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Original Research Article

Study of Thyroid Profile in Relation to Glycemic Control in Type 2 Diabetes Mellitus.

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Abstract:

Background: Type 2 Diabetes Mellitus (T2DM) is a complex metabolic disorder often related with alterations in thyroid function. Understanding the interplay between thyroid profile parameters and glycemic control is crucial for optimizing patient management strategies. The study seeks to examine the relationship between thyroid profile parameters and glycemic control in people with T2DM, shedding light on potential implications for patient care.

Methods: A cross-sectional analysis was conducted involving fifty participants, comprising 25 T2DM patients (Cases group) and 25 healthy individuals (Control group), were enrolled. Inclusion criteria for Cases included age 45 to 60 years, T2DM diagnosis, and absence of thyroid disease. Controls were age and sex-matched without diabetes or systemic disorders. Thyroid profile parameters (T3, T4, TSH), glycemic control indicators (FBG, HbA1c), and treatment modalities were assessed. Statistical analysis included Student t-test and correlation analysis.

Results: T2DM patients exhibited lower serum T3 levels compared to controls ($p = 0.028$), while T4 and TSH levels did not differ significantly. T2DM patients had significantly higher FBG ($p < 0.001$) and HbA1c levels ($p < 0.001$) than controls. Negative relations were found between T3 levels and FBG ($r = -0.512$, $p < 0.01$) and HbA1c ($r = -0.457$, $p < 0.05$) in T2DM patients. Treatment modalities and diabetes duration did not significantly affect thyroid function.

Conclusion: Lower T3 levels are associated with poorer glycemic control in T2DM patients, emphasizing the potential role of thyroid hormones in diabetes management. Additional investigation is needed to clarify the fundamental processes involved and create specific interventions.

Recommendations: Healthcare providers should consider assessing thyroid function in T2DM individuals, particularly those with suboptimal glycemic control. Multifaceted interventions addressing both thyroid function and glycemic control may improve clinical outcomes in T2DM.

Keywords: Type 2 Diabetes Mellitus, Thyroid Profile, Glycemic Control, Thyroid Hormones.

Introduction

The investigation of the thyroid profile's impact on glycemic control in individuals with Type 2 Diabetes Mellitus (T2DM) is a significant area of study due to the intricate interplay between thyroid function and glucose metabolism. Diabetes Mellitus (DM) is a multifaceted metabolic condition marked by high blood sugar levels, mainly stemming from either resistance to insulin or insufficient insulin production. Simultaneously, the thyroid gland is vital for metabolism regulation, releasing hormones like triiodothyronine (T3) and thyroxine (T4) [1]. These hormones are essential for the modulation of metabolic processes including glucose utilization and lipid metabolism.

The interaction between thyroid dysfunction and diabetes is particularly noteworthy as thyroid disorders are more prevalent in diabetic individuals compared to the healthy population. Research indicates that even subclinical changes in thyroid hormone levels can significantly impact glycemic control in individuals with diabetes. For instance, hypothyroidism is commonly observed in diabetic patients and is linked to poorer glycemic outcomes. This relationship is likely due to the effects of reduced thyroid hormone levels on insulin sensitivity and hepatic glucose production [2].

Studies have shown that both low and high thyroid hormone levels correlate with adverse effects on glycemic control. For example, low levels of T3 and T4 are related with poor glycemic control, as indicated by higher glycated hemoglobin (HbA1c) levels [2,3]. Conversely, high thyroid-stimulating

hormone (TSH) levels, even within the subclinical range, have been associated with increased insulin resistance and poor glucose metabolism.

This complex interplay suggests that thyroid function testing should be a routine part of managing diabetes, as early identification and treatment of thyroid abnormalities can significantly improve glycemic control and overall metabolic outcomes in diabetic patients. Moreover, understanding the mechanisms underlying these interactions can aid in the development of more effective treatment strategies for managing both diabetes and thyroid disorders [4]. Thus, the investigation into how the thyroid profile affects glycemic control in T2DM patients not only helps in managing these patients more effectively but also offers insights into the broader implications of endocrine interactions on metabolic diseases.

The aim of the study was to examine the correlation between thyroid profile parameters and glycemic control in individuals diagnosed with Type 2 Diabetes Mellitus, with the goal of elucidating potential connections and implications for patient management and care.

Methodology

Study Design: The study was designed as a cross-sectional analysis.

Study Setting: The study was conducted over the course of one year, from 2022 to 2023, within Bhagwan Mahavir Institute of Medical Sciences, Pawapuri, Bihar, India.

Participants: A total of 50 subjects participated, comprising 25 patients diagnosed with T2DM (Cases group) and 25 healthy individuals (Control group). The Cases group included both well and poorly controlled diabetic individuals.

Inclusion Criteria: Participants in the Cases group were selected through a straightforward random sampling method. The Cases group included individuals of both genders, aged 45 to 60 years, who were diagnosed with T2DM, receiving treatment without any known complications, and without a history of prior thyroid disease. Controls were healthy individuals of matching age and sex, with no diabetes history or systemic disorders.

Exclusion Criteria: Exclusion criteria for both groups included individuals with coronary artery disease, cerebrovascular accident, hypertension, previous thyroid disease, those on medications affecting thyroid function, pregnant individuals, and patients with diabetic complications.

Bias: To mitigate selection bias, participants were randomly sampled from the target population, and strict inclusion and exclusion criteria were applied to ensure homogeneity within groups. Additionally, blinding of researchers conducting laboratory assays minimized potential bias in data interpretation. However, potential information bias may have arisen due to self-reporting of medical history and lifestyle factors by participants.

Variables: The variables in this study included thyroid profile parameters (T3, T4, and TSH levels), glycemic control status (measured by fasting blood glucose and HbA1c levels), period of diabetes, and treatment modality. The dependent variables comprised the presence or absence of T2DM and its relationship with thyroid function.

Data collection and Procedure: Data collection involved collecting fasting blood samples from both cases and controls. Serum levels of T3, T4, and TSH were determined using the CLIA (Chemiluminescence Immunoassay) method, while fasting blood glucose was measured using the Glucose Oxidase-Peroxidase method. HbA1c levels were assessed using the Ion-Exchange Resin method.

The diagnosis of T2DM adhered to the criteria outlined by the American Diabetic Association, which includes fasting blood glucose (FBG) levels ≥ 126 mg/dl (7.0 mmol/L) or the presence of diabetes symptoms along with random blood sugar (RBS) levels ≥ 200 mg/dl (11.1 mmol/L).

Statistical Analysis: The mean plus or minus standard deviation (SD) was used in the statistical analysis. To compare parameters between the Cases and Control groups, a Student t-test was employed. The statistical software SPSS version 15.0 was utilised to conduct the analysis, and a significance level of $p < 0.05$ was established.

Ethical Considerations: The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

The study enrolled 50 participants, evenly divided between the Cases and the Control group. The average age in the Cases group was 52.6 years (± 4.3 SD), while in the Control group, it was 53.1 years (± 3.8 SD). Gender distribution was balanced across both groups.

Table 1: Thyroid Profile Parameters

Variable	Cases (n=25)	Controls (n=25)	p-value
T3 (ng/dL)	2.85 ± 0.42	3.12 ± 0.38	0.028
T4 (µg/dL)	8.47 ± 1.20	8.92 ± 1.15	0.096
TSH (µIU/mL)	2.61 ± 0.75	2.34 ± 0.69	0.178

Table 1 summarizes the serum levels of T3, T4 and TSH in both the groups. Comparison of serum thyroid hormone levels between the Cases and Control groups revealed statistically significant differences in serum T3 levels ($p = 0.028$), with the Cases group exhibiting lower levels compared to the Control group. However, there were no substantial differences in serum T4 ($p = 0.096$) and TSH ($p = 0.178$) levels between the two groups.

Table 2: Glycemic Control Parameters

Variable	Cases (n=25)	Controls (n=25)	p-value
FBG (mg/dL)	156.4 ± 24.8	93.5 ± 12.1	<0.001
HbA1c (%)	8.2 ± 0.9	5.3 ± 0.6	<0.001

Table 2 displays the FBG and HbA1c levels in the Cases group compared to the Control group. The Cases group exhibited notably higher levels of FBG (156.4 ± 24.8 mg/dL) than the Control group (93.5 ± 12.1 mg/dL) ($p < 0.001$). Similarly, HbA1c levels were notably higher in the Cases group (8.2 ± 0.9%) compared to the Control group (5.3 ± 0.6%) ($p < 0.001$).

Correlation assessment within the Cases group showed a substantial negative correlation between serum T3 levels and both fasting blood glucose ($r = -0.512$, $p < 0.01$) and HbA1c levels ($r = -0.457$, $p < 0.05$). This suggests that lower T3 levels are related with poorer glycemic control in people with T2DM. However, no significant correlations were observed between T4 or TSH levels and glycemic control parameters.

Subgroup analysis based on treatment modality within the Cases group (hypoglycemic agent, insulin, or diet control alone) revealed no substantial differences in serum thyroid hormone levels (T3, T4, TSH) among the treatment subgroups ($p > 0.05$).

There was no considerable correlation between the duration of diabetes and serum thyroid hormone levels (T3, T4, TSH) in the Cases group ($p > 0.05$), indicating that the duration of diabetes did not influence thyroid function in these patients.

Discussion

The study examined the link between thyroid profile parameters and glycemic control in T2DM patients compared to healthy individuals. Fifty participants were enrolled, with 25 in each group. The T2DM group had a mean age of 52.6 years, while the control group had an average age of 53.1 years, with a balanced gender distribution.

Regarding thyroid profile parameters, there were notable variations in serum T3 levels between both group ($p = 0.028$). The T2DM group showed lower T3 levels compared to the control group. However, there were no substantial differences in serum T4 and TSH levels between the two groups.

Analysis of glycemic control parameters revealed significant discrepancies between the T2DM and control groups. FBG levels were notably higher in the T2DM group (156.4 ± 24.8 mg/dL) compared to the control group (93.5 ± 12.1 mg/dL) ($p < 0.001$). Similarly, HbA1c levels were notably elevated in the T2DM group (8.2 ± 0.9%) compared to the control group (5.3 ± 0.6%) ($p < 0.001$).

Correlation analysis within the T2DM group showed a negative correlation between serum T3 levels and both FBG ($r = -0.512$, $p < 0.01$) and HbA1c levels ($r = -0.457$, $p < 0.05$). This suggests that lower T3 levels are linked to poorer glycemic control in T2DM patients. However, no significant correlations were found between T4 or TSH levels and glycemic control parameters.

Subgroup analysis based on treatment modality within the T2DM group did not reveal significant differences in serum thyroid hormone levels among the treatment subgroups ($p > 0.05$). Additionally, there was no considerable correlation between the duration of diabetes and serum thyroid hormone levels in the T2DM group ($p > 0.05$), indicating that diabetes duration did not impact thyroid function in these patients.Overall, these findings imply a potential connection between thyroid function, particularly T3 levels, and glycemic control in T2DM patients.

Recent research has further elucidated the significant impact of thyroid dysfunctions on glycemic control among patients with T2DM. For instance, a study discovered that diabetics with thyroid abnormalities, especially hypothyroidism, experienced significant metabolic disturbances. They advocate for routine thyroid function screening to help manage and potentially mitigate complications arising from these disturbances [5]. Similarly, another study reported that uncontrolled diabetic patients had significantly higher TSH levels and lower FT4 levels, highlighting a poor correlation between advanced thyroid dysfunction and suboptimal glycemic control [6].

Furthermore, research focused on the impact of subclinical hypothyroidism on insulin resistance and glycemic control, observing that T2DM patients with subclinical hypothyroidism exhibited poor glycemic and cholesterol control, particularly when TSH levels were elevated [7]. On a broader scale, a study undertook a study in Ghana, which showed a high prevalence of thyroid disorders among diabetics, correlating significantly with poor glycemic control, thus underscoring the necessity for routine thyroid function tests in diabetic care to improve overall metabolic management [8].

Additionally, a study discovered significant relationships between poor glycemic control and elevated TSH and reduced FT4 levels, suggesting a direct impact of thyroid status on the metabolic control of diabetes [9]. Likewise, a study provided insights into the gender-specific impacts of thyroid function on diabetes, noting that males with lower FT3 levels had significantly better glycemic control, suggesting a unique interplay between thyroid hormones and glycemic management in men [10]. These studies collectively highlight the critical need for integrated care approaches that include thyroid health management to optimize outcomes for diabetic patients.

Conclusion

The study provides valuable insights into the association between thyroid function and glycemic control in T2DM patients. The findings indicate that lower serum T3 levels are associated with poorer glycemic control, as evidenced by higher fasting blood glucose and HbA1c levels. However, no significant correlations were observed between T4 or TSH levels and glycemic control parameters. These results underscore the potential importance of thyroid hormones, particularly T3, in the management of T2DM.

Limitations: The study has a few limitations worth noting. First, its cross-sectional design means it cannot establish causality, only associations. Second, the relatively small sample size may limit the generalizability of the findings to a broader population. These factors suggest that caution is warranted when interpreting and applying the study's results.Additionally, self-reported medical history and lifestyle factors may introduce information bias, and the lack of control for potential confounders such as dietary habits and physical activity levels could influence the results.

Recommendation: Healthcare providers should consider assessing thyroid function in T2DM individuals, particularly those with suboptimal glycemic control. Multifaceted interventions addressing both thyroid function and glycemic control may improve clinical outcomes in T2DM.

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List of abbreviations:

T2DM: Type 2 Diabetes Mellitus

T3: Triiodothyronine

T4: Thyroxine

TSH: Thyroid-Stimulating Hormone

FBG: Fasting Blood Glucose

HbA1c: Glycated Hemoglobin

NCEP-ATP III: National Cholesterol Education Programme-Adult Treatment Panel III

CLIA: Chemiluminescence Immunoassay

SD: Standard Deviation

TC: Total Cholesterol

LDL: Low-Density Lipoprotein

HDL: High-Density Lipoprotein

VLDL: Very Low-Density Lipoprotein

RBS: Random Blood Sugar

DM: Diabetes Mellitus

FT4: Free Thyroxine

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Conflict of interest: The authors have no competing interests to declare.

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