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Original Research Article

Prospective Assessment of the Electrocardiographic Changes Associated with Subclinical Hypothyroidism

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Abstract

Aim: To evaluate the electrocardiographic changes in subclinical hypothyroidism. **Methods:** The present Prospective study was conducted in the Department of Physiology, Jan Nayak Karpoori Thakur Medical College and Hospital, Madhepura, Bihar, India from December 2018 to December 2019. We studied 40 patients with newly diagnosed and untreated primary SCH with non-specific complaints such as fatigue, mild weight gain, dry skin, and depressive feelings but without overt symptoms and signs of thyroid hormone deficiency. ECG was done to determine the electrical changes in functioning of the heart using 12-lead ECG machine. Then, reports were examined manually using magnifier. PR interval, QRS interval, QT interval, and QRS axis were recorded and tabulated. **Results:** A total of 80 subjects (40 in the study group and 40 in the control group) were included in the study. The clinical and biochemical parameters are tabulated in Tables 1 and 2. Both groups were well matched with regard to age and BMI. Heart rate and blood pressure were comparable in both the groups. TSH levels were significantly higher in SCH patients than controls, but fT4 and fT3 were comparable. Mean QTc interval of the study group was significantly longer than those of the control group ($P = 0.041$). Other parameters in ECG were comparable in both the groups. **Conclusion:** The present study concludes with the following important finding that patients of SCH have prolonged QTc interval, which predisposes to the potentially life-threatening ventricular arrhythmias. Therefore, it may present as a useful tool in monitoring the cardiovascular risk.

Keywords: ECG, QTc interval, CVS etc.

Introduction

Cardiac involvement in myxedema has been well known for a long time[1]. The cardiovascular findings of hypothyroidism are, however, more subtle. The cardiovascular system (CVS) manifestations of hypothyroidism include the following: (a) Reduced total intravascular volume, (b) reduced contractility, (c) reduced heart rate, (d) raised systemic vascular resistance (increased diastolic blood pressure), and (e) raised capillary permeability (pericardial effusion), and the thyroid hormone is an important regulator of cardiac function and cardiovascular hemodynamics[2]. In hyperthyroidism, cardiac contractility and cardiac output are enhanced, and systemic vascular resistance is decreased, while in hypothyroidism, the opposite is true. Other changes observed in hypothyroid individuals include alteration in lipid profile values with increased cholesterol and low-density lipoproteins and electrocardiogram (ECG) changes such as bradycardia and low-voltage complexes[3]. Triiodothyronine (T3) mediates the expression of cardiac genes, inducing transcription of alpha-myosin heavy chain (MHC) and the sarcoplasmic reticulum calcium ATPase and negatively regulating expression of beta-MHC and phospholamban[4]. Santos et al. first reported reversible cardiomyopathy, manifested by asymmetric septal hypertrophy in untreated hypothyroid patients[5]. This finding was also described in children[6]. The increased thickness of interventricular septum (IVS) and left ventricular posterior wall (LVPW) thickness were observed in untreated patients with hypothyroidism, and there is a correlation between severity of disease cardiac findings[7]. In the same study, such findings are also reported to be dependent on advancing age. It has also been postulated that long-standing hypothyroidism leads to reversible cardiomyopathy, manifested by both asymmetric septal hypertrophy and features of hypertrophic obstructive cardiomyopathy[5]. Pericardial effusion is seen in hypothyroidism, and this also appears to be dependent on the severity of the disease[8]. The cardiac changes noted in overt primary hypothyroidism are also observable in patients with subclinical hypothyroidism[9]. Patients with subclinical hypothyroidism thus manifest many of the same cardiovascular changes, but to a lesser degree than that which occurs in overt hypothyroidism. Subclinical hypothyroidism may thus be a potentially modifiable risk factor for cardiovascular disease and mortality[10,11].

Material and methods

The present Prospective study was conducted in the Department of Physiology, Jan Nayak Karpoori Thakur Medical College and Hospital, Madhepura, Bihar, India from December 2018 to December 2019.

Methodology

The present study included 40 patients with newly diagnosed and untreated primary SCH with non-specific complaints such as fatigue, mild weight gain, dry skin, and depressive feelings but without overt symptoms and signs of thyroid hormone deficiency. They underwent routine investigations including thyroid profile. Subjects with TSH levels above 5 mIU/L and below 10 mIU/L with normal fT3 and fT4 were included in the study group. Thirty age- and sex-matched healthy volunteers from staff and friends formed the control group.

All the participants were in the age group of 20–40 years and body mass index (BMI) was below 30 kg/m2. None of them were suffering from any known illness or on medication. They were non-smokers and non-alcoholics. Subjects with any

physiologic or pathologic condition which affects respiration were excluded from the study. They underwent detailed clinical history and physical examination. Blood samples were collected for thyroid hormone assay and electrocardiography was done.

All cases underwent anthropometric investigation. Body weight was measured in light clothing and BMI was calculated by dividing the weight in kilograms by height in meter squared. Blood pressure was measured with a standard mercury manometer after a 15 min rest in a sitting position. Pulse rate was obtained from the radial artery. Serum TSH, fT3, and fT4 levels were measured by Chemiluminescence micro particle immunoassay method using Roche Cobas E411 Immunology Analyzer, which is designed to detect glow-based chemiluminescent reactions.

ECG was done to determine the electrical changes in functioning of the heart using 12-lead ECG machine. Then, reports were examined manually using magnifier. PR interval, QRS interval, QT interval, and QRS axis were recorded and tabulated.

In the present study, we have included QTc interval as QT interval varies with heart rate, i.e., prolonged at slower heart rate and shortened at faster heart rate. QTc interval is QT interval corrected for heart rate which is calculated by dividing QT interval by the square root of the RR interval – Bazett formula. QTc interval in the ECG includes both ventricular depolarization and repolarization[12].

Statistical software, "Graph Pad QuickCalcs," was used for the statistical analysis. Data were presented as means ± standard deviation, $P < 0.05$ was considered statistically significant.

Results

A total of 80 subjects (40 in the study group and 40 in the control group) were included in the study. The clinical and biochemical parameters are tabulated in Tables 1 and 2. Both groups were well matched with regard to age and BMI. Heart rate and blood pressure were comparable in both the groups. TSH levels were significantly higher in SCH patients than controls, but fT4 and fT3 were comparable.

Mean QTc interval [Table 3] of the study group was significantly longer than those of the control group ($P = 0.041$). Other parameters in ECG were comparable in both the groups.

Table 1: Biochemical data of the controls and study subjects

Parameters	Controls (Mean±SD)	Subjects (Mean±SD)
BMI (kg/m^2)	23.16±1.54	23.71±1.89
TSH (mIU/L)	2.8±0.7	7.45±1.55
T3 (ng/ml)	0.14±0.03	0.13±0.03
T4 (µg/dl)	8.15±1.8	7.83±1.71
BMI: Body mass index, TSH: Thyroid-stimulating hormone, SD: Standard deviation		

Table 2: Hemodynamic parameters

Parameters	Controls (Mean±SD)	Subjects (Mean±SD)
Heart rate (bpm)	77.1±5.11	75.03±6.4
SBP (mmHg)	117±3.79	119.26±3.88
DBP (mmHg)	77.6±3.24	76.93±4.01
SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SD: Standard deviation		

Table 3: Comparison of ECG parameters

Parameters	Controls (Mean±SD) (*n*=40)	Subjects (Mean±SD) (*n*=40)	*t*-value	*P*-value	Significance
PR interval (ms)	123.23±25.1	126.33±28.1	0.47	0.678	NS
QRS interval (ms)	86.83±12.67	90.3±5.44	1.55	0.122	NS
QTc interval (ms)	401.1±32.27	414.46±11.7	2.17	0.041	S
QRS axis (°)	61.03±24.5	60.53±23.8	0.08	0.977	NS
NS: Non-significant, S: Significant					

Discussion

In this study conducted in Indian population, we evaluated the cardiovascular function in newly detected subclinical hypothyroidism. This indicates the need for efficient screening programs to identify this condition. SCH can be considered as milder form of or early stage of thyroid dysfunction. The cause of SCH may be same as its clinical counterpart such as chronic autoimmune thyroiditis, subacute thyroiditis, thyroidectomy, overtreatment with radioactive iodine, or inadequate hormone replacement therapy[13].

ECG changes are well established in clinical hypothyroidism, which include bradycardia, ST-T changes, and low voltage complexes. ST-T changes in the form of T wave inversion or ST segment depression and flattening are seen. QT interval may be prolonged in patients of hypothyroidism which is a well-known risk factor for the development of ventricular arrhythmias[14-17].

In the present study, we observed, QTc interval was significantly prolonged in subclinical hypothyroid subjects compared to controls ($P< 0.05$) and these results were compatible with observations made by Bakiner et al.[18] and Galetta et al.[19] who have also showed that the mean QTc interval was significantly prolonged in SCH patients compared to the control group. Other parameters in ECG did not show much significant changes.

Conclusion

The present study concludes with the following important finding that patients of SCH have prolonged QTc interval, which predisposes to the potentially life-threatening ventricular arrhythmias. Therefore, it may present as a useful tool in monitoring the cardiovascular risk.

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