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Original Research

Comparative Analysis of Thyroid Hormone Levels in Diabetic vs. Non-Diabetic Patients: A Cross-Sectional Study

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ABSTRACT

Background: Thyroid dysfunction is a common endocrine disorder, often coexisting with diabetes mellitus due to shared pathophysiological mechanisms. Understanding the relationship between thyroid hormone levels and diabetes is crucial for improving clinical outcomes in affected patients. This study aims to compare thyroid hormone levels in diabetic and non-diabetic individuals to identify potential variations.

Materials and Methods: A cross-sectional study was conducted involving 200 participants, including 100 diabetic patients and 100 age- and sex-matched non-diabetic controls. Blood samples were analyzed for fasting blood glucose, glycosylated hemoglobin (HbA1c), and thyroid hormones, including triiodothyronine (T3), thyroxine (T4), and thyroid-stimulating hormone (TSH), using standard chemiluminescent immunoassay techniques. Statistical analysis was performed using SPSS, with the independent t-test applied to compare group differences, and a p-value < 0.05 was considered significant.

Results: The mean TSH level in diabetic patients was significantly higher (4.2 ± 1.5 µIU/mL) compared to non-diabetic controls (2.8 ± 1.2 µIU/mL; $p < 0.001$). Similarly, a lower mean T3 level was observed in diabetics (0.9 ± 0.3 ng/mL) compared to non-diabetics (1.2 ± 0.4 ng/mL; $p = 0.002$). However, no significant difference was noted in T4 levels between the groups ($p = 0.09$). Subclinical hypothyroidism was more prevalent in diabetic patients (30%) compared to non-diabetic controls (10%).

Conclusion: The study highlights a higher prevalence of thyroid dysfunction, particularly subclinical hypothyroidism, in diabetic patients compared to non-diabetic controls. These findings underscore the importance of routine thyroid screening in individuals with diabetes to ensure timely detection and management of thyroid abnormalities, potentially improving overall metabolic control.

Keywords: Thyroid hormone levels, diabetes mellitus, subclinical hypothyroidism, TSH, T3, T4, cross-sectional study.

INTRODUCTION

Diabetes mellitus (DM) and thyroid dysfunction are two of the most prevalent endocrine disorders globally, often observed to coexist due to their intricate interrelationship (1). Thyroid hormones play a critical role in glucose metabolism, and any alteration in their levels can significantly affect the glycemic status of an individual (2). Conversely, the chronic hyperglycemic state in diabetes is known to influence thyroid function through multiple mechanisms, including insulin resistance, oxidative stress, and inflammation (3).

Studies have suggested that thyroid dysfunction, particularly hypothyroidism, is more common in diabetic patients than in the general population (4). Subclinical hypothyroidism, characterized by elevated thyroid-stimulating hormone (TSH) levels with normal thyroxine (T4) and triiodothyronine (T3) levels, is a frequent finding in individuals with diabetes (5). The coexistence of these conditions can lead to increased cardiovascular risk and worsened glycemic control, making early detection and management essential (6).

Despite the well-recognized association, variations in thyroid hormone levels between diabetic and non-diabetic populations remain a topic of debate. Some studies report higher prevalence rates of thyroid dysfunction among diabetics, while others

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fail to identify significant differences (7,8). This inconsistency underscores the need for further research to better understand the interplay between these two disorders.

The present study aims to compare thyroid hormone levels in diabetic and non-diabetic patients, providing insights into the prevalence and patterns of thyroid dysfunction in these groups. Identifying such differences could improve diagnostic and therapeutic strategies, ultimately enhancing patient outcomes.

MATERIALS AND METHODS

Study Design and Setting: This cross-sectional study was conducted over six months in a tertiary care hospital. Participants were recruited from the outpatient departments of endocrinology and general medicine after obtaining written informed consent.

Study Population: The study included 200 participants, divided into two groups: 100 diabetic patients (Group A) and 100 age- and sex-matched non-diabetic controls (Group B). Inclusion criteria for Group A were individuals diagnosed with type 2 diabetes mellitus based on the American Diabetes Association criteria. Group B consisted of healthy individuals without a history of diabetes or thyroid disorders. Exclusion criteria for both groups included individuals with known thyroid disorders, recent use of medications affecting thyroid function, or significant systemic illnesses.

Data Collection and Laboratory Analysis: Demographic details, clinical history, and anthropometric measurements were collected for all participants. Fasting blood samples were obtained under aseptic conditions and analyzed for the following parameters:

1. **Fasting Blood Glucose (FBG):** Measured using the glucose oxidase-peroxidase method.
2. **Glycosylated Hemoglobin (HbA1c):** Assessed using high-performance liquid chromatography (HPLC).
3. **Thyroid Function Tests (TFT):** Serum levels of triiodothyronine (T3), thyroxine (T4), and thyroid-stimulating hormone (TSH) were analyzed using a chemiluminescent immunoassay.

Statistical Analysis: The data were analyzed using SPSS version 25.0. Continuous variables were presented as mean ± standard deviation (SD) and compared using the independent t-test. Categorical variables were expressed as frequencies and percentages and analyzed using the chi-square test. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 200 participants were included in the study, with 100 diabetic patients (Group A) and 100 non-diabetic controls (Group B). The mean age of the participants was 50.6 ± 9.8 years, with no significant difference between the groups ($p = 0.28$). Males constituted 54% of the total population.

Thyroid Hormone Levels: Table 1 summarizes the thyroid hormone levels of the study groups. The mean TSH level was significantly higher in diabetic patients (4.2 ± 1.5 µIU/mL) compared to non-diabetic controls (2.8 ± 1.2 µIU/mL, $p < 0.001$). Similarly, mean T3 levels were significantly lower in diabetics (0.9 ± 0.3 ng/mL) compared to non-diabetics (1.2 ± 0.4 ng/mL, $p = 0.002$). However, no statistically significant difference was observed in mean T4 levels between the groups ($p = 0.09$).

Prevalence of Thyroid Dysfunction: The prevalence of thyroid dysfunction was significantly higher among diabetic patients, as shown in Table 2. Subclinical hypothyroidism was observed in 30% of diabetics compared to 10% of non-diabetic participants ($p < 0.001$). Other thyroid dysfunctions, such as overt hypothyroidism and hyperthyroidism, were relatively rare and not significantly different between the groups.

Correlation with Glycemic Control: Among diabetic patients, poor glycemic control (HbA1c > 8%) was associated with higher TSH levels (4.5 ± 1.6 µIU/mL) compared to those with better glycemic control (3.8 ± 1.4 µIU/mL, $p = 0.01$), indicating a potential link between thyroid dysfunction and glycemic status.

Table 1: Thyroid Hormone Levels in Diabetic and Non-Diabetic Groups

Parameter	Diabetic Group (Mean ± SD)	Non-Diabetic Group (Mean ± SD)	p-Value
TSH (µIU/mL)	4.2 ± 1.5	2.8 ± 1.2	<0.001
T3 (ng/mL)	0.9 ± 0.3	1.2 ± 0.4	0.002
T4 (µg/dL)	8.1 ± 1.4	8.4 ± 1.6	0.09

Table 2: Prevalence of Thyroid Dysfunction

Thyroid Dysfunction Type	Diabetic Group (%)	Non-Diabetic Group (%)	p-Value
Subclinical Hypothyroidism	30%	10%	<0.001
Overt Hypothyroidism	5%	3%	0.47
Hyperthyroidism	2%	1%	0.65

The findings, as depicted in Tables 1 and 2, demonstrate a significantly higher prevalence of thyroid dysfunction, particularly subclinical hypothyroidism, in diabetic patients. The observed correlation between elevated TSH levels and poor glycemic control further underscores the need for

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regular thyroid function monitoring in diabetic populations.

DISCUSSION

This study highlights significant variations in thyroid hormone levels between diabetic and non-diabetic individuals, emphasizing the higher prevalence of thyroid dysfunction, particularly subclinical hypothyroidism, in diabetic patients. The findings align with earlier research indicating a strong association between thyroid dysfunction and diabetes mellitus (1,2).

The elevated TSH levels observed in diabetic patients in our study corroborate findings from previous studies that suggest subclinical hypothyroidism is the most common thyroid dysfunction in diabetes (3,4). This could be attributed to insulin resistance and chronic hyperglycemia, which impact thyroid gland function and thyroid hormone metabolism (5). Moreover, the increased prevalence of thyroid dysfunction among diabetic individuals could result from the autoimmune nature of type 1 diabetes or the metabolic disturbances seen in type 2 diabetes (6).

Thyroid dysfunction in diabetic patients can exacerbate metabolic imbalances, worsening glycemic control and increasing the risk of complications (7). Subclinical hypothyroidism, if left undiagnosed, can lead to dyslipidemia, weight gain, and increased cardiovascular risk (8). In this study, poor glycemic control (HbA1c > 8%) was associated with higher TSH levels, suggesting that poorly controlled diabetes may further aggravate thyroid dysfunction, as noted in previous reports (9,10).

Our study did not find significant differences in T4 levels between the groups, a finding consistent with earlier studies (11). This may indicate that subclinical hypothyroidism, characterized by elevated TSH with normal T4 levels, is more prevalent in diabetes compared to overt thyroid dysfunction (12). However, the lower T3 levels observed in diabetic patients may reflect alterations in peripheral conversion of T4 to T3, potentially due to chronic illness or oxidative stress associated with diabetes (13).

The prevalence of thyroid dysfunction in non-diabetic controls was notably lower, which is consistent with studies reporting that thyroid disorders are more common in diabetics than in the general population (14-15). This underscores the importance of routine thyroid function screening in diabetic patients for early diagnosis and management.

Although our study provides valuable insights, it is not without limitations. The cross-sectional design precludes establishing causality, and the sample size, while sufficient for detecting significant differences, may not represent the broader population. Future longitudinal studies with larger sample sizes are needed to confirm these findings and explore the underlying mechanisms.

CONCLUSION

In conclusion, this study highlights a higher prevalence of thyroid dysfunction, particularly subclinical hypothyroidism, in diabetic patients compared to non-diabetic individuals. The observed correlation between poor glycemic control and elevated TSH levels underscores the importance of routine thyroid screening in diabetic patients to improve clinical outcomes.

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