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Research Article

THYROID FUNCTION ABNORMALITIES IN PATIENTS WITH METABOLIC SYNDROME: AN OBSERVATIONAL STUDY

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ABSTRACT

Objective: The objective of the study is to study the presence of thyroid function abnormalities in cases with metabolic syndrome.

Methods: This was a prospective observational study done in the department of biochemistry of a tertiary care medical college. 60 patients fulfilling the criteria for metabolic syndrome as per the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) criteria were included in this study. Demographic details of all the patients were noted. A detailed history was taken and thorough clinical examination was done. Thyroid function test was done in all cases. The presence of thyroid function test abnormalities was analyzed. Statistical analysis was done using SSPS 21.0 software and $p<0.05$ was taken as statistically significant.

Results: Out of these 60 cases, there were 37 (61.67%) males and 23 (38.33%) females with a M: F ratio of 1:0.62. The mean age of male and female patients was found to be 47.96±14.78 and 45.78±13.26 years, respectively. The mean age of male and female patients was found to be comparable with no statistically significant difference. Skin changes were present in 23 (38.33%) cases followed by tiredness (36.67%), constipation (25.00%), weight gain (21.67%), and pallor (15%). 29 (48.33%) were euthyroid whereas subclinical and clinical hypothyroidism was present in 18 (30%) and 10 (16.67%), respectively. 3 (5%) patients were found to have subclinical hyperthyroidism whereas there was no patient with clinical hyperthyroidism.

Conclusion: Thyroid function abnormalities are common in patients with metabolic syndrome. It is therefore important to screen patients for thyroid function abnormalities so that appropriate interventions can be undertaken if necessary.

Keywords: Metabolic syndrome, Thyroid function test, Hypothyroidism, Hyperthyroidism.

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INTRODUCTION

Metabolic syndrome is characterized by the presence of multiple risk factors that significantly elevate the likelihood of cardiovascular diseases, diabetes, and other metabolic disorders in an individual. The clinical features of metabolic syndrome include abdominal obesity, insulin resistance, dyslipidemia, and hypertension. Other than these features, hyperglycemia, hypertriglyceridemia, reduced high-density lipoprotein cholesterol (HDL-C), and skin manifestations such as Acanthosis nigricans, hirsutism, and presence of xanthomas and xanthelasmas, may frequently be present [1]. The diagnosis of metabolic syndrome is confirmed if any 3 features out of the following 5 are present: Fasting glucose ≥100 mg/dL, blood pressure ≥130/85 mmHg, triglycerides ≥150 mg/dL, HDL-C < 40 mg/dL in men or < 50 mg/dL in women, and waist circumference ≥102 cm (40 in) in men or ≥88 cm (35 in) in women. The prevalence of metabolic syndrome has been steadily rising, mirroring the escalating global epidemic of obesity and sedentary lifestyles. This increase is attributed to various factors, including changes in dietary habits, reduced physical activity, and genetic predispositions [2].

Metabolic syndrome is not merely a collection of disparate risk factors; rather, it represents a systemic imbalance with profound implications for various physiological processes, including thyroid function [3]. Individuals with metabolic syndrome often exhibit alterations in thyroid hormone levels, thyroid autoimmunity, and structural thyroid abnormalities. The intricate interplay between metabolic abnormalities and thyroid functions involves complex molecular mechanisms that warrant meticulous exploration. Insulin resistance, a hallmark of metabolic syndrome, has been implicated in disrupting thyroid hormone homeostasis [4]. Studies have suggested that insulin resistance may impair the conversion of thyroxine (T4) to the more active triiodothyronine (T3) in peripheral tissues, contributing to a state of relative hypothyroidism. Furthermore, dyslipidemia, a common feature of metabolic syndrome, may influence thyroid hormone transport and metabolism. These intricate connections underscore the need for a detailed investigation into the bidirectional relationship between metabolic syndrome and thyroid function [5].

The most common thyroid function abnormality in individuals with metabolic syndrome is reported to be subclinical hypothyroidism. Majority of the individuals with metabolic syndrome usually do not have any overt clinical symptoms related to thyroid functions [6]. However, screening of these patients for thyroid functions in many cases has shown subclinical hypothyroidism in the form of isolated rise in TSH levels and normal free triiodothyronine (FT3) and free thyroxine (FT4). This subclinical hypothyroidism may further exacerbate the dyslipidemia which is already present in metabolic syndrome, thereby further increasing the risk of adverse cardiovascular events in these patients [7].

Given the fact that many studies have reported thyroid function abnormalities to be common among metabolic syndrome patients, it becomes important to screen individuals with metabolic syndrome for thyroid abnormalities [8]. Thyroid dysfunction in the context of metabolic syndrome may exacerbate cardiovascular risks, worsen insulin resistance, and contribute to an unfavorable metabolic profile [9]. Identifying thyroid dysfunction early in the course of metabolic syndrome could facilitate timely interventions, potentially mitigating

the progression of associated complications. In patients with metabolic syndrome, thyroid hormone replacement therapy may need to be modified in the presence of coexisting metabolic abnormalities [10].

With this background, we conducted this study to know the presence of thyroid function abnormalities in cases with metabolic syndrome.

METHODS

This was a cross-sectional observational study conducted in the department of biochemistry of a tertiary care medical college. 60 patients fulfilling the criteria for metabolic syndrome were included in this study on the basis of pre-defined inclusion and exclusion criteria. Informed written consent was obtained from all the patients. The sample size was calculated on the basis of pilot study on the topic of thyroid functions in metabolic syndrome, assuming 90% power and 95% confidence interval, the sample size required was 60 patients; therefore, we included 60 patients in our study. Detailed history of all individuals including age, sex, history of any medications, physical activities, any surgery, eating habits, and lifestyle was taken. Height and weight were noted and BMI was calculated. Fasting blood glucose, blood pressure and triglycerides, HDL-C, and waist circumference were noted in all cases.

Patients with any 3 of the 5 following factors were labeled to be having metabolic syndrome as per the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) criteria [11].

1. Fasting glucose ≥100 mg/dL.
2. Blood pressure ≥130/85 mmHg,
3. Triglycerides ≥150 mg/dL.
4. HDL-C < 40 mg/dL in men or < 50 mg/dL in women
5. Waist circumference ≥102 cm (40 in) in men or ≥88 cm (35 in) in women.

Free triiodothyronine (FT3), free thyroxine (FT4), and Thyroid stimulating hormone (TSH) levels were done in all the cases. Blood samples were obtained in the morning before breakfast for thyroid function tests. The normal reference values used for diagnosing subclinical and clinical hypothyroidism were 0.8–2 ng/mL for T3, 5.5–12.2 µg/dL for T4, and 0.6–4.5 µIU/ml for TSH. Based on the results of the thyroid function tests and clinical features, patients were categorized as having either subclinical hypothyroidism (elevated TSH with normal T3 and T4) or clinical hypothyroidism (elevated TSH with reduced T3 and T4). The analysis was conducted considering both thyroid function test results and clinical features.

The statistical analysis utilized SPSS version 21.0, presenting quantitative data as mean and standard deviation, while qualitative data were summarized using frequency and percentage tables. Unpaired t-tests were employed for quantitative data, and Chi-square tests were used for qualitative data. Statistical significance was set at $p<0.05$.

Inclusion criteria

1. Patients diagnosed to be having metabolic syndrome as per the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) criteria.
2. Age above 18 years.
3. Those who gave informed and written consent to be part of the study.

Exclusion criteria

1. Age <18 years.
2. Those who refused consent to be part of study.
3. Patients with known thyroid functional abnormalities such as hypothyroidism or hyperthyroidism.
4. Patients taking any drug which is likely to affect thyroid hormone levels such as lithium or metformin.

RESULTS

In this study of thyroid function abnormalities in cases with metabolic syndrome, a total of 60 patients were included. Out of these 60 cases, there were 37 (61.67%) males and 23 (38.33%) females with a M:F ratio of 1:0.62 (Fig. 1).

Majority of the patients were between 41 and 50 years (46.67%) followed by more than 50 years of age (31.67%) and 31–40 years (16.67%). Only 3 (5%) patients below 30 were found to fulfill the criteria for metabolic syndrome. The mean age of male and female patients was found to be 47.96±14.78 and 45.78±13.26 years, respectively. The mean age of male and female patients was found to be comparable with no statistically significant difference (Table 1).

The analysis of patients on the basis of signs and symptoms showed that skin changes were present in 23 (38.33%) cases followed by tiredness (36.67%), constipation (25.00%), weight gain (21.67%), and pallor (15%) (Fig. 2).

All patients underwent thyroid function tests. On the basis of thyroid function tests, patients were divided into euthyroid, subclinical hypothyroidism, subclinical hyperthyroidism, hypothyroidism, and hyperthyroidism (Table 2). 29 (48.33%) were euthyroid whereas subclinical and clinical hypothyroidism was present in 18 (30%) and 10 (16.67%), respectively. 3 (5%) patients were found to have subclinical hyperthyroidism whereas there was no patient with clinical hyperthyroidism (Table 2).

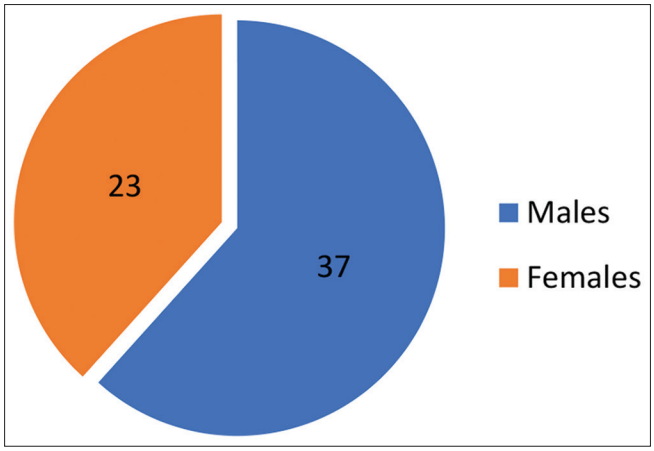

Fig. 1: Gender distribution of the studied cases

Table 1: Gender-wise distribution of age groups

Age group	Males		Females	
	No of patients	Percentage	No of patients	Percentage
18–30 years	**2**	**3.33**	**1**	**1.67**
31–40 years	5	8.33	5	8.33
41–50 years	19	31.67	9	15.00
>50 years	11	18.33	8	13.33
Total	37	61.67	23	38.33
	Mean age: 47.96±14.78		Mean age: 45.78±13.26	

p=0.566 (Not significant)

Table 2: Thyroid function status in studied cases

Thyroid function status	Number of patients	Percentage
Euthyroid	29	48.33
Subclinical hypothyroidism	18	30.00
Clinical hypothyroidism	10	16.67
Subclinical hyperthyroidism	3	5.00
Hyperthyroidism	0	0.00
Total	60	100

In the euthyroid group, the mean T3 was 1.21±0.82 ng/mL, mean T4 was 9.2±2.4 µg/dL, and mean TSH was 4.1±2.1 µIU/ml. Subclinical hypothyroidism exhibited higher mean T3 (1.98±0.76 ng/mL) and mean TSH (10.22±4.10 µIU/ml) but slightly lower mean T4 (8.84±3.12 µg/dL). Clinical hypothyroidism was characterized by significantly lower mean T3 (0.64±0.32 ng/mL) and T4 (3.9±2.46 µg/dL) but markedly elevated mean TSH (32.86±11.12 µIU/ml). Subclinical hyperthyroidism displayed higher mean T3 (1.92±0.64 ng/mL), lower mean T4 (6.2±2.98 µg/dL), and significantly reduced mean TSH (0.42±0.24 µIU/ml) (Table 3).

DISCUSSION

In our study of thyroid function abnormalities in cases with metabolic syndrome, a total of 60 patients were included. Out of these 60 cases, there were 37 (61.67%) males and 23 (38.33%) females with a M:F ratio of 1:0.62. The mean age of male and female patients was found to be 47.96±14.78 and 45.78±13.26 years, respectively. The mean age of male and female patients was found to be comparable with no statistically significant difference. Tamrakar *et al*. conducted a study to determine the prevalence of metabolic syndrome in new-onset type 2 diabetes mellitus (T2DM) and to study the risk components of metabolic syndrome [12]. For this purpose, the authors conducted hospital-based cross-sectional study conducted in 132 patients. Majority of the patients (58.9%) were in the age group of 40–60 years with the mean age of 49.72±12.44 years. The prevalence of metabolic syndrome was 111 (84.1%), 106 (80.3%), 94 (71.2%), and 82 (62.1%) using the World Health Organization (WHO), Harmonized, National Cholesterol Education Program-Adult Treatment Panel III (NCEP ATP III), and International Diabetes Federation (IDF) definitions, respectively. One hundred and six patients (80.3%) had 3 or more individual components of metabolic syndrome. There was substantial agreement between NCEP ATP III-Harmonized (k=0.714, p<0.001) and Harmonized-WHO (k=0.716, p<0.001) definitions for diagnosing metabolic syndrome. The mean age of cases in this study was found to be similar to mean age of cases in our study. Similar mean age of the cases with metabolic syndrome has also been reported by the authors such as Ogedengbe *et al.* [13] and Onesi *et al.* [14].

The analysis of patients on the basis of signs and symptoms showed that skin changes were present in 23 (38.33%) cases followed by tiredness (36.67%), constipation (25.00%), weight gain (21.67%), and pallor (15%). Since metabolic syndrome in many cases is associated with subclinical and clinical hypothyroidism, these clinical features may be seen in individuals with metabolic syndrome. These clinical features may be an indication of thyroid function abnormalities or that of metabolic syndrome itself. Khan *et al*. conducted a study to determine the frequency, modes of clinical presentation, and indications for replacement therapy in a cohort of patients with subclinical hypothyroidism [15]. In this study, common clinical features of subclinical hypothyroidism were reported to be common presenting symptoms that were lethargy in 146 patients (56.2%), increase in weight in 102 patients (39.2%), and menstrual irregularities in 90 patients (34.6%). The clinical features in our study were found to be similar to this study. Similar clinical features were also reported by the authors such as Khatiwada *et al.* [16] and Tehrani *et al.* [17].

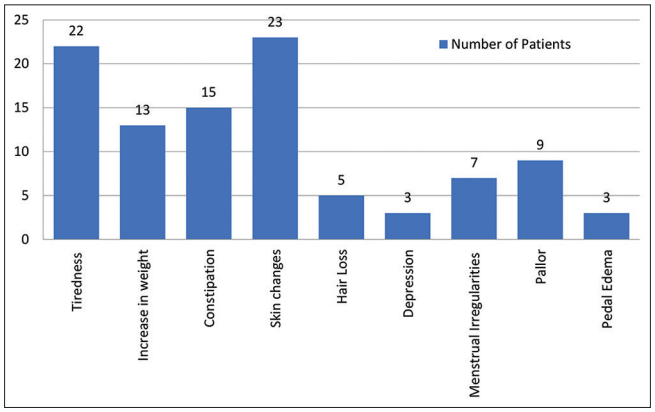

Fig. 2: Signs and symptoms of patients with metabolic syndrome

Table 3: Mean T3, T4, and mean TSH of studied cases

Thyroid function status	Mean T3	Mean T4	Mean TSH
Euthyroid	1.21±0.82	9.2±2.4	4.1±2.1
Subclinical hypothyroidism	1.98±0.76	8.84±3.12	10.22±4.10
Clinical hypothyroidism	0.64±0.32	3.9±2.46	32 0.86±11.12
Subclinical hyperthyroidism	1.92±0.64	6.2±2.98	0.42±0.24
Hyperthyroidism	-	-	-

In our study, 29 (48.33%) were euthyroid whereas subclinical and clinical hypothyroidism was present in 18 (30%) and 10 (16.67%), respectively. 3 (5%) patients were found to have subclinical hyperthyroidism whereas there was no patient with clinical hyperthyroidism. Senthil *et al*. conducted a study to find the thyroid functions in patients with metabolic syndrome diagnosed as per the International Diabetes Federation (IDF) criteria and to know the spectrum of thyroid dysfunction [18]. A total of 300 patients with metabolic syndrome were included in this study. Thyroid dysfunction was present in 45% of the patients. Hypothyroidism was noted in 43 patients, subclinical hypothyroidism was noted in 114 patients, subclinical hyperthyroidism in 6 patients, and hyperthyroidism in 1 patient. Although our study has also shown similar results, unlike this study, there was no patient with clinical hyperthyroidism in our study. Subclinical hypothyroidism being the most common thyroid function abnormality in cases with metabolic syndrome has also been reported by the authors such as Abha *et al.* [19] and Deshmukh *et al.* [20]

CONCLUSION

Among patients having metabolic syndrome, a significant number of individuals was found to have thyroid function abnormalities. The most common thyroid function abnormality was found to be subclinical hypothyroidism. It is important to screen all the patients having metabolism for the presence of thyroid function abnormalities so that early intervention can be done at appropriate time. Delay in the diagnosis of thyroid function abnormalities may further worsen dyslipidemia seen in patients with metabolic syndrome.

CONFLICT OF INTEREST

None.

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