e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(11); 353-357

Original Research Article

Electrocardiographic Changes in Subclinical Hypothyroidism: A Case-Control Study

Sanjay Kumar

Assistant Professor, Department of Physiology, Patna Medical College and Hospital, Patna, Bihar, India

Received: 25-09-2022 / Revised: 05-10-2022 / Accepted: 30-10-2022
Corresponding author: Dr. Sanjay Kumar
Conflict of interest: Nil

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.

Methods: This study was conducted in the Department of Physiology, Patna Medical College and Hospital, Patna, Bihar, India,for one year. We studied 50 patients with newly diagnosed and untreated primary SCH who presented to Patna Medical College and Hospital, outpatient department (Dermatology, Medicine, and Obstetrician-Gynecologist) 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 50 subjects (25 in the study group and 25 in the control group) were included in the study. 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 = 0.027). Other parameters in ECG were comparable in both the groups.

Conclusion: The present study concluded with the following important finding that patients of SCH have prolonged QTc interval, which predisposes to the potentially life-threatening ventricular arrhythmias. Cardiovascular manifestations are common in thyroid disorders.

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]

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. [3] 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. [4] 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. [5]

Subclinical hypothyroidism (SCH) is an apparently asymptomatic condition defined as thyroid state associated with an elevated serum thyroid-stimulating hormone (TSH) concentration (TSH between 5.5 and 10 mIU/L) and normal serum free T4 (fT4) and free T3 (fT3) levels. [6] SCH is a risk factor which has higher chances of progressing to clinical state. [7] The overall prevalence of hypothyroidism is 10.95%, of which 3.47% previously undetected and 7.48% self-reported cases. There was a predominance of thyroid dysfunction in women and was consistent with the worldwide reports, especially those in midlife, i.e., between 46 and 54 years. [8]

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.

Methods

This study was conducted in the Department of Physiology, Patna Medical College and Hospital, Patna, Bihar, India for one year. We studied 50 patients with newly diagnosed and untreated primary SCH who presented to Patna Medical College and Hospital, outpatient department (Dermatology, Medicine, and Obstetrician-Gynecologist) 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 >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 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.

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

Results

Table 1: Biochemical data of the controls and study subjects

Parameters	Controls (Mean±SD)	Subjects (Mean±SD)
BMI (kg/m2)	24.16±1.64	22.68±1.90
TSH (mIU/L)	2.5±0.8	7.40±1.50
T3 (ng/ml)	0.14±0.04	0.12±0.03
T4 (µg/dl)	8.07±1.8	7.43±1.78

Table 2: Hemodynamic parameters

Parameters	Controls (Mean±SD)	Subjects (Mean±SD)
Heart rate (bpm)	76.4±5.15	74.06±6.4
SBP (mmHg)	116±3.77	118.26±3.88
DBP (mmHg)	76.4±3.24	75.90±4.01

A total of 50 subjects (25 in the study group and 25 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.

Table 3: Comparison of ECG parameters

Parameters	Controls (Mean±SD) (n=25)	Subjects (Mean±SD) (n=25)	t-value	P-value
PR interval (ms)	122.24±25.1	125.35±28.1	0.46	0.650
QRS interval (ms)	85.85±12.68	89.1±5.45	1.55	0.110
QTc interval (ms)	400.1±32.28	413.47±11.9	2.15	0.027
QRS axis (°)	60.04±24.6	59.51±23.7	0.07	0.920

Mean QTc interval of the study group was significantly longer than those of the control group ($P = 0.027$). Other parameters in ECG were comparable in both the groups.

Discussion

The manifestations of thyroid dysfunction are protean. The advent of better investigative modalities and sensitive chemiluminescence assays has made possible the early detection of thyroid diseases. The present study was undertaken to investigate the effect of thyroid disorders on cardiac status. Patients were examined clinically, biochemically and cardiac status was assessed by electrocardiography. It was compared with euthyroid controls and results of other studies.

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. [4,9-11]

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. [12] and Galetta et al. [13] 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.

Thyroid hormones have significant effect on the heart and cardiovascular system. [14] The most common clinical signs are a narrowed pulse pressure, diastolic hypertension, low cardiac output, reduced EF impaired diastolic function and bradycardia. [15,16]

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. [9-12]

Conclusion

The present study concluded with the following important finding that patients of SCH have prolonged QTc interval, which predisposes to the potentially life-threatening ventricular arrhythmias. Cardiovascular manifestations are common in thyroid disorders. Electrocardiography is a cheap easily available tool to assess cardiac status of patients with thyroid dysfunction. Therefore, it may present as a useful tool in monitoring the cardiovascular risk.

References

1. Biondi B, Klein I. Hypothyroidism as a risk factor for cardiovascular disease. Endocrine. 2004 Jun;24(1):1-3.
2. Disorders of thyroid gland J. Larry Jameson Anthony P. Weetman, 18th edition Harrison'sinternal medicine. 2011; 341:2911-2939.
3. McAllister RM, Delp MD, Laughlin MH. Thyroid status and exercise tolerance. Sports Medicine. 1995 Sep; 20(3):189-98.
4. Ramesh K, Nayak BP. A study of cardiovascular involvement in Hypothyroidism. Int Arch Integr Med 2016; 3:74-80.
5. Danzi S, Klein I. Thyroid hormone and the cardiovascular system. Minerva endocrinologica. 2004 Sep 1;29(3):13 9-50.
6. Duggal J, Singh S, Barsano CP, Arora R. Cardiovascular risk with subclinical hyperthyroidism and hypothyroidism: pathophysiology and management. Journal of the Cardiometabolic Syndrome. 2007 Jun;2(3):198-206.
7. Kek PC, Ho SC, Khoo DH. Subclinical thyroid disease. Singapore medical journal. 2003 Nov 1;44(11):595-600.
8. Unnikrishnan AG, Kalra S, Sahay RK, Bantwal G, John M, Tewari N. Prevalence of hypothyroidism in adults: An epidemiological study in eight cities of India. Indian journal of endocrinology and metabolism. 2013 Jul;17(4):647.
9. Sureshbabu KP, Oswal A. Cardiac manifestations in hypothyroidism-a cross sectional study. Res J Pharm Biol Chem Sci. 2014; 5:966-75.
10. Shashi BM. A Study of Cardiovascular Changes in Newly Detected Hypothyroid Patients (Doctoral dissertation).
11. Goyal S, Goyal V. A study of electrocardiographic changes in thyroid disorders. Int J Med Res Rev. 2016; 4:486-90.
12. Bakiner O, Ertorer ME, Haydardedeoglu FE, Bozkirli E, Tutuncu NB, Demirag NG. Subclinical hypothyroidism is characterized by increased QT interval dispersion among women. Medical Principles and Practice. 2008;17(5):390-4.

13. Galetta F, Franzoni F, Fallahi P, Rossi M, Carpi A, Rubello D, Antonelli A, Santoro G. Heart rate variability and QT dispersion in patients with subclinical hypothyroidism. Biomedi cine & pharmacotherapy. 2006 Sep 1; 60(8):425-30.
14. Klein I, Danzi S. Thyroid disease and the heart. Circulation. 2007 Oct 9;116 (15):1725-35.
15. Danzi S, Klein I. Thyroid hormone and blood pressure regulation. Current hypertension reports. 2003 Dec;5 (6): 513-20.
16. Atbib Y., Essad A., Zhar H., Tadlaoui yasmina., Ait El Cadi M., & Bousliman Y. Impact de l'immunothérapie dans la prise en charge du cancer du poumon, Etude rétrospective menée à l'Hôpital Militaire d'Instruction Mohammed V-Rabat. Journal of Medical Research and Health Sciences. 2022; 5(9): 2221–2243.