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Original Research Article

PREVALENCE AND PATTERNS OF THYROID DYSFUNCTION AND DYSLIPIDEMIA IN TYPE 2 DIABETES MELLITUS: A COMPARATIVE CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is a growing global health problem globally. It is associated with a range of metabolic and endocrine disturbances including thyroid dysfunction and dyslipidemia. Both conditions independently contribute to cardiovascular risk and glycaemic instability. The co-existence of thyroid dysfunction and lipid abnormalities in T2DM patients is being extensively study. This study aims to assess the prevalence and pattern of thyroid dysfunction and dyslipidemia in T2DM patients compared to healthy controls and analyze their association with glycaemic control.

Materials and Methods: A comparative case-control study was conducted in the department of medicine of Adichunchanagiri Institute of Medical Sciences. 40 known cases of T2DM patients (Group A) and 40 healthy individuals (Group B) were included in this study on the basis of a predefined inclusion and exclusion criteria. Participants underwent detailed laboratory assessments including fasting and postprandial blood sugar, HbA1c, lipid profile and thyroid function tests (T3, T4, TSH). For statistical purposes P value less than 0.05 was taken as significant.

Results: Thyroid dysfunction was significantly more common in diabetics (35%) than controls (12.5%) (p=0.0339). Most common thyroid function abnormality was found to be subclinical hypothyroidism. Thyroid dysfunction was observed in 90% of diabetics with poor glycemic control (HbA1c >7%), compared to only 16.7% in those with good control (p<0.0001). Dyslipidemia was more prevalent in T2DM patients (60%) than in controls (30%) (p=0.0129). Additionally, 90% of poorly controlled diabetics had dyslipidemia versus 50% in well-controlled individuals (p=0.0315).

Conclusion: T2DM patients exhibit a significantly higher prevalence of thyroid dysfunction and dyslipidemia compared to healthy individuals. Routine screening for thyroid function and lipid profile in T2DM patients is recommended.

Keywords: Type 2 Diabetes Mellitus, Thyroid Dysfunction, Dyslipidemia, Glycaemic Control, Subclinical Hypothyroidism.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder which is due to insulin resistance and relative insulin deficiency which collectively manifest as hyperglycemia which is a cardinal sign of diabetes mellitus.[1] According to estimates by International Diabetes Federation (IDF) approximately 537 million adults were living with diabetes in 2021.[2] In India also the incidence of diabetes is increasing at a rapid pace with current estimates that suggest that more than 77 million

people are affected by diabetes in India.[3] This significant increase in T2DM cases may be due to a combination of genetic predisposition, lifestyles changes, dietary habits and aging populations. Despite widespread awareness about the consequence of diabetes early detection and appropriate management remain suboptimal causing a considerable burden on healthcare systems.[4]

The chronic nature of T2DM and its persistent hyperglycemic state are associated with a number of long-term complications. These complications are broadly classified into microvascular complications (retinopathy, nephropathy, and neuropathy) and macrovascular complications (coronary artery disease, peripheral arterial disease, and stroke). In addition to micro and macrovascular complications individuals with T2DM are at an increased risk of developing cardiovascular disease as compared to non-diabetics. These complications not only increase morbidity and mortality in T2DM cases but also significantly reduce quality of life and contribute to increasing healthcare expenditures. Although glycaemic control remains important part of diabetes management it is increasingly evident that comprehensive risk factor (Blood pressure, endocrine function and dyslipidemia) is essential for mitigating the long-term consequences of Diabetes Mellitus.[5]

Among the various systemic involvements in T2DM endocrinological derangements are commonly reported. Endocrine abnormalities involving thyroid gland have gained substantial attention in recent years. The relationship between diabetes and thyroid dysfunction is reported to be bidirectional. Thyroid hormones play an important role in glucose metabolism and their dysregulation can affect insulin sensitivity as well as glucose homeostasis. Conversely, chronic hyperglycemia may influence the hypothalamic-pituitary-thyroid (HPT) axis leading to altered thyroid hormone levels.[6] Several studies have reported a higher prevalence of thyroid dysfunction in diabetic individuals compared to the general population. Subclinical hypothyroidism is the most frequently reported thyroid function abnormality in cases of T2DM. It's also known that subtle thyroid dysfunction, even in its subclinical form, may exacerbate cardiovascular risks and worsen glycaemic control.[7]

In addition to endocrine disruptions dyslipidemia is another hallmark of T2DM. Diabetic dyslipidemia is typically characterized by elevated triglycerides, decreased high-density lipoprotein (HDL) cholesterol and the presence of small dense low-density lipoprotein (LDL) particles. The underlying pathophysiology of dyslipidemia in T2DM cases involves insulin resistance adversely affecting inhibitory effect of insulin on hormone-sensitive lipase causing hepatic overproduction of very-low-density lipoprotein (VLDL) which is associated with atherogenesis and increases cardiovascular risk.[8]

Despite the well-documented lipid abnormalities in T2DM, lipid targets are often unmet in routine clinical practice, and the full spectrum of lipid changes remains relatively under-explored.

Current literature extensively deals with the individual burden of thyroid function abnormalities as well as dyslipidemia in individuals with T2DM. However there remains a considerable knowledge gap with respect to analysing their interrelationship and combined impact. This study aims to bridge this gap by evaluating thyroid dysfunction and lipid abnormalities in patients with T2DM.

MATERIALS AND METHODS

This comparative observational study was carried out in the Department of medicine of Adichunchanagiri Institute of Medical Sciences. The primary objective of this study was to assess the prevalence and pattern of thyroid dysfunction and associated lipid profile abnormalities among cases diagnosed with Type 2 Diabetes Mellitus (T2DM) and to compare these abnormalities with age matched healthy individuals. For this purpose 40 known cases of T2DM were enrolled as cases on the basis of a predefined inclusion and exclusion criteria. A control group of 40 healthy individuals matched for age was also enrolled. The sample size was determined using data from a preliminary pilot study that evaluated the prevalence of thyroid dysfunction in T2DM patients. Based on calculations using OpenEpi software (version 3.0), with a power of 90% and a 95% confidence interval a minimum sample size of 35subjects per group was estimated. To accommodate potential drop outs 40 individuals were recruited in each group.

Group A (Cases) : 40 patients with a confirmed diagnosis of T2DM enrolled as cases

Group B (Controls): 40 age matched healthy individuals enrolled as control group.

Demographic information such as age, gender, residence, occupation, height, weight, and BMI, was recorded. For the diabetic group, additional clinical details such as duration of diabetes, current antidiabetic treatment (oral hypoglycaemics or insulin) and associated systemic conditions (e.g., hypertension, COPD) were noted. A detailed history was taken with respect to symptoms indicative of thyroid dysfunction. Medication history was evaluated to exclude individuals on drugs that interfere with thyroid function.All participants underwent a detailed clinical and systemic examination. Evaluation of diabetes-related complications included renal function assessment and fundoscopy.

Both groups underwent laboratory investigations including fasting blood sugar (FBS), postprandial blood sugar (PPBS) as well as glycosylated hemoglobin (HbA1c). lipid profile and renal function tests (blood urea and serum creatinine) were also performed in cases as well as control group. Thyroid function was evaluated by estimating serum levels of triiodothyronine (T3), thyroxine (T4), and thyroid-

stimulating hormone (TSH). Thyroid dysfunction was categorized based on standard reference ranges: T3 (0.9–2.4 ng/dL), T4 (5.5–12.4 µg/dL), and TSH (0.6–5.5 IU/mL). Correlation between HbA1c level and thyroid function test and lipid profile was done to analyse relationship between long term glycemic control and its impact o thyroid function and lipid profile.

Microsoft Excel and word was used for data collection and graphical representation. SSPS version 23.0 software was used for data analysis. Continuous variables such as FBS, T3, T4, TSH and lipid profile were presented as mean and standard deviation (SD). Categorical variables (e.g., thyroid dysfunction, comorbidities) were summarized as frequencies and percentages. The chi-square test was applied for categorical data comparison. A p-value of less than 0.05 was considered statistically significant.

Inclusion Criteria

1. Age above 18 years.
2. Ready to give informed and written consent to be part of study.
3. Diagnosed cases of Type 2 Diabetes Mellitus (T2DM) as per ADA criteria9, for at least 1 year.
4. Age matched healthy individuals enrolled as control group.

Exclusion Criteria

1. Age less than 18 years.
2. Refusal to give written consent to be part of study.
3. Type 1 Diabetes mellitus.
4. Known cases of thyroid function disorders diagnosed prior to the onset of diabetes.
5. Patients on lipid-lowering agents (e.g., statins, fibrates).
6. Patients with Chronic kidney diseases, hepatic failure of significant psychiatric illnesses.

RESULTS

The analysis of the gender distribution of the studied cases showed that in Group A (patients with Diabetes Mellitus) there were 24 (60%) males 16 (40%) females. Group B (healthy controls) had 22 (55%) males and 18 (45%) females. The gender distribution in Group A and group B was found to be comparable with no statistically significant difference (P=0.8213) (Figure 1).

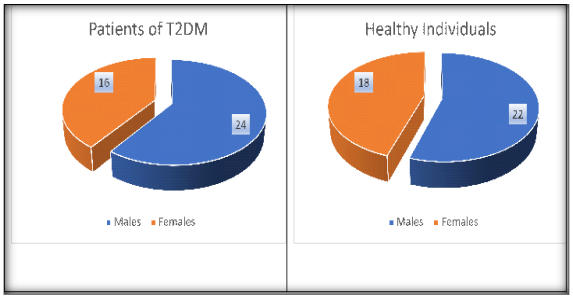

Figure 1: Gender Distribution in studied cases.

The analysis of the age distribution of the studied cases showed that in Group A (patients with Diabetes Mellitus), the majority of individuals were in the 51–60 years age group (40.0%), followed by those aged 46–50 years (32.5%). The younger age groups, 19–40 years and 41–45 years included 6 (15.0%) and 5 (12.5%) individuals respectively. Similarly, in Group B (healthy controls) the most common age group was also 51–60 years (32.5%) followed by 46–50 years (30.0%). The mean age was slightly higher in the diabetic group (48.1 ± 8.9 years) compared to the healthy controls (45.4 ± 8.7 years). However, the age difference between diabetic and healthy individuals was not statistically significant (P=0.1740). (Table 1)

Table 1: Comparison of Mean age in both the groups

Age Groups	Group A (Diabetes Mellitus)	Group B (Healthy Controls)
19–40 years (n, %)	6 (15.0%)	8 (20.0%)
41–45 years (n, %)	5 (12.5%)	7 (17.5%)
46–50 years (n, %)	13 (32.5%)	12 (30.0%)
51–60 years (n, %)	16 (40.0%)	13 (32.5%)
Total Subjects	40	40
Mean Age (years)	48.1 ± 8.9	45.4 ± 8.7
P = 0.1740 (Not Signficant)		

In Group A (patients with Diabetes Mellitus) the majority were euthyroid (65.0%). 9 individuals (22.5%) were found to have subclinical hypothyroidism and 4 (10.0%) patients were having overt hypothyroidism. Subclinical hyperthyroidism was seen in 1 (2.5%) and no case of overt hyperthyroidism were seen. In contrast, Group B (healthy controls) had a higher proportion of euthyroid individuals at 35 (87.5%). Subclinical and overt hypothyroidism was seen in 3 individuals (7.5%) and 2 individuals (5.0%) respectively. No cases of subclinical or overt hyperthyroidism were found in this group. Patients of T2DM were found to have higher incidence of thyroid function abnormalities as compared to healthy individuals and the difference was found to be statistically significant (P= 0.0339) (Table 2).

Table 2: Comparison of Thyroid Function Abnormalities in both the groups

Thyroid Status	Group A (Diabetes Mellitus)	Group B (Healthy Controls)
Euthyroid (n, %)	26 (65.0%)	35 (87.5%)

Subclinical Hypothyroidism	9 (22.5%)	3 (7.5%)
Overt Hypothyroidism	4 (10.0%)	2 (5.0%)
Subclinical Hyperthyroidism	1 (2.5%)	0 (0.0%)
Overt Hyperthyroidism	0 (0.0%)	0 (0.0%)
Total Subjects	40 (100%)	40 (100%)
P-value = 0.0339		

The analysis of thyroid abnormalities in relation to glycaemic control among diabetic patients showed that among those with good glycaemic control (HbA1c <7%), 5 out of 30 individuals (16.7%) had thyroid abnormalities, whereas in the group with suboptimal or poor control (HbA1c >7%), 9 out of 10 individuals (90%) exhibited thyroid abnormalities. The prevalence in thyroid function abnormalities was more in patients with suboptimal or poor glycaemic control as compared to individuals having good glycaemic control and the difference was found to be statistically highly significant (P< 0.0001) (Table 3)

Table 3: Comparison of Thyroid Function and HbA1C levels

Parameter	Good Control	Suboptimal/Poor Control
HbA1c (%)	<7	>7
No. of Cases	30	10
Thyroid Abnormalities (n)	5	9
P-value < 0.0001 (Highly Significant)*		

Dyslipidemia was more prevalent in Group A (Diabetes Mellitus) as compared to Group B (Healthy Controls). In Group A, a total of 24 individuals (60.0%) had dyslipidemia, whereas in Group B, only 12 individuals (30.0 %) were dyslipidemic. There was a higher prevalence of dyslipidemia among patients having diabetes mellitus when compared to healthy individuals and the difference was statistically significant (P=0.0129) (Table 4).

Table 4: Comparison of Lipid Profile in both the groups

Parameter	Group A (Diabetes Mellitus)	Group B (Healthy Controls)
Normal Lipid Profile	16 (40.00%)	28 (70.00%)
Dyslipidemia (n, %)	24 (60.00%%)	12 (30.00%)
Total Subjects	40	40
P= 0.0129 (Significant)		

The analysis of dyslipidemia in relation to glycaemic control status showed that among the 30 individuals with good glycaemic control (HbA1c <7%), 15 (50.0 %) had dyslipidemia, whereas among the 10 individuals with suboptimal or poor control (HbA1c >7%), 9 (90.0%) were dyslipidemic. The difference in prevalence of dyslipidemia between the two groups was statistically significant (P=0.0315) (Table 5).

Table 5: Comparison of Lipid Profile and HbA1C levels

Parameter	Good Control	Suboptimal/Poor Control
HbA1c (%)	<7	>7
No. of Cases	30	10
Glycaemic Control Status	Good	Suboptimal
Dyslipidemia (n)	15	9
P-value 0.0315 (Significant) *		

DISCUSSION

In this study there was a higher prevalence of thyroid dysfunction among patients with Type 2 Diabetes Mellitus (T2DM) compared to age matched healthy controls. Subclinical hypothyroidism was the most frequently observed abnormality among diabetic patients. This finding is consistent with findings reported by Díez JJ et al who reported a higher prevalence of subclinical hypothyroidism in T2DM patients versus healthy controls.[10] Similarly Celani et al also found a higher incidence of thyroid dysfunction in elderly diabetic patients.[11] These studies suggested possible vulnerability of diabetic population for developing thyroid dysfunction. Our study higher incidence of thyroid function abnormalities in diabetic patients as compared to controls reinforces the hypothesis that T2DM patients are predisposed to thyroid dysfunction. This finding underscores the clinical importance of routine thyroid screening in T2DM populations because in many cases thyroid dysfunction was found to be subtle and subclinical.

In this study a significant association was found between poor glycaemic control and thyroid function abnormalities. Among diabetic subjects with poor glycemic control (HbA1c >7%) 90% exhibited thyroid abnormalities. In comparison only 16.7% of those with good glycemic control (HbA1c <7%) had abnormal thyroid function. Similar findings were reported by Ogbonna SU et al who found that HbA1c had a positive linear relationship with the presence of thyroid dysfunction (regression coefficient=1.89, p=0.001).[12] Additionally, Demitrost L et al also observed that poor diabetic control and BMI above

25 were risk factors for development of thyroid dysfunction in diabetics.[13] Impaired glucose homeostasis may influence hypothalamic-pituitary-thyroid (HPT) axis regulation and alter peripheral thyroid hormone metabolism thereby causing thyroid function abnormalities in diabetic population.

The current study also demonstrated an increased incidence of dyslipidemia among patients with diabetic (60%) as compared to healthy individuals (30%). Dyslipidemia in T2DM has been reported by many authors. Mooradian et al described the typical lipid triad in diabetes and its atherogenic potential.[14] Moreover, Haffner et al also emphasized that insulin resistance in T2DM is a major determinant of abnormal lipid metabolism, even independent of glycaemic status.[15] Our data showing a greater prevalence of dyslipidemia in diabetics suggest that lipid abnormalities persist despite apparent glycaemic control indicating that lipid assessment and therapy should be an integral part of diabetic care.

Our study also found that individuals with poor glycemic control had a significantly higher prevalence of dyslipidemia (90%) compared to those with good control (50%). Similar findings were reported by Sharahili AY et al who undertook a study to investigate the association between HbA1c level and the lipid profile in elderly T2DM patients at a primary care hospital.[16] The authors found that the correlation between HbA1c and total cholesterol (TC) as well astriglycerides (TGs) was positively significant thereby highlighting the important link between glycemic control and dyslipidemia. On the basis of these findings the authors concluded that HbA1c was significantly associated with cholesterol and triglyceride levels in the T2DM patients. Similar corrlation between HbA1c levels and incidence of dyslipidemia has also been reported by the authors such as Hussain A et al,[17] and Alzahrani SH et al.[18]

An important intersection observed in this study was the concurrent presence of both thyroid dysfunction and dyslipidemia in diabetic individuals, particularly among those with poorly controlled diabetes. Although our study did not perform a direct correlation analysis between thyroid status and lipid profile, existing literature supports this interaction. For instance, Bajpai P et al reported that dyslipidemia and complications related to diabetes were also found to be more enhanced in diabetics with thyroid dysfunction as compared to non-diabetics.[19] On the basis of these findings the authors concluded that diabetes Mellitus and thyroid dysfunction both have a significant role in alteration of lipoprotein levels and their collective presence have greater effect on control of diabetes and its complications. Similar findings were also reported by the authors such as Koyyada A et al.[20]

CONCLUSION

T2DM patients exhibit a significantly higher prevalence of thyroid dysfunction and dyslipidemia compared to healthy individuals. Both abnormalities were found to be strongly associated with poor glycaemic control. Routine screening for thyroid function and lipid profile in T2DM patients therefore is recommended for comprehensive risk stratification and improved metabolic management.

Conflict of Interest: None.

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