Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Association of Thyroid Dysfunction with Glycemic Control and Diabetic Complications in Patients with Type 2 Diabetes Mellitus

Dr. Kamlesh Bhatt[1] (Associate Professor)

Department of General Medicine, Pacific Medical College and Hospital, Udaipur[1]
Corresponding Author: Dr. Kamlesh Bhatt

Abstract

Background: Type 2 diabetes mellitus (T2DM) is a major metabolic disorder characterized by chronic hyperglycemia resulting from insulin resistance and progressive pancreatic β-cell dysfunction. Thyroid dysfunction and diabetes mellitus frequently coexist due to shared autoimmune, genetic, and metabolic pathways. Thyroid hormones influence glucose metabolism through effects on insulin secretion, insulin sensitivity, and lipid metabolism. Altered thyroid function may contribute to poor glycemic control and increased risk of diabetic complications.

Materials and Methods: A prospective observational study was conducted among 108 patients diagnosed with Type 2 Diabetes Mellitus attending the Department of Medicine. Patients were evaluated for demographic characteristics, duration of diabetes, body mass index (BMI), glycemic parameters including fasting blood glucose and glycated hemoglobin (HbA1c), and thyroid function tests including thyroid-stimulating hormone (TSH), free triiodothyronine (FT3), and free thyroxine (FT4). The presence of diabetic complications including neuropathy, nephropathy, retinopathy, and cardiovascular complications was assessed. Statistical analysis was performed using appropriate tests, and a p-value <0.05 was considered statistically significant.

Results: Among 108 patients, thyroid dysfunction was identified in a significant proportion of individuals with Type 2 Diabetes Mellitus. Patients with thyroid dysfunction demonstrated higher mean HbA1c levels compared with euthyroid diabetic patients, indicating poorer glycemic control. Subclinical hypothyroidism was the most common thyroid abnormality observed. The prevalence of diabetic complications was higher among patients with thyroid dysfunction, particularly diabetic nephropathy and peripheral neuropathy. Significant associations were observed between thyroid dysfunction, elevated HbA1c levels, and diabetic complications.

Conclusion: Thyroid dysfunction is frequently associated with Type 2 Diabetes Mellitus and may contribute to inadequate glycemic control and increased occurrence of diabetic complications. Routine screening of thyroid function in diabetic patients may help in early identification and appropriate management of thyroid abnormalities, thereby improving metabolic outcomes.

Keywords: Type 2 Diabetes Mellitus, Thyroid Dysfunction, HbA1c, Subclinical Hypothyroidism, Diabetic Complications, Glycemic Control

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Introduction

One of the most common chronic metabolic diseases in the world, type 2 diabetes mellitus (T2DM) poses a serious threat to public health. Persistent hyperglycemia brought on by decreased insulin production, elevated insulin resistance, or a combination of the two is its hallmark. Diabetes-related comorbidities, such as cardiovascular disease, nephropathy, neuropathy, and retinopathy, have risen in tandem with the global burden of diabetes in recent decades.

Thyroid dysfunction is one of the most common endocrine problems linked to diabetes mellitus. Due to the intricate biochemical linkages between diabetes and thyroid diseases, their coexistence has become increasingly important from a therapeutic standpoint. By influencing intestinal glucose absorption, hepatic glucose synthesis, peripheral glucose consumption, and insulin secretion from pancreatic β-cells, thyroid hormones control the metabolism of carbohydrates.

Glucose homeostasis may be considerably altered by thyroid dysfunction. Hypothyroidism can affect metabolic regulation by decreasing insulin sensitivity, reducing glucose consumption, and contributing to dyslipidemia. On the other hand, hyperthyroidism may worsen glycemic control by increasing the synthesis of glucose in the liver and speeding up the breakdown of insulin. Thus, HbA1c levels and long-term diabetic outcomes may be impacted by aberrant thyroid hormone levels.

Patients with type 2 diabetes are often found to have subclinical hypothyroidism, which is defined by high thyroid-stimulating hormone (TSH) levels with normal free thyroxine (FT4) concentrations. Thyroid dysfunction is more common in diabetics than in the general population, according to a number of studies. Common risk factors like obesity, insulin resistance, chronic inflammation, and autoimmune processes could account for the connection.

One of the main causes of the onset and development of diabetes complications is poor glycemic control. Chronic hyperglycemia causes inflammatory pathways, endothelial dysfunction, and oxidative stress, which can lead to microvascular and macrovascular problems. By negatively impacting lipid metabolism, vascular function, and inflammatory responses, thyroid impairment may hasten these processes even further.

One of the most dangerous side effects of diabetes is diabetic nephropathy, which is a major contributor to chronic kidney disease. Changes in renal blood flow, glomerular filtration rate, and vascular resistance have all been linked to thyroid disorders, especially hypothyroidism. Similarly, aberrant thyroid hormone levels may have an impact on cardiovascular problems and diabetic neuropathy.

In order to evaluate the relationship between thyroid dysfunction, glycemic control, and diabetes complications in individuals with Type 2 Diabetes Mellitus, this study was carried out.

Aim: To evaluate the association of thyroid dysfunction with glycemic control and diabetic complications in patients with Type 2 Diabetes Mellitus.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Objectives:

1. To determine the prevalence and pattern of thyroid dysfunction among patients with Type 2 Diabetes Mellitus.
2. To compare glycemic parameters (fasting blood glucose and HbA1c) between diabetic patients with and without thyroid dysfunction.
3. To assess the association between thyroid dysfunction and diabetic complications including neuropathy, nephropathy, retinopathy, and cardiovascular complications.
4. To evaluate the correlation between thyroid hormone levels (TSH, FT3, and FT4) and glycemic control parameters.

Method

This was a prospective observational study conducted in the Department of Medicine to evaluate the association between thyroid dysfunction, glycemic control, and diabetic complications among patients with Type 2 Diabetes Mellitus for six months. A total of 108 patients diagnosed with Type 2 Diabetes Mellitus attending the Medicine outpatient department and admitted to the medical wards were enrolled in the study.

Sample Size: The study included 108 patients with Type 2 Diabetes Mellitus who fulfilled the predefined inclusion and exclusion criteria.

Inclusion Criteria:

Patients fulfilling the following criteria were included:

1. Patients diagnosed with Type 2 Diabetes Mellitus according to American Diabetes Association (ADA) criteria.
2. Age group ≥30 years.
3. Patients willing to participate and provide written informed consent.
4. Patients with available glycemic parameters and thyroid function test reports.

Exclusion Criteria:

Patients were excluded if they had:

1. Type 1 Diabetes Mellitus.
2. Gestational diabetes mellitus.
3. Known thyroid disease already on thyroid replacement therapy or antithyroid medications.
4. Acute severe illness, infection, or critical illness at the time of evaluation.
5. Chronic liver disease, malignancy, or systemic inflammatory disorders.
6. Patients unwilling to provide informed consent.

Methodology

All eligible patients were evaluated through detailed history taking, clinical examination, and laboratory investigations.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Clinical Assessment

Baseline demographic and clinical details were recorded, including:

- Age
- Sex
- Duration of diabetes mellitus
- Family history of diabetes
- History of hypertension
- Body mass index (BMI)
- Current antidiabetic treatment

A detailed examination was performed to identify diabetic complications. Fasting blood glucose levels were measured after overnight fasting of at least 8 hours. HbA1c was measured as an indicator of long-term glycemic control.

Patients were categorized according to HbA1c values:

- Good glycemic control: HbA1c <7%
- Poor glycemic control: HbA1c ≥7%

Assessment of Thyroid Function

Thyroid function was assessed by measuring:

- Thyroid-stimulating hormone (TSH)
- Free triiodothyronine (FT3)
- Free thyroxine (FT4)

Cardiovascular Complications

Assessment included:

- History of ischemic heart disease
- Blood pressure measurement
- Electrocardiographic evaluation

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Statistical Analysis

Data collected were entered into a database and analyzed using appropriate statistical software.

- Continuous variables were expressed as mean ± standard deviation.
- Categorical variables were expressed as frequencies and percentages.
- Independent sample **t-test** was used for comparison of continuous variables between two groups.
- Chi-square test was used to analyze associations between categorical variables.
- Pearson correlation analysis was performed to determine relationships between thyroid parameters and glycemic indices.
- A p-value of **<0.05** was considered statistically significant.

Results

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n=108)

Parameters	Number of Patients (%) / Mean ± SD
Age (years)	56.8 ± 9.7
Male	63 (58.3%)
Female	45 (41.7%)
Duration of Diabetes (years)	8.2 ± 4.6
BMI (kg/m²)	27.4 ± 3.8
Hypertension present	52 (48.1%)
Poor glycemic control (HbA1c ≥7%)	72 (66.7%)
Mean HbA1c (%)	8.1 ± 1.6

A total of 108 patients with Type 2 Diabetes Mellitus were included in the study. Patients were evaluated for thyroid abnormalities, glycemic status, and diabetic complications. The mean age of study participants was 56.8 years. Majority of patients were males (58.3%). Poor glycemic control was observed in two-thirds of patients, with mean HbA1c of 8.1%.

Table 2: Distribution of Thyroid Dysfunction among Patients with Type 2 Diabetes Mellitus (n=108)

Thyroid Status	Number of Patients (%)
Euthyroid	73 (67.6%)
Subclinical hypothyroidism	25 (23.1%)
Overt hypothyroidism	8 (7.4%)
Hyperthyroidism	2 (1.9%)
Total thyroid dysfunction	**35 (32.4%)**

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Thyroid dysfunction was present in 32.4% of diabetic patients. Subclinical hypothyroidism was the most frequent thyroid abnormality. The glycemic parameters were compared between patients with thyroid dysfunction and those with normal thyroid function. Patients with thyroid dysfunction showed higher fasting blood glucose and HbA1c levels compared with euthyroid diabetic patients.

Table 3: Comparison of Glycemic Parameters **b**etween Patients With and Without Thyroid Dysfunction (n=108)

Glycemic Parameters	Thyroid Dysfunction Present (n=35) Mean ± SD	Euthyroid Group (n=73) Mean ± SD	p-value
Fasting Blood Glucose (mg/dL)	178.6 ± 42.5	151.4 ± 36.8	0.001*
Postprandial Blood Glucose (mg/dL)	276.3 ± 61.7	231.8 ± 54.2	0.0004*
HbA1c (%)	8.9 ± 1.5	7.7 ± 1.4	<0.001*
Duration of Diabetes (years)	10.1 ± 4.8	7.3 ± 4.3	0.004*
BMI (kg/m²)	28.5 ± 3.9	26.9 ± 3.6	0.041*

*Statistically significant

Patients with thyroid dysfunction had significantly higher fasting blood glucose, postprandial glucose, HbA1c levels, longer duration of diabetes, and higher BMI compared with euthyroid patients. The difference in HbA1c levels was statistically significant ($p<0.001$), suggesting an association between thyroid dysfunction and poor glycemic control. The occurrence of diabetic complications was compared between patients with thyroid dysfunction and those without thyroid abnormalities.

Table 4: Association between Thyroid Dysfunction and Diabetic Complications in Type 2 Diabetes Mellitus Patients (n=108)

Diabetic Complication	Thyroid Dysfunction Present (n=35)	Euthyroid Group (n=73)	Total Cases (%)	p-value
Peripheral neuropathy	16 (45.7%)	17 (23.3%)	33 (30.6%)	0.018*
Diabetic nephropathy	13 (37.1%)	12 (16.4%)	25 (23.1%)	0.022*
Diabetic retinopathy	9 (25.7%)	10 (13.7%)	19 (17.6%)	0.127
Cardiovascular complications	11 (31.4%)	12 (16.4%)	23 (21.3%)	0.081

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Diabetic Complication	Thyroid Dysfunction Present (n=35)	Euthyroid Group (n=73)	Total Cases (%)	p-value
Any diabetic complication	26 (74.3%)	32 (43.8%)	58 (53.7%)	0.003*

*Statistically significant

Patients with thyroid dysfunction had a significantly higher prevalence of diabetic complications compared with euthyroid patients. Peripheral neuropathy and diabetic nephropathy showed statistically significant associations with thyroid dysfunction (p=0.018 and p=0.022 respectively). Overall, the presence of any diabetic complication was significantly higher among patients with thyroid dysfunction (p=0.003).

Discussion

Among 108 patients with Type 2 Diabetes Mellitus, the current prospective observational study assessed the relationship between thyroid dysfunction, glycemic control, and diabetic complications. The study showed that patients with diabetes frequently had thyroid abnormalities, which were strongly linked to poor glycemic control and a higher incidence of diabetic complications.

Thyroid dysfunction was found in 32.4% of Type 2 Diabetes Mellitus participants in the current study. Subclinical hypothyroidism (23.1%) was the most prevalent thyroid abnormality, followed by overt hypothyroidism (7.4%) and hyperthyroidism (1.9%). Previous investigations have revealed similar findings, with thyroid dysfunction prevalence among diabetes patients ranging from 20 to 35%. Diabetes-related metabolic problems, obesity, chronic inflammation, and common immunological pathways may all contribute to the greater occurrence of hypothyroidism in diabetics.

By controlling hepatic glucose synthesis, intestinal glucose absorption, insulin secretion, and peripheral glucose utilization, thyroid hormones have a significant impact on glucose metabolism. Reduced thyroid hormone activity in hypothyroid conditions may cause skeletal muscles and adipose tissue to absorb less glucose, increasing insulin resistance. On the other hand, too much thyroid hormone might exacerbate hyperglycemia by increasing hepatic gluconeogenesis. Thyroid dysfunction can therefore have a direct impact on diabetic patients' ability to control their metabolism.

In the current investigation, the mean HbA1c levels of patients with thyroid dysfunction were substantially higher than those of euthyroid patients (8.9 ± 1.5% vs. 7.7 ± 1.4%; $p<0.001$). Previous researchers have observed similar results, showing that glycemic control is often worse in diabetes patients with thyroid dysfunction. Higher HbA1c readings and enhanced insulin resistance have been linked to elevated TSH levels.

Additionally, the study found that patients with thyroid dysfunction had considerably higher fasting and postprandial glucose levels. Thyroid hormone imbalance-related changes in carbohydrate metabolism and decreased insulin sensitivity could account for the rise in

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

glucose levels. These results emphasize how crucial thyroid assessment is for individuals with uncontrolled diabetes.

Thyroid dysfunction and consequences from diabetes were found to be significantly correlated in this study. Compared to 23.3% of patients who were euthyroid, 45.7% of patients with thyroid dysfunction had peripheral neuropathy (p=0.018). Through mechanisms including altered myelin development, microvascular alterations, and decreased nerve conduction, thyroid hormone deprivation may lead to nerve dysfunction. Peripheral nerve injury can be independently increased by hypothyroidism and diabetes.

Diabetic nephropathy was also significantly higher among patients with thyroid dysfunction (**37.1% vs 16.4%, p=0.022**). Previous studies have suggested that hypothyroidism may accelerate renal dysfunction by reducing renal blood flow, decreasing glomerular filtration rate, and promoting endothelial dysfunction. Additionally, thyroid dysfunction is associated with increased vascular resistance and inflammatory activation, which may worsen diabetic kidney injury.

Conclusion

Thyroid dysfunction is a frequent endocrine abnormality among patients with Type 2 Diabetes Mellitus and is significantly associated with poor glycemic control and increased prevalence of diabetic complications. In the present study, subclinical hypothyroidism was the most common thyroid disorder. Patients with thyroid dysfunction had significantly higher HbA1c levels, fasting glucose levels, and a greater frequency of complications, particularly peripheral neuropathy and diabetic nephropathy.

Assessment of thyroid function should be considered as an integral part of the evaluation of patients with Type 2 Diabetes Mellitus, especially in those with inadequate glycemic control. Early detection and appropriate management of thyroid abnormalities may contribute to improved metabolic outcomes and reduction in diabetes-associated morbidity.

References

1. American Diabetes Association Professional Practice Committee. Classification and diagnosis of diabetes: Standards of Medical Care in Diabetes. Diabetes Care. 2024;47(Suppl 1):S20-S42.
2. Biondi B, Kahaly GJ, Robertson RP. Thyroid dysfunction and diabetes mellitus: Two closely associated disorders. Endocr Rev. 2019;40(3):789-824.
3. Wang C. The relationship between type 2 diabetes mellitus and related thyroid diseases. J Diabetes Res. 2013;2013:390534.
4. Díez JJ, Iglesias P. An analysis of the relative risk for hypothyroidism in patients with type 2 diabetes mellitus. Diabet Med. 2012;29(12):1510-1514.
5. Smithson M, Peacock I, Sönksen P. Thyroid dysfunction in diabetes mellitus. Br J Diabetes Vasc Dis. 2015;15(1):8-12.
6. Hage M, Zantout MS, Azar ST. Thyroid disorders and diabetes mellitus. J Thyroid Res. 2011;2011:439463.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

7. Chen HS, Wu TE, Jap TS, et al. Subclinical hypothyroidism is a risk factor for nephropathy and cardiovascular diseases in type 2 diabetic patients. Diabet Med. 2007;24(12):1336-1344.
8. Díez JJ, Sánchez P, Iglesias P. Prevalence of thyroid dysfunction in patients with type 2 diabetes mellitus. Endocrinol Nutr. 2011;58(10):507-513.
9. Papazafiropoulou AK, Sotiropoulos A, Kokolaki A, et al. Prevalence of thyroid dysfunction among Greek type 2 diabetic patients. J Diabetes Complications. 2010;24(5):316-321.
10. Vyakaranam S, Vanaparthy S, Nori S, et al. Study of thyroid dysfunction in type 2 diabetes mellitus. J Clin Diagn Res. 2014;8(12):OC01-OC04.
11. Palma CC, Pavesi M, Nogueira VG, et al. Prevalence of thyroid dysfunction in patients with diabetes mellitus. Diabetes Metab Syndr. 2013;7(3):123-127.
12. Chubb SA, Davis WA, Davis TM. Interactions among thyroid function, insulin sensitivity, and glucose tolerance in type 2 diabetes. Diabetes Care. 2005;28(12):2926-2931.
13. Udiong CEJ, Udoh AE, Etukudoh ME. Evaluation of thyroid function in diabetes mellitus patients. Indian J Clin Biochem. 2007;22(2):14-18.
14. Biondi B. Mechanisms in endocrinology: Heart failure and thyroid dysfunction. Eur J Endocrinol. 2012;167(5):609-618.