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Original Research Article

Reaction Time Study as a Tool to Identify Central Nervous System Affect due to Hypothyroidism

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ABSTRACT

Introduction: Hypothyroidism is a state in which the thyroid gland does not synthesize enough thyroid hormone. It has been known that hypothyroidism affect the central nervous system (CNS) and at the early stage the CNS manifestations are less appreciated by the patient and so less addressed. Since, reaction time is an index of processing ability of central nervous system, this study was undertaken to examine the reaction times in hypothyroidism.

Materials and methods: This case control study included 60 hypothyroid and 60 healthy volunteers who were right handed and aged between 40-50 years and without practising any form of exercises. The anthropometric parameters of all the subjects were recorded, followed by the measurement of auditory reaction time (ART), visual reaction time (VRT) and cutaneous reaction times (CRT) were measured. The values of the cases and controls were compared and analysed statistically.

Results: The results showed that in hypothyroid patients there is significant increase ($p<0.01$) in ART, VRT and CRT. The Pearson's correlation between reaction time parameters and thyroid profile showed no significant correlation both in cases as well as in controls.

Conclusion: This study showed that hypothyroid patients had longer reaction times which were statistically highly significant, suggesting the use of reaction time testing to identify the CNS affect and thereby indicate the need for adjuvant measures to improve on reaction times which in turn improve the quality of life.

Key words: Hypothyroidism, Auditory reaction time, Visual reaction time, Cutaneous reaction time

INTRODUCTION

Hypothyroidism is a state in which the thyroid gland does not synthesize enough thyroid hormone. The causes include Iodine deficiency, treatment with iodine-131, surgical removal of thyroid gland and Stress. Hypothyroidism is common worldwide. In India, there is a significant burden of hypothyroid condition. Hypothyroidism can occur irrespective of age. A study in Mumbai showed that out of 800 children with thyroid disease 79% had hypothyroidism. The common causes are being thyroid dysgenesis, dyshormonogenesis, and thyroiditis.[1] A population-based study done in Cochin on 971 adult iodine sufficient subjects revealed the prevalence of hypothyroidism as 3.9%.

[2] Sub clinical hypothyroidism is also prevalent and a study conducted in Andhra Pradesh showed its prevalence as 8.9%. [3]

It has been known that hypothyroidism affect the central nervous system (CNS). It is associated with impaired memory, impaired cognitive function, inattentiveness, and sluggish reflexes. The early hypothyroidism is often asymptomatic and can have very mild symptoms like cold intolerance, constipation, weight gain, easy fatigue, dry itchy skin, hypotonia etc. Only later, serious manifestations like hoarseness of voice, abnormal menstrual cycles, depression, and Infertility to both men and women make the appearance. [4] Usually the CNS manifestations are less appreciated by the patient and so less addressed.

Reaction time is an index of processing ability of central nervous system. It is used in experimental physiology to assess sensory-motor performance. It is the time interval between the onset of a signal (stimulus) and the initiation of a movement response. This is being used in mental chronometry, psychometric psychology and in training mentally challenged children. Reaction time is also utilised by athletes for better performance. [5]

Since hypothyroidism has an effect on central nervous system and reaction time an index of CNS process ability, this study intended to examine the reaction times in hypothyroidism.

MATERIALS AND METHODS

The present case control up study was conducted at Rajarajeshwari Medical College, Bangalore during 2011. The study subjects were 60 hypothyroid and 60 healthy volunteers who were right handed and aged between 40-50 years. In order to avoid the gender bias only male patients were included. Subjects had clinically normal hearing and vision. They were not practicing any long term exercises, sports or yogic postures previously. Smokers, alcoholics and subjects with any chronic illness like hypertension or diabetes were excluded. Selected subjects were briefed about the study protocol and written informed consent was obtained. The subject's anthropometric parameters were recorded. ART, VRT and CRT were measured. The values of the cases and controls were compared and analysed statistically. In order to avoid the familiarity bias, a session was organized to familiarize the participants to instrument and to train them on the test process. Only later the actual values were obtained.

Reaction times were measured in a quiet secluded room whose ambient temperature was about 27°C, between 10 AM and 12.30 PM. RT was assessed by making use of an instrument, RESPONSE – ANALYSER. It has an audio mode, visual mode and cutaneous mode for ART, VRT and CRT respectively. The instrument has 2 buttons, first one is a start button, handled by the examiner to deliver the stimulus and the second button is the stop button (response switch), which is to be pressed by the participant when he perceives the stimulus. Thumbs of right and left hands of each subject were being used alternatively to press response switch to get reading for that particular hand. For ART, stimulus was delivered through a head phone of capacity 1000 Hz tone and for VRT; visual stimulus was through a glowing bulb. Start and stop buttons are connected to a computer which records the reaction time in milliseconds. CRT test measures the response to a cutaneous (touch) stimulus. Cutaneous mode was selected. Here the stimulus was contact between the plunger and the skin. Subjects were asked to press the response switch as soon as the touch with the plunger was felt by the other hand. The reading on the display indicated response time to the cutaneous stimulus in milliseconds.

RESULTS

The results obtained are tabulated in tables 1and 2. Table 1 shows the comparison of parameters in hypothyroid patients and healthy controls. It shows that in hypothyroid patients there is significant increase ($p<0.01$) in all the reaction times. Table 2 shows the Pearson's correlation between reaction time parameters and thyroid profile. It is shown that the there is no correlation between the reaction time parameters and thyroid profile both in cases as well as in controls.

TABLE 1: COMPARISON OF PARAMETERS IN HYPOTHYROID PATIENTS AND HEALTHY CONTROLS

PARAMETERS	CASES MEAN±SD	CONTROLS MEAN±SD	P VALUE
AGE (yrs)	56.82 ± 9.84	54.97 ± 8.20	0.27
T3 (nmol/L)	1.89 ± 0.72	2.09 ± 0.68	0.12
T4 (nmol/L)	78.20 ± 20.52	109.82 ± 31.06	0.001
TSH (µIU/ml)	21.22 ± 22.86	2.66 ± 1.18	0.001
ART- Right (m.sec)	176.53 ± 16.26	168.98 ± 16.22	0.01
ART- Left (m.sec)	177.62 ± 16.16	169.94 ± 16.30	0.01
VRT- Right (m.sec)	181.57 ± 15.87	173.84 ± 16.67	0.01
VRT- Left (m.sec)	182.89 ± 15.65	174.73 ± 16.45	0.01
CRT- Right (m.sec)	187.16 ± 15.44	179.42 ± 16.73	0.01
CRT- Left (m.sec)	188.37 ± 15.25	180.42 ± 16.46	0.01

TABLE 2: PEARSON'S CORRELATION BETWEEN REACTION TIME PARAMETERS AND THYROID PROFILE

		ARTR	ARTL	VRTR	VRTL	CRTR	CRTL
CASES	AGE	r=-0.24 p=0.06	r=-0.24 p=0.06	r=-0.24 p=0.06	r=-0.22 p=0.09	r=-0.18 p=0.16	r=-0.17 p=0.19
	T3	r=-0.11 p=0.40	r=-0.11 p=0.40	r=-0.11 p=0.40	r=-0.12 p=0.36	r=-0.11 p=0.40	r=-0.11 p=0.40
	T4	r=0.03 p=0.82	r=0.02 p=0.87	r=0.00 p=1.0	r=0.00 p=1.0	r=-0.02 p=0.87	r=-0.02 p=0.87
	TSH	r=0.10 p=0.44	r=0.10 p=0.44	r=0.10 p=0.44	r=0.09 p=0.49	r=0.12 p=0.36	r=0.11 p=0.40
CONTROLS	AGE	r=0.06 p=0.64	r=0.06 p=0.64	r=0.08 p=0.54	r=0.08 p=0.54	r=0.10 p=0.44	r=0.11 p=0.40
	T3	r=0.02 p=0.87	r=-0.01 p=0.93	r=0.03 p=0.82	r=0.03 p=0.82	r=0.04 p=0.76	r=0.04 p=0.76
	T4	r=-0.20 p=0.12	r=-0.19 p=0.14	r=-0.19 p=0.14	r=-0.19 p=0.14	r=-0.16 p=0.22	r=-0.16 p=0.22
	TSH	r=0.09 p=0.49	r=0.09 p=0.49	r=0.08 p=0.54	r=0.08 p=0.54	r=0.07 p=0.59	r=0.08 p=0.54

DISCUSSION

Thyroid hormones increase the basal metabolic rate by acting on protein, carbohydrate and lipid metabolism. Therefore, hypothyroidism, a condition with decreased thyroid hormones affects various systems like cardiovascular, central nervous system and even the connective tissue. [6] Since, hypothyroidism affects central nervous system this study intended to evaluate reaction times in hypothyroidism. Reaction time studies not only help in diagnosing the affect on central nervous system but also help in assessing the prognosis. Therefore, this study was undertaken.

This study showed that hypothyroid patients had significantly low T4 levels and significantly high TSH levels. And these patients had significant longer reaction times which were statistically highly significant. It was known that hypothyroidism has the effect on central nervous system. This study has shown the delay in the reaction time

which is a measurable tool. Hence reaction time can be used to assess the extent of affect on CNS in thyroid patients. It has been shown that reaction times can be improved by various forms of exercises like yoga. [7] Improvement on the reaction time is required not only for the personal health but also for better performance in the profession. Thus, reaction times can be used in assessing the prognosis after the induction of the improvising measures.

This study also showed that reaction times did not correlate with any of the thyroid profile parameters significantly in both cases and controls. The probable reason may be that, Reaction times study is a physiological tool which is an index of long duration of health status where as hormones are subjected to variations. Hence, reaction time evaluation may be considered to identify the CNS affect at the earliest due to hypothyroidism, irrespective of the hormonal status.

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