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Original Research Article

Effect of hypothyroidism on glycemic control in type 2 diabetics

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ABSTRACT

Background: The major cause for complications of diabetes is hyperglycemia which can be prevent or reversing complications by using key effective blood sugar control and improving the life quality. Recognizing the link between thyroid disease and diabetes is important to guide clinicians in optimal management of both conditions. Therefore, the current study is undertaken to study the effects of thyroid disease on glycerin administration in patients with type 2 diabetes mellitus (DM).
Methods: The present cross-sectional study was carried out in the Department of General Medicine, ARMCH and RC, Kumbhari during study period of two years. All patients with type 2 diabetics who met the inclusion and exclusion criteria during the study period were sampled for the present study. Baseline data were recorded, including medical history, family history, drug history, and personal history. Clinical data was collected by using pre-structured questionnaires.
Results: In the present study, Euthyroid was 84%, subclinical hypothyroidism was 12% and clinical hypothyroidism was 4%. Majority of the subjects belongs to age group of 51-60 years (36%). The association of hypothyroidism was found to be significant with glycated hemoglobin (HbA1c), duration of DM, electrocardiography (ECG) changes, retinopathy and nephropathy ($p<0.0001$).
Conclusions: Early identification of thyroid dysfunction and correction of thyroid function may result in better glycerin control and help prevent the development of long-term complications.

Keywords: Euthyroid, Subclinical hypothyroidism, Clinical hypothyroidism, Type 2 diabetes

INTRODUCTION

Thyroid disease and diabetes mellitus (DM) are the most common endocrine disorders found in medical practice.[1] Several studies have found that the rate of decline in thyroid function is higher in diabetics than in the non-diabetic population.[2-4] The major cause for complications of diabetes is hyperglycemia which can be prevent or reversing complications by using key effective blood sugar control and improving the life quality, thus reducing resistance to hyperglycaemia will decrease the risk of developing complications like microvascular and macrovascular.[5,6]

In South East Asia region, India is one of the six countries according to the International Diabetes Federation. Genetic predisposition, different diet patterns, sedentary lifestyle, and ethnicity for the causes of the epidemic as the main factors responsible.[7]

Thyroid hormone has a strong influence on the regulation of testosterone glucose homeostasis.[5,6] Both Thyroid hormones and insulin are involved in the proteins, cellular metabolism of carbohydrates, and fats. If their level changes, the functional impairment occurs with thyroid hormones as well as with insulin.[8] Because of synthesis and release of insulin is decreased, the undiagnosed

hypothyroidism induces frequent attacks of hypoglycemia. From the liver, the rate of glucose release is also decreased because of reduced gluconeogenesis and as a result, control of body metabolism got affected.[5,9]

Recognizing the link between thyroid disease and diabetes is important to guide clinicians in optimal management of both conditions. Therefore, the current study is undertaken to study the effects of thyroid disease on glycerin administration in patients with type 2 diabetes.

METHODS

The present cross-sectional study was carried out in the Department of General Medicine, ARMCH and RC, Kumbhari during study period of two years. All patients with type 2 diabetics who met the inclusion and exclusion criteria during the study period were sampled for the present study. Permission from The Institutional Ethical Committee clearance was obtained prior to the start of the study. The purpose of study was explained to the patient in their understanding language and consent was obtained from the study subjects.

Inclusion criteria

All type 2 diabetics above the age of 30 years, all diabetics irrespective of treatment (OHA/Insulin).

Exclusion criteria

Smokers, subjects taking thyroid hormones, on metformin therapy, who underwent thyroid surgery, radioiodine therapy, taking steroids, pregnant women.

Data collection procedure

Baseline data were recorded, including medical history, family history, drug history, and personal history. Clinical data was collected by using pre-structured questionnaires. For all participants, regular clinical and related examinations were performed. According to the American Diabetes Association criteria or if the participant has already taken diabetes medication, labelled as Diabetes. Subjects were tested for diabetes, such as thyroid development, ischemic heart disease and neurological disorders. Laboratory investigations were performed by taking venous blood samples from an antecubital vein of arm by means of clean venipuncture after an overnight fast for fasting blood glucose and 2-hour post glucose blood sugar, glycosylated hemoglobin, lipid profile and thyroid function (triiodothyronine (T3), tetraiodothyronine (T4) and thyroid stimulating hormone (TSH)).

Statistical analysis

Descriptive statistics such as mean, standard deviation (SD) and percentage was used to present the data. Chi-square test was used to compare differences in categorical variables. The statistical significance level was considered at $p<0.05$. Data entry and statistical analysis were performed with the help of Microsoft excel and statistical package for social sciences (SPSS) version 20.0.

RESULTS

Majority of the subjects belongs to age group of 51-60 years (36%) followed 34% for 41-50 years followed by 24% for the age group of 61-70 years, with mean age of 53.14±8.3. 61% were females, 39% of the total study subjects were males. In the present study, 84% are euthyroid, 12% had subclinical and 4% had clinical hypothyroidism. 84% had <5 years of duration followed by 6-10 years (9%), 11-15 years (5%) and >16 years (2%). 53% had hypertension whereas 47% had without hypertension. In diabetic complications, 22% had retinopathy and 13% nephropathy (Table 1).

Table 1: Baseline characteristics.

Characteristics	Number	Percentage
Age (years)		
30-40	6	6
41-50	34	34
51-60	36	36
61-70	24	24
Gender		
Male	39	39
Female	61	61
Type of thyroid dysfunction		
Euthyroid	84	84
Subclinical	12	12
Clinical	4	4
Duration of diabetes in type 2 diabetics (years)		
<5	84	84.0
6-10	9	9.0
11-15	5	5.0
>16	2	2.0
Hypertension		
Present	53	53.0
Absent	47	47.0
Diabetic complications		
Retinopathy	22	22
Nephropathy	13	13

Majority of study subjects belongs to FBS >126 mg/dl (77%) followed by 101-125 mg/dl (14%) and <100 mg/dl (10%). Majority of study subjects belongs to PPBS >201 mg/dl (79%) followed by 141-200 mg/dl (17%) and <140 mg/dl (4%). 49% had HbA1C <6.5 followed by >7.6 (27%) and 6.6-7.5 (24%) (Table 2).

For FBS, 75% had FBS >126 mg/dl levels for euthyroid patients and subclinical state patients, whereas for clinical state, all the patients (100%) had >126 mg/dl levels. The association between FBS category and hypothyroidism was found to be statistically not significant (p=0.6).

For PPBS, in euthyroid state patients, 79.8% had PPBS >201mg/dl levels whereas subclinical state patients, 66.7% had PPBS >201mg/dl levels. In clinical state, all the patients (100%) had >201 mg/dl levels. The association between PPBS category and hypothyroidism was found to be statistically not significant (p=0.67).

Table 2: Distribution of investigation parameters in patients with type 2 diabetics.

Parameters	Frequency	Percentage
FBS		
<100 mg/dl	10	10
101-125 mg/dl	14	14
>126 mg/dl	77	77
PPBS		
<140 mg/dl	4	4
141-200 mg/dl	17	17
>201 mg/dl	79	79
HBA1C		
<6.5	49	49
6.6-7.5	24	24
>7.6	27	27

For HbA1c, in euthyroid state patients, 58.3% had HbA1c <6.5 levels. In subclinical state and clinical state patients, all the patients (100%) had >7.6 HbA1c levels. The association between HbA1c category and hypothyroidism was found to be statistically significant (p<0.0001).

For duration of DM, in euthyroid state patients, 90.5% had diabetes <5 years duration whereas subclinical state patients had 66.7%. In clinical state, 50% had diabetes of 6-10 years duration. The association between duration of DM and hypothyroidism was found to be statistically significant (p<0.0001).

For hypertension, in clinical state patients, all patients (100.0%) presented with hypertension followed by euthyroid state patients (54.8%) and subclinical state patient (33.3%). The association between hypertension and hypothyroidism was found to be statistically not significant (p=0.42).

For diabetic complications, the association between retinopathy and hypothyroidism was found to be statistically significant (p<0.0001). All patients (100%) of clinical state patients had retinopathy, whereas subclinical state patients had 66.7% and euthyroid state patients (11.9%). The association between nephropathy and hypothyroidism was found to be statistically significant (p<0.0001). All patients (100%) of clinical state patients had nephropathy, whereas subclinical state patients had 58.3% and euthyroid state patients (2.4%) (Table 3).

Table 3: Effect of hypothyroidism on different parameters in patients with type 2 diabetics.

Parameters	Hypothyroidism (%)			χ^2 value	P value
	Euthyroid	Subclinical	Clinical		
FBS					
<100 mg/dl	9 (10.7)	1 (8.3)	0	0.29	0.6
101-125 mg/dl	12 (14.3)	2 (16.7)	0		
>126mg/dl	63 (75.0)	9 (75.0)	4 (100)		
PPBS					
<140 mg/dl	3 (3.6)	1 (8.3)	0	0.18	0.67
141-200 mg/dl	14 (16.7)	3 (25.0)	0		
>201 mg/dl	67 (79.8)	8 (66.7)	4 (100)		
HbA1C					
<6.5	49 (58.3)	0	0	16.04	<0.0001
6.6-7.5	24 (28.6)	0	0		
>7.6	11 (13.1)	12 (100)	4 (100)		
Duration of diabetes (years)					
<5	76 (90.5)	8 (66.7)	0	16.38	<0.0001
6-10	4 (4.8)	3 (25.0)	2 (50)		
11-15	3 (3.6)	1 (8.3)	1 (25)		
>16	1 (1.2)	0	1 (25)		
Hypertension					
Present	46 (54.8)	4 (33.3)	3 (75)	0.65	0.42
Absent	38 (45.2)	8 (66.7)	1 (25)		
Diabetic complications					
Retinopathy	10 (11.9)	8 (66.7)	4 (100)	31.18	<0.0001
Nephropathy	2 (2.4)	7 (58.3)	4 (100)	46.6	<0.0001

DISCUSSION

In the present study, Euthyroid accounted for 84%, subclinical hypothyroidism was 12% and clinical hypothyroidism was 4%. Similar findings were observed in other studies. Swamy et al reported that, in type 2 DM patients, 7 (12.06%) patients had hypothyroidism and 18 (31.03%) subjects had subclinical hypothyroidism in 58 subjects.[10]

A cross-sectional study of 369 type 2 DM patients reported of hypothyroidism 7.3%, with 2.3% clinical hypothyroidism, 5.0% subclinical hypothyroidism.[11]

A retrospective study on 100 type 2 diabetics reported of 28.5% hypothyroidism, 25% had subclinical hypothyroidism, 3.5% had clinical hypothyroidism.[12]

Effect of hypothyroidism

FBS

In the present study, in patients with euthyroid and subclinical hypothyroid, 75% had FBS >126 mg/dl levels while in clinical hypothyroid patients, all the patients (100%) had >126 mg/dl levels. The association between FBS and hypothyroidism was found to be statistically not significant (p=0.6). Similar findings were reported by Swamy et al, Serum T3 and T4 hormone concentrations were low and TSH concentrations were high in type 2 DM when compared to controls. However significant difference was found with T4 and TSH only (p<0.001). FSG did not show significant correlations with thyroid profile parameters. Type 2 DM patients are at risk for hypothyroidism and hence have to be followed up with serum TSH levels.[10]

PPBS

In the present study, 79.8% of patients with euthyroid state had PPBS >201 mg/dl levels, for subclinical state patients, 66.7% had PPBS >201 mg/dl levels and for in clinical state, all the patients (100%) had >201 mg/dl levels. The association between PPBS and hypothyroidism was found to be not significant (p=0.67). When compared to Raval et al that shows a statistically significant association between PPBS and hypothyroidism.

In the study conducted by Raval et al on 50 subjects , the mean value of PPBS was 223±72.11 (diabetics) and 160.34±21.01 (healthy controls) showed a statistically significant difference between the groups, with higher blood sugar levels seen amongst diabetic individuals (p<0.05).[13]

HBA1C

In the present study for euthyroid state patients, 58.3% had HbA1c <6.5 levels, whereas 100% subclinical and clinical state patients had HbA1c >7.6 levels. The association between HbA1c and hypothyroidism was found to be statistically highly significant (p<0.0001). The results were found to be similar compared to other studies.

In the cross-sectional study by Cho et al on 8528 subjects, showed a statistical significance increases in prevalence of subclinical hypothyroidism in those with highest HbA1c. An important finding was, the risk of SCH is increased with poor glycemic control, especially HbA1c >9%. The OR for HbA1c ≥9% compared to <7% was 2.52 (95% CI, 1.09 to 5.86; p=0.031). It tended to more increase in older age and women (OR for HbA1c ≥ 9% compared to< 7%, 4.77; 95% CI, 1.18 to 19.29; p=0.028, and OR, 4.58; 95% CI, 1.41 to 14.87; p = 0.011, respectively). In addition, the relationship was more obvious, especially in older women (OR for HbA1c ≥9% compared to <7%, 12.76; 95% CI, 1.41 to 115.68; p=0.024) but not in men.[14]

In a study by Pasupathi et al., reported a significant increase in blood glucose level, HbA1c (>7%), serum cholesterol, triglyceride, low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C), urea, creatinine and microalbuminurea was observed in diabetic patients compared to non-diabetic subjects. This study showed higher incidence of abnormal thyroid hormone levels among diabetics.[15]

While in another study, they reported that an inverse relationship between HbA1c and serum free T3, and a positive relationship between HbA1c and TSH in the type 2 DM patients with hypothyroidism.[16]

In study on 212 diabetics reported that, prevalence of euthyroid state was higher in patients with a comparatively good glycemic control i.e. with HbA1C <10, the prevalence of which was 34.85%, while in patients with a poorer glycemic control i.e. with HbA1C >10, the prevalence of euthyroid state was just 17.5%. Thus it can be concluded that the prevalence of TD proportionately increases with poorer glycemic index and therefore there is a strong relationship between the two.[17]

Duration of diabetes

In the present study, 90.5% of euthyroid state patients had diabetes <5 years duration while 66.7% of patients with subclinical state had diabetes <5 years duration. The relationship between duration of DM and hypothyroidism was found to be statistically highly significant (p< 0.0001). Similar results were reported in a study by Brahme et al, diabetes <5 years duration, 130 (91.45%) cases were euthyroid and only 12 (8.55%) cases had TD. 70 patients had a longer duration of DM (>5 years). Of these, only 30 (42.85%) cases were euthyroid while 40 (57.15%) cases had TD. They concluded that the prevalence of TD is higher in the population with longer duration of DM, while the prevalence of the euthyroid state was higher than in the other group with shorter duration of DM, with significant

association.[17] However, another study reported that thyroid dysfunction were more common in patients with type 2 diabetic with a duration of diabetes >5 years (7.9% less than 5 years versus 33.4% over 5 years).[18]

Hypertension

In the present study, 54.8% had hypertension in patients with euthyroid state, 75% had presented with hypertension in clinical hypothyroidism, while 33.3% with subclinical hypothyroidism had hypertension. There was no statistically significant association between hypertension and hypothyroidism (p=0.42). Similar findings were observed in other studies.

In the cross-sectional study on 110 patients, 82 (74.5%) were hypertensive. The subclinical hypothyroidism group had a higher prevalence of dyslipidemia (p=0.076), diabetic nephropathy (p=0.003), diabetic retinopathy (p=0.004) and ischemic heart disease (IHD) (p=0.011).[19]

In the another study of 175 patients, 41 (23.4%) patients had hypertension. Among clinical hypothyroidism, 18.1% had hypertension, 28% with subclinical hypothyroidism had hypertension.[20]

Diabetic retinopathy

In the present study, majority of subclinical hypothyroid patients (66.7%) had diabetic retinopathy and all the clinical hypothyroid patients (100%) had diabetic retinopathy and 11.9% had retinopathy in euthyroid state patients. The association between retinopathy and hypothyroidism was found to be statistically significant (p<0.0001). This finding is consistent with other studies.

In the study done, the prevalence of severe diabetic retinopathy was significantly higher in the subclinical hypothyroidism (32.8%) as compared to euthyroid group (19.6 %).[21]

In the meta-analysis study showed a significant association between DR and SCH (odds ratio=2.13, 95% confidence interval=1.41-3.23, p<0.001).[22]

Diabetic nephropathy

In the present study, the association between nephropathy and hypothyroidism was found to be statistically significant (p<0.0001).

In a study done by Qi et al found significant association of diabetic nephropathy with increased in TSH levels with 31% prevalence (p<0.001).[23]

In the study done by Zhou et al, found that diabetic nephropathy is higher in diabetics with hypothyroidism with a prevalence of 15.6%.[24]

In another study, the prevalence of diabetic nephropathy was 7.0%. Diabetic nephropathy patients had higher HbA1c and creatinine levels than the normal and microalbuminuria groups (p<0.05 for both) and longer duration of type 2 DM than the normal group (p<0.05).[25]

CONCLUSION

Early identification of thyroid dysfunction and correction of thyroid function may result in better glycerin control and help prevent the development of long-term complications such as diabetes mellitus and heart disease.

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