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Evaluation of Thyroid Stimulating Hormone and Free Thyroxine among Diabetes Mellitus Patients at Shendi Locality, Sudan

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Abstract

Background: Diabetes Mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Thyroid disease is found commonly in most forms of diabetes and is associated with advanced age, particularly in type 2 diabetes and underlying autoimmune disease in type 1 diabetes. Objective: This study aims to evaluate TSH and Free T4 among Diabetes Mellitus Patients in the Shendi locality, from August to December 2021.

Methodology: Thirty plasma samples were collected from diabetic patients of different ages and 20 plasma samples from healthy non-diabetic subjects of the same period for the cases of hormone comparison thyroid (TSH) and free T4. Thyroid hormone levels in the study were estimated using the 360 Automated Immunoassay Analyzer (TOSOH). And the results were analyzed using the computer program SPSS (Social Science Statistical Package).

Results: The result of this study showed that the mean concentration of TSH and Free T4 level in the diabetic subjects was (Mean ± SD): (1.6 ± 0.99) (13.5 ± 2.3) and control (2.0 ± 0.81) (12.5 ± 2.0) respectively with P. value =0.148, 0.124 which is insignificant. Also showed the mean concentration of TSH and FT4 according to gender is (1.6, 14.7) respectively for males (1.7, 12.7), and a female with P. value (0.718 for TSH which is insignificant) and (0.016 of Free T4 which is significant). There are an insignificant association of diabetes on TSH, and Free T4 levels with P. value (0.417, 0.277) respectively. And the significant association of the presence of hypertension on the level of TSH and FreeT4 with P. value (0.043, 0.018). Also the significant association of history on Free T4 level with P. value (0.018), insignificant on TSH level with P. value (0.773). Also showed the mean concentration of TSH, and FreeT4 with the intake of the treatment of diabetic and seafood, which was insignificant.

Conclusion: There is no statistical difference between TSH and FT4 levels between cases and controls. There was a correlation between FT4 levels and gender, with FT4 being higher in females than in males. FT4 is significantly elevated in patients with a family history of diabetes. No significant difference in FT4 levels by age.

Keywords: Diabetes mellitus; Thyroid stimulating hormone; Free thyroxine; Thyroid hormones

Introduction

The term diabetes is derived from the Greek word [Dia; pass through and betes; to go]. Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion or increased cellular resistance to insulin [1]. Diabetes mellitus is broadly classified into two main types; Type I diabetes mellitus: which is also known as immune-mediated diabetes, insulin-dependent diabetes, or juvenile-mediated diabetes. It accounts for 5-10% of diabetes mellitus and results due to autoimmune destruction of pancreatic B-cells. Type II diabetes mellitus: It is also known as non-insulin-dependent diabetes or adult-onset diabetes. It accounts for 90-95% of diabetes mellitus and occurs because of insulin resistance and progressive insulin deficiency [2]. The prevalence and incidence of DM in Sudan, as in many other low-income countries, are increasing to epidemic proportions, leading to the emergence of a public health problem of major socioeconomic impact [3]. Diabetes Mellitus in Sudan is associated with poor glycemic control, a high prevalence of complications, 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 [4]. The thyroid, the largest endocrine organ located in the neck region, consists of two right and left lateral lobes associated with a narrow band of the thyroid tissue called Isthmus, it weighs about 25-30gr and is usually larger in men than women [5]. And stores many inactive hormones within extracellular follicles [6,7]. These hormones play a vital role in the regulation of glucose metabolism, and hepatic lipid cholesterol and mediate important physiological processes like growth and development [8]. On the other hand, thyroid diseases had also become common among the general population affecting 750 million people worldwide according to the data provided by the World health organization [9]. Thyroid hormones are produced by a butterfly-shaped thyroid gland located in the lower anterior neck [10]. Thyroxine (T4) is the primary hormone secreted by the thyroid gland which is relatively inactive and is converted to the highly active form triiodothyronine (T3) by the enzyme thyroxine 5- deiodinase [11]. 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 [12]. The thyroid hormones are insulin antagonists and influence the action of insulin indirectly which could be responsible for the occurrences of low thyroid hormone levels in diabetic Mellitus patients [13]. Insulin, an anabolic hormone has been found to enhance the levels of FT4 and suppresses the levels of FT3 by inhibiting the hepatic conversion of T4 to T3. Therefore, this may be the reason for low FT3 in type 2 diabetes mellitus patients. Diabetes mellitus influences thyroid functions mainly at two sites; first, at the level of hypothalamic control of thyroid-stimulating hormone release, and second, at the conversion of T4 to T3 in the peripheral tissue [14].

Materials and Methods

The present study was a cross-sectional, case-control study. Conducted in the Shendi locality, from August to November 2021, the study included Sudanese diabetes mellitus patients as a case group and healthy individuals as a control group. 30 Sudanese patients with diabetes mellitus were controlled as the study group and 20 healthy Sudanese were controlled. Their ages are (30–55 years old). Venous blood was collected using a sterile, single-use plastic syringe, the venipuncture site was washed with 70% ethanol, and the blood was placed in a heparin container and mixed gently. Each sample was centrifuged at 4000 (rpm) for 5 minutes to separate the plasma and stored at -20°C until analysis. TSH and Free T4 were estimated using Automated Immune assay Analyzer 360 (TOSOH).

Quality Control

The precision and accuracy of the method used in this study were checked and analyzed by commercially prepared control sera.

Statistical Analysis

Data were analyzed by using the SPSS computer program. The means and standard deviations of serum levels of TSH, and free T4 were detected, and at-test was used for comparison (P. value of < 0.05 is significant).

Ethical Approval and Consent

Ethical approval for the study was obtained from the Board of the Faculty of Graduates Studies at Shendi University. The written informed consent form was obtained from each guardian of the participant as well as from the subject himself before recruitment into the study. All protocols in this study were done according to the Declaration of Helsinki (1964).

Results

The result of this study showed that the mean concentration of TSH and Free T4 level in the diabetic subjects was (Mean ± SD): (1.6 ± 0.99) (13.5 ± 2.3) and control (2.0 ± 0.81) (12.5 ± 2.0) respectively with P. value =0.148, 0.124 which is insignificant (Table 1,2). Also showed the mean concentration of TSH and FT4 according to gender level is (1.6, 14.7) respectively for males (1.7, 12.7), and a female (1.6, 14.7) with a P. value (of 0.718 TSH which is insignificant) and (0.016 of Free T4which is significant) (Table 3). There is an insignificant association of type of diabetic

on TSH, Free T4 level with P. value (0.417, 0.277) respectively (Table 4,5). And the significant association of the presence of hypertension on the level of TSH and FreeT4 with P. value (0.043, 0.018) (Table 6). Also the significant association of history on Free T4 level with P. value (0.018), insignificant on TSH level with P. value (0.773) (Table 7). Also showed that the mean concentration of TSH, FreeT4 with intake in the treatment of diabetes was insignificant (Table 8).

Table 1: *The Mean of TSH levels and St.d between case and control.*

Variables	No	Mean ng\dl	St.d	P.value
Case	30	1.6	0.99	**0.148**
Control	20	2.0	0.81	

Table 2: *The Mean of FT4 levels and St.d between case and control.*

Variables	No	Mean ng\dl	St.d	P.value
Case	30	13.5	2.3	**0.124**
Control	20	12.5	2.0	

Table 3: *The concentration of TSH and FT4 according to gender among case group.*

Gender	Frequency	Percent %	Mean of TSH ng\dl	Mean of FT4 ng\dl
Male	12	40%	1.6	14.7
Female	18	60%	1.7	12.7
P. value			**0.718**	**0.016**

Table 4: *The concentration of TSH and FT4 according to Age among case group.*

Age	No	Mean of TSH ng\dl	Mean of FT4 ng\dl
30-40	2	2.5	13.8
41-50	12	1.6	14.8
51-60	16	1.6	12.6
P. value		**0.456**	**0.035**

Table 5: *The concentration of TSH and FT4 according to Type of diabetic mellitus among case group.*

Type of diabetic mellitus	Mean of TSH ng\dl	Mean of FT4 ng\dl
Type1	1.9	12.8
Type2	1.5	13.8
P. value	**0.417**	**0.277**

Table 6: *The concentration of TSH and FT4 according to presence of hypertension among case group.*

Hypertension	Mean of TSH ng\dl	Mean of FT4 ng\dl
Yes	2.1	12.7
No	1.4	13.9
P. value	**0.043**	**0.018**

Table 7: *The concentration of TSH and FT4 according to history of diabetes among case group.*

History of D.M	Mean of TSH ng\dl	Mean of FT4 ng\dl
Yes	1.7	14.0
No	1.5	11.6
P. value	**0.773**	**0.018**

Table 8: *The concentration of TSH and FT4 according to uses of medication of D.M among case group.*

Treatment of D.M	Mean of TSH ng\dl	Mean of FT4 ng\dl
Regular	1.8	13.5
Irregular	1.2	13.6
P. value	**0.213**	**0.902**

Discussion

Diabetes mellitus and thyroid abnormalities are the two most prevalent endocrine diseases [15]. Diabetes is one the fastest growing non-communicable metabolic syndrome which is characterized by the increased blood glucose level and is mainly due to a reduction of insulin secretion or suppression in insulin action. It is global health anxiety, and its incidences are increasing [16]. This cross-sectional case-control descriptive study was conducted from July to November 2021 in Shendi City to assess thyroid status and understand the association between thyroid disease and diabetes mellitus. The population included 50 of his participants in the study, 30 of whom were diabetic and 20 of whom were healthy as controls. There are 12 male and 18 female representatives. Serum samples were collected in heparinized containers. Thyroid hormone levels in this study were estimated using the Automated Immune Assay Analyzer 360 (TOSOH). The results were analyzed using the Statistical Package of Social Sciences (SPSS) computer program. The results of this study showed that there was no significant difference in TSH and FT4 levels between diabetic and non-diabetic subjects (*P. value* = 0.148 and 0.124, respectively). This result is in agreement with the result obtained by Islam and her colleague in South East Asia (2008), who denoted that there is no significant statistical difference in TSH and FT4 levels among diabetic and non-diabetic participants [17]. This result was opposed to a study carried out by Panneerselvam and his collage in 2015, they showed that serum levels of FT4 were significantly lower in diabetic subjects as compared to the non-diabetic subjects while serum level of TSH was found to be significantly higher in type 2 diabetes mellitus patients as compared to normal individuals [13]. Refluxes that different in results to a geographical area or environmental difference between countries. Also, there is a correlation between FT4 level and gender, the level of FT4 increased in males (Mean =14.7) than in females (Mean=12.7) with a statistically significant difference between them (*P. value* =0.016) this result consensus with Kaur I and his team's 2017, said that hypothyroidism is frequently observed and most commonly seen in female patients [5]. Although there are statistically insignificant differences between the level of TSH and the gender (*P.value*= 0.718) and this was infringing with a study carried out by Uppal Vand and his classmates Said Hypothyroidism was more common in females (15%) than in males (4%) [18]. these differences belong to Thyroid hormone levels may be altered by various medications that diabetic subjects used to take and determine the change in body composition. Moreover, there was a statistically significant difference in FT4 according to age (*P. value*=0.035) and this is agreed by SU Ogbonna 2010 and his colleague were show that T2DM increases were prevalent with age. Also, there are no differences in age in TSH between diabetic patients with (*P. value*=0.456) this disagree with the study carried out by Khalid S Aljabri who said there was a statistically non-significant difference between thyroid dysfunctions in males compared to females (P<0.0001) [19]. This might be due to the sociodemographic and lifestyle differences in the represented populations. Also this study show, there is no variation among type one diabetic and type two in the level of TSH, and FT4 with insignificant value (*P. value*= 0.456)(*P. value* = 0.277) respectively this result differs from the study conducted by Mirella Hage, and his team It has been shown that thyroid dysfunctions are more prevalent in people with diabetes and particularly type 1 diabetes this belong to social status or the genetic factor of the population who shared in the study [20]. The result of conducted study denoted that there is a significant statistical variation of diabetic people were have hypertension disease with (*P. value* =0.043) of TSH and (*P. value*= 0.014) of FT4, this is close to the study carried by Pradeep Talwalkar and

his pals in India 2019, reported a high prevalence of hypothyroidism in patients with T2DM (24.8%), hypertension (33.5%), and T2DM + hypertension (28.9%) [21]. on another hand, there is a significant difference between the history of diabetes in FT4 with (*P. value*= 0.018) and no difference in TSH level. In this conducted study there was no different statistical study in patients who intake the treatment of diabetes in the level of TSH and FT4 with insignificant value (*P. value*= 0.213), (0.902) respectively and this is not accepted with a study conducted in Iraq in 2019 by Khalid Ibrahim Al-Lehibi and his college were accessed to metformin has a significant TSH lowering effect in hypothyroid patients. This change in result probably back to variation in physical activities or nutrition status [22].

Conclusion

There is no statistical difference between TSH and FT4 levels between cases and controls. There was a correlation between FT4 levels and gender, with FT4 being higher in females than in males. FT4 is significantly elevated in patients with a family history of diabetes. No significant difference in her FT4 levels by age.

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Competing Interests

Authors have declared that no competing interests exist.

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