

Study of Thyroid Profile in Patients with Type 2 Diabetes Mellitus

Madavaram Sreelatha¹, V Suresh Kumar¹, G Chandra Shekar³, V Chandra Shekar⁴

¹Assistant Professor, Department of General Medicine, Mahatma Gandhi Memorial Hospital, Warangal, Telangana, India, ²Professor, Department of General Medicine, Mahatma Gandhi Memorial Hospital, Warangal, Telangana, India

Abstract

Background: Diabetes mellitus (DM), a common endocrine metabolic disorder, is an important cause of morbidity and mortality worldwide. Patients with diabetes have a higher prevalence of thyroid disorders when compared with general population. Alteration in thyroid function complicates the management of DM and its complications.

Materials and Methods: This study was conducted from June 2015 to June 2016 in Medicine Department of Mahatma Gandhi Memorial Hospital, Warangal. 108 patients with known Type 2 DM or newly detected cases were included in the study. All the patients were evaluated for thyroid dysfunction by testing thyroid profile (triiodothyronine, thyroxine, and thyroid-stimulating hormone). The correlation of prevalence of thyroid disorder with gender distribution, age distribution, hemoglobin A1C, duration of diabetes, hypertension, family history of diabetes, body mass index, usage of oral hypoglycemic agents and insulin, and dyslipidemia was then done. The observations and interpretations were recorded, and results obtained were statistically analyzed.

Results: In this study, age of the patient ranges from 35 to 70 years with maximum number of patients between the age group 41 and 60 years. In our study, 13% of the patients with Type 2 DM had abnormal thyroid profile. Among abnormal thyroid profile, the most common abnormality was subclinical hypothyroidism (64.2%) followed by subclinical hyperthyroidism (21.4%) followed by overt hypothyroidism. The prevalence of thyroid abnormality is more common in females than in males. Our study showed a significant correlation between abnormal thyroid profile and family history of diabetes and serum lipid profile.

Conclusion: The occurrence of thyroid dysfunction among Type 2 DM patients is very high (13%) with subclinical hypothyroidism is being most common. All patients with Type 2 DM should be screened for thyroid dysfunction to reduce the mortality rate.

Key words: Diabetes mellitus, Hyperthyroidism, Hypothyroidism

INTRODUCTION

Diabetes mellitus (DM) is a common endocrine disorder which involves multiple organ systems and leads to significant morbidity and mortality due to accompanying complications.¹⁻⁵

DM has been defined as “a metabolic syndrome characterized by chronic hyperglycemia and disturbance of carbohydrate, fat and protein metabolism associated with absolute or relative deficiency in insulin secretion and or insulin action.”

Much has been accomplished in the field of diabetes but what has been troubling one and all are the large macrovascular and microvascular complications of diabetes involving kidneys, eyes, blood vessels, nerves, and heart. Thyroid diseases are also a common endocrinopathy seen in the adult population. Thyroid hormones are intimately involved in cellular metabolism.⁶⁻²³

Thus, excess or deficit of either insulin or thyroid hormones could result in the functional derangement of the cellular metabolism.

The present work is a modest attempt to study the occurrence of thyroid disorders in patients with Type 2 DM.

MATERIALS AND METHODS

This study titled “study of thyroid profile in patients with Type 2 DM” was carried out in the Department

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Corresponding Author: Dr. Madavaram Sreelatha, Department of General Medicine, Mahatma Gandhi Memorial Hospital, H.No: 25-7-186, Vishnupuri, Kazipet, Warangal - 506 003, Telangana, India. Phone: 9849091006. E-mail: drlathavenkat@gmail.com

of Medicine, Mahatma Gandhi Memorial Hospital, Warangal.

Study Design

The study design was cross-sectional study.

Period of Study

Period of study was June 2015-2016.

Materials

Questionnaire, body mass index (BMI) calculation, blood pressure, fasting blood sugar, post-prandial blood-sugar, blood urea, serum creatinine, fasting lipid profile, thyroid profile triiodothyronine (T3), thyroxine (T4) and thyroid-stimulating hormone (TSH), hemoglobin A1C (HbA1C), urinalysis, urine spot protein creatinine ratio, electrocardiogram, chest X-ray, and liver function tests.

Study Group

The study group included 108 persons with known Type 2 DM or newly detected Type 2 DM without known thyroid disorders either admitted in wards or attending the outpatient departments who met the inclusion criteria.

Inclusion Criteria

Known Type 2 DM and newly detected Type 2 DM subjects who gave informed consent to participate in the study.

Exclusion Criteria

- Patients with Type 1 DM,
- Patients not willing for the study,
- Patients with known thyroid disease,
- Patients with chronic renal failure and diabetic nephropathy,
- 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).

All patients in the study group were selected without any bias for sex, duration, severity, or control of diabetes. A thorough history was recorded with particular emphasis on symptoms of hypothyroidism and hyperthyroidism. History of associated illness such as coronary artery disease, hypertension, and cerebrovascular accident were noted. Family history regarding DM, thyroid disorders, and treatment history of oral hypoglycemics or insulin along with duration was also included in the study. A thorough general and systemic examination were carried out.

RESULTS

This study titled “Study of thyroid profile in patients with Type 2 DM” was undertaken in the Department of Medicine, MGM Hospital over a period of 13 months from June 2015 to June 2016.

The study sample included 108 Type 2 diabetes patients in the wards and outpatient departments. Following were the observations (Tables 1-23).

In this study, 14 (13%) patients are in the age group of 35-40 years, 40 (37.03%) patients are in between 41 and

Table 1: Age distribution of cases

| Age group (years) | Number of cases (%) |
|-------------------|---------------------|
| 35-40 | 14 (13.0) |
| 41-50 | 40 (37.03) |
| 51-60 | 38 (35.18) |
| 61-70 | 16 (14.8) |
| Total | 108 (100.0) |

Table 2: Distribution of cases according to sex

| Gender | Number of cases (%) |
|--------|---------------------|
| Male | 44 (40.7) |
| Female | 64 (59.3) |
| Total | 108 (100.0) |

Table 3: Distribution according to duration of diabetes mellitus

| Duration of DM (in years) | Number of cases (%) |
|---------------------------|---------------------|
| Up to 5 years | 76 (70.4) |
| 6-10 years | 20 (18.5) |
| >10 years | 12 (11.1) |
| Total | 108 (100.0) |

DM: Diabetes mellitus

Table 4: Distribution according to type of treatment

| Type of treatment | Number of cases (%) |
|-------------------|---------------------|
| Insulin | 15 (13.9) |
| OHA | 74 (67.6) |
| OHA/Insulin | 19 (17.6) |
| Total | 108 (100) |

OHA: Oral hypoglycemic agent

Table 5: Distribution according to regularity of treatment

| Regularity of treatment | Number of cases (%) |
|----------------------------------|---------------------|
| Regular | 82 (75.9) |
| Irregular | 20 (18.5) |
| Newly detected diabetic patients | 6 (5.6) |
| Total | 108 (100.0) |

Table 6: Distribution according to family history of diabetes mellitus

| Family H/O of DM | Number of cases (%) |
|------------------|---------------------|
| Yes | 42 (38.9) |
| No | 66 (61.1) |
| Total | 108 (100.0) |

DM: Diabetes mellitus

Table 7: Distribution of cases according to systemic hypertension

| Systemic hypertension | Number of cases (%) |
|-----------------------|---------------------|
| Yes | 54 (50.0) |
| No | 54 (50.0) |
| Total | 108 (100.0) |

Table 8: Distribution of cases according to BMI

| BMI group (kg/m ²) | Number of cases (%) |
|--------------------------------|---------------------|
| <18.5 | 2 (1.9) |
| 18.5-22.9 | 42 (38.9) |
| 23-29.9 | 48 (44.4) |
| ≥30 | 16 (14.8) |
| Total | 108 (100.0) |

BMI: Body mass index

Table 9: Distribution of cases according to HbA1C level

| HbA1C level | Number of cases (%) |
|-------------|---------------------|
| <7 | 18 (16.66) |
| ≥7 | 90 (83.33) |
| Total | 108 (100) |

HbA1C: Hemoglobin A1C

Table 10: Distribution of cases according to altered lipid profile

| | N (%) |
|-----------------------|-------------|
| HDL (%) | |
| Normal | 72 (66.7) |
| Abnormal | 36 (33.3) |
| Total | 108 (100.0) |
| Total cholesterol (%) | |
| Normal | 54 (50) |
| Abnormal | 54 (50) |
| Total | 108 (100.0) |
| TG (%) | |
| Normal | 54 (50) |
| Abnormal | 54 (50) |
| Total | 108 (100.0) |
| LDL (%) | |
| Normal | 30 (27.8) |
| Abnormal | 78 (72.2) |
| Total | 108 (100.0) |

HDL: High density lipoproteins, TG: Triglyceride, LDL: Low density lipoproteins

Table 11: Diabetic cases with abnormal thyroid profile

| Thyroid function | N (%) |
|-------------------------------|-------------|
| With normal thyroid profile | 94 (87.0) |
| With abnormal thyroid profile | 14 (13.0) |
| Total | 108 (100.0) |

Table 12: Distribution of thyroid disease

| Thyroid profile | Number of cases (%) |
|-----------------------------|---------------------|
| Normal | 94 (87) |
| Overt hypothyroidism | 2 (1.9) |
| Subclinical hypothyroidism | 9 (8.3) |
| Overt hyperthyroidism | 0 (0) |
| Subclinical hyperthyroidism | 3 (2.8) |
| Total | 108 (100) |

Table 13: Abnormal thyroid profile verses age group

| Age | Status | | Total |
|-----------------|--------|----------|-------|
| | Normal | Abnormal | |
| 35-40 | | | |
| Count | 12 | 2 | 14 |
| % within status | 12.8 | 14.3 | 13.0 |
| 41-50 | | | |
| Count | 36 | 4 | 40 |
| % within status | 38.29 | 28.5 | 37.03 |
| 51-60 | | | |
| Count | 33 | 5 | 38 |
| % within status | 35.10 | 35.7 | 35.18 |
| 61-70 | | | |
| Count | 13 | 3 | 16 |
| % within status | 13.8 | 21.4 | 14.8 |
| Total | | | |
| Count | 94 | 14 | 108 |
| % within status | 100.0 | 100.0 | 100.0 |

Chi-square tests

| | Value | df | P value (significant if <0.05) |
|-----------------------|-------|----|--------------------------------|
| Pearson Chi-square | 0.809 | 3 | 0.847 |
| Number of valid cases | 108 | - | - |

50 years, 38 patients (35.18%) are in the age group 51-60 years, and 16 (14.8%) patients are in between 61 and 70 years.

In this study, 40.7% (44) patients were male and 59.3% (64) patients were female.

In this study, 76 patients had duration of diabetes <5 years, 20 patients had duration of 6-10 years, and 12 patients had duration of diabetes more than 10 years.

Table 14: Abnormal thyroid profile verses sex

| Sex | Crosstab | | Total |
|-----------------|----------|----------|-------|
| | Status | | |
| | Normal | Abnormal | |
| Female | | | |
| Count | 52 | 12 | 64 |
| % within status | 55.3 | 85.7 | 59.3 |
| Male | | | |
| Count | 42 | 2 | 44 |
| % within status | 44.7 | 14.3 | 40.7 |
| Total | | | |
| Count | 94 | 14 | 108 |
| % within status | 100.0 | 100.0 | 100.0 |

Chi-square tests

| | Value | df | P value (significant if<0.05) |
|-----------------------|-------|----|-------------------------------|
| Pearson Chi-square | 4.663 | 1 | 0.031 ^b |
| Number of valid cases | 108 | | |

^bComputed only for a 2x2 table

Table 15: Abnormal thyroid profile verses duration of diabetes

| Duration (years) | Crosstab | | Total |
|------------------|----------|----------|-------|
| | Status | | |
| | Normal | Abnormal | |
| Up to 5 | | | |
| Count | 70 | 6 | 76 |
| % within status | 74.5 | 42.9 | 70.4 |
| 6-10 | | | |
| Count | 15 | 5 | 20 |
| % within status | 16.0 | 35.7 | 18.5 |
| >10 | | | |
| Count | 9 | 3 | 12 |
| % within status | 9.6 | 21.4 | 11.1 |
| Total | | | |
| Count | 94 | 14 | 108 |
| % within status | 100.0 | 100.0 | 100.0 |

Chi-square tests

| | Value | df | P value (significant if<0.05) |
|-----------------------|-------|----|-------------------------------|
| Pearson Chi-square | 5.840 | 2 | 0.054 |
| Number of valid cases | 108 | | |

Table 4 shows that 13.9% (15) patients were on insulin therapy, 67.6% (74) patients were on oral hypoglycemic agent (OHA) therapy, and 17.6% (19) patients were on both OHA/insulin therapy.

Among the study group, 75.9% (82) patients were on regular treatment, 18.5% (20) patients were on irregular treatment, and 5.6% (6) patients were newly detected during the study.

Table 16: Abnormal thyroid profile verses type of treatment

| Type of treatment | Crosstab | | Total |
|-------------------|----------|----------|-------|
| | Status | | |
| | Normal | Abnormal | |
| Insulin | | | |
| Count | 13 | 2 | 15 |
| % within status | 13.8 | 14.3 | 13.9 |
| OHA | | | |
| Count | 66 | 8 | 74 |
| % within status | 69.1 | 57.1 | 67.6 |
| OHA/Insulin | | | |
| Count | 15 | 4 | 19 |
| % within status | 16.0 | 28.6 | 17.6 |
| Total | | | |
| Count | 94 | 14 | 108 |
| % within status | 100.0 | 100.0 | 100 |

OHA: Oral hypoglycemic agent

Chi-square tests

| | Value | df | P value (significant if<0.05) |
|-----------------------|-------|----|-------------------------------|
| Pearson Chi-square | 1.513 | 3 | 0.679 |
| Number of valid cases | 108 | | |

Table 17: Abnormal thyroid profile verses family history of diabetes mellitus

| Family history | Status | | Total |
|-----------------|--------|----------|-------|
| | Normal | Abnormal | |
| | No | | |
| Count | 66 | 0 | 66 |
| % within status | 70.2 | 0.0 | 61.1 |
| Yes | | | |
| Count | 28 | 14 | 42 |
| % within status | 29.8 | 100.0 | 38.9 |
| Total | | | |
| Count | 94 | 14 | 108 |
| % within status | 100.0 | 100.0 | 100.0 |

Chi-square tests

| | Value | df | P value (significant if<0.05) |
|-----------------------|--------|----|-------------------------------|
| Pearson Chi-square | 25.277 | 1 | <0.001 |
| Number of valid cases | 108 | | |

Above table shows that 42 (38.9%) patients had family history of DM 66 (61.6%) had no family history of DM.

Among the study group, 50% (54) of cases had systemic hypertension 50% (54) cases had no systemic hypertension.

Among the study population, 59.2% (64/108) were overweight and obese; 38.9% (42/108) had normal BMI.

Table 18: Abnormal thyroid profile verses hypertension

| Hypertension | Status | | Total |
|-----------------|--------|----------|-------|
| | Normal | Abnormal | |
| No | | | |
| Count | 48 | 6 | 54 |
| % within status | 51.06 | 42.8 | 50 |
| Yes | | | |
| Count | 46 | 8 | 54 |
| % within status | 48.9 | 57.1 | 50 |
| Total | | | |
| Count | 94 | 14 | 108 |
| % within status | 100.0 | 100.0 | 100.0 |

P=0.567

Table 19: Absnormal thyroid Profile verses BMI

| BMI | Status | | Total |
|-----------------|--------|----------|-------|
| | Normal | Abnormal | |
| <18.5 | | | |
| Count | 4 | 0 | 4 |
| % within status | 4.3 | 0.0 | 3.7 |
| 18.5-22.9 | | | |
| Count | 31 | 3 | 34 |
| % within status | 33.0 | 21.4 | 31.5 |
| 23-29.9 | | | |
| Count | 47 | 7 | 54 |
| % within status | 50.0 | 50.0 | 50.0 |
| ≥30.0 | | | |
| Count | 12 | 4 | 16 |
| % within status | 12.8 | 28.6 | 14.8 |
| Total | | | |
| Count | 94 | 94 | 108 |
| % within status | 100.0 | 100.0 | 100.0 |

BMI: Body mass index

Chi-square tests

| | Value | df | P value |
|-----------------------|-------|----|---------|
| Pearson Chi-square | 3.167 | 3 | 0.367 |
| Number of valid cases | 108 | | |

Table 20: Abnormal thyroid profile verses HbA1C level

| HbA1C | Status | | Total |
|-----------------|--------|----------|-------|
| | Normal | Abnormal | |
| <7 | | | |
| Count | 15 | 3 | 18 |
| % within status | 15.9 | 21.4 | 16.66 |
| ≥7 | | | |
| Count | 79 | 11 | 90 |
| % within status | 84.04 | 78.57 | 83.33 |
| Total | | | |
| Count | 94 | 14 | 108 |
| % within status | 100.0 | 100.0 | 100.0 |

Chi-square tests

| | Value | df | P value (significant IF<0.05) |
|-----------------------|-------|----|-------------------------------|
| Pearson Chi-square | 0.262 | 1 | 0.608 |
| Number of valid cases | 108 | | |

HbA1C: Hemoglobin A1C

Table 21: Abnormal thyroid profile verses regularity of treatment

| Regularity | Status | | Total |
|-----------------|--------|----------|-------|
| | Normal | Abnormal | |
| Irregular | | | |
| Count | 20 | 0 | 20 |
| % within status | 21.3 | 0.0 | 18.5 |
| New | | | |
| Count | 6 | 0 | 6 |
| % within status | 6.4 | 0.0 | 5.6 |
| Regular | | | |
| Count | 68 | 14 | 82 |
| % within status | 72.3 | 100.0 | 75.9 |
| Total | | | |
| Count | 94 | 14 | 108 |
| % within status | 100.0 | 100.0 | 100.0 |

Chi-square tests

| | Value | df | P value (significant IF<0.05) |
|-----------------------|-------|----|-------------------------------|
| Pearson Chi-square | 5.100 | 2 | 0.078 |
| Number of valid cases | 108 | | |

Among the study group, 90 (83.33%) patients had HbA1C level 7% and more than 7% and 18 (16.66%) patients had <7%.

Table 11 shows 13% (14/108) of the patients with DM in the study group had abnormal thyroid profile.

Table 12 shows that 8.3% (9/108) of the patients had report suggestive of subclinical hypothyroidism, 2.8% (3/108) of the patients had report suggestive of subclinical hyperthyroidism, and 1.9% (2/108) of the patients had report suggestive of overt hypothyroidism.

Out of 14 patients with abnormal thyroid profile, 3 patients (21.4%) were found to be of age 61-70 years, 5 (35.7%) were found to be of age between 51 and About 60 years, 4 (28.5%) were found to be of age between 41 and 50 years and 2 (14.2%) were in the age group 35-40 years. Compared with normal thyroid profile group it has no statistical significance.

Out of 14 patients with abnormal thyroid profile, 14.3% (2) were males and 85.7% (12) were females. Compared with normal thyroid profile group, this is statistically significant.

Table 22: Abnormal thyroid profile verses serum lipid profile

| Status | N | Mean±SD | t | df | P value |
|------------|----|---------------|-------|--------|---------|
| HDL | | | | | |
| Normal | 94 | 42.04±4.999 | 3.801 | 106 | <0.001 |
| Abnormal | 14 | 47.43±4.553 | | | |
| TC | | | | | |
| Normal | 94 | 221.8±32.758 | 7.585 | 105.93 | <0.001 |
| Abnormal | 14 | 249.29±4.906 | | | |
| TG | | | | | |
| Normal | 94 | 149.68±31.12 | 15.94 | 72.718 | <0.001 |
| Abnormal | 14 | 212.86±8.708 | | | |
| LDL | | | | | |
| Normal | 94 | 128.66±13.506 | 3.437 | 37.48 | 0.001 |
| Abnormal | 14 | 135.93±5.954 | | | |

HDL: High density lipoprotein, TC: Total cholesterol, TG: Triglyceride, LDL: Low density lipoprotein, SD: Standard deviation

Table 23: Comparing other studies with the present study

| Studies | Prevalence of thyroid disorder in T2DM (%) |
|----------------------------------|--|
| Uppal <i>et al.</i> (2013) n=120 | 24.5 |
| Demitrost (2012) n=202 | 31.50 |
| Radaideh (2004) n=908 | 12.50 |
| Papazafirovouli (2010) n=1,092 | 12.30 |
| Present study n=108 | 13.00 |

T2DM: Type 2 diabetes mellitus

Among the 14 patients with abnormal thyroid profile, 21.4% (3) had diabetes more than 10 years, 35.7% (5) had duration between 6 and 10 years, and 42.9% (6) had diabetes 5 years or less. Compared with normal thyroid group, it is not statistically significant.

Out of 14 patients with thyroid abnormality, 57.1% (8) were on OHA, 14.3% (2) were on insulin and the rest (28.6%) were on both OHA/insulin. Compared with normal thyroid group, it has no statistical significance.

All patients with thyroid abnormality had family history of DM abnormality, but only 29.8% (28) of normal thyroid group had it. Statistically the difference is significant.

Out of 14 patients with abnormal thyroid profile, 57.1% (8) had hypertension and the rest (42.9%) did not. Compared with patients with normal thyroid profile, it has no statistical significance.

Out of 14 persons with abnormal thyroid profile, 78.6% (11) were overweight and obese. Compared with normal thyroid profile group, this is not statistically significant.

Out of 14 patients with altered thyroid profile, 78.57% (11) had HbA1C value 7% and above and the remaining (21.4%) 3 patients had HbA1C <Seven compared with normal thyroid profile group this is not statistically significant.

Out of 14 patients with abnormal thyroid profile, all the 14 patients were on regular treatment. Compared with normal thyroid profile group, it is not statistically significant.

- Comparison of the high-density lipoprotein (HDL) between the two groups shows that HDL is higher in abnormal group with a $t = -3.801$ and is statistically significant with a $P < 0.001$.
- Comparison of the triglycerides (TGs) total cholesterol (TC) between the two groups shows that TC is higher in abnormal group with a $t = -7.585$ and is statistically significant with a $P < 0.001$.
- Comparison of the TG between the two groups shows that TG is higher in abnormal group with a $t = -15.935$ and is statistically significant with a $P < 0.001$.
- Comparison of the low-density lipoprotein, (LDL) between the two groups shows that LDL is higher in abnormal group with a $t = -3.437$ and is statistically significant with a $P = 0.001$.

Statistical analysis was performed using Statistical Package for the Social Sciences for Windows (version 15.0). Categorical variables were described as frequency (percentage), mean \pm standard deviation was used for continuous parameters. Categorical variables were compared between two groups using the Chi-square test. For all statistical analysis, $P < 0.05$ was considered statistically significant.

DISCUSSION

DM is the most common endocrine disorder which involves multiple organ systems and leads to significant morbidity and mortality due to accompanying complications. Thyroid diseases are also a common endocrinopathy seen in the adult population. Thyroid hormones are intimately involved in cellular metabolism. Thus, excess or deficit of either insulin or thyroid hormone could result in the functional derangement of the cellular metabolism.

Age Distribution

In this study of 108 Type 2 diabetic patients, 14 patients (13%) were up to 40 years, 78 patients (72.2%) were between 41 and 60 years, and 16 patients (14.8%) were 61 years or more. This shows that the disease was more prevalent between 41 and 60 years of age.

This observation was similar to WHO report which predicts that while the main increase in diabetes would be in >65 year age group in the developed countries, in India and developing countries the highest increase would occur in the age group of 45-65 year of age group. This observation is also similar to Kapur *et al.*, who reported

that maximum number of cases were diagnosed between 40 and 59 years of age with no significant difference between the genders.

Gender Distribution

In this study, 40.7% (44) of the studied population were males and 59.3% (64) were females. Female to male ratio was 1.45:1.

This observation was similar to Michalek *et al.* who reported that prevalence of diabetes among women was higher than in men. This is in contrast to Jali *et al.* and Flatau *et al.* who reported that diabetes was more prevalent in men than in women.

Sample size in our study is too small. This might have affected the results.

Duration of DM

In the present study, the majority of cases that is 70.4% (76/108) had duration of diabetes up to 5 years, 18.5% (20/108) of patients had duration between 6 and 10 years, and 11.1% (12/108) of patients had duration of illness more than 10 years. The majority of people are in the age group between 41 and 60 years and have duration of disease less than 5 years.

Systemic Hypertension

In the present study, 50% (54/108) of the studied population had hypertension. Tanow observed that 78% of IDDM patients and 50% of NIDDM had hypertension. Fuller *et al.* observed that the frequency of WHO defined hypertension was highest in NIDDM patients older than 53 years, being 43% of male and 52% of females. Both these studies support our findings.

Family History of DM

In the present study, 38.9% (42) of patients had family history of DM and the remaining 61.1% (66) had no family history.

This study is similar to that of Bener *et al.* (2013) and Vishwanathan *et al.* who conducted a study among 107 subjects. Out of 73 subjects who gave positive family history diabetes, 19 subjects (26%) later developed diabetes.

Regularity of Treatment

In the present study, out of 108 subjects of the study group, 6 (5.6%) were newly detected diabetic patients. In the remaining, 75.9% (82/108) were on regular treatment and 18.5% (20/108) were irregular.

Asha *et al.* observed that 97% of type 2 diabetics were on antidiabetic agents and most were using them irregularly. Kaur *et al.* observed that oral antidiabetic drug compliance

rate was 62.9% in diabetic population. The difference in our study may be due to small sample size.

BMI

Among the study population, 59.2% (64/108) were overweight and obese; 38.9% (42/108) had normal BMI.

Gray *et al.* reported that prevalence of IGT in subjects of all age group increased with rising BMI. Gik *et al.* reported that the prevalence of DM and IGT increased with rising BMI and with increase in WHR. Both these studies support our findings.

Dyslipidemia

In the present study, 50% (54/108) of the study group had raised TC level, 72.2% (78/108) had raised LDL-cholesterol (LDL-C) level, 66.7% (72/108) had decreased HDL-cholesterol (HDL-C) level, and 50% (54/108) had hypertriglyceridemia. This shows that the incidence of dyslipidemia is high in diabetics.

Liao *et al.* reported that patients who had diabetic glycemic tolerance had more of intra-abdominal fat, higher TG levels, lower HDL-C levels, and higher blood pressure than those with normal glucose tolerance. Southwell *et al.* in their study found that 40% of the patients with diabetes had hypercholesterolemia.

HbA1C level

In the present study, 18 (16.66%) patients had HbA1C level <7. More than half of the patients, i.e., 90 (83.33%) had HbA1C more than or equal to 7. Paolo fumelli in his study of 562 diabetic patients found that all the patients had level HbA1C >8%.

Abnormal Thyroid Profile

In the present study, 13% (14) of the total 108 patients with DM had abnormal thyroid profile.

The present study is similar to Abdel-Rahman *et al.* who in his study of 908 Type 2 diabetic patients found that the prevalence of thyroid disease was 12.5%, 6.6% of whom were newly diagnosed and 5.9% had known thyroid dysfunction. The prevalence of thyroid disease in the nondiabetic control group was 6.6%.

Chubb *et al.* in a cross-sectional study of 420 patients with Type 2 DM found that 8.6% of patients had subclinical hypothyroidism.

Uppal in his study found that the prevalence of thyroid disease in the diabetic patients registered in general practice was 24.5%. In the control group of nondiabetics, the prevalence was 5%. Akbar *et al.* in their study of 100 type 2 diabetics found that the prevalence of

thyroid dysfunction was 16% and in control group of nondiabetics, it was 7%.

Zdrojewicz *et al.* in their study of 75 diabetic patients found that there was no difference in thyroid gland function between patients with Type 2 DM and nondiabetics. This study contradicts our findings.

Distribution of Thyroid Abnormalities

In the present study, 8.3% (9) of the patients had report suggestive of subclinical hypothyroidism, 2.8% (3) of the patients had report suggestive of subclinical hyperthyroidism, and 1.9% (2) of the patients had overt hypothyroidism.

This study was similar to Abdel-Rahman *et al.* who in their study of 908 type 2 diabetic patients found that 10.3% of patients had hypothyroidism (overt and subclinical) and 1.7% of patients had hyperthyroidism (overt and sub clinical). Uppal in his study of 120 diabetic patients, 17% of patients had hypothyroidism and 7.5% had hyperthyroidism.

Celani *et al.* in their study of 290 type 2 DM patients found that 91 patients (31.4%) had abnormal TSH concentrations out of which 48.3% had subclinical hypothyroidism, 24.2% had subclinical hyperthyroidism, 23.1% had overt hypothyroidism, and 4.4% had overt hyperthyroidism.

In the present study, diabetic patients when compared with the control group of normal patients in Whickham study and a 20 years follow-up of Whickham survey by Vanderpump *et al.* shows that the prevalence of altered thyroid profile in the study group is significant ($P = 0.0064$). The prevalence of thyroid disease as per colorado thyroid disease prevalence conducted in 1995 was estimated to be 6.6% in the general population, with hypothyroidism being the most common presentation.

The presence of altered thyroid profile in diabetic patients may be due to the fact that:

- In euthyroid individuals with DM, the serum T3 levels, basal TSH levels and TSH response to thyrotropin-releasing hormone (TRH) may all be strongly influenced by the glycemic status.
- Poorly controlled diabetes may also result in impaired TSH response to TRH or loss of normal nocturnal TSH peak.
- It may be related to older age of the type 2 DM patients.

Significance of Age in Patients with Abnormal Thyroid Profile

Among the patients with abnormal thyroid profile, 14.35% (2/14) of patients were found to be of age 40 or less,

28.5% (4/14) were in between 41 and 50 years age group, 35.7% (5/14) are found to be in between 51 and 60 years, and 3 of them were of age group 61-70 years. Although there is difference, when compared between patients with normal and abnormal thyroid profile, it has no significance ($P = 0.847$).

The present study findings contradict with that of Chubb *et al.* who in their study found that age and anti-TPO status correlates with altered thyroid profile in diabetic patients.

Vondra *et al.* in his study found that thyroid diseases in diabetic patients are 2-3 times higher than in nondiabetic subjects; it raises with age and is strongly influenced by female gender and autoimmune diabetes. This also contradicts with our findings.

Analysis of Sex Distribution in Cases with Abnormal Thyroid Profile

In the present study, 85.7% (12/14) patients were found to be female compared to 14.3% (2/12) male in the group with abnormal thyroid profile. Compared between patients with normal and abnormal thyroid profile the difference is statistically significant ($P = 0.031$).

Celani *et al.*, Michalek *et al.*, and Abdel-Rahman *et al.* in their study found that the prevalence of thyroid dysfunction was significantly higher in the female than in the male diabetic patients.

Furthermore, Vondra *et al.* and Cardoso *et al.* found a significant correlation between female gender and altered thyroid profile.

Significance of Type of Treatment in Patients with Abnormal Thyroid Profile

Out of 14 patients with thyroid abnormality, 57.1% (8/14) were on OHA, 14.3% (2/14) were on insulin, and 28.6% (4/14) were on both OHA/insulin. Compared with normal thyroid profile group, it has no statistical significance ($P = 0.293$).

The findings of our study are similar with Chubb *et al.*, who in their study found that altered thyroid profile was associated with anti-TPO status and age, but there were no independent associations with serum cholesterol, history of coronary heart disease, SHT, HbA1C, or hypoglycemic therapy. Celani *et al.* in their study found that the prevalence of abnormal thyroid function test results was significantly higher in insulin-treated patients than in those receiving OHA. This contradicts with our study.

Significance of Associated Systemic Hypertension in Patients with Abnormal Thyroid Profile

In the present study, 57.1% (8/14) of patients had hypertension in the group of 14 patients with abnormal thyroid profile, whereas 42.9% (6/14) of patients had no hypertension. This finding has no statistical significance ($P = 0.567$).

The findings of our study are similar with Chubb *et al.* who in their study found that there was no independent association of altered thyroid profile with a history of systemic hypertension.

Analysis of BMI in Cases with Normal and Abnormal Thyroid Profile

Out of 14 patients with abnormal thyroid profile, 50.0% (7/14) were overweight and 28.6% (4/14) were obese. The mean BMI of the patients with altered thyroid profile was 26.50 Kg/m² compared to 24.24 Kg/m² in patients with normal thyroid profile. There was no significant correlation between BMI and abnormal thyroid profile ($P = 0.367$).

Fan *et al.* observed in their study that obese individuals have normal levels of T4 and TSH but increased levels of T3 in a minority of subjects.

The findings contradict with Process *et al.* who in their study found that besides known parameters such as age and drugs, thyroid-function tests can also be altered by DM and obesity.

Analysis of HbA1C Level in Cases with Normal and Abnormal Thyroid Profile

Out of 14 patients with abnormal thyroid profile, 21.4% (3/14) had HbA1C value less than 7% and the remaining 78.5% (11/14) had HbA1C more than or equal to 7. The mean HbA1C level of the patients with abnormal thyroid profile was 9.02% compared to 8.67% in the patients with normal thyroid profile. However, this difference is not statistically significant ($P = 0.757$).

The findings are similar to the studies by Parr *et al.* and Chubb *et al.* who found no correlation between changes in free thyroid hormone concentrations and HbA1C level.

Celani *et al.* in their study in 91 diabetic patients with altered thyroid profile found that TSH level in serum decreased in subclinical hypothyroidism and increased in subclinical hyperthyroidism with significant fall in HbA1C level. This contradicts with our findings.

Analysis of Duration of Diabetes in Cases with Normal and Abnormal Thyroid Profile

Among the 14 patients with abnormal thyroid profile, 21.4% (3) had diabetes more than 10 years, 35.7% (5) had

duration between 6 and 10 years and 42.9% (6) had diabetes 5 years or less. The mean duration of diabetes in patients with abnormal thyroid profile is 7.07 years compared to 4.6 years in normal thyroid profile group. The difference is statistically not significant (0.054).

Analysis of Family History of DM in Cases with Normal and Abnormal Thyroid Profile

All the 14 patients with abnormal thyroid profile had family history of DM, whereas only 28 patients with normal thyroid profile had family history of diabetes ($P < 0.0001$). The difference is statistically significant.

Analysis of Serum Lipid Profile in Cases with Normal and Abnormal Thyroid Profile

In the present study, mean HDL (47.43) in patients with abnormal thyroid profile patients is higher compared to the mean HDL level (42.04) in patients with normal thyroid profile group. These results are similar to the study Papazafropoulo *et al.* who showed higher values of HDL-C in diabetic patients with thyroid disorders.

Mean TC in patients with abnormal thyroid profile (249.29) is higher compared to the mean value of TC in normal thyroid profile group (221.8).

About 13% of patients with abnormal thyroid profile had mean LDL-C levels higher (135.93) compared to mean LDL-C level in patients with normal thyroid profile (128.66). Similarly, mean TG value is higher (212.86) in patients with abnormal thyroid profile compared to the mean TG level in normal thyroid profile group (149.68).

Comparing both the groups showed statistical significance with serum lipid profile.

Chubb *et al.* in their sub study of Fremantle diabetes study found that there was strong association between TSH and lipid parameters with adverse cardiac risks at low insulin sensitivity that was absent at higher insulin sensitivity.

Bakker *et al.* also concluded the same in their study in nondiabetic individuals with insulin resistance. Findings in this study are similar to these studies.

Our study found that the occurrence of thyroid disease in diabetic population is 13%. Age, type of treatment, BMI, HbA1C level, regularity of treatment, and history of hypertension have no correlation with thyroid profile in type 2 DM, but there is significant correlation between female gender, family history of DM, serum lipid profile, and abnormal thyroid profile.

CONCLUSION

- Occurrence of thyroid dysfunction is 13% of the total 108 patients with Type 2 DM in our study.
- There is a significant correlation between sex, family history of diabetes, serum lipid profile, and abnormal thyroid profile.
- Patients with thyroid dysfunction had higher mean TC, HDL and LDL-C in comparison to patients without thyroid dysfunction in our study.
- There is no significant correlation between abnormal thyroid profile and age, duration of diabetes, type of treatment, systemic hypertension, BMI.
- There was no significant correlation between glycemic control (HbA1C) and occurrence of altered thyroid function in Type 2 DM.

LIMITATIONS

- Study population was small.
- Associated thyroid autoimmunity was not evaluated due to constraints. Hence, it was not able to refine the spectrum of thyroid dysfunction in Type 2 diabetics.
- Follow-up study was not done. Hence, the natural history of subclinical thyroid dysfunction and its effect on various parameters could not be assessed.

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