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ECG Changes in Thyroid Dysfunction in Diabetes Mellitus

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Abstract

Introduction: *Thyroid disorder and DM are the two most common endocrine disorders encountered in clinical practice which have been shown to mutually influence each other and relationship between both the conditions had long been reported. A certain ECG changes have been recognized in thyroid disorder. this study conducted to see the relation of Thyroid gland with diabetes mellitus in already diagnosed diabetic patients.*

Aim: *To see the relation of Thyroid gland with diabetes mellitus in already diagnosed diabetic patients.*

Material and Methods: *A cross sectional study conducted in Rohilkhand Medical College and Hospital, Bareilly to see the relation of Thyroid gland with diabetes mellitus in already diagnosed diabetic patients. Total 130 Diabetes mellitus patients, 7 patients (5.4%) had T1DM and 123 patients (94.6%) had T2DM selected purposively for the study [Table 2].A patients were undergone to check the status of thyroid hormone, along with ECG. The data was collected and stastastically analyzed.*

Results: *Mean age of the all patients were 49.20 ± 13.2 years. The most common clinical signs are a narrowed pulse pressure, diastolic hypertension, low cardiac output, reduced EF impaired diastolic function and bradycardia.[18] Overt hypothyroidism is associated with accelerated atherosclerosis and CAD due to hypercholesterolemia and diastolic hypertension. 34% of hypothyroidism showed significant ST-T ECG changes with angina and CAD on subsequent investigation. Reduced EF and diastolic dysfunction were also significant in this study. In hyperthyroidism, sinus tachycardia, AF, wide pulse pressure, dyspnoea on exertion, exercise intolerance are common.[17] Increased LV mass due to sustained volume overload with resultant cardiac work occurs in hyperthyroidism.[25] This may cause ST-T ECG changes due to LV strain. In this study, sinus tachycardia was the commonest ECG finding (61%), LV chamber hypertrophy was the second common abnormality (43%). ST-T ECG changes are due to LV strain occurs in 21% of cases of hyperthyroidism.*

Conclusions: *Horizontal ST- segment depression of 1mm or more 0.08 s from the J- point with T- wave inversion was the ECG finding in 15 hypothyroidism; 3 in anterior LV wall leads, 4 in inferolateral LV wall leads. 10 hypothyroidism has sinus bradycardia in ECG , being the second commonest ECG abnormality. All hypothyroidism with ST- T changes had stable angina. The present study findings are in conformity with earlier studies. Sinus tachycardia was the commonest ECG finding in the hyperthyroidism 6(40%);LV hypertrophy 3 (20%); prolonged Q-Tc interval 2(13.3%); LV strain(ST-T changes), Atrial fibrillation, Atrial ectopics and Ventricular ectopics 1(6.7%).*

Introduction

Diabetes mellitus (DM) is one of the modern pandemics and an important health problem worldwide. It is on rising trend. Thyroid disorder and DM are the two most common endocrine disorders encountered in clinical practice which have been shown to mutually influence each other and relationship between both the conditions had long been reported(1).

The number of people living with diabetes has risen from 108 million in 1980 to 422 million in 2014. The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014. Diabetes prevalence has been rising more rapidly in middle- and low-income countries.[2]

In Type 2 diabetes mellitus (T2DM) there had been many reports showing a higher occurrence of thyroid diseases, particularly hypothyroidism, among people with Type 2 diabetes. The association between Type 2 diabetes and thyroid disorder, however, remains unexplained(3). A recent study done in Manipurhad found higher prevalence of thyroid dysfunction (31.2%) in type 2 DM(4). Though numbers of studies done in different part of the world had reported prevalence of thyroid dysfunction among diabetes patients various from 10 to 32.4%.(5–9)

Thyroid disease was common in the general population and the prevalence increases with age. Hypothyroidism was by far the most common thyroid disorder in the adult population and was more common in older women. Diabetic patients had a higher prevalence of thyroid disorders compared with the normal population. Prevalence of thyroid disease in diabetic patients was 10.81% as compared to 6.6% in general population. The reason for this high prevalence was that patients with autoimmune disease of one organ were at risk of developing autoimmune diseases of other organs. Thyroid disorders were more common in females; up to 30% of female patients with type 1 diabetic had thyroid disease. The rate of postpartum thyroiditis in diabetic patients were three times that in normal women.[10]

Effects of Diabetes Mellitus on Thyroid Hormones and Thyroid Diseases

There are multiple systems on which thyroid hormone acts or contributes to their function but Heart and the vessels are the major target organs. Marked changes in these organs occur in Patients with thyroid dysfunction.[11] Many symptoms and signs recognized in patients with Overt hyperthyroidism and hypothyroidism are due to increased or reduced action of thyroid hormones on heart and vascular system.[12]

Altered thyroid hormones had been described in patients with diabetes especially those with poor glycemic control. In diabetic patients, the nocturnal TSH peak was blunted or ended and the TSH response to TRH was diminished(13). Reduced T3 levels had been observed in uncontrolled diabetic patients. This “low T3 state” could be explained by impairment in peripheral conversion of T4 to T3 that normalizes with improvement in glycemic control.

Though, in a study by Coiro et al. involving type 1 diabetes patients with absent residual pancreatic beta cell function, amelioration in glycemic control did not restore the normal nocturnal TSH peak suggesting a diabetes-dependent alteration in the central control of TSH(14.). Higher levels of circulating insulin connected with insulin resistance had shown a proliferative effect on thyroid tissue resulting in larger thyroid size with increased formation of nodules (15,16.)

In thyroid disease diabetes coexists with various metabolic abnormalities and induce insulin Resistance and oxidative stress vicious cycle. The above associations in combination with the thyroid hormones-induced hemodynamic alterations might explain

The increased risk of coronary artery disease (CAD), cerebral ischemia risk in patients with overt or subclinical hypothyroidism.[6] Recognized electrocardiogram (ECG)

changes in hyperthyroidism include tachycardia, arrhythmias and non-specific T-wave changes. ST-segment changes are not well documented.[2-3] Common ECG changes in hypothyroidism are bradycardia, Low voltage complex, ST-segment depression, QT interval lengthening and increased QT dispersion, flattening or inversion of T wave, which reflects the prolonged cardiac action potential. In addition, these patients are more prone to ventricular arrhythmias particularly in presence of ischemic heart disease, due to increased electrical depression in myocardium.[10-12] There is QRS prolongation, right bundle branch block and infrequently Torsades de pointes in hypothyroidism.

Materials and Methods

Study Setting: All patients with diagnosis of diabetes mellitus, attending Rohilkhand Medical College and Hospital, Bareilly, taken as cases in the study.

Study Design: Cross Sectional Study.

Study Population: Diabetes patients newly registered at the OPD/IPD of Rohilkhand Medical College and Hospital, Bareilly.

Sample Size: Purposive selection of 130 patients

Study tools: Pre designed semi-structured questionnaire

A total of1 30 cases of diabetes diagnosed as hypothyroidism and hyperthyroidism by their Clinical presentation and thyroid function tests were studied for the cardiovascular manifestations. Out of these 82 cases were of Euthyroid, 33cases were of hypothyroidism and 15 cases were of Hyperthyroidism. Patients of both sexes and above 18years of age were included. Pre-existing heart diseases like rheumatic heart disease, congenital heart disease, ischemic heart disease ,hypertensive heart disease cardiomyopathy ,chronic smokers, metabolic syndrome, and Patients taking medications that alter the thyroid function like beta- blockers, lithium, oral contraceptive pills, steroids, amiodarone and alcohol were excluded. Cardinal symptoms of ischemic heart disease were recorded. Investigations included T3, T4,, thyroid stimulating hormone (TSH), HbAIc, ECG.

Statistical Analysis

Data were compiled and analysed. Differences in HbA1c and ECG findings between hypothyroid and hyperthyroid patients were tested for statistical significance by two sample test along with 95% confidence intervals of the mean difference.

Results

Age and Gender Distribution

Amongst 130 diabetes patients, youngest patient was a 18-year-old male and oldest was a 80-year-old male, with peak incidence of thyroid dysfunction in4th and 5thdecade [Table1]. Distribution of patients based on Gender and DM type [Table 2].

ECG Findings in Hypothyroidism

Horizontal ST-segment depression of 1mm or more 0.08s from the J-point with T-wave inversion was the ECG finding in 15 hypothyroidism (45.45%); , low voltage complex in 8 (24.24%), Prolonged Q-Tc in 8 (24.24%), Sinus bradycardia in 1 (3.03%),and ventricular ectopics in 1 (3.03%) [Table3]. All hypothyroidism with ST-T changes had stable angina.

ECG Findings in Hyperthyroidism

Sinus tachycardia was the commonest ECG finding in the hyperthyroidism 6(40%); LV hypertrophy 3 (20%); prolonged Q-Tc interval 2(13.3%); LV strain(ST-T changes) 1(6.7%); atrial fibrillation 1(6.7%); atrial ectopics 1(6.7%); ventricular ectopics 1(6.7%). [Table4]

Table 1: Age and Gender wise distribution of all Patients

val Sr. no	Age groups (Years)	Gender		
		Male (%)	Female (%)	Total (%)
1	18 -30	7 (17.9)	5 (5.5)	12 (9.2)
2	31 – 40	4 (10.3)	22 (24.2)	26 (20)
3	41 – 50	9 (23.1)	29 (31.9)	38 (29.2)
4	51 – 60	13 (33.3)	19 (20.9)	32 (24.6)
5	61 – 70	4 (10.3)	16 (17.6)	20 (15.4)
6	71 – 80	1 (2.6)	0	1 (0.8)
7	> 80	1 (2.6)	0	1 (0.8)
	Total	39 (100)	91 (100)	130 (100)

Table 2 : Distribution of patients based on Gender and DM type

Sr. no	Gender	Type of Diabetes mellitus (DM)		
		Type 1 (%)	Type 2 (%)	Total (%)
1	Male	6 (85.7)	33 (26.8)	39 (30)
2	Female	1(14.3)	90 (73.2)	91 (70)
	Total	7(100)	123 (100)	130 (100)

Table 3: Electrocardiographic findings in hypothyroidism (*n*=33)

Findings	No. of cases	%
ST depression T inversion	15	45.45
Low voltage complex	8	24.24
Prolonged Q- Tc interval	8	24.24
Sinus bradycardia	1	3.03
Ventricular Ectopic	1	3.03
Chi square test = 17.76; df = 2; p value = 0.0014* *P<0.05 statistically significant.		

Table 4: Electrocardiographic findings in hyperthyroidism (*n*=15)

Findings	No. of cases	%
Sinus tachycardia	6	40.0
LV hypertrophy	3	20.0
Prolonged Q-Tc interval	2	13.3
LV strain (ST-T changes)	1	6.7
Atrial fibrillation	1	6.7
Atrial ectopics	1	6.7
Ventricular ectopics	1	6.7
Chi square test = 5.5; df = 2; p value = 0.4815* *P>0.05 statistically not significant.		

Table 5: Distribution of patients based on thyroid condition and Type of DM

Sr. no	Thyroid Condition	Type of Diabetes mellitus (DM)		
		Type 1 (%)	Type 2 (%)	Total (%)
1	No Deformity	5 (71.4)	77 (62.6)	82 (63.1)
2	Hyperthyroidism	1 (14.3)	14 (11.4)	15 (11.5)
3	Hypothyroidism	1 (14.3)	32 (26.0)	33 (25.4)
	Total	7(100)	123 (100)	130 (100)
Chi square test = 0.489; df = 2; p value = 0.783# *P>0.05 statistically not significant.				

Discussion

A cross sectional study conducted in Rohilkhand Medical College and Hospital, Bareilly to see the relation of Thyroid gland with diabetes mellitus in already diagnosed diabetic patients. Total 130 Diabetes mellitus patients, 7 patients (5.4%) had T1DM and 123 patients (94.6%) had T2DM selected purposively for the study [Table 2].A patients were undergone to check the status of thyroid hormone, along with ECG. No deformity develop in 82 patient, Hypothyroidism occur in 33 patient and hypothyroidism occur in 15 patient in total of 130 patients [Table 5].

Mean age of the all patients were 49.20 ± 13.2 years with minimum age of the patients in study was 18 years and maximum age was 88 years.

Thyroid hormones have significant effect on the heart and cardiovascular system.[17] The most common clinical signs are a narrowed pulse pressure, diastolic hypertension, low cardiac output, reduced EF impaired diastolic function and bradycardia.[18] Overt hypothyroidism is associated with accelerated atherosclerosis and CAD due to hypercholesterolemia and diastolic hypertension.[19-22] A prospective study from Japan showed an increase risk of ischemic heart disease in men but not women with subclinical hypothyroidism.[23] A prospective study in the United States, followed up men and women age 65 or older for more than 10 years showed no influence of hypothyroidism (overt or subclinical) on cardiovascular outcome and mortality.[24] In this study, 34% of hypothyroidism showed

significant ST-T ECG changes with angina and CAD on subsequent investigation. Reduced EF and diastolic dysfunction were also significant in this study.

In hyperthyroidism, sinus tachycardia, AF, wide pulse pressure, dyspnoea on exertion, exercise intolerance are common.[17] Increased LV mass due to sustained volume overload with resultant cardiac work occurs in hyperthyroidism.[25] This may cause ST-T ECG changes due to LV strain. In this study, sinus tachycardia was the commonest ECG finding (61%), LV chamber hypertrophy was the second common abnormality (43%). ST-T ECG changes are due to LV strain occurs in 21% of cases of hyperthyroidism.

Conclusions

Horizontal ST- segment depression of 1mm or more 0.08 s from the J- point with T- wave inversion was the ECG finding in 15 hypothyroidism; 3 in anterior LV wall leads, 4 in inferolateral LV wall leads. 10 hypothyroidism has sinus bradycardia in ECG, being the second commonest ECG abnormality. All hypothyroidism with ST- T changes had stable angina. The present study findings are in conformity with earlier studies. Sinus tachycardia was the commonest ECG finding in the hyperthyroidism 6(40%);LV hypertrophy 3 (20%); prolonged Q-Tc interval 2 (13.3%); LV strain (ST-T changes), Atrial fibrillation, Atrial ectopics and Ventricular ectopics 1 (6.7%).

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