

# Analysis of Thyroid Disorders in Type - 2 Diabetes Mellitus Patients

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## ABSTRACT

**Introduction:** Among endocrine disorders after diabetes mellitus condition, thyroid dysfunction is the most common. Thyroid disorders and Diabetes are interrelated conditions and the most common conditions presenting in clinical practice. Neglected thyroid disorders can lead to Diabetes, where as people with diabetes are at increased risk of thyroid disorders. The Present study aim is to find the prevalence of thyroid dysfunction among type - 2 Diabetes mellitus and assessing the thyroid disorders in normal population by comparing with Type - 2 Diabetes mellitus.

**Materials and Methods:** A total of 140 patients were selected for study, among these 70 were type 2 Diabetes mellitus patients and another 70 were normal subjects. Venous Blood sample collected from all patients and tested for Thyroid hormone levels (T3, T4, TSH). Fasting blood sugar, Random Blood sugar, HbA1c, Lipid profile estimation also done in all patients.

**Results:** Thyroid dysfunction has seen in 11 out of 70 Type 2 Diabetes mellitus patients about 15.7% and in 3 out of 70 normal subjects about 4.2%. Serum T3 and T4 levels were comparatively lower in Type 2 Diabetes on comparison with normal subjects and TSH levels were higher in Type 2 Diabetes mellitus. Out of 70 Type 2 Diabetes mellitus patients, Hypothyroidism observed in 12.8% (55.5% of Subclinical hypothyroidism, 44.4% of Primary hypothyroidism) and only Subclinical Hyperthyroidism observed in 2.8%.

**Conclusion:** Thyroid dysfunction causes major impact on Diabetic control and aggravates diabetic complications. Regular screening is necessary for thyroid disease among patients with diabetes mellitus.

**Keywords:** Diabetes Mellitus, Thyroid disorders, Hypothyroidism, Hyperthyroidism.

## INTRODUCTION

Diabetes mellitus is the third leading cause of death in many developed countries. It affects about 2 to 3% of the general population. It is a clinical condition characterized by hyperglycemia due to insufficient production of insulin from beta cells of pancreas or inefficient insulin. Globally the prevalence of Diabetes is increasing because of rising population, population ageing, urbanization, lifestyle changes like physical inactivity, obesity, smoking and medical illness like Hypertension, dyslipidemia.

Diabetes was previously rare in developing countries, but now it's prevalence becoming more in developing countries

as compared to western countries.<sup>1-3</sup> Worldwide by 2010, it was estimated that 285 million people suffering with Diabetes mellitus, among which 3.90% had Type 2 Diabetes Mellitus.<sup>4</sup> Globally by 2030 diabetes mellitus will projected towards 439 million, which represents 7.7% of the total adult population of the world aged 20–79 years.<sup>1</sup> Before Type 2 Diabetes mellitus usually seen in adults, but now it has become more common not only in young adults but also in adolescents and, occasionally, in children.<sup>5</sup>

Among endocrine disorders after diabetes mellitus condition, thyroid dysfunction is the most common. Thyroid is a gland that produces Triiodothyronine (T3), Thyroxine (T4) which are regulated by Thyroid stimulating hormone produced by Hypothalamus. Thyroid disorders are causing problems worldwide. In India about 42 million people suffer from thyroid diseases.<sup>6</sup>

Thyroid disorders and Diabetes are interrelated conditions and the most common conditions presenting in clinical practice.<sup>7</sup> Diabetes and thyroid disorders are caused by a group of endocrine glands that secrete hormones that help regulate growth, reproduction and nutrient use by cells. Diabetes and thyroid disorders association known since 1979.<sup>8</sup> Neglected thyroid disorders can lead to Diabetes, where as people with diabetes are at increased risk of thyroid disorders.

When compared with normal population thyroid disorders shown higher prevalence among Diabetics. The prevalence of Diabetes mellitus associated with thyroid dysfunction estimated between 2.2 to 17%<sup>9</sup> and few other studies observed high prevalence of thyroid dysfunction among Diabetes about 31-46.5%.<sup>10</sup> Thyroid disorders found in both Type 1 and Type 2 Diabetes, but Autoimmune thyroid diseases is commonly seen in Type 1 Diabetes.

Reason for thyroid dysfunction in Diabetes Mellitus may be due to affecting thyroid function at two levels, one is at the level Thyroid stimulating hormone secretion i.e., from hypothalamus and another in peripheral tissue during conversion of thyroxine (T4) to triiodothyronine (T3). Thyroid dysfunction include low T3, elevated levels of reverse T3 (rT3) and low, normal or high levels of T4.<sup>11</sup> After treating hyperglycemia these values return to normal level.<sup>12</sup>

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The Present study aim is to find the prevalence of thyroid dysfunction among type - 2 Diabetes mellitus and assessing the thyroid disorders in normal population by comparing with Type - 2 Diabetes mellitus.

## MATERIALS AND METHODS

The study has done in the Biochemistry department as a prospective at RIMS, Srikakulam. Informed consent has taken from all the patients.

A total of 140 patients were selected for study, among these 70 were type 2 Diabetes mellitus patients and another 70 were normal subjects. Normal subjects were selected such that their Fasting blood sugar levels and Glycated Hemoglobin (HbA1C) were normal, non-pregnant, no history of usage of steroids, amiodarone, lithium bromide and without any evidence of renal disorders, thyroid disorders. 70 normal subjects matches with type 2 Diabetes mellitus study population by their age and BMI.

Type 2 Diabetes mellitus patients were selected by following the criteria of American Diabetic Association, such as Fasting Blood sugar  $\geq 110$  mg/dl and Random blood sugar  $\geq 200$  mg/dl or taking any hypoglycemic medications or insulin or any evidence of ketosis in the past.

Venous Blood sample about 5 ml is collected from all patients in a test tube under aseptic precautions and tested for Thyroid hormone levels (T3, T4, TSH). Fasting blood sugar, Random Blood sugar, HbA1c, Lipid profile estimation also done in all patients.

Thyroid hormone levels (T3, T4, TSH) in the serum sample were estimated by Chemiluminescence Immunoassay (CLIA) Method. Normal values of Thyroid hormone levels: T3 - 0.60-1.81 ng/mL; T4 - 5.01-12.45  $\mu$ g/dL; TSH - 0.35 - 5.50  $\mu$ IU/mL.

Other variables were estimated by following methods: 1. Estimation of serum glucose by Glucose oxidase-peroxidase method. 2. Estimation of Glycated haemoglobin (HbA1c) by Ion Exchange Resin method Principle. 3. Estimation of serum Total Cholesterol (TC) and High Density Lipoprotein (HDL) by cholesterol oxidase / phenol aminoantipyrine method. 4. Estimation of serum triglycerides (TGs) by glycerol phosphate oxidase – phenol aminoantipyrine method. 5. Estimation of serum Low density lipoprotein (LDL) and Very low density lipoprotein (VLDL) using Friedewald's equation.

Guidelines to detect different types of thyroid dysfunction:

1. Primary Hypothyroidism - TSH more than 5.50  $\mu$ IU/mL and T3, T4 less than normal.
2. Subclinical Hypothyroidism - TSH more than 5.50  $\mu$ IU/mL and T3, T4 is within normal range.
3. Primary Hyperthyroidism - TSH less than 0.35  $\mu$ IU/mL and T3, T4 more than normal.
4. Subclinical Hyperthyroidism - TSH less than 0.35  $\mu$ IU/mL and T3, T4 is within normal range. All the results were analyzed and tabulated. Results between Diabetes mellitus patients and Normal subjects were compared.

## STATISTICAL ANALYSIS

Statistical Significance assessed using Graph pad software. The P value  $< 0.05$  is considered significant.

## RESULTS

Among 140 subjects, 70 were Type 2 Diabetes mellitus (Study Group) and 70 were normal subjects (Control Group). The mean age of Type 2 DM patients were  $40.5 \pm 2.9$  and normal subjects were  $41.2 \pm 1.7$ . There was more female preponderance in both Type 2 DM patients and Normal subjects about 64% and 52% respectively.

All the variables estimated among Type 2 DM patients (70) and normal subjects (70) such as Fasting Blood sugar, Glycated hemoglobin, Total cholesterol, TGs, HDL, LDL, VLDL were compared and significance was analyzed (Table No:1). Except HDL all other lipids and lipoproteins were increased in Type-2 diabetes mellitus significantly.

Table No:1 Various Biochemical changes compared among type 2 Diabetes Mellitus and Normal subjects.

Thyroid dysfunction has seen in 11 out of 70 Type 2 Diabetes mellitus patients about 15.7% and in 3 out of 70 normal subjects about 4.2%.

Thyroid hormones - T3, T4, TSH levels were estimated in Type 2 Diabetes Mellitus patients and normal subjects, tabulated in Table No.2. This shown that serum T3 and T4 levels were comparatively lower in Type-2 Diabetes on comparison with normal subjects and TSH levels were higher in Type-2 Diabetes mellitus.

15.7% of thyroid disorders has seen in Type 2 Diabetes mellitus, among which Subclinical hypothyroidism (45.4%) was more prevalent followed by Primary hypothyroidism,

S. No.	Biochemical changes	Type 2 Diabetes Mellitus	Normal subjects	P value	Significance
1	Fasting Blood Sugar	158.5 $\pm$ 7.99	83.5 $\pm$ 2.3	$< 0.0001$	ESS
2	Glycated Hemoglobin	7.6 $\pm$ 2.13	5.2 $\pm$ 3.6	$< 0.0001$	ESS
3	Total Cholesterol	209.7 $\pm$ 3.4	164.3 $\pm$ 1.89	$< 0.0001$	ESS
4	Triglycerides	159.6 $\pm$ 1.7	128.5 $\pm$ 4.5	$< 0.0001$	ESS
5	High Density Lipoprotein	40.6 $\pm$ 1.4	44.2 $\pm$ 1.32	$< 0.0001$	ESS
6	Low Density Lipoprotein	113.5 $\pm$ 6.5	96.5 $\pm$ 2.33	$< 0.0001$	ESS
7	Very Low Density Lipoprotein	36.5 $\pm$ 4.5	25.6 $\pm$ 4.1	$< 0.0001$	ESS

**Table-1:** Various Biochemical changes compared among type 2 Diabetes Mellitus and Normal subjects.

Thyroid hormones	Type-2 Diabetes Mellitus patients (Mean±S.D)	Normal Subjects (Mean±S.D)	P value	Significance
Serum T3	0.92±2.4	1.61±1.4	0.0396	SS
Serum T4	8.11±1.3	9.4±3.1	0.0016	SS
Serum TSH	7.32±2.2	3.21±1.5	<0.0001	ESS

**Table-2:** Thyroid hormone levels among Type 2 Diabetics and Normal persons

Groups	Gender	Primary Hypothyroidism	Subclinical Hypothyroidism	Primary Hyperthyroidism	Subclinical Hyperthyroidism
Type2 Diabetes Mellitus	Male	2	1	0	0
	Female	2	4	0	2
Normal subjects	Male	0	0	0	1
	Female	1	0	1	0

**Table-3:** Showing types of thyroid disorders among Diabetics and Normal subjects

Subclinical hyperthyroidism. Females were most commonly diagnosed with thyroid disorders among both groups (Table No:3).

## DISCUSSION

As Diabetes and Thyroid disorders were most common presenting conditions in clinical practice. Type 2 Diabetes mellitus (T2DM) condition is more prevalent worldwide, which is a cause for many complications such as diabetic nephropathy, neuropathy, delayed wound healing, infections. Along with these Diabetes patients were also facing problem with thyroid dysfunction.

Diabetics has prevalence of thyroid disorders about 2-50%.<sup>9,10</sup> In the present study the prevalence of thyroid dysfunction among diabetics was 15.7%. This wide range of prevalence may be due to varying percentage of Diabetics in different communities.

As per this study, TC, TGs, LDL, VLDL, FBS, HbA1C were increased and HDL levels were decreased in Type-2 diabetes mellitus significantly when compared with normal subjects. Sulaiman et al<sup>13</sup> and Sawant et al<sup>14</sup> also reported that except HDL all other lipids and lipoproteins increased in T2 DM. Few studies<sup>15-18</sup> documented that Overt hypothyroidism results in dyslipidemia among both Diabetics and Non Diabetics.

Thyroid dysfunction has seen in 11 out of 70 Type 2 Diabetes mellitus patients about 15.7% and in 3 out of 70 normal subjects about 4.2%. In line with this study Catiacristina et al,<sup>19</sup> Radaideh AR et al,<sup>10</sup> Perros et al,<sup>20</sup> Papzafiropoulou A et al<sup>8</sup> reported thyroid dysfunction among Diabetics as 14.7%, 12.5%, 13.4% and 12.3% respectively. In contrast to the present study few studies reported high percentage of Thyroid dysfunction among Diabetics like Vikram B vikhe et al - 30%<sup>21</sup>, Ghazia SM et al - 29.7%,<sup>22</sup> Gurjeetsingh et al - 30%,<sup>23</sup> LalooDemitrost et al - 31.2%,<sup>24</sup> Diaz et al - 32.4%.<sup>25</sup> Serum T3 and T4 levels were comparatively lower in Type 2 Diabetes on comparison with normal subjects and TSH levels were higher in Type 2 Diabetes mellitus. This was even supported by other studies.<sup>26</sup>

Out of 70 Type 2 Diabetes mellitus patients, Hypothyroidism observed in 12.8% (55.5% of Subclinical hypothyroidism, 44.4% of Primary hypothyroidism) and only Subclinical Hyperthyroidism observed in 2.8%. Vikram B vikheet al<sup>21</sup> reported 22 % had hypothyroidism and 8 % had hyperthyroidism. Laloo demistrot<sup>24</sup> observed that 68.8% were euthyroid, 16.3% have subclinical hypothyroidism, 11.4% had hypothyroidism, 2% had subclinical hyperthyroidism and 1.5% were hyperthyroidism cases. Catiacristina et al<sup>19</sup> reported that Subclinical hypothyroidism was more frequent, in 13% of patients with T1DM and in 12% of patients with T2DM.

Thyroid disorders occur in both Type 1 and type 2 Diabetes mellitus.<sup>20</sup> Thyroid disorders which goes unidentified could influence negative impact on diabetes and its complications.<sup>11</sup> The unrecognized TD may adversely affect the metabolic control and add more risk to an already predisposing scenario for cardiovascular diseases.

## CONCLUSION

We conclude that as thyroid dysfunction causes major impact on Diabetic control, regular screening for thyroid disease among patients with diabetes mellitus should perform. By considering the prevalence of Thyroid disorders among Diabetics and as there is possibility of aggravation of complications such as hypertension, dyslipidemia among Diabetics due to undiagnosed thyroid dysfunction.

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