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Interplay of Thyroid Dynamics in Type 2 Diabetes: A Comprehensive Analytical Study at Government Medical College, Kota, and Affiliated Hospitals

Akansha Vyas[1,] *, Gulab Kanwar[2], Mukesh Vijayvergia[3], Madhu Shekhar Bissa[4], Varsha Nagar[1]

Abstract

Diabetes mellitus is a prevalent endocrine metabolic condition that causes significant morbidity and mortality globally. Innumerable metabolic processes within our bodies depend on thyroid hormones. Excess or deficiency in insulin or thyroid hormones might cause functional problems. The intricate relationship between thyroid disorders and diabetes has been recognized for a considerable period. Patients with diabetes have been known to experience thyroid malfunction, the most prevalent kind of which is hypothyroidism. Thyroid issues are more common in diabetics than in the general population. Diabetes mellitus and its consequences are more difficult to treat when thyroid function is altered. The present study was conducted from November 2022 to August 2023 at the Department of Biochemistry, NMCH and MBS Central Laboratory, Government Medical College, Kota, Rajasthan, India. The research participants comprised of 50 individuals with Type 2 Diabetes and 50 healthy controls without diabetes, aged between 40 and 70 years. Thyroid function assessment for all subjects involved testing the thyroid profile, which includes triiodothyronine, thyroxine, and thyroid-stimulating hormone. The observations and interpretations were documented, and the findings were statistically evaluated. It was shown that just 72% of diabetes patients had normal thyroid function. Hypothyroidism was more common than hyperthyroidism among individuals with thyroid disorders (26% versus 2%, respectively). Following additional evaluation for primary and subclinical thyroid disorders, it was shown that among individuals with diabetes, subclinical hypothyroidism (20%) was more prevalent than primary hypothyroidism (6%). Abnormal thyroid hormone levels in type 2 diabetics stem from changes in the hypothalamic–pituitary–thyroid axis, leading to significant metabolic disruptions. Regular testing for thyroid dysfunction in diabetics is crucial, as early identification and treatment can reduce morbidity rates and improve their overall quality of life.

***Author for Correspondence**
Akansha Vyas
E-mail: aksmeluck@yahoo.com

[1]PG Resident, Department of Biochemistry, Government Medical College (Kota), Kota, Rajasthan, India
[2]Principal and Controller, Department of Biochemistry, Government, Medical College, Bundi, Rajasthan, India
[3]Deputy Director, Department of Biochemistry, Salumber Government Hospital Udaipur, Rajasthan, India
[4]Senior Resident, Department of Biochemistry, Government Medical College, Sirohi, Rajasthan, India

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INTRODUCTION

Diabetes mellitus (DM) is a widespread endocrine condition that affects various organ systems and causes considerable morbidity and death owing to associated complications [1–5]. It is a group of common metabolic disorders characterized primarily by hyperglycemia, which is the result of either insufficient insulin production, insufficient insulin action, or both [6]. These illnesses are varied in nature and have a range of

etiologies, including genetic, environmental, and societal variables that can interact or operate independently of one another [7].

Type 2 DM is on the rise in India owing to lifestyle changes and societal influences. According to estimates from the World Health Organization, 170 million people (2.8%) worldwide were suffering from DM in 2002; by 2030, this figure is predicted to increase to 366 million people (4.4%) or higher [8–10].

Thyroid hormones are essential for a variety of metabolic processes in our body. Thyroid hormones (T3 and T4) are produced by the thyroid gland. The most significant change in the thyroid hormone system is a decrease in Thyroid stimulating hormone (TSH) stimulation to the thyroid gland, which might be caused by central hypothyroidism, as well as a drop in T3 and T4 production locally. These hormones serve a crucial function in cell differentiation throughout development and contribute to thermogenesis and metabolic equilibrium in adults [11,12].

Excess or deficiency of insulin or thyroid hormones might cause functional problems in other cases. It has long been known that there is a complicated interaction between thyroid disorders and diabetes. Patients with diabetes have been known to experience thyroid malfunction, the most prevalent kind of which is hypothyroidism. Thyroid issues are more common in diabetics than in the general population. DM and its consequences are more difficult to treat when thyroid function is altered.

MATERIALS AND METHODS

The present study was carried out in the Department of Biochemistry, Government Medical College and Central Laboratory, New Medical College & Hospital and MBS Hospital, Kota, Rajasthan, India.

Study Design

The study design was case-control study.

Period of Study

The period of study was from November 2022 to August 2023.

Materials

Questionnaire, fasting blood sugar (FBS), thyroid profile—triiodothyronine (T3), thyroxine (T4), and thyroid-stimulating hormone (TSH).

Study Group

The study comprised of 50 individuals with diagnosed Type 2 DM who did not have thyroid issues and were admitted to hospitals or outpatient departments and 50 nondiabetics were also included as controls, all between the age group of 40–70 years.

Inclusion Criteria

Participants in the research included diagnosed Type 2 diabetics along with 50 nondiabetics as controls who provided informed consent.

Exclusion Criteria

- Patients with Type 1 DM;
- Patients not willing to participate in the study;
- Patients with known thyroid disease;
- Individuals with diabetic nephropathy and chronic renal failure;
- Patients with acute illness (sepsis, acute myocardial infarction, severe heart failure, recent admission in intensive care unit);
- Patients with hepatic dysfunction;

- Patients with psychiatric illness;
- Pregnancy;
- Patients on treatment with drugs interfering with thyroid function (amiodarone, propranolol, corticosteroids, and oral contraceptives).

Methodology

All the patients were evaluated for fasting blood glucose and thyroid dysfunction by testing thyroid profile (total T3, T4, and TSH) estimated by various methods on fully automatic analyzer.

Statistical Analysis

Data were summarized in the form of mean±SD and differences in means of both the groups were analyzed using unpaired t-test. p-value<0.05 was taken as significant.

OBSERVATIONS

Table 1 summarizes thyroid parameters in the study (50 individuals with Type 2 DM) and control groups (50 without diabetes). For TSH, 72% of the study group and 86% of the control group had normal levels. T3 and T4 levels varied, with 94% and 92%, respectively having normal levels in the study group and 98% in the control group. Table 1 provides a concise overview of thyroid function in both the groups.

Table 2 outlines the distribution of thyroid dysfunction in the study (50 individuals with Type 2 DM) and control groups (50 without diabetes). In the study group, 72% had normal thyroid function, 6% had hypothyroidism, 2% had hyperthyroidism, and 20% had subclinical hypothyroidism. Overall, 28% of the study group exhibited thyroid dysfunction. In the control group, 86% had normal thyroid function, with 2% showing hypothyroidism and 12% having subclinical hypothyroidism. The prevalence of thyroid dysfunction was 14% in the control group. Table 2 succinctly outlines the distribution of thyroid dysfunction in both sets of participants.

Table 1. Distribution of various thyroid parameters in the study group and control group.

Thyroid biochemical parameters		**Study group (n=50)**		**Control group (n=50)**	
		n	***%***	***N***	***%***
TSH (μU/L)	Low (<0.27)	1	2	0	0
	Normal (0.27–4.2)	36	72	43	86
	High (>4.2)	13	26	7	14
T3 (ng/ml)	Low (<0.8)	2	4	1	2
	Normal (0.8–2.0)	47	94	49	98
	High (>2.0)	1	2	0	0
T4 (mcg/dl)	Low (<5.1)	3	6	1	2
	Normal (5.1–14.1)	46	92	49	98
	High (14.1)	1	2	0	0

T3: triiodothyronine, T4: thyroxine, TSH: thyroid-stimulating hormone.

Table 2. Distribution of thyroid dysfunction in the study group and control group.

Classification	**Study group (n=50)**		**Control group (n=50)**	
	n	***%***	***n***	***%***
Normal	36	72%	43	86%
Hypothyroidism	3	6%	1	2%
Hyperthyroidism	1	2%	0	0%
Subclinical hypothyroidism	10	20%	6	12%

Thyroid dysfunction	14	28%	7	14%
Total	50	100%	50	100%

Table 3. Descriptive statistics of various thyroid parameters in the T2DM group and control group.

Parameter	Diabetics (n=50)	Nondiabetics (n=50)	P-value
Mean FBS (mg/dl)	209.69±93.79	81.09±7.60	<0.05
TSH (μU/L)	4.64±3.99	3.20±1.34	<0.05
Total T3 (ng/ml)	1.29±0.41	1.26±0.31	>0.05
Total T4 (mcg/dl)	10.89±1.98	10.95±1.27	>0.05

T3: triiodothyronine, T4: thyroxine, TSH: thyroid-stimulating hormone, FBS: fasting blood sugar.

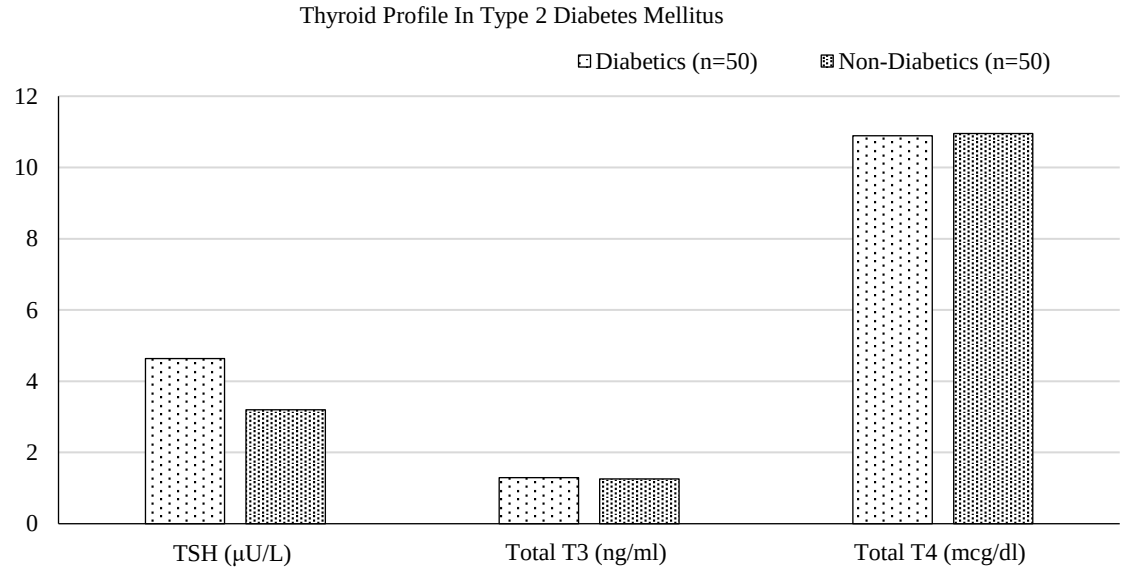

Figure 1. Thyroid profile in Type 2 Diabetes mellitus patients.

Table 3 and Figure 1 provides descriptive statistics for various thyroid parameters in the Type 2 diabetes mellitus (T2DM) group (n=50) as compared to the control group (n=50). The mean FBS level in diabetics was significantly higher (209.69±93.79 mg/dl) as compared to (81.09±7.60 mg/dl) in non-diabetics ($p<0.05$). Additionally, the TSH levels were elevated in diabetics (4.64±3.99 μU/L) as compared to nondiabetics (3.20±1.34 μU/L) with statistical significance ($p<0.05$). However, there were no significant differences in total T3 and total T4 levels between the two groups ($p>0.05$). The table succinctly highlighted the key statistical findings regarding thyroid and glucose metabolism in T2DM and control groups.

RESULTS

It was a case-control, hospital-based study of 50 T2DM patients who attended the OPD/IPD, with an equal number of age and gender-matched controls. The mean age of diabetes and control patients was 50.70±9.85 years. Both the groups were evenly distributed in terms of age and gender.

The study group with diabetes had a higher number of participants with deranged TSH, T3 and T4 groups than the controls. Diabetes subjects in the research had similar mean T3 and T4 levels to controls, and the difference was not statistically significant ($p>0.05$). Diabetes subjects had a higher mean TSH levels than controls which was statistically significant ($p<0.05$).

DISCUSSION

Despite therapeutic breakthroughs, a significant proportion of people with DM still have complications because of inadequate glycemic control, making it the most prevalent health issue among the world's populations. Thyroid dysfunction is a significant component that leads to impaired glycemic regulation and is often associated with DM. The purpose of the present study was to determine the prevalence of thyroid dysfunction among our region's type 2 diabetics.

The study findings indicated that among 50 DM participants, 28% had thyroid illness, whereas only 14% in the control group had the same condition. Among them, 20% exhibited subclinical hypothyroidism. It is comparable to several studies, including Vij et al., Celani et al., Singh et al., and Udiong et al [13–16].

In the study population next to subclinical hypothyroidism (SCH), hypothyroidism (6%) was more frequent in the study population than hyperthyroidism (2%). Therefore, cumulative hypothyroidism (26%) is more prevalent than hyperthyroidism (2%). Numerous studies, such as one by Moghetti et al., which revealed 89% hypothyroidism and 11% hyperthyroidism, also confirmed this finding.

The altered production and release of thyrotropin releasing hormone (TRH) is the cause of both high and low thyroid hormone levels in diabetics. This is also a result of the different drugs used in the treatment of diabetes. Numerous investigations concluded that goiter and hypothyroidism are more common when sulfonylureas are used to treat DM.

SCH is described as having an elevated blood TSH level but normal free thyroxine levels. SCH may disrupt sensitive processes such as left ventricular diastolic failure, ovulation, increased expression of low-density lipoprotein (LDL) receptors and reduced high-density lipoprotein (HDL) receptors. This is a risk predictor for cardiovascular diseases, specifically atherosclerosis and coronary heart disease. Additionally, SCH alone raises the risk of insulin resistance, primarily in adipose and muscular tissue.

CONCLUSION

In line with numerous prior studies, the present research has demonstrated a higher prevalence of hypothyroidism, particularly SCH, in T2DM patients. As a result, it may be prudent to assess thyroid function in all T2DM patients to improve treatment outcomes and lower the risk of complications. Early detection and treatment of SCH in diabetic individuals is crucial to avoid complications.

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