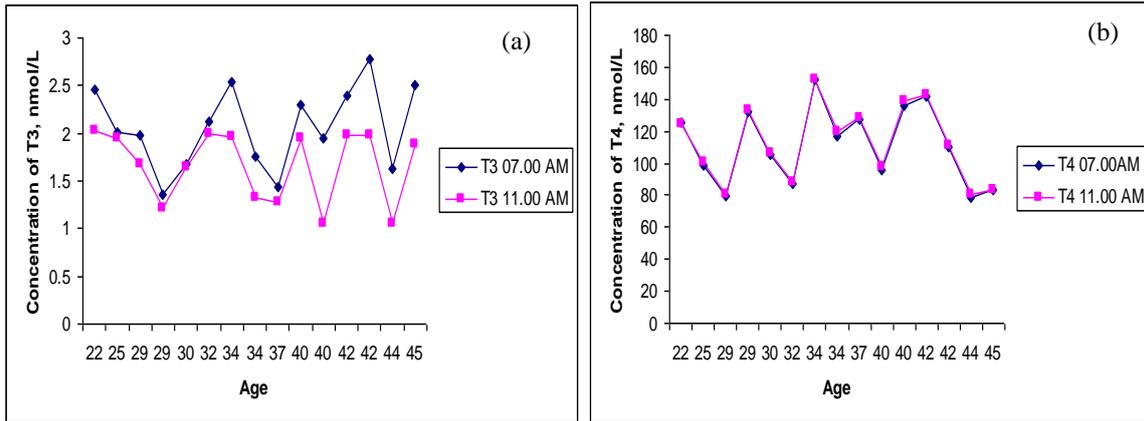


Figure 1: Levels of thyroid hormones in men before and after the stress of teaching, (a) T3 levels were lower after teaching ($t_{14} = 6.22, p < 0.001$); (b) T4 levels were unaffected ($t_{14} = -0.09, n.s.$).

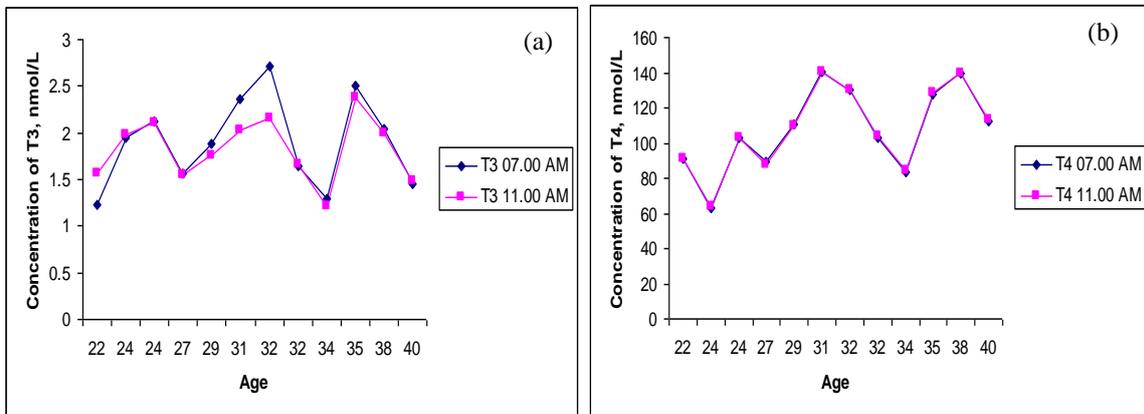


Figure 2: Levels of thyroid hormones in women before and after the stress of teaching, (a) T3 levels did not change ($t_{11} = 1.74, p = 0.055$); and (b) T4 levels were also unaffected ($t_{11} = -0.29, n.s.$).

Discussion

The teaching assignment was an important real life stress situation for carrying out this study. Increased level of T4 in serum has been reported during short and transient periods of stress in animals (Langer *et al.* 1983). However, in the present study teaching stress did not seem to influence the serum level of T4. This does not exclude the possibility of change in the level of this hormone at some other time point in relation to the teaching stress test (Johansson *et al.* 1987). T3 is considered to be an active thyroid hormone and in our examination its level was significantly lower for women than men. This lowering can be attributed due to a protective metabolic mechanism directed to reduce catabolic energy expenditure in the individual's body (Johansson *et al.* 1987).

The data reported here indicate hormonal sex differences and also suggest that during the teaching stress situation, the pituitary system of the women does not react as strongly as does that of the men, and women may re-establish normal levels more effectively than men.

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الملخص العربي

فحص مستوى هرمون الغدة الدرقية باستخدام تقنية الإشعاع المناعي للمواطنين بمنطقة جارهوال بالهند

تريبتى نيچى

معهد الحياة الفطرية بالهند - ديهرادون - 248005 - الهند

من المعروف علمياً أن الضغوط الحياتية المختلفة قد تحدث بعض التغيرات فى تركيز عديد من الهرمونات داخل الجسم. وعلى ما يبدو ان هرمون الغدة الدرقية يتأثر بانواع مختلفة من الضغوط. خلال هذه التجربة، تم قياس تركيز هرمون الغدة الدرقية شاملاً ت3 و ت4 وذلك باستخدام تقنية الإشعاع المناعي على عينة من الإناث والذكور البالغين وذلك بأخذ عينات قبل وبعد إحداث ضغوط صناعية على العينات المختارة. أوضحت النتائج أن مستوى ت3 كان أعلى فى الذكور عنه فى الإناث خلال فترة محددة من الضغوط، بينما كان مستوى ت4 متشابهاً فى كلا الجنسين. أوضحت النتائج أن الغدد الصماء تعمل بطريقة متباينة وتختلف ميكانيكية عملها فى الإناث عنه فى الذكور.