**Thyroid Function Tests of Type 2 Diabetic Patients in Baghdad Governorate ( El-Mahmoodiya District)**

Monthir Mahmood Suhail

El-Mahmoodiya General Hospital, Baghdad General Directory of Health,

El Mahmoodiya, Iraq.

E-mail: [monthirsuhail@yahoo.com](mailto:monthirsuhail@yahoo.com), Mobile(07706158409)

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**Abstract**

**Background:** Diabetes mellitus type 2 and thyroid disorders are the two most common endocrine disorders encountered in clinical practice, and associations between both conditions have long been reported.

**Objectives:** To study thyroid function tests in our type 2 diabetic patients.

**Methods:** The study was conducted at El-Mahmoodiya general hospital in Baghdad governorate from March to June 2013 where 30 diabetic type 2 patients included randomly in the study and another 30 healthy non diabetic were included as a control group. The two groups were sex and age matched. Thyroid function tests were assessed for both groups.

**Results:** Abnormal thyroid function tests ( T3, T4, and TSH ) are significantly higher in prevalence among the diabetic than control group, with hypothyroidism being the mostly encountered abnormality.

**Conclusion:** A systematic approach to thyroid testing in diabetic type 2 patients is favorable.

**فحوص وظائف الغدة الدرقية في مرضى السكر النوع الثاني في محافظة بغداد (منطقة المحمودية**

**الخلاصة**

**الخلفية:** داء السكر واضطرابات الغدة الدرقية هما من اضطرابات الغدد الصماء الأكثر حضورا خلال العمل السريري. كما ان الترابط بين الحالتين بحث منذ مدة طويلة.

**الاهداف:** دراسة وظائف الغدة الدرقية في مرضانا المصابين بداء السكر النوع الثاني.

**الطرائق:** أنجزت الدراسة في مستشفى المحمودية العام في محافظة بغداد خلال الفترة من اذار لغاية حزيران 2013 حيت ادخل ثلاثون مريض مصابين بالنوع الثاني داء السكري بشكل عشوائي كما ادخلت مجموعة اخرى من 30 شخص من غير المصابين بداء السكر و السليمين كمجموعة سيطرة للمقارنة. المجموعتان كانتا متماثلتين من ناحية العمر والجنس.وظائف الغدة الدرقية قيمت لكلى المجموعتين.

**النتائج:** اضطرابات فحوص وظائف الغدة الدرقية كانت أكثر مشاهدة وبشكل مؤثر من الناحية الاحصائية بين مجموعة المصابين بداء السكر النوع الثاني بالمقارنة مع مجموعة غير المصابين.

**الاستنتاجات:** من الأفضل العمل بشكل نظامي على فحص وظائف الغدة الدرقية في مرض السكري.

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**Introduction**

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iabetes mellitus (DM) is one of the most common non-communicable diseases globally [1]. Type 2 diabetes is a heterogeneous disorder. Three basic metabolic defects characterize the disease: insulin resistance, an insulin secretary defect that is not autoimmune-mediated, and an increase in glucose production by the liver [2]. Type 2 diabetes comprises 90% of people with diabetes around the world [3].

Thyroid disorders are widely common with variable prevalence among the different populations [4]. In the Colorado thyroid Disease prevalence study involving ( 25862 ) participants attending a state health fair, 9.5% of the studied population were found to have an elevated TSH, while 2.2% had a low TSH [5]. Diabetes and thyroid disorders have been shown to mutually influence each other and associations between both conditions have long been reported [6]. Several reports documented a higher than normal prevalence of thyroid dysfunction in the diabetic population. Particularly, Perros *et al*. demonstrated an overall prevalence of 13.4% of thyroid diseases in diabetics with the highest prevalence in type 1 female diabetics (31.4%) and lowest prevalence in type 2 male diabetics (6.9%) [7].

The relationship between thyroid disorders and diabetes mellitus is characterized by a complex interdependent interaction [8]. Thyroid hormones are insulin antagonists, both insulin and thyroid hormones are involved in cellular metabolism and excess and deficit of any can result in functional derangement of the other [9]. Thyroid disorders, including both hypo- and hyper have been associated with insulin resistance due to various mechanisms [10]. Thyroid hormones exert profound effects in the regulation of glucose homeostasis. These effects include modifications of circulating insulin levels and counter-regulatory hormones, intestinal absorption, hepatic production and peripheral tissues (fat and muscle) uptake of glucose . It has long been known that thyroid hormones act differentially in liver, skeletal muscle and adipose tissue – the main targets of insulin action [11]. While thyroid hormones oppose the action of insulin and stimulate hepatic gluconeogenesis and glycogenolysis [12] they up-regulate the expression of genes such as GLUT-4 and phosphoglycerate kinase, involved in glucose transport and glycolysis respectively, thus acting synergistically with insulin in facilitating glucose disposal and utilization in peripheral tissues [13].

Altered thyroid hormones have been described in patients with diabetes especially those with poor glycemic control. In diabetic patients, the nocturnal TSH peak is blunted or abolished, and the TSH response to TRH is impaired [14]. Reduced T3 levels have been observed in uncontrolled diabetic patients. This “low T3 state” could be explained by impairment in peripheral conversion of T4 to T3 that normalizes with improvement in glycemic control [15]. Higher levels of circulating insulin associated with insulin resistance have shown a proliferative effect on thyroid tissue resulting in larger thyroid size with increased formation of nodules [16] .

It has been shown, both in euthyroid non-diabetic [17]and diabetic adults [18] that small variations in TSH at different levels of insulin sensitivity might exert a marked effect on lipid levels. The interaction between insulin resistance and lower thyroid function might be a key determinant for a more atherogenic lipid profile in these populations. Furthermore, an increased risk of nephropathy was shown in type 2 diabetic patients with subclinical hypothyroidism [19]. As for retinopathy, Yang et al demonstrated recently that diabetic patients with subclinical hypothyroidism have more severe retinopathy than euthyroid patients with diabetes [20].

The aim of this control case study is to determine the features of thyroid function tests in our type 2 diabetic patients.

**Methods**

This study was carried out at El Mahmoodiya General Hospital in Baghdad Governorate from March to June 2013 .

Thirty diabetic type 2 patients were included randomly in the study and thirty other healthy non diabetic persons from those who have visited the hospital for check up were selected in a way to have a sex and age control group. The diagnosis or exclusion of DM was according to the American diabetic association [21]. Type 2 DM were distinguished in the case group based on clinical circumstances [22]. None of the diabetic patients or persons within the control group were known to have a thyroid disease or taking medications that might affect thyroid function. All the diabetic patients and persons in the control group were subjected to detailed history, physical examination, and were investigated for ( FBG, renal function tests, liver function tests, lipid profile, CBP and electrocardiography).

Total triiodothyronine T3, total thyroxine T4 , and thyroid stimulating hormone TSH were determined for all the diabetic and control group by the two site - immunoenzymometric assay. The values for thyroid function test which considered normal were as follow ; T3 ( 0.79 – 1.58 ) ng/ml , T4 (4.9 – 11 ) µg/dl, and TSH ( 0.38 – 4.31) mIU/ml. Thyroid function tests results were interpreted as illustrated in the table -1- below [23, 24] .

**Table 1** thyroid function tests results and their potential meaning

|  |  |  |  |
| --- | --- | --- | --- |
| **TSH** | **T4** | **T3** | **interpretation** |
| **High** | **Normal** | **Normal** | **(subclinical) hypothyroidism** |
| **High** | **Low** | **Low or normal** | **clinical Hypothyroidism** |
| **Low** | **Normal** | **Normal** | **(subclinical) hyperthyroidism** |
| **Low** | **High or normal** | **High or normal** | **Clinical Hyperthyroidism** |
| **normal** | **normal** | **low** | **Low T3 syndrome** |

The Statistical Analysis System- SAS (2010) was used to effect of difference factors (groups) in study parameters [25]. Least significant difference-LSD test was used to compare between means and chi-square test was used to compare between percentages in this study and p value <0.05 considered significant.

**Results**

30 diabetic type 2 patients were included in the study, and 30 non diabetic were included also as a control group .Table -2- shows the mean ages comparison and gender comparison between the two groups. The two groups were matched with regard to both age and gender.

Table -3- illustrates the mean levels and standard deviations of thyroid function tests ( T3, T4, and TSH ) in the two groups .

Table -4- shows the number and percentage of those who were found to have abnormal thyroid function tests in each group. 6 of the 30 diabetics i.e (20%) have abnormal thyroid function tests versus 1 of the 30 (3.33%) in the control group ( the difference is statistically significant with p value < 0.01) .

Table -5- demonstrates the types of abnormal thyroid function tests in the diabetic group .

**Table 2** Gender and age distribution of diabetic type 2 and control subjects.

|  |  |  |  |
| --- | --- | --- | --- |
| **Group** | **Gender** | **Number** | **Mean age ± SD (years)** |
| **Diabetic**  **Total (30)** | **Male**  **Female** | **14**  **16** | **53.00 ± 11.90** |
| **Control**  **Total (30)** | **Male**  **Female** | **15**  **15** | **52.00 ± 11.20** |

**Table 3** Comparison between control and diabetic groups according to mean levels of thyroid function tests.

|  |  |  |  |
| --- | --- | --- | --- |
| **Group** | **Mean ± SD** | | |
| **T3ng/ml** | **T4 µg/dl** | **TSH mIU/ml** |
| **control** | **1.0434 ± 0.157** | **7.260 ± 1.336** | **1.384 ± 0.994** |
| **diabetic** | **1.090 ± 0.399** | **7.033 ± 0.970** | **1.737 ± 1.274** |
| **LSD Value**  **P-value** | **0.083 NS**  **0.736** | **0.0454 \***  **0.036** | **0.187 \***  **0.0218** |
| **\* (P<0.05), NS: Non-significant.** | | | |

**Table 4** Number and percentage of those with abnormal thyroid function tests in both groups.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | | **Normal thyroid function tests** | **Abnormal thyroid**  **Function tests** | **Total No.** | **Chi-square value** |
| **Diabetes** | **No.** | **24** | **6** | **30** | **10.25 \*\*** |
| **%** | **80.00** | **20.00** | **100 %** |
| **Control** | **No.** | **29** | **1** | **30** | **12.04 \*\*** |
| **%** | **96.67** | **3.33** | **100 %** |
| **\*\* (P<0.01).** | | | | | |

**Table 5** pattern of thyroid function tests in the diabetic group.

|  |  |  |
| --- | --- | --- |
| **percentage** | **number** | **Thyroid function tests** |
| **80%** | **24** | **Normal** |
| **3.33%** | **1** | **Clinical hypothyroidism** |
| **6.66%** | **2** | **Subclinical hypothyroidism** |
| **6.66%** | **2** | **Low T3 syndrome** |
| **3.33%** | **1** | **Subclinical hyperthyroidism** |
| **100%** | **30** | **total** |

**Discussion**

In this case-control study, both the diabetic type 2 patients and control groups were matched in age and gender ( as it is shown in table 2). Table (3) shows the means with standard deviations of T3, T4, and TSH in both groups. The mean level of T4 is lower in the diabetic group, while that of TSH is higher in the diabetic than control group.

Considering the number and percentage of those who have abnormal thyroid function tests in both groups ( table 4), there is a statistically significant difference, as 6 of the 30 diabetic patients i.e (20%) have abnormal thyroid function tests versus one in the 30 control group (3.33%) . By this we agree with several other studies which revealed higher incidence of thyroid dysfunction in diabetic type 2 patients comparing to general population . A prevalence of 12.3% was reported among Greek diabetic type 2 patients [26] and 16% of Saudi patients with type 2 diabetes were found to have thyroid dysfunction [27]. In Jordan, a study reported that thyroid dysfunction was present in 12.5% of type 2 diabetic patients [28] , and an Indian study showed 28.75% of abnormal thyroid function tests among type 2 diabetic patients [29]. The prevalence was 12.9% in a Kuwaiti study[30] .

Several studies [7 , 26 , and 30 ] have shown female gender as a predictive factor for development of abnormal thyroid function tests in diabetic type 2 patients, however we have not found this result, probably because of the smaller size of the number of patients.

Regarding the pattern of thyroid dysfunction ( table 5) , from the total of six patients who have thyroid dysfunction in the diabetic group, ( 2 patients) have subclinical hypothyroidism, (1 patient) has clinical hypothyroidism , (2 patients) have low T3 syndrome, and (1 patient) has subclinical hyperthyroidism, so the pattern of dysfunction is toward hypothyroidism rather than hyperthyroidism. This comes in accordance with other studies like perros *et al* [7] , and AL Wazzan HT *et al* [30] studies which revealed higher incidence of subclinical hypothyroidism among all other patterns of thyroid dysfunction in diabetes mellitus type 2 . The only person in the control group who has abnormal thyroid function tests showed the pattern of subclinical hypothyroidism . Two of 6 (33.33%) of those with abnormal thyroid function tests in diabetic group of present study showed the pattern of lowT3, normal T4, and TSH. This pattern goes with low T3 syndrome. low T3 syndrome is the most common pattern among patients with euthyroid sick syndrome in practice [31] . In Al Wazzan *et al* study, sick euthyroid syndrome constituted 15.7% of those with abnormal thyroid function in diabetic type 2 patients .

In conclusion ; the incidence of abnormal thyroid function tests in our type 2 diabetic patients is 20% with hypothyroidism being the mostly encountered. Despite the absence of definite guidelines regarding screening for thyroid dysfunction in diabetic patients, in the view of this incidence together with the mutual effect of the common two endocrinopathies on each other and the increased risk of complications in diabetic patients in the setting of abnormal thyroid dysfunction, a systematic approach to thyroid testing in diabetic patients is favorable .

**References**

1. Motala A, Pirie FJ, Rauff S, Bacus HB. Cost-effective management of diabetes mellitus. Ethn Dis. 2006; Spring; 16( 2 Suppl 2) : S2-79-84.

2. Barbara A. Ramlo-Halsted, and Steven V. Edelman. The Natural history of type 2 diabetes: Practical points to consider in developing prevention and treatment Strategies. **Clinical diabetes. 2000; Spring ;VOL.18.NO.2.**  
3. American diabetic association. Diagnosis & classification of diabetes mellitus. Diabetes care. 2006 Jan; 29 (suppl 1): 43 – 48.

4. W. M. G. Tunbridge, D. C. Evered, and R. Hall.The spectrum of thyroid disease in a community: the Whickham survey. Clinical Endocrinology. 1977;7(6):481– 493.

5. G. J. Canaris, N. R. Manowitz, G. Mayor, and E. C. Ridgway. The colorado thyroid disease prevalence study. Archives of Internal Medicine. 2000; 160( 4): 526 –534.

6. J. Feely and T. E. Isles. Screening for thyroid dysfunction in diabetics. BMJ.1979; June; 1(6179):1678.

7. P. Perros, R. J. McCrimmon, G. Shaw, and B. M. Frier. Frequency of thyroid dysfunction in diabetic patients: value of annual screening. Diabetic Medicine.1995; 12( 7): 622–627.

8. MirellaHage, Mira S. Zantout, and Sami T. Azar .Thyroid disorders and diabetes mellitus. Journal of Thyroid Research.2011;doi:10.4061/2011/439463.

9. SugureD,McEvoy, and Drury M. Thyroid disease in diabetics. Postgrad Med J.1982; NOV; 58(685): 680–684.

10. KapadiaK,Bhatt P, and Shah J. Association between altered thyroid state and insulin resistance. J Pharmacol Pharmacother. 2012 Apr-Jun; 3(2): 156–160.

11. Gabriela Brenta .Diabetes and Thyroid Disorders. British Journal of Diabetes and Vascular Disease. 2010;10(4):172-177

12. R aboudi N, Arem R, Jones RH et al. Fasting and postabsorptive hepatic glucose and insulin metabolism in hyperthyroidism. Am J Physiol.1989;256:E159–66

13. Clement K, Viguerie N, Diehn M et al.In vivo regulation of human skeletal muscle gene expression by thyroid hormone.Genome Res 2002;12:281–91.

14. Gursoy NT, Tuncel E. The relationship between the glycemic control and the hypothalamus-pituitary-thyroid axis in diabetic patients. Turkish Journal of Endocrinology and Metabolism. 1999;(4):163–168.

15. Coiro V, Volpi R, Marchesi C, et al. Influence of residual C-peptide secretion on nocturnal serum TSH peak in well-controlled diabetic patients. Clinical Endocrinology. 1997;47(3):305–310.

16. Rezzonico J, Rezzonico M, Pusiol E, Pitoia F, Niepomniszcze H. Introducing the thyroid gland as another victim of the insulin resistance syndrome. Thyroid. 2008;18(4):461–464.

17. Bakker SJ, terMaaten JC, Popp-Snijders C. The relationship between thyrotropin and low density lipoprotein cholesterol is modified by insulin sensitivity in healthy euthyroid subjects. J Clin Endocrinol Metab 2001;86:1206–11.

18. Chubb SA, Davis WA, Davis TM. Interactions among thyroid function, insulin sensitivity, and serum lipid concentrations: The Fremantle Diabetes Study. J Clin Endocrinol Metab 2005;90:5317–20.

19. Chen HS, Wu TEJ, Jap TS, *et al*. Subclinical hypothyroidism is a risk factor for nephropathy and cardiovascular diseases in Type 2 diabetic patients. Diabetic Medicine. 2007; 24(12):1336–1344.

20. Yang GR, Yang JK, Zhang L, An YH, Lu JK. Association between subclinical hypothyroidism and proliferative diabetic retinopathy in type 2 diabetic patients: a case-control study. Tohoku journal of experimental medicine. 2010; 222(4): 303–310.

21. Genuth S, Alberti KG, Bennett P, Buse J, et al. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Diabetes Care. 2003;26(11):3160.

22. International Expert, Committee (2009 Jul). : Expert Committee report on the role of the A1C assay in the diagnosis of diabetes". Diabetes Care 2009 Jul; 32 (7): 1327–34.

23. Edwin J. Supit,, and Alan N. Peiris, Interpretation of Laboratory Thyroid Function Tests for the Primary Care Physician. South Med J. 2002; 95 (5).

24. Burman KD, Wartofsky L. Endocrine and metabolic dysfunction syndromes in the critically ill: thyroid function in the intensive care unit setting. Crit Care Clin 2001; 17:43–57.

25. Statistical Analysis System (SAS) 2010, User's Guide. Statistical.Version 9.1th ed. SAS. Inst. Inc. Cary.N.C. USA.

26. Papazafiropoulou A. Prevalence of thyroid dysfunction among greek Type 2 diabetic patients attending an outpatient clinic. Journal of Clinical Medicine Research. 2010;2(2):75–78.

27. Akbar DH, Ahmed MM, Al-Mughales J. Thyroid dysfunction and thyroid autoimmunity in Saudi type 2 diabetics. Acta Diabetologica. 2006;43(1):14–18.

28. Radaideh ARM, Nusier MK, Amari FL, *et al*. Thyroid dysfunction in patients with type 2 diabetes mellitus in Jordan. Saudi medical Journal. 2004;25(8):1046–1050.

29. Vinu V, Pallavi C,Vijay G. Evaluation of thyroid dysfunction among type 2 diabetic patients. IJPBS .2012 dec;2(4):150-155.

30. AL-WazzanHT, AlaaD, RafaaA, MedhetK. Prevalence and associated factors of thyroid dysfunction among type 2 diabetic patients, Kuwait. Bull Allex. Med. 2012;46(2).

31. Marechaud R. Low T3 syndrome. Rev Prat.1998;48:2018-22.

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