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Hypothyroidism among Sudanese Patients with Type 2 Diabetes Mellitus: A Hospital Based Study

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Abstract: *Hypothyroidism is a major disorder of the endocrine system in which the thyroid gland has not ability to produce enough thyroid hormones. Diabetes Mellitus is one metabolic disease associated with hyperglycemia resulting from defect in insulin secretion or insulin action or both of them. Hypothyroidism associated with T2DM is not reported In southern Darfur state-Sudan. The objective of this study was to evaluate the effect of type2 diabetes mellitus on hypothyroidism. Two hundred type 2 diabetic patients were involved in this study, 66% were females and 34% males. Fasting blood glucose (FBG), thyroid stimulating hormone (TSH), total triiodothyronine (T3), total thyroxin (T4) and glycosylated hemoglobin (HbA1C) were detected. Significant increases in blood glucose and HbA1C levels were observed in 9 patients represented 4.5%, (7) out of (9) were females and (2) were males. The level of TSH significantly (P—0.000) increased whereas; the level of T3 and T4 were decreased. However, no significant differences were observed in T3 and T4 among thyroid disorder patients. 2% (4) of females were subclinically hypothyroidism while 1.5% (3) clinical hypothyroidism, however, only 1% (2) of males were subclinical hypothyroidism. In conclusion, our findings demonstrate that detection of abnormal thyroid hormone levels in the early stage of diabetes mellitus may help the patients to improve quality of life and reduce the morbidity rate.*

Keywords: *Diabetes mellitus; Hypothyroidism; Endocrine System; South Darfur State*

1. INTRODUCTION

Diabetes mellitus (DM), a group of metabolic diseases associated by hyperglycemia over prolonged period, which produces a variety of symptoms include frequent urination, increased thirst and increased blood glucose [1]. DM is as a result of failure of pancreas to produce enough insulin or failure of the cells of body to respond properly to the insulin [2]. Type2 DM (T2DM) begins when the cells fail to respond to insulin properly (insulin resistance) and a lack of insulin may also develop [3]. This type of diabetes known as non-insulin -dependent diabetes mellitus (NIDDM) or adult - onset diabetes [4]. The primary causes of this type include body excessive weight and lack of exercise [5]. The untreated diabetes can lead to many complications. Acute complications of diabetes include diabetic ketoacidosis [6], non ketotic hyperosmolar [7], coma or death [8]. Serious long term complications of DMinclude heart [9], stroke [10], chronic kidney [11], foot [12], and eye [13]. There are two main types of diabetes mellitus including type1 DM and type2 DM and gestational diabetes [14]. Hypothyroidism or low thyroid hormone levels in which thyroid gland does not produce enough thyroid hormones [15]. It has a number of symptoms including poor ability to tolerate cold, a feeling of tiredness, constipation, depression, weight gain and occasionally swelling of the front part of the neck due to goiter may be develops [16]. The consequences of untreated hypothyroidism during pregnancy include delays in growth associated with intellectual development producing the cretinism [17].

Lack of iodine in the diet is the most common cause of hypothyroidism Worldwide. Hashimoto's thyroiditis is the autoimmune condition of hypothyroidism(add explanation for autoimm…). Less common causes of hypothyroidism include previous treatment with radioactive iodine, injury to hypothalamus or the anterior pituitary gland, certain medications, a lack of functioning thyroid at the birth, or previous thyroid surgery [18]. The diagnosis of suspected hypothyroidism must be confirmed by blood thyroid function test (TFT) that measure thyroid stimulating hormone (TSH) and thyroxin levels [19]. Subclinical hypothyroidism is a milder form of hypothyroidism associated with normal thyroxin levels and an elevated TSH level [20]. Over 60 years old people are having more predisposition to the hypothyroidism compared to other age groups [21], however, women are more than e due to the hormonal factor. The autoimmune thyroid diseases are more common prevalent in all forms of diabetes as mixed endocrine disorders [22]. Diagnosis of thyroid dysfunction (hypothyroidism) in diabetic patients will minimize the risk factor in such cases [23]. The prevalence of hypothyroidism among

diabetic patient is not reported. Therefore in this study, we aimed to screen thyroid hormone levels in patients with type 2 DM in southern Darfur state (Nyala).

2. MATERIALS AND METHODS

2.1Study design

Two hankered confirmed diabetic patients (n=60 female, n=140 male) from Yashfeen Insurance Hospital in Nyala city, South Darfur State, Sudan were involved in this study. Blood samples were collected from November 2016 to January 2017. 5 mL of venous blood was been collected from each patient, 3 ml into lithium heparin blood containers for thyroid hormones and 2 ml in fluoride oxalate blood containers for measuring of plasma glucose.

2.2 Blood glucose measurement

Serum was obtained from blood by centrifugation (at 3000 rpm for 15 min) and stored at -20 ºC until analyzed. Blood glucose was measured by (Mindary BS-200) using assay kits (bio system Company) according to the manufacturers' instructions.

2.3. Hormones measurement

Serum was obtained from blood by centrifugation (at 3000 rpm for 15 min) and stored at -20 ºC until analyzed. Thyroid hormone concentrations were measured by automated analyzer (TOSOH AIA360 Japan), using assay kits (Bio system Company), according to the manufacturers' instructions.

2.4. Calculation of HbA1C

HbAIC calculated from the flowing equation:

Estimated average of glucose(mg/dl) = 28.7xHbA1C – 46.7.

2.5. Statistical analysis

Fasting blood glucose, T3, T4, TSH and HbA1c were analyzed by one-way ANOVA using SPSS 21.0 for Windows, followed by a least-significant differences (LSD) test for individual comparisons. A P-value ≤0.05 was considered significant.

3. RESULTS

3.1. The distribution of gender

The present study revealed the percentage of gender distribution among type2 diabetic patients as 66% females and 34% males(figure 1) .

3.2. Percentage classification of hypothyroidism among type2 DM

In this present study the prevalence of thyroid dysfunction (hypothyroidism) was 4.5%, clinical hypothyroidism was found 1.5%, while subclinical hypothyroidism 3% (Table1)

3.3. Classification of hypothyroidism in type 2 diabetic patients according to gender

In this study hypothyroidism when classified according to gender, 2(22%) were males and 7(78%) were females, all of the 2 males was diagnosed as subclinical hypothyroidism. Moreover 4 out of 7 females were subclinical hypothyroidism. The remainders were clinical hypothyroidism (Table 2). Females seem to be more affected than male by hypothyroidism and that may attributed to autoimmune disease.

3.4. Relation between thyroid hormones and biochemical values among thyroid dysfunction (hypothyroidism) and other DM group

Regarding thyroid hormones levels (TSH, T3, T4) in hypothyroidism patient when compared with other group of DM, type 2DM revealed statistically significant difference p-value (0.000, 0.007, 0.004) respectively, because both thyroid hormones and insulin act antagonistically. While the mean concentration of FBG and HbA1C among hypothyroidism patients compared with other group of type2 DM showed statistically not significant (Table 3).

3.5. Correlation between HbA1C% and T3 (ng/ml)

In the present study correlation between HbA1C and T3 showed negative correlation, p-value (0.007), R-value (-0.302)(Fig 3).

3.6. Correlation between TSH (µIU/mL) and T3 (ng/ml)

The present study reported that the level of TSH was significantly increased, whereas the levels of T3 and T4 were significantly decreased in diabetic patients type 2 compared to control subjects (Fig 4).

3.7. Correlation between FBG (mg/dl) and T4(ug/dl)

The present study demonstrated inverse correlation between FBG and T4, p-value (0.032), R-value (0.166) (Fig 5).

4. DISCUSSION

Type 2 diabetes mellitus is a metabolic endocrine disorder occurs due to insulin resistance or insulin shortage[24-27]. Association of diabetes with other endocrine disorders has been a topic of endocrine field[28-30]. The present study investigated the prevalence of hypothyroidism among type 2 diabetes mellitus depending on the scientific facts of mixed endocrine disorder [31,32,27]. The prevalence of hypothyroidism revealed percentage of females higher than males [33], (66%), (34%), respectively. High females predisposition may be based on the fact that females are more affected with autoimmune diseases than males [34].

The prevalence of thyroid dysfunction (hypothyroidism) was 4.5%, classified as clinical hypothyroidism 1.5%, while subclinical

hypothyroidism 3%. In subclinical hypothyroidism cases thyroxin levels (T3,T4) appeared normal associated with elevated TSH level, and we hypothesized that diabetes mellitus makes alteration in thyroid gland to produce quiet enough level of (T3,T4), so the TSH level becomes elevated to stimulates more production of (T3,T4) to be at the normal level leading to asymptomatic hypothyroidism (subclinical hypothyroidism) associated with elevated TSH [35].

The present study compared between the means of (FBG, HbA1C) and thyroxin hormones, the comparison revealed significant increased, that means increase of FBG associated with increase of HbA1C and according to mixed endocrine disorder this increasing of glucose affect thyroid gland leading to decrease of thyroxin hormones (T3, T4), however the THS level was significantly increased because decreasing of thyroxin levels leads to increase of TSH level to stimulate more thyroxin hormones production [36]. The relation between diabetic laboratory parameters (FBG, HbA1C) and thyroid hormones (T3, T4 and TSH) in diabetic patients when compared to control subjects revealed that statistically not significant.

In the present study the correlation between HbA1C and T3 showed negative correlation, it means increasing of HbA1C associated with decrease of T3 explaining the meaning of mixed endocrine disorder and the same correlation between HbA1C and T4[37]. The present study demonstrated inverse correlation between FBG and T4, and T3 and that is mean increasing of blood glucose affect production of T3 and T4 from thyroid gland leading increase TSH hormone to stimulate thyroid gland to produce normal T3 and T4 as a scientific fact due to mixed endocrine disorder when compared to control subject, however, the mechanism of thyroid function alteration by diabetes mellitus is not yet fully elucidated, due to the lack of researches in this field.

5. CONCLUSION

Our findings in this study conclude that diabetes mellitus type 2 may alter thyroid gland to produce normal thyroid hormone levels, so TFT screening for diabetic patient will be important to investigate hypothyroidism among diabetic patient.

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Tables

Table 1: Illustrated the general characteristics of the study of DM subjects (n=200) and laboratory tests of thyroid hormones.

Variables	Range	Median	Mean±SD	Mean (R.V)	*P-value*
Age /Years	60.00	56.29	56.29±10.28	-	-
Duration/ Years	29.84	10.27	7.51±5.54	-	-
FBG (mg/dL)	301.00	198.50	199.49±58.83	100.5	0.000
HbA1C (%)	9.47	7.30	7.69±1.92	5	0.000
TSH (µ UI/mL)	15.38	0.83	1.34±1.79	2.345	0.000
T3 (ng/mL)	2.18	1.04	1.06±0.31	1.185	0.000
T4 (ug/dL)	12.40	7.30	7.49±1.88	7.95	0.001

Table 2: Shows the thyroid function status in type 2 diabetic patients in both sex.

Thyroid dysfunction	Gender	
	Male N & Percent	Female N & Percent
(Subclinical) hypothyroidism	2 (1%)	4 (2%)
Clinical Hypothyroidism	0 (0.0%)	3 (1.5%)
Other group	71 (35%)	120 (60%)
Total	73 (36%)	127 (64%)

Table 3: Shows mean concentration of thyroid hormones and biochemical values among thyroid dysfunction (hypothyroidism) and other DM group.

Parameters	Hypothyroidism (Mean±SD)	Other group of D.M (Mean±SD)	*P-value*
FBG (mg/dL)	181.12±42.95	200.25±59.35	0.369
HbA1C (%)	7.73±2.97	7.69±1.87	0.945
TSH (µ UI/mL)	8.78±3.06	1.02±0.75	0.000
T3 (ng/mL)	0.77±0.166	1.07±0.31	0.007
T4 (ug/dL)	5.62±1.66	7.56±1.84	0.004

Figures

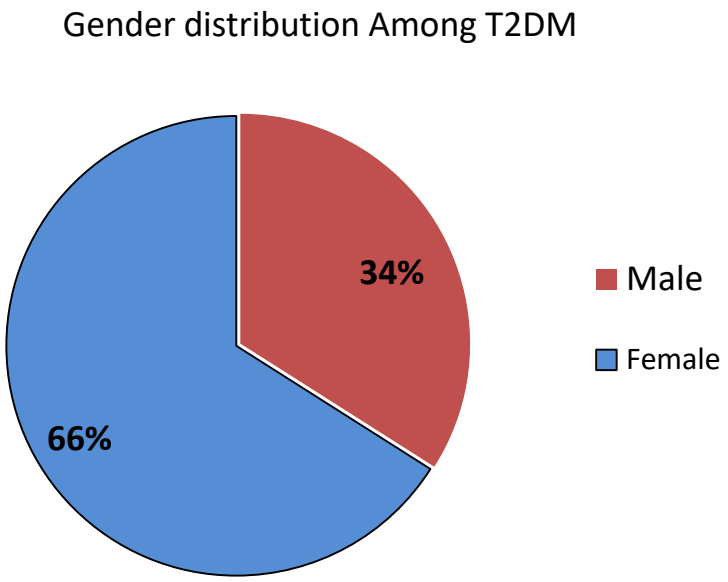

Figure 1: Shows male and female distribution among type 2 diabetic patients.

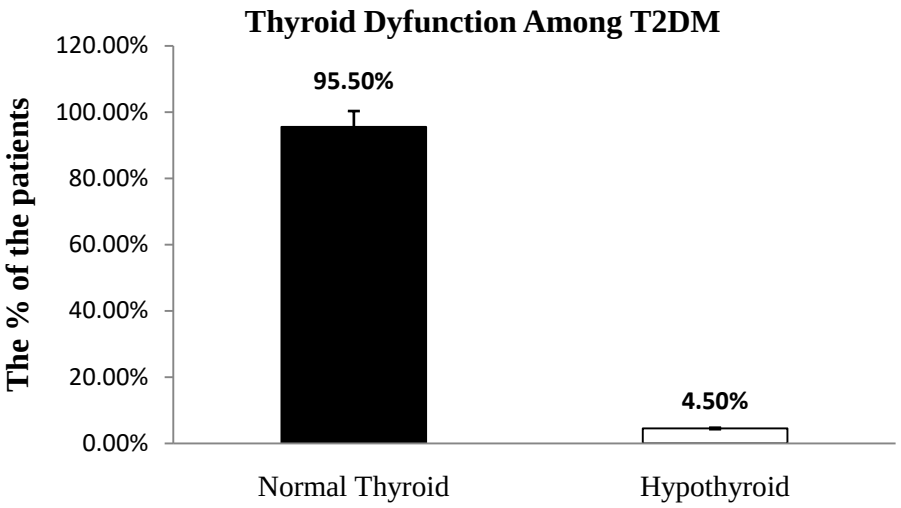

Figure 2: Shows the classification of thyroid dysfunction (hypothyroidism) among type2 diabetes mellitus patients.

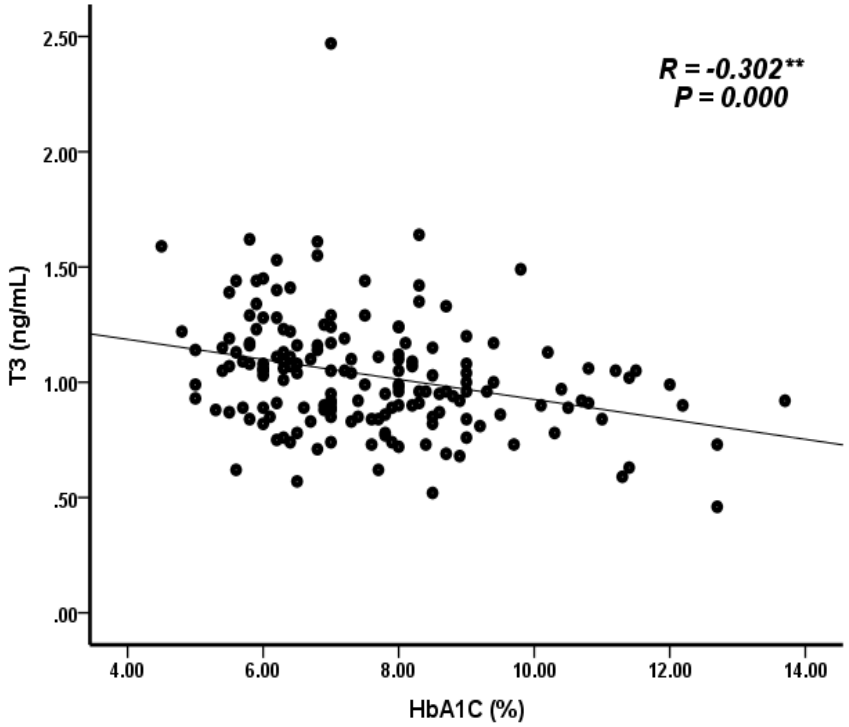

Figure 3: Shows pearson's correlation between HbA1C% and T3 (ng/ml).

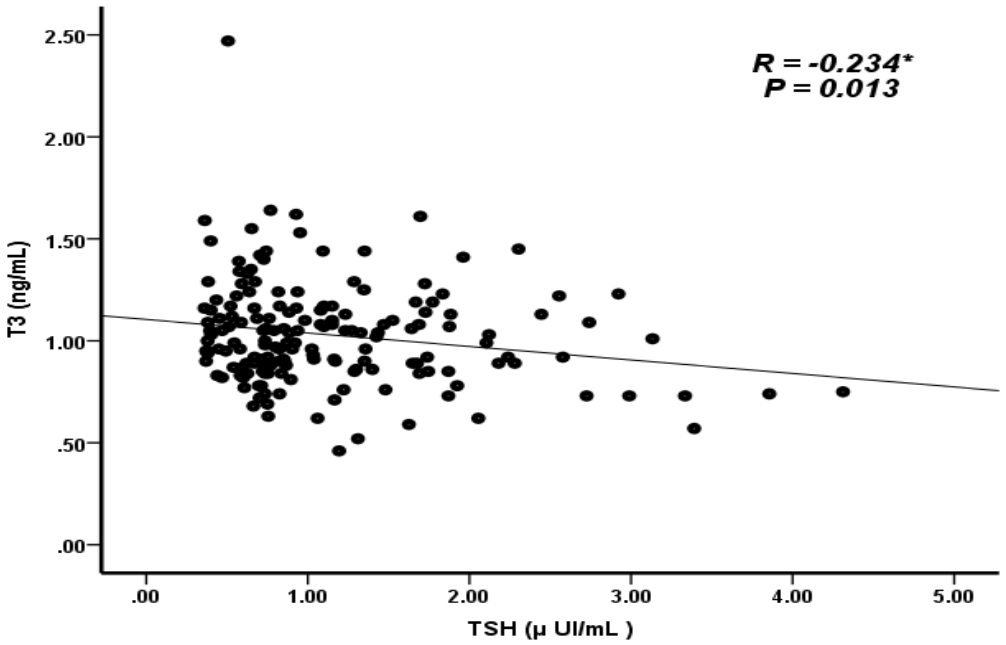

Figure 4: Represent pearson's correlation between TSH (µIU/mL) and T3 (ng/ml).

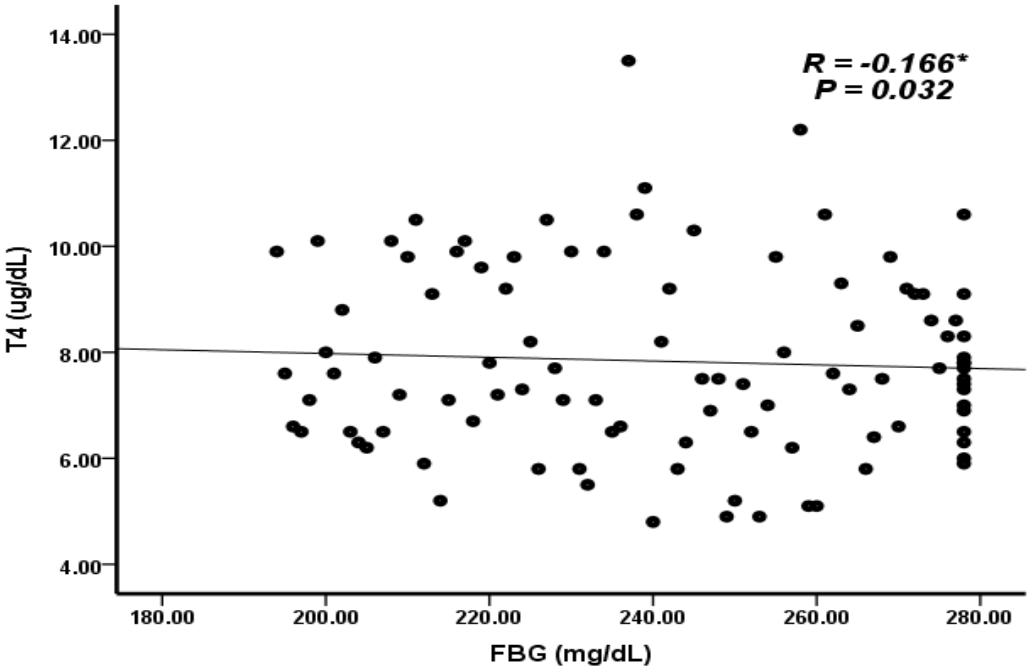

Figure 5: Demonstrate pearson's correlation between FBG (mg/dl) and T4(ug/dl).