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Original Research Article

Assessment of the Serum Levels of Thyroid Hormones and Thyroid Stimulating Hormone among Sudanese with Type 1 Diabetes Mellitus

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ABSTRACT

The aim of this study was to assess the serum levels of thyroid hormones (T3, T4) and Thyroid Stimulating Hormone (TSH) among Sudanese with type 1 diabetes mellitus in comparison with apparently healthy individuals as a control group and to determine the relationship between these hormones and the duration of diabetes. A case-control study was conducted during the period from December 2012 up to august 2013in Khartoum state among 500 Sudanese with type 1 diabetes mellitus patients and 250 healthy controls for comparison. The serum levels of Thyroid Hormones (T3, T4) and Thyroid Stimulating Hormones (TSH) were measured using full automated chemistry analyzer (Elecsys 2010) and commercial kits from Roche Diagnostic. The results of this study showed the means of the serum levels of Thyroid Hormones (T3, T4) of diabetics group were significantly raised when compared to the control group, whereas the means of serum level of TSH of the diabetic group were significantly reduced when compared to the control group. The study showed a significant strong positive correlation between the duration of diabetes (in years) and the serum levels of T4 (r=0.98), whereas it showed an insignificant weak positive correlation between the duration of diabetes and the serum levels of TSH (r=0.03).This suggests a relationship between type 1 diabetes and Thyroid disorders.

Key words: Type 1 diabetes mellitus, Thyroid stimulating hormone and Thyroid hormone.

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects of insulin secretion or increased cellular resistance to insulin. Chronic hyperglycemia and other metabolic disturbances of DM lead to long-term tissue and organ damage as well as dysfunction involving the eyes, kidneys, nervous and vascular systems. [1]

Type 1 indicates the processes of beta–cell destruction that may ultimately lead to diabetes mellitus in which "insulin is required for survival" to prevent the development of ketoacidosis, coma and death. It can be associated with other autoimmune endocrine disorders as well as autoimmune impairment of non-endocrine tissue.

The prevalence and incidence of DM in Sudan, as in many others low-income countries, are increasing to epidemics proportion, leading to the emergence of a public health problem of major socio-economic impact. [2]

Diabetes Mellitus in Sudan is associated with poor glycemic control, a high prevalence of complications and a low quality of life and particularly with morbidity. Patients with a median duration of diabetes of 9 years showed a high prevalence of micro and macro vascular complications. [3]

The thyroid hormones, thyroxin (T4) and triiodothyronine (T3), are tyrosine-based hormones produced by the thyroid gland primarily responsible for regulation of metabolism. Iodine is important for the production of T3 and T4. A deficiency of iodine leads to decreased production of T3 and T4 enlarges the thyroid tissue and will cause the disease known as goiter. The major form of thyroid hormone in the blood is thyroxin (T4), which has a longer half-life than T3. The ratio of T4 to T3 released into the blood is roughly 20 to 1. Thyroxin is converted to the active T3 (three to four times more potent than T4) within cells by deiodinases.

Most of the thyroid hormones circulating in the blood are bound to transport proteins (thyroxin (TBG), transthyretin or "thyroxin-binding prealbumin" (TTR or TBPA), and par albumin). Only a very small fraction of the circulating hormones is free (unbound) and biologically active (T4 0.03% and T3 0.3%), hence measuring concentrations of free thyroid hormones is of great diagnostic value. [4]

Thyroid-stimulating hormone (TSH; thyrotropin) and TSH receptor (TSHR) are key proteins in the control of thyroid function. TSH synthesis in the anterior pituitary is stimulated by thyrotropin-releasing hormone (TRH) and inhibited by thyroid hormone in a classical endocrine negative-feedback loop. [5]

MATERIALS & METHODS

This study was conducted in Khartoum state in different hospitals (Khartoum, Omdurman, Khartoum North hospitals) in Sudanese patients with type 1 diabetes mellitus as a test group (n = 500, 192 males and 308 females) and apparently healthy non-diabetic volunteers as a control group (n = 250, 94 males and 156 females).

Clinical data was obtained from the patient's history and recorded on a questionnaire sheet. Clinical assessment of the study group was done by a medical doctor. Those with other types of diabetes (type 2, gestational and secondary diabetes) had been excluded from this study.

After informed consent, 5 ml venous blood sample was collected from each of the study subjects. After blood clotting, the samples were centrifuged within 20 minutes after collection at 3000 rpm for 5 minutes and the sera were stored at -20 $^{\circ}$C until analysis. The serum was allowed to reach the room temperature before analysis and Elisa technique was used for measurement of T3, T4 and TSH using full automated Elecsys 2010 chemistry analyzer.

The precision and accuracy of all methods that were used in this study were checked each time a batch was analyzed by including commercially prepared control sera.

The data collected in this study were analyzed using SPSS computer program. The means and standard deviations of the serum levels of T3, T4 and TSH were calculated and the independent t test was used for comparison. Linear regression analysis was used to assess correlations of the serum levels of T3, T4 and TSH with the duration of type 1 diabetes.

RESULTS

Serum T_3:

Table (1): Showed a significant difference between the mean of the serum level of T_3 among the test group compared to that of the control group. (Mean ± SD): (1.59±0.93) versus (1.37±0.30) ng/ml, (P<0.05). The mean of the test group was significantly raised.

Fig (1) Showed a weak positive correlation between the duration of diabetes mellitus and the serum levels of T3 among the diabetic group (r=0.09, P = 0.731).

Table 1: Comparison of the means of T3, T4 and TSH of the test group and the control group.

Variable	Test group (n=500)	Control group (n=250)	P-value
Serum T3 (ng/ml)	1.59±0.93 (0.32-6.91)	1.37±0.30 (0.61-1.99)	0.041
Serum T4 (ng/ml)	10.05±3.32 (2.12-24.86)	8.68±1.96 (4.3-14.8)	0.028
Serum TSH (ng/ml)i	1.44±0.96 (0.5-4.69)	1.76±0.93 (0.37-6.05)	0.037

-The table 1 shows the mean ± standard deviation, range between brackets and the level of significance (P-value).
-t-test was used for comparison.
-P-value ≤0.05 is considered significant.

Serum T_4:

Table (1): Showed a significant difference between the mean of the serum level of T_4 among the test group compare to that of the control group. (Mean ± SD): (10.05±3.32) versus (8.68±1.96) ng/ml, (P<0.05).

Fig (2) Showed a significant strong positive correlation between the duration of diabetes in years and the serum level of T_4 among the diabetic group (r=0.98, P = 0.000).

Serum TSH:

Table (1): Showed a significant difference between the mean of the serum level of TSH among the test group compare to that of the control group. (Mean ± SD): (1.44±0.96) versus (1.76±0.93) ng/ml, (P<0.05). The mean of the test group was significantly reduced.

Fig (3) Showed insignificant weak positive correlation between the duration of diabetes in years and the serum level of TSH among the diabetic group (r=0.03, P = 0.852).

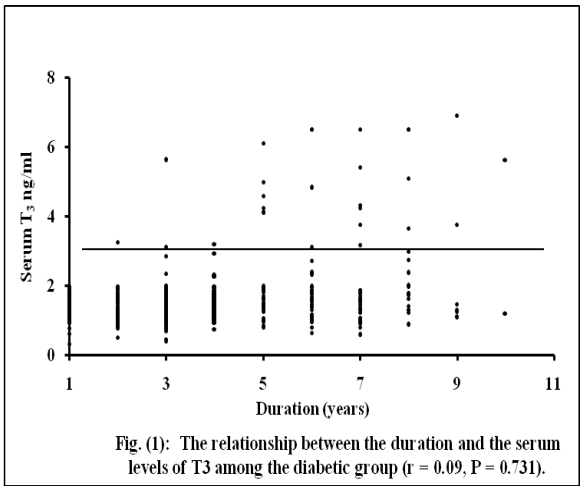

Fig. (1): The relationship between the duration and the serum levels of T3 among the diabetic group (r = 0.09, P = 0.731).

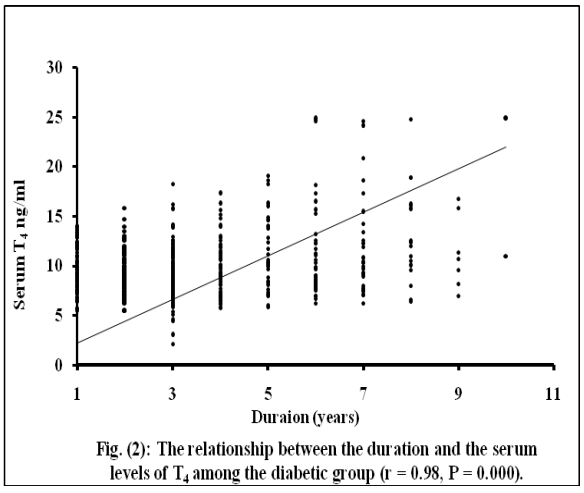

Fig. (2): The relationship between the duration and the serum levels of T_4 among the diabetic group (r = 0.98, P = 0.000).

DISCUSSION

Type 1 diabetes mellitus (T1D) has in common high blood glucose levels (hyperglycemia) that can cause serious health complications including ketoacidosis, kidney failure, heart disease, stroke, and blindness. Patients are often diagnosed with diabetes when they see a physician for clinical signs such as excessive thirst, urination, and hunger. These symptoms result from the underlying hyperglycemia that is in turn caused by insufficient insulin functionality. T1D on the other hand usually starts in people younger than 30 and is therefore also termed juvenile-onset diabetes, even though it can occur at any age. T1D is a chronic autoimmune disorder

that precipitates in genetically susceptible individuals by environmental factors. [6]

In the test group of the current study there is a significant increase in the mean of the serum levels of T3 when compared with the control group as shown in table 1 (P = 0.041). This agrees with the results of a study done by Notarbartolo [7] who found that the means of the serum levels of T3 in patients with type1 diabetes mellitus were significantly higher than that in healthy subjects (P < 0.001).

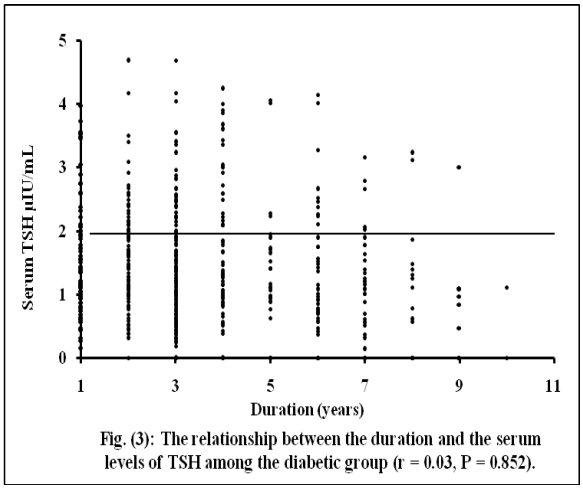

Fig. (3): The relationship between the duration and the serum levels of TSH among the diabetic group (r = 0.03, P = 0.852).

In this study the test group has a significant increase in the means of the serum levels of T4 when compared with the control group as shown in table 1 (P = 0.028) .This disagrees with a study done by Samaneh [8] who reported There was no significant differences between diabetic patients and non-diabetic ones regarding the mean of the serum levels of T4. Also disagrees with a study done by Ditta [9] who reported that 30% of diabetics with type 1 showed decreased T_4 concentrations than controls.

In this study the test group has a significant increase in the means of the serum levels of TSH when compared with the control group as shown in table 1 (P = 0.037) and the increased TSH is an early and sensitive index of the occurrence of hypothyroidism. This agrees with a study done by Sharifi [10] who reported type 1 diabetic patients have higher TSH concentration (p value = 0.03).

In this study there is a significant strong positive correlation between the duration of diabetes and T4, Insignificant weak positive correlation and Insignificant correlation with T3 among the diabetic group as shown in fig (1), (2), and (3) respectively.

CONCLUSION

From this study, it was concluded that; in Sudanese patients with type1 diabetes mellitus the serum levels of T3 and T4 are significantly elevated in type 1 diabetic patients whereas the serum levels of TSH are significantly decreased in diabetics compared to non diabetics. There is a strong positive correlation between the duration of diabetes and the serum levels of thyroxin.

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