Prevalence of thyroid dysfunction among Type 2 Diabetic Patients

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Abstract

Background: Hypothyroidism is prevalent in patients with type 2 diabetes mellitus (DM).

Objectives: To assess the prevalence and the factors associated with hypothyroidism among type 2 DM patients.

Subjects and methods: A retrospective cohort study design was applied through record reviewing of type 2 diabetic patients at the Armed Forces Hospital, Southern Region (AFHSR), Khamis Mushayt, Saudi Arabia. All type 2 diabetics registered at the Diabetes Center of the AFHSR constituted the study population. A data collection sheet was used, which included personal characteristics, diabetes assessment, thyroid function assessment, and other possible risk factors.

Results: The study included 251 type 2 diabetic patients. Their mean age was 38.6±23.5 years with 39.6% of them aged 50 years or more. Slightly more than half of participants (52.4%) were females. Uncontrolled diabetes, manifested by having HbA1c ≥7%, was observed among 60.4% of patients. The mean duration of diabetes was 11.1±7.49 years. Thyroid disease was reported among 14.8% of type 2 diabetics. None of them reported family history of thyroid dysfunction. Factors significantly associated with thyroid disorders were female gender, (p=0.007), obese patients (p=0.014), being treated with oral hypoglycemic agents and insulin or insulin alone (p=0.049).

Conclusion: A considerable proportion of type 2 diabetic patients have thyroid dysfunction. Screening for early detection of thyroid dysfunction in patients with type 2 diabetes mellitus should be done routinely in all places taking care of those patients in Khamis Mushait.

Key words: Type 2 Diabetes, Hypothyroidism, Risk factors, Saudi Arabia.

Introduction

Diabetes mellitus (DM) is one of the common endocrine disorders which affects multiple organs and systems and can cause significant complications ending by undesirable and significant morbidity and mortality. One of the organs negatively affected by diabetes is the thyroid gland and its function (1).

Hypothyroidism is considered to be the most common thyroid disorder among adults, especially older women. It is frequently autoimmune in origin, presenting as either primary atrophic hypothyroidism or Hashimoto's thyroiditis. Thyroid failure secondary to radioactive iodine therapy or thyroid surgery is also common. Hypothyroidism and subclinical hypothyroidism have major prevalence in patients with type 2 DM, and it is possible that hypothyroidism is a risk factor for the development of DM (2).

In diabetes patients, there are alterations in the hypothalamus-pituitary-thyroid axis. Hypothalamic and plasma thyroid releasing hormone (TRH), pituitary and plasma thyroid stimulating hormone (TSH), as well as TSH secretion rates are reduced and the TSH response to TRH is decreased despite normal peripheral TSH metabolism. Triiodothyronine (T3) and thyroxine (T4) production and iodide uptake by the thyroid are diminished (3).

Insulin and thyroid hormones are both involved in cellular metabolism. Therefore, excess or deficit of either of these hormones could result in the functional derangement of the other, i.e., hyperthyroidism can result in hyperglycemia and hypothyroidism can result in hypoglycemia (4). Moreover, it has to be reported that thyroid hormones exert profound effects on the regulation of glucose homeostasis, which includes modifications of the circulating levels of insulin and counter-regulatory hormones, intestinal absorption, hepatic production and peripheral tissue uptake of glucose (5).

Thyroid diseases and diabetes mellitus are the two most common endocrine disorders encountered in clinical practice. They mutually influence each other and the associations between these two conditions (thyroid diseases and diabetes) have been reported (6). Thyroid disease is common in the general population, and its prevalence increases with age. However, there is reported higher prevalence of thyroid dysfunction among type 2 diabetics than in the general population (7). On the other hand, unrecognized thyroid dysfunction can impair metabolic control among diabetics. Prompt detection and treatment may reduce risk of cellular metabolism derangement in DM and can help achieve metabolic control in diabetes (8).

Unrecognized thyroid dysfunction may impair glycemic control by causing hypoglycemia or hyperglycemia. Continuing deterioration of endocrine control exacerbates the metabolic disturbances and leads primarily to hyperglycemia as is the case if one has hyperthyroidism. It has been noted that sustained reduction of hyperglycemia will decrease the risk of developing microvascular complications and most likely reduce the risk of macrovascular complications in patients with type 2 DM (9).

Despite the increasing interest toward exploring the possible interaction between thyroid dysfunction and insulin resistance, studies that explore the association between thyroid dysfunction and diabetes mellitus in Saudi Arabia are still very scarce.

The present study aimed to assess prevalence and the associated factors of hypothyroidism among type 2 DM patients.

Patients and Methods

The present study followed a retrospective cohort research design through reviewing electronic health records of type 2 diabetic patients registered at the Armed Forces Hospital, Southern Region (AFHSR), Khamis Mushayt City, Saudi Arabia. The total number of registered type 2 diabetic patients during 2015-2017 was 8,965 patients. A data collection sheet was constructed by the researcher. It included patients' characteristics; data related to thyroid function assessment.

Assuming that the prevalence of thyroid dysfunction among diabetics is 30%, 4.5% absolute error (15% of prevalence) and a finite population correction, at 95% level of confidence, the single proportion equation for dichotomous variables in Epi-Info 6.04 Software Package, the required sample size was calculated to be 231 patients. However, after adjustment for a dropout rate of about 5%, the sample size was increased to 250 patients. A systematic random sample with one-tenth sampling fraction, was followed to collect the necessary number of health records.

Data were entered into a personal computer and were analyzed using the Statistical Package for Social Sciences (IBM, SPSS version 25). Tests of significance, (i.e., Chi-square, and t-test) were applied. P-values less than 0.05 were considered as statistically significant.

All the necessary official approvals to conduct this study (e.g., the Ethical Committee, hospital administration, academic supervisors) were fulfilled. All collected data were kept confidential and were not used except for research purposes.

Results

The study included 250 type 2 diabetic patients. Their characteristics are summarized in Table (1). Their mean age was 38.6±23.5 years with 39.6% of them aged 50 years or more. Slightly more than half of patients (52.4%) were females. Almost one-quarter (24.4%) were illiterate, whereas 17.6% were university graduated. The majority were non-smokers (90.8%), while the prevalence of active smoking was 7.6%. The mean body mass index (BMI) was 27.64±8.6 kg/m2 with a prevalence of overweight and obesity of 18% and 20.8%, respectively. Oral hypoglycemic

agents were received by 44% of patients, whereas 14% were treated by insulin alone and the remaining 42% were treated by a combination of both. Uncontrolled diabetes, manifested by having HbA1c ≥7% levels, was present among 60.4% of patients. The mean duration of diabetes was 11.1±7.5 years.

Table (2) shows that thyroid dysfunction was found among 14.8% of type 2 diabetic patients. None of them had positive family history of thyroid dysfunction. The mean values of T3, FT4 and TSH were 5.1 ± 1.32, 13.02 ± 3.02 and 2.89 ± 2.56, respectively.

As shown in Table (3), female patients had significantly higher prevalence of thyroid dysfunction than male patients (20.6% and 8.4%, respectively, p=0.007). Obese patients had the highest rate of thyroid diseases (26.9%), whereas underweight patients had the lowest rate (2.3%). Overall, the association between history of thyroid diseases and BMI was statistically significant (p=0.014). 21% of type 2 diabetic patients were treated with a combination of insulin and oral hypoglycemic compared to 14.3% of those treated with insulin only and 9.1% of patients treated with oral hypoglycemic only had a history of thyroid diseases. The association between type of diabetic medication and history of thyroid diseases was significant (p=0.049). There was no statistically significant association between history of thyroid dysfunction and type 2 DM control. Although history of thyroid diseases was more reported among type 2 diabetics with longer duration of the disease than those with shorter duration (13.3±8.5 versus 10.7±7.3 years), the difference was not statistically significant.

Table 1: Characteristics of type 2 diabetic patients

Variables	No.	%
Age category		
• <50 years	151	60.4
• ≥50 years	99	39.6
• Mean ±SD	38.6 ±23.5	
Gender		
• Male	119	47.6
• Female	131	52.4
Educational level		
• Illiterate	61	24.4
• Primary	57	22.8
• Intermediate	20	8.0
• Secondary	68	27.2
• University	44	17.6
Smoking		
• Non-smoker	227	90.8
• Active Smoker	19	7.6
• Ex-Smoker	4	1.6
BMI category (kg/m²)		
• <18.5	44	17.6
• 18.5-24.9	56	22.4
• 25-29.9	53	21.2 %
• 30-34.9	45	18.0 %
• >35	52	20.8 %
• Mean ±SD	27.6 ±8.6	
Received medication		
• Insulin	35	14.0
• Oral hypoglycemic agents	110	44.0
• Both	105	42.0
HbA1c Category		
• < 7%	99	39.6
• ≥ 7%	151	60.4
• Mean ±SD	8.58 ±2.69	
Duration of diabetes (Mean ± SD)	11.1 ±7.49 years	

Table 2: Medical characteristics of the studied patients regarding thyroid dysfunction

Variables	No.	%
Present history of thyroid dysfunction		
• Yes	37	14.8
• No	213	85.2
Family history of thyroid disease	0	0.0
Serum hormone levels (Mean ± SD)		
• T3	5.1 ±1.32 µg/dL	
• FT4	13.02 ±3.02 ng/dL	
• TSH	2.89 ±2.56 mU/L	

Table 3: Type 2 diabetic patients' demographic and medical characteristics according to their present history of thyroid diseases

Variables		History of thyroid disease		P value
		Yes (n=37) No. (%)	No (n=213) No. (%)	
Age Group	• <50 years	20 (13.2)	131 (86.8)	0.393
	• ≥50 years	17 (17.2)	82 (82.8)	
Gender	• Male	10 (8.4)	109 (91.6)	0.007
	• Female	27 (20.6)	104 (79.4)	
Level of education	• Illiterate	7 (11.5)	54 (88.5)	0.728
	• Primary	7 (12.3)	50 (87.7)	
	• Intermediate	3 (15.0)	17 (85.0)	
	• Secondary	11 (16.2)	57 (83.8)	
	• University	9 (20.5)	35 (79.5)	
Smoking status	• Non-smoker	35 (15.4)	192 (84.6)	0.308
	• Active smoker	1 (5.3)	18 (94.7)	
	• Ex-smoker	1 (25.0)	3 (75.0)	
BMI (kg/m²)	• lessthan18.5	1 (2.3)	43 (97.7)	0.014
	• 18.5-24.9	6 (10.7)	50 (89.3)	
	• 25-29.9	9 (17.0)	44 (83.0)	
	• 30-34.9	7 (15.6)	38 (84.4)	
	• ≥35 52)	14 (26.9)	38 (73.1)	
Type of medication	• Insulin	5 (14.3)	30 (85.7)	0.049
	• Oral hypoglycemic agents	10 (9.1)	100 (90.9)	
	• Both	22 (21.0)	83 (79.0)	
HbA1c level	• ≥7%	18 (12.1)	131 (87.9)	0.141
	• <7%	19 (18.8)	82 (81.2)	
Duration of diabetes	• Mean±SD	13.3±8.5	10.7±7.3	0.069

Discussion

Results of the current study revealed a prevalence of 14.8% of thyroid dysfunction among type 2 diabetic patients.

Different figures have been reported from various studies carried out locally and worldwide. Al-Geffari et al. (10) reported that prevalence of thyroid dysfunction among Saudi Type 2 diabetic patients was 28.5%. In Jeddah, Saudi Arabia, thyroid autoimmunity was detected in 10% of diabetics versus 5% among controls, while thyroid dysfunction was found in 16% and 7%, respectively (11).

The prevalence reported in the current study is not so high compared to that reported by Geffari et al. (10) and slightly lower than that reported in Jeddah (11) despite the high prevalence of latent autoimmune diabetes of adults among Saudi Type 2 diabetics (26%) (11).

In India, Geetha et al. (12) reported that 25.1% of type 2 diabetic patients showed abnormal thyroid function (21.9% had hypothyroidism and 3.2% had hyperthyroidism) and 74.89% showed normal thyroid hormone level. The ability to diagnose and treat unsuspected hypothyroidism in type 2 diabetic patients may result in better control of diabetes, thereby greatly enhancing the quality of life. Their study justified the view that all type 2 diabetic patients should be screened for hypothyroidism.

In UK, Smithson (13) reported that the prevalence of thyroid disease in the entire population of diabetic patients registered in the general practice was 10.8%. Devi et al. (14) observed that serum T3 and T4 levels among type 2 diabetic patients were significantly lower than that of the controls, while TSH level was higher. They concluded that type 2 diabetic patients were significantly more associated with hypothyroidism than controls.

In Punjab, Khurana et al. (15) reported a prevalence of 16% of thyroid disorders in patients of type 2 diabetes mellitus; 7.5% were subclinical cases. In another Indian study, Uppal et al. (16) reported a prevalence of 24.5% of thyroid dysfunction among diabetic patients; 17 % hypothyroidism and 7.5 hyperthyroidism.

In Argentina, Maxzud et al. (17) reported that prevalence of thyroid dysfunction in type 2 diabetic patients was 48%, with 8% subclinical hypothyroidism. In Jordan, Radaideh et al. (18) reported a prevalence of 12.5% among type 2 diabetics. In Nepal, Khatiwada et al. (19) reported a very high prevalence of thyroid dysfunctions (36%) among diabetic patients. In Greece, thyroid dysfunction prevalence among type 2 diabetic patients was 12.3%.(20).

In the present study, female type 2 diabetic patients had higher significant rate of thyroid dysfunction compared to males. The same finding has been reported among Saudi type 2 diabetics by Al-Geffari et al (2013) (10). In Nepal (19), higher prevalence of thyroid dysfunction in females (42.9%) than in males (30%) was reported. Similar findings have been reported in India (20) Punjab (15) and Greece(21).

In accordance with what has been documented by Al-Geffari et al in Saudi Arabia,(10) age was not associated with thyroid dysfunction among type 2 diabetic patients. This contradicts what has been reported by several studies that age is a significant risk factor for thyroid dysfunction (15,22,23).

Obesity was associated with a higher rate of thyroid dysfunction among type 2 diabetic patients in the present study. Similarly, Khurana et al. (15) found that subclinical hypothyroidism was observed in obese diabetic patients.

However, there was no significant association between smoking and thyroid dysfunction among type 2 diabetic patients which disagrees with findings of Vestergaard et al. (24) and Khatiwada et al., (19) who stated that smoking is a significant risk factor for thyroid dysfunction. In agreement with our finding, Al-Geffari et al (10) found no association between smoking and thyroid dysfunction.

The present study revealed no association between level of HbA1c and prevalence of thyroid dysfunction among type 2 diabetic patients. Bhattacharjee et al. (25) suggested that cautions should be taken while interpreting HbA1c data in patients with hypothyroidism as they hypothesized that HbA1c levels may be altered due to change in the thyroid status, mainly due to changes in red blood cells turnover (26) and observed that baseline HbA1c levels were significantly higher in hypothyroid patients, and then reduced significantly after achievement of euthyroidism without any change in glucose levels. Khurana et al. (15) reported that patients with uncontrolled diabetes, i.e., HbA1c $\geq$7%, were at a higher risk for subclinical hypothyroidism. In India, Geetha et al. (12) reported that the ability to diagnose and treat unsuspected hypothyroidism in type 2 diabetic patients may result in better control of the diabetic status.

Type 2 diabetic patients treated with a combination of insulin and oral hypoglycemic and those treated with insulin alone had a higher rate of thyroid dysfunction as opposed to those treated with oral hypoglycemic alone. Khurana et al. (15) found that subclinical hypothyroidism was observed in diabetic patients on insulin.

Duration of type 2 diabetes was not a significant predictor for thyroid dysfunction in the present study. This is in accordance with those reported by other studies carried out in Spain (22) and China (27). However, in another Saudi study,(10) diabetic patients with longer duration of the disease (more than 10 years) were more likely to have thyroid dysfunction.

The possible limitations of the present study include its retrospective research design that depends on reviewing of medical records. In addition, the iodine status of the study participants was not assessed. Finally, conduction of the study in only one health institution could affect the generalizability of results.

Conclusion

A considerable proportion of type 2 diabetic patients have thyroid dysfunction. Females, obese, and those treated with a combination of oral hypoglycemic and insulin or insulin alone are at higher risk to develop thyroid dysfunction. Diabetes control, as evidenced by glycated hemoglobin, and duration of diabetes are not associated with thyroid dysfunction in type 2 diabetic patients.

Therefore, screening of type 2 diabetic patients for early detection of thyroid dysfunction should be routinely done, particularly females, obese and those treated with insulin. Further studies are needed in other places taking care of diabetic patients to confirm the present study`s findings.

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