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Original research article

Assessment of the electrocardiographic changes in subclinical hypothyroidism

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Abstract:

Aim: The objectives of this study were to study the electrocardiogram (ECG) changes in a group of newly diagnosed subclinical hypothyroid females and to compare the ECG changes in subclinical hypothyroid females with normal healthy euthyroid individuals.

Material & Methods: This study was conducted in the Department of Physiology. We studied 30 patients with newly diagnosed and untreated primary SCH, outpatient department (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.

Results: A total of 60 subjects (30 in the study group and 30 in the control group) were included in the study. TSH levels were significantly higher in SCH patients than controls, but fT_4 and fT_3 were comparable.

Conclusion: ECG changes in SCH showed increase in the QTc interval as compared to controls, which predisposes to the potentially life-threatening ventricular arrhythmias. However, the other parameters of ECG such as QRS interval, PR interval, and QRS axis were similar to the controls.

Keywords: Subclinical Hypothyroidism; Thyroid Hormones; Electrocardiogram; QTc Interval

Introduction:

Thyroid plays an important role in orchestration of various metabolic functions in the body and thus thyroid disorders affect each and every organ out of which heart is particularly sensitive to its effects. Therefore, it is not surprising that thyroid dysfunction can produce dramatic cardiovascular effects, often mimicking primary cardiac disease [1]. Hypothyroidism is a clinical syndrome resulting from a deficiency of thyroid hormones which in turn results in generalized slowing down of metabolic processes [2].

Recent study by AG Unnikrishnan showed prevalence of hypothyroidism in Indian population was 10.95%, with significantly higher proportion of female vs. male(15.86% vs. 5.02%).%. The prevalence of subclinical hypothyroidism in the developed world is about 4-15%. [4,6]. Subclinical hypothyroidism (SCH) was observed in 8.02% of the population.

Cardiovascular complications are some of the most profound and reproducible clinical findings associated with thyroid disease [3-5]. The identification of patients with hypothyroidism is an

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important individual and public health issue. The completely reversible nature of these complications is well known.

In SCH, several metabolic and organ function indices will show only marginal alterations in view of minor thyroid hormone secretion impairment. Nonetheless, such changes may become clinically relevant when they affect target organs over a period of several years. [6]

Although SCH is milder form of thyroid dysfunction, risk of cardiovascular abnormalities is high as compared to normal population.[7]

Till date, very few studies are there on effect of SCH on electrocardiogram (ECG) changes. Hence, we have made an effort to know whether newly diagnosed subclinical hypothyroid young females are going to manifest dysfunctions in the cardiovascular parameters as compared to their healthy counterparts.

Material & Methods:

This study was conducted in the Department of Physiology, Chalmeda Anand Rao Institute of Medical Sciences , Karimnagar, Telangana, India for one year. We studied 30 patients with newly diagnosed and untreated primary SCH, outpatient department (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 fT_3 and fT_4 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/m^2. 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.

Methodology

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, fT_3, and fT_4 levels were measured by chemiluminescence microparticle 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

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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.[9]

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 60 subjects (30 in the study group and 30 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 fT_4 and fT_3 were comparable.

Mean QTc interval [Table 3] of the study group was significantly longer than those of the control group ($P = 0.001$). 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)	22.132 ± 1.70	22.58 ± 1.54
TSH (mIU/L)	2.6 ±0.71	7.71± 1.79
T3 (ng/ml)	0.15 ± 0.04	0.22 ± 0.02
T4 (µg/dl)	8.10 ± 1.66	7.59 ± 1.81

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)	75.2 ± 5.42	74.31 ± 6.7
SBP (mmHg)	111 ± 3.61	118.63 ± 3.90
DBP (mmHg)	76.8 ± 3.66	75.68 ± 4.26

Table 3: Comparison of ECG parameters

Parameters	Controls (Mean±SD)	Subjects (Mean±SD)	P-value
PR interval (ms)	120.72 ± 25.4	125.37 ± 28.4	0.528 (NS)
QRS interval (ms)	85.71 ± 12.62	89.28 ± 5.30	0.538 (NS)
QTc interval (ms)	400.20 ± 32.38	413.73 ± 11.5	0.001 (Sig.)
QRS axis (°)	60.81 ± 24.61	59.65 ± 23.8	0.552 (NS)

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Discussion:

This large registry-based study demonstrates associations of both overt and subclinical thyroid dysfunction with a range of common ECG parameters such as heart rate, QTc interval, PR interval, QRS duration, P-wave duration and presence of low voltage that verifies some of the findings from previous studies in a larger cohort. [10-11] The most novel finding of the current study is that the impact of thyroid dysfunction on heart rate, QTc interval and presence of low-voltage is lower with higher patient age. Moreover, women have significantly greater changes in heart rate and QTc interval than men. These findings expand our existing knowledge on ECG changes associated with thyroid dysfunction.

Most of the previous studies have investigated the relationship of thyroid dysfunction with QTc interval as both prolonged and shorter QTc interval have been associated with sudden cardiac death and complex ventricular arrhythmias. [12]

The lipid profile in hypothyroidism in characterized by increased total and LDL cholesterol with increased or normal HDL levels involving HDL2 sub fraction. [13-14] TG levels are not affected or are slightly elevated.[21] The most frequent form of dyslipidemia, as shown in a study of 295 hypothyroid patients is pure hypercholesterolemia (56%), followed by combined hypercholesterolemia and hypertriglyceridemia (34%) and isolated hypertriglyceridemia (1.5%), only 8.5% had no lipid abnormalities. [15]

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.[16] and Galetta et al.[17] 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:

ECG changes in SCH showed increase in the QTc interval as compared to controls, which predisposes to the potentially life-threatening ventricular arrhythmias. However, the other parameters of ECG such as QRS interval, PR interval, and QRS axis were similar to the controls.

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