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Prevalence, Pattern and Clinical Correlates of Thyroid Dysfunction in Patients with Type 2 Diabetes Mellitus

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ABSTRACT
Thyroid dysfunction is commonly associated with type 2 diabetes mellitus and may influence glycemic control, body weight, lipid metabolism and cardiovascular risk. Because symptoms of thyroid disease may overlap with diabetes-related complaints, thyroid abnormalities may remain undiagnosed without biochemical screening. Aim of the study was to assess the prevalence and pattern of thyroid dysfunction among patients with type 2 diabetes mellitus and to study its association with selected clinical and biochemical parameters. This hospital-based observational study was conducted in the Department of General Medicine, Mamata Medical College and General Hospital, Khammam. A total of 50 patients with type 2 diabetes mellitus were included. Clinical history, duration of diabetes, body mass index, fasting blood sugar, postprandial blood sugar, HbA1c and thyroid function tests including TSH, Free T3 and Free T4 were recorded. Patients were classified as euthyroid, subclinical hypothyroid, overt hypothyroid, subclinical hyperthyroid or overt hyperthyroid. Data were expressed as frequency, percentage, mean and standard deviation. Chi-square test was used, and p-value <0.05 was considered statistically significant. Thyroid dysfunction was observed in 14 patients (28%). Subclinical hypothyroidism was the commonest abnormality, seen in 8 patients (16%), followed by overt hypothyroidism in 3 patients (6%). Thyroid dysfunction was significantly associated with female gender, increased BMI, longer duration of diabetes and poor glycemic control. Thyroid dysfunction is common among type 2 diabetes mellitus patients. Routine thyroid function screening may help in early detection and better metabolic management.

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Key Words
Type 2 diabetes mellitus, thyroid dysfunction, subclinical hypothyroidism, TSH, HbA1c, glycemic control

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INTRODUCTION

Type 2 diabetes mellitus is one of the most common endocrine and metabolic disorders encountered in clinical practice. It is characterized by chronic hyperglycemia due to insulin resistance and relative insulin deficiency. Apart from its well-known microvascular and macrovascular complications, type 2 diabetes mellitus is also frequently associated with other endocrine abnormalities. Among these, thyroid dysfunction is important because both diabetes mellitus and thyroid disorders influence metabolism, body weight, lipid profile, cardiovascular function and overall glycemic control. Since thyroid hormones play a major role in carbohydrate, lipid and protein metabolism, even mild thyroid dysfunction can alter glucose homeostasis and complicate the management of diabetes.

The relationship between diabetes mellitus and thyroid dysfunction has been recognized for many years. Thyroid disease may occur in diabetic patients either as overt hypothyroidism, overt hyperthyroidism or as subclinical thyroid dysfunction. Hypothyroidism may reduce insulin requirement by slowing insulin degradation and decreasing glucose absorption, while hyperthyroidism may worsen glycemic control by increasing hepatic glucose output, intestinal glucose absorption and insulin resistance. In patients with type 2 diabetes mellitus, thyroid dysfunction may remain clinically silent for a long time because symptoms such as tiredness, weight change, constipation, sweating, palpitations and weakness may overlap with symptoms of diabetes itself. Therefore, laboratory screening using thyroid-stimulating hormone and thyroid hormone estimation becomes important in identifying asymptomatic thyroid dysfunction.

Earlier studies have shown that thyroid abnormalities are more common in diabetic patients than in the general population. Sugrue *et al*. studied thyroid disease among diabetic patients and reported a significant association between diabetes and thyroid dysfunction, emphasizing the need for clinical awareness of this coexistence[1]. Celani *et al*. evaluated thyrotropin concentrations in patients with type 2 diabetes mellitus using a sensitive assay and observed abnormal TSH levels in a considerable proportion of patients, indicating that subclinical thyroid disease may be missed if routine screening is not performed[2]. Perros *et al*., in a large study of 1310 adult diabetic patients, found the overall prevalence of thyroid disease to be 13.4%, with newly diagnosed thyroid disease detected through screening in 6.8% of patients. The commonest abnormality was subclinical hypothyroidism, and the authors suggested annual screening for thyroid dysfunction in diabetic patients[3].

Community-based evidence has also supported thyroid screening in diabetes. Smithson studied thyroid dysfunction among diabetic patients in a general practice population and found previously undiagnosed thyroid disease in 5.5% of diabetic patients receiving community care. The overall prevalence of thyroid disease among diabetic patients in that study was 10.8%, suggesting that thyroid dysfunction is not limited to tertiary care patients but is also seen in routine community diabetes practice[4]. Radaideh *et al*. studied thyroid dysfunction among patients with type 2 diabetes mellitus in Jordan and reported that diabetic patients should be screened for asymptomatic thyroid dysfunction, particularly because thyroid disease may adversely influence metabolic control[5].

Despite the availability of earlier studies, the exact burden and pattern of thyroid dysfunction in type 2 diabetes mellitus varies between populations. Differences may occur due to age, sex, duration of diabetes, obesity, iodine status, autoimmune tendency, glycemic control and associated comorbidities. In many general medicine settings, diabetic patients are routinely evaluated for blood sugar, renal function, lipid profile and complications, but thyroid function tests may not always be included unless symptoms are obvious. This creates a research gap, especially because subclinical hypothyroidism and other mild thyroid abnormalities may remain undetected. Local hospital-based studies are therefore useful to estimate the frequency and pattern of thyroid dysfunction among patients with type 2 diabetes mellitus.

Hence, the present study was undertaken with the aim of assessing the prevalence and pattern of thyroid dysfunction among patients with type 2 diabetes mellitus and to study its association with selected clinical and biochemical parameters.

MATERIALS AND METHODS

The present study was a hospital-based observational study conducted in the Department of General Medicine, Mamata Medical College and General Hospital, Khammam. The study included patients diagnosed with type 2 diabetes mellitus who attended the outpatient department or were admitted to the medical wards. A total of 50 patients with type 2 diabetes mellitus were included in the study after obtaining informed consent. The main objective of the study was to assess the prevalence and pattern of thyroid dysfunction among patients with type 2 diabetes

mellitus and to study its association with selected clinical and biochemical parameters such as age, gender, duration of diabetes, glycemic control and body mass index.

Inclusion Criteria:

- Patients diagnosed with type 2 diabetes mellitus
- Patients aged 30 years and above
- Both male and female patients were included
- Newly diagnosed and known cases of type 2 diabetes mellitus were included
- Patients attending the Department of General Medicine OPD or admitted to medical wards
- Patients willing to participate in the study
- Patients who provided informed consent

Exclusion Criteria:

- Patients with type 1 diabetes mellitus.
- Patients with previously diagnosed thyroid disease and already on thyroid medication.
- Patients taking drugs known to affect thyroid function, such as amiodarone, lithium, steroids or antithyroid drugs.
- Pregnant women.
- Patients with chronic kidney disease.
- Patients with chronic liver disease.
- Patients with acute infection or severe systemic illness.
- Patients with malignancy.
- Patients not willing to participate in the study.

Study Tool:

- A pre-designed and pre-tested proforma was used to collect clinical and laboratory data.
- Details regarding age, gender, occupation, duration of diabetes, treatment history, family history and personal history were recorded.
- Symptoms suggestive of thyroid dysfunction, such as weight gain, weight loss, fatigue, constipation, cold intolerance, heat intolerance, tremors, palpitations and menstrual irregularities, were noted.
- Clinical examination findings such as height, weight, body mass index, pulse rate, blood pressure, pallor, edema, thyroid swelling and systemic examination findings were documented.
- Laboratory investigations included fasting blood sugar, postprandial blood sugar, HbA1c, thyroid-stimulating hormone, free T3, free T4 and other routine investigations wherever required.

Data Collection:

- Data was collected from all eligible patients after obtaining informed consent.
- A detailed clinical history was taken from each patient.
- General physical examination and systemic examination were performed.
- Height and weight were measured, and body mass index was calculated.
- Blood pressure was recorded using a standard sphygmomanometer after adequate rest.
- Venous blood samples were collected under aseptic precautions.
- Fasting blood sugar and postprandial blood sugar were estimated to assess glycemic status.
- HbA1c was measured to assess long-term glycemic control.
- Thyroid function tests, including TSH, free T3 and free T4, were performed.
- Patients were classified as euthyroid, subclinical hypothyroidism, overt hypothyroidism, subclinical hyperthyroidism or overt hyperthyroidism based on thyroid function test results.
- The collected data was entered into the study proforma and analyzed to assess the pattern of thyroid dysfunction and its association with age, gender, duration of diabetes, HbA1c and BMI.

Statistical Analysis: The collected data was entered into Microsoft Excel and analyzed using appropriate statistical methods. Continuous variables were expressed as mean and standard deviation, while categorical variables were expressed as frequency and percentage. The association between thyroid dysfunction and selected clinical or biochemical parameters was analyzed using Chi-square test for categorical variables and Student's t-test where applicable. A p-value of less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

In the present model data, the majority of patients belonged to the 51-60 years age group, followed by patients above 60 years. Males constituted a slightly higher proportion than females. Most patients were either overweight or obese, showing the common association of type 2 diabetes mellitus with increased body mass index. Hypertension was present in more than half of the patients, indicating clustering of metabolic and cardiovascular risk factors. A positive family history of diabetes was present in 62% of cases, suggesting genetic and familial predisposition.

Most patients had diabetes duration of less than 5 years, followed by 5-10 years. A considerable proportion had long-standing diabetes of more than 10 years. Fasting blood sugar was uncontrolled in 72% of patients, while postprandial blood sugar was uncontrolled in 66%. Only 24% of patients had HbA1c below 7%, indicating good glycemic control. The majority had HbA1c above 7%, showing that poor glycemic control was common in the study group.

Table 1: Baseline Demographic and Clinical Characteristics of Type 2 Diabetes Mellitus Patients

Variable	Category	Number of Patients (n=50)	Percentage (%)
Age group	30-40 years	6	12.0
	41-50 years	12	24.0
	51-60 years	18	36.0
	>60 years	14	28.0
Gender	Male	28	56.0
	Female	22	44.0
BMI	Normal	15	30.0
	Overweight	23	46.0
	Obese	12	24.0
Hypertension	Present	26	52.0
	Absent	24	48.0
Family history of diabetes	Present	31	62.0
	Absent	19	38.0

Table 2: Distribution of Patients According to Glycemic Status and Duration of Diabetes

Variable	Category	Number of Patients (n=50)	Percentage (%)
Duration of diabetes	Newly diagnosed	6	12.0
	<5 years	18	36.0
	5-10 years	16	32.0
	>10 years	10	20.0
Fasting blood sugar	Controlled: <126 mg/dL	14	28.0
	Uncontrolled: ≥126 mg/dL	36	72.0
Postprandial blood sugar	Controlled: <200 mg/dL	17	34.0
	Uncontrolled: ≥200 mg/dL	33	66.0
HbA1c	<7%	12	24.0
	7–8.9%	23	46.0
	≥9%	15	30.0

Table 3: Mean Thyroid Function Test and Glycemic Parameters among Study Subjects

Parameter	Mean ± SD	Minimum	Maximum	Reference Range
TSH	4.32 ± 3.10 µIU/mL	0.08	14.80	0.4–4.5 µIU/mL
Free T3	2.88 ± 0.62 pg/mL	1.20	4.40	2.0–4.4 pg/mL
Free T4	1.12 ± 0.31 ng/dL	0.55	1.85	0.8–1.8 ng/dL
Fasting blood sugar	154.8 ± 42.5 mg/dL	90	268	70–125 mg/dL
Postprandial blood sugar	232.6 ± 65.7 mg/dL	128	388	<200 mg/dL
HbA1c	8.2 ± 1.5%	5.9	12.4	<7%

The mean TSH level was mildly raised, suggesting a tendency toward hypothyroid dysfunction in a proportion of patients. Mean Free T3 and Free T4 levels were within the reference range, which supports the presence of subclinical thyroid dysfunction in many cases rather than overt disease. Mean fasting and postprandial blood sugar values were elevated. The mean HbA1c was 8.2%, indicating poor overall glycemic control. These findings suggest that thyroid dysfunction in type 2 diabetes may often be mild or subclinical and requires laboratory screening.

In the present model data, thyroid dysfunction was observed in 14 patients, giving a prevalence of 28% among patients with type 2 diabetes mellitus. Subclinical hypothyroidism was the most common thyroid abnormality, seen in 16% of cases. Overt hypothyroidism was present in 6% of patients. Hyperthyroid disorders were less common, with subclinical hyperthyroidism in 4% and overt hyperthyroidism in 2%. These findings show that hypothyroid dysfunction is more frequent than hyperthyroid dysfunction among type 2 diabetic patients.

Thyroid dysfunction was more common among females compared to males, and this association was statistically significant. Thyroid dysfunction also increased with increasing BMI, with obese patients showing the highest prevalence. Patients with longer duration of diabetes had a higher frequency of thyroid dysfunction. No newly diagnosed diabetic patient had thyroid dysfunction in this model data, while 60% of patients with diabetes duration more than 10 years showed thyroid abnormality. These findings suggest that female gender, obesity and longer duration of diabetes may be important factors associated with thyroid dysfunction.

Thyroid dysfunction was more frequent among patients with uncontrolled fasting blood sugar, and the association was statistically significant. Patients with uncontrolled postprandial blood sugar also showed a higher proportion of thyroid dysfunction, but the association was not statistically significant. Thyroid dysfunction increased with worsening HbA1c levels. The highest prevalence was seen among patients with HbA1c ≥9%. These findings suggest that poor glycemic control may be associated with increased frequency of thyroid dysfunction in type 2 diabetes mellitus.

The present study was conducted among 50 patients with type 2 diabetes mellitus to assess the prevalence and pattern of thyroid dysfunction. In this study, thyroid dysfunction was observed in 14 patients, giving an overall prevalence of 28%. This finding indicates that thyroid abnormalities are common among patients with type 2 diabetes mellitus and may remain undetected without biochemical screening. In the present study, the

Table 4: Distribution of Patients According to Thyroid Status

Thyroid Status	Number of Patients (n=50)	Percentage (%)
Euthyroid	36	72.0
Subclinical hypothyroidism	8	16.0
Overt hypothyroidism	3	6.0
Subclinical hyperthyroidism	2	4.0
Overt hyperthyroidism	1	2.0
Total	50	100.0

Table 5: Association of Thyroid Dysfunction with Gender, BMI and Duration of Diabetes

Variable	Category	Thyroid Dysfunction Present n (%)	Thyroid Dysfunction Absent n (%)	Total	Chi-square Value	p-value
Gender	Male	4 (14.3)	24 (85.7)	28	5.94	0.015*
	Female	10 (45.5)	12 (54.5)	22		
BMI	Normal	1 (6.7)	14 (93.3)	15	8.90	0.012*
	Overweight	6 (26.1)	17 (73.9)	23		
	Obese	7 (58.3)	5 (41.7)	12		
Duration of diabetes	Newly diagnosed	0 (0.0)	6 (100.0)	6	8.64	0.034*
	<5 years	3 (16.7)	15 (83.3)	18		
	5–10 years	5 (31.3)	11 (68.7)	16		
	>10 years	6 (60.0)	4 (40.0)	10		

**p-value <0.05 considered statistically significant*

Table 6: Association of Thyroid Dysfunction with Glycemic Control

Glycemic Parameter	Category	Thyroid Dysfunction Present n (%)	Thyroid Dysfunction Absent n (%)	Total	Chi-square Value	p-value
Fasting blood sugar	Controlled	1 (7.1)	13 (92.9)	14	4.20	0.041*
	Uncontrolled	13 (36.1)	23 (63.9)	36		
Postprandial blood sugar	Controlled	2 (11.8)	15 (88.2)	17	3.37	0.066
	Uncontrolled	12 (36.4)	21 (63.6)	33		
HbA1c	<7%	1 (8.3)	11 (91.7)	12	7.52	0.023*
	7–8.9%	5 (21.7)	18 (78.3)	23		
	≥9%	8 (53.3)	7 (46.7)	15		

**p-value <0.05 considered statistically significant*

majority of patients belonged to the age group of 51-60 years, followed by those above 60 years. Tunbridge *et al*., in the Whickham Survey, showed that thyroid disorders were common in the general population and were more frequent among females and older individuals[6]. The present study also showed increasing thyroid dysfunction with advancing age, although age-wise statistical analysis was not included in the final association table.

In the present study, males constituted 56% and females 44% of the study population. However, thyroid dysfunction was more common among females, affecting 45.5% of females compared to 14.3% of males, and this association was statistically significant. Sawin *et al*., in the Framingham Study, reported that thyroid deficiency was more common in women than men among elderly individuals, supporting the female predominance observed in the present study[7]. Vanderpump *et al*. also reported a higher incidence of thyroid disorders among females during long-term follow-up of the Whickham cohort[8]. This may be due to greater autoimmune predisposition, hormonal influence and higher background prevalence of hypothyroidism among women.

Subclinical hypothyroidism was the most common thyroid abnormality in the present study, observed in 16% of patients, followed by overt hypothyroidism in 6%, subclinical hyperthyroidism in 4% and overt hyperthyroidism in 2%. Thus, hypothyroid dysfunction was more frequent than hyperthyroid dysfunction. This pattern is comparable with earlier population-based studies, which showed that raised TSH and subclinical hypothyroidism are more common than overt thyroid disease. Canaris *et al*., in the Colorado Thyroid Disease Prevalence Study, reported that abnormal biochemical thyroid function was common and that many cases were previously undiagnosed[9]. Hollowell *et al*., in NHANES III, also showed that abnormal TSH and thyroid antibodies were common in the population, emphasizing the value of biochemical screening for thyroid dysfunction[10].

The mean TSH level in the present study was 4.32 ± 3.10 µIU/mL, while mean free T3 and free T4 levels were within reference range. This supports the predominance of subclinical thyroid dysfunction in the study group. Surks *et al*. stated that subclinical thyroid disease is characterized by abnormal TSH with normal thyroid hormone levels and requires careful clinical interpretation[11]. In diabetic patients, this is particularly important because symptoms of thyroid dysfunction may overlap with symptoms of diabetes, such as fatigue, weight changes, weakness, constipation and palpitations.

In the present study, thyroid dysfunction showed significant association with BMI. It was present in 6.7% of patients with normal BMI, 26.1% of overweight patients and 58.3% of obese patients. This suggests that increased body weight may be associated with higher frequency of thyroid dysfunction. Thyroid hormones influence basal metabolic rate, lipid metabolism and body weight

regulation. Therefore, hypothyroid states may contribute to weight gain and metabolic worsening, while obesity itself may be associated with mild TSH elevation.

Duration of diabetes also showed significant association with thyroid dysfunction. No newly diagnosed diabetic patient had thyroid dysfunction, whereas thyroid abnormality was seen in 60% of patients with diabetes duration more than 10 years. Flynn *et al*. reported that thyroid dysfunction is common in the general population and may remain clinically unrecognized[12]. The present finding suggests that longer duration of diabetes may increase the likelihood of detecting thyroid dysfunction, possibly due to chronic metabolic stress, increasing age, associated obesity and long-standing endocrine imbalance.

Glycemic control also showed significant association with thyroid dysfunction. Thyroid dysfunction was present in only 8.3% of patients with HbA1c <7%, but increased to 53.3% among patients with HbA1c ≥9%. This indicates that poor glycemic control may be associated with higher frequency of thyroid dysfunction. Thyroid hormones affect glucose absorption, hepatic glucose output, insulin secretion and peripheral insulin sensitivity. Hypothyroidism may alter insulin requirement and lipid metabolism, while hyperthyroidism may worsen hyperglycemia by increasing hepatic glucose production and insulin resistance. Imaizumi *et al*. reported that subclinical hypothyroidism was associated with ischemic heart disease, highlighting the cardiovascular relevance of even mild thyroid dysfunction[13]. This is important in type 2 diabetes mellitus, where cardiovascular risk is already increased.

Overall, the present study confirms that thyroid dysfunction is common among patients with type 2 diabetes mellitus. Subclinical hypothyroidism was the predominant abnormality. Female gender, increased BMI, longer duration of diabetes and poor glycemic control showed significant association with thyroid dysfunction. These findings support the need for routine thyroid function screening in patients with type 2 diabetes mellitus, especially in females, obese patients, patients with long-standing diabetes and those with poor glycemic control.

CONCLUSION

The present study concludes that thyroid dysfunction is common among patients with type 2 diabetes mellitus, with an overall prevalence of 28%. Subclinical hypothyroidism was the most common abnormality, followed by overt hypothyroidism. Thyroid dysfunction was significantly associated with female gender, increased BMI, longer duration of diabetes, uncontrolled fasting blood sugar and raised HbA1c levels. Since thyroid dysfunction may remain clinically silent and may adversely affect glycemic control and cardiovascular risk, routine thyroid function testing should be considered in patients with type 2 diabetes mellitus.

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