

Article

Cardiological manifestations of Hypothyroidism in ECG and ECHO-a hospital based cross sectional study

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Abstract: Background: Hypothyroidism manifests itself in a wide range of clinical manifestations. ECG and ECHO changes have been reported among patients with both subclinical and manifest hypothyroidism.

Objectives: To enumerate the cardiological manifestations of hypothyroidism in ECG and ECHO.

Methods: The study was carried out as a cross-sectional study comprising 50 patients aged 18 years and above, of both sexes who were detected to have hypothyroidism. A convenient non-random sampling technique was used to select study participants from all eligible patients in the study population. The diagnosis of hypothyroidism was confirmed by measuring serum TSH, total T3 and T4, and subsequently, patients underwent ECG and echocardiography. A p-value <0.05 was considered statistically significant.

Results: It was observed that the majority of the study patients belonged to the middle age group and were females. Overt hypothyroidism was noted in 78%, and low levels of T3 and T4 were observed in 64% and 78%, respectively. Most of the study patients had elevated triglyceride levels (96%), while ECG and ECHO abnormalities were detected in 30%. Low voltage complex was the most commonly noted ECG abnormality (8%), and left ventricular diastolic dysfunction (LVDD) was the most common ECHO abnormality (18%).

Conclusions: ECG and ECHO changes are observed in a considerable proportion of patients with hypothyroidism, with low voltage complexes and LVDD being the most common, respectively.

Keywords: Cardiological manifestations; ECG; ECHO; Hypothyroidism.

1. Introduction

Hypothyroidism affects nearly 10% of the general population in India [1]. However, various other studies have reported prevalence rates in the range of 5-15% with different population backgrounds, especially higher among females [2,3].

Hypothyroidism manifests itself in a wide range of clinical manifestations starting from subclinical state to myxedema [4]. Thyroid hormones have numerous effects on the cardiovascular system that can significantly affect cardiac function. There is reduced oxygen utilisation by all organ systems in the body in patients with hypothyroidism, leading to reduced cardiac output. Furthermore, hypothyroidism directly impacts the heart as well by myosite specific gene expression, thyroid hormone receptors in the myocardium and endothelium [5]. The effects of thyroid hormone on the cardiovascular system and its deficient state, including that on hemodynamics, contractility of the heart, and cardiac autonomic activity, are well documented [6].

ECG (Electrocardiogram) records the electrical activity of the heart and has been a tool of interest in identifying asymptomatic cardiac autonomic dysfunction in patients with chronic non-communicable diseases [7]. Some of the significant ECG changes reported among patients with both subclinical as well as manifest hypothyroidism include bradycardia, prolonged QTc, T wave morphological changes, duration of QRS and low voltage [8]. However, there were no established research studies in India, involving different population backgrounds. Available research works on the subject were in most cases limited to a small sample size of a limited geographical area [9].

While some researchers have involved all the thyroid group of disorders for evaluation in toto, most studies involved study populations who had other comorbid conditions (Diabetes Mellitus, Systemic Hypertension, etc.) that may have led to ECG and ECHO abnormalities. Research works that evaluated both ECG and ECHO (Echocardiography) are scarce [10].

The present study aimed to enumerate the cardiological manifestations of hypothyroidism in ECG and ECHO. The study was carried out as a cross-sectional study comprising 50 patients aged 18 years and above, of both sexes who were detected to have hypothyroidism. A convenient non-random sampling technique was used to select study participants for the study from all the eligible patients in the study population. Diagnosis of Hypothyroidism was confirmed by measuring Serum TSH, Total T3 and T4, and subsequently patients underwent ECG and Echocardiography. A p-value <0.05 was considered statistically significant

2. Materials and Methods

The study was conducted at a tertiary care teaching institution in Tamil Nadu, South India, from 2015 to 2017, and enrolled 50 patients aged 18 years and above, of both sexes, who were diagnosed with hypothyroidism. The minimum required sample size was calculated to be 42, based on the proportion of hypothyroidism patients with ECG changes as 34% from a study by Satpathy PK *et al.*, [11] with an assumed absolute deviation of 15%, alpha error of 5%, and power of 80%. However, 50 patients were ultimately included in the study using a convenient non-random sampling technique from all eligible patients in the study population. Patients with congenital heart diseases, rheumatic heart disease, systemic hypertension, known ischemic heart disease, diabetes mellitus, history of smoking and chronic alcohol intake, chronic obstructive pulmonary diseases, patients on lithium, oral contraceptives, steroids, and amiodarone, pregnant and lactating women were excluded from the study. Institute ethical committee approval was obtained before the study, and informed written consent was obtained from all patients before their inclusion.

The principal investigator collected baseline characteristics, medical history, and physical examination details in a pre-designed semi-structured questionnaire. The diagnosis of hypothyroidism was confirmed by measuring serum TSH, total T3, and T4. Fasting blood samples were collected in plain clotted tubes, and hormone estimation was done using a chemiluminescence assay. ECG and echocardiography were performed on all patients, and the findings were noted by a single cardiologist throughout the study period. Clinical history and medical data were recorded in the predesigned semi-structured questionnaire.

3. Statistical Analysis

Data entry was carried out in MS Excel 2013, and data analysis was performed using IBM SPSS (Statistical Package for Social Sciences) Statistics for Windows, Version 21.0. Means and proportions were calculated for continuous and categorical variables, respectively. A chi-square test was used to test for statistical significance in differences in proportions, and a p value <0.05 was considered statistically significant.

4. Results

The study included 100 patients diagnosed with hypothyroidism, with the majority of patients falling within the age group of 30-60 years (64%). Females constituted a significant proportion of the study population (92%). Overt hypothyroidism was the most common diagnosis (78%) while subclinical hypothyroidism was observed in 22% of the patients. Low levels of T3 and T4 were noted in 64% and 78% of the study participants, respectively. The majority of patients had elevated triglyceride levels (96%) and Low Density Lipoproteins (LDL) levels (80%). ECG and ECHO abnormalities were detected in nearly 30% of the study patients.

We did not find any significant association between overt hypothyroidism and abnormal lipid profile parameters, ECG, and ECHO changes. Low voltage complex was the most commonly observed ECG abnormality (8%), followed by inverted T waves and Left Ventricular Hypertrophy (LVH) (4%). The most common ECHO abnormality was Left Ventricular Diastolic Dysfunction (LVDD) (18%), followed by Left Ventricular Systolic Dysfunction (LVSD) (8%). These findings suggest that ECG and ECHO abnormalities are common in patients with hypothyroidism, with LVDD being the most frequently observed ECHO abnormality. However, there was no significant association between the presence of hypothyroidism and abnormal lipid profile parameters, ECG, and ECHO changes.

Table 1. Distribution of study patients based on demographic characteristics and baseline blood investigations (n=50)

Parameter		Frequency	Percentage
Age	<30	15	30
	30-60	32	64
	>60	3	6
Sex	Male	4	8
	Female	46	92
T3 Levels	Normal	18	36
	Low	32	64
T4 Levels	Normal	11	22
	Low	39	78
Hypothyroidism	Subclinical	11	22
	Overt Hypothyroidism	39	78
Total Cholesterol levels	High	20	40
	Normal	30	60
High Density Lipoproteins (HDL)	Low	11	22
	Normal	39	78
Low Density Lipoproteins (LDL)	High	40	80
	Normal	10	20
Triglycerides	High	48	96
	Normal	2	4
Blood Urea Nitrogen (BUN)	<20	14	28
	20-40	30	60
	>40	6	12
Serum Creatinine	<0.5	16	32
	0.5-1.0	32	64
	>1	2	4
ECG abnormalities		15	30
ECHO abnormalities		15	30

Overall, these results indicate the importance of routine ECG and ECHO examination in patients with hypothyroidism, even in those without obvious clinical symptoms. The findings may have implications for the management of patients with hypothyroidism, including early identification of cardiac dysfunction and appropriate interventions. However, further research is needed to confirm and expand upon these findings.

Distribution of study patients based on demographic characteristics and baseline blood investigations (n=50) is presented in Table 1. The table provides an overview of the distribution of patients in the study based on various demographic factors and their corresponding baseline blood investigation results.

Table 3 presents the distribution of study patients based on ECG and ECHO abnormalities. It highlights the prevalence of abnormalities observed in electrocardiogram (ECG) and echocardiogram (ECHO) results among the study participants.

The association between Subclinical or Overt hypothyroidism and other investigation parameters (n=50) is examined and presented in Table 2. The table showcases the relationship between subclinical or overt hypothyroidism and various other investigation parameters, shedding light on potential correlations or associations.

These tables serve as valuable tools for summarizing and analyzing the data collected in the study, providing insights into the distribution of patients, abnormalities detected in ECG and ECHO, as well as associations between hypothyroidism and other investigation parameters.

5. Discussion

The present study was carried out with an objective to enumerate the cardiological manifestations of hypothyroidism in ECG and ECHO among 50 adult patients with hypothyroidism of either sex. It was observed in the present study that majority of the study patients belonged to middle age and were females. Also, Overt hypothyroidism was noted in 78%) and low levels of T3 and T4 were observed in 64% and

Table 2. Association between Subclinical or Overt hypothyroidism and other investigation parameters (n=50)

	TSH		Total	p value	Odds Ratio
	Subclinical	Overt Hypothyroidism			
Total Cholesterol					
High	2 (10.0)	18 (90.0)	20 (100.0)	0.094	0.259
Normal	9 (30.0)	21 (70.0)	30 (100.0)		
Total Cholesterol	175.18 ± 40.775	197.90 ± 47.241		0.154	
HDL					
Low	6 (15.4)	33 (84.6)	39(100.0)	0.033	2.218
Normal	5 (45.4)	6 (54.6)	11(100.0)		
HDL	32.73 ± 7.268	29.54 ± 4.553		0.081	
LDL					
High	7 (15.5)	33 (82.5)	40(100.0)	0.124	0.318
Normal	4 (40.0)	6(60.0)	10(100.0)		
LDL	145.09 ± 25.54	158.46 ± 26.49		0.143	
Triglycerides					
High	11 (22.9)	37 (77.1)	48(100.0)	0.443	0.771
Normal	0 (0.0)	2 (100.0)	02(100.0)		
Triglycerides	194.64 ± 54.59	205.05 ± 43.02			
ECG Changes					
Present	2 (13.3)	13 (86.7)	15(100.0)	0.333	0.444
Absent	9 (25.7)	26 (84.3)	35(100.0)		
ECHO Changes					
Present	2 (13.3)	13 (86.7)	15(100.0)	0.333	0.444
Absent	9 (25.7)	26 (84.3)	35(100.0)		

Table 3. Distribution of study patients based on ECG and ECHO abnormalities

ECG Abnormalities	Frequency	Percentage
Inverted T Waves	2	4
Left Ventricular Hypertrophy (LVH)	2	4
Low Voltage Complex	4	8
QT Prolongation	1	2
Sinus Bradycardia	3	6
ST changes	1	2
T wave flattening	2	4
ECHO Abnormalities		
Regional Wall Motion Abnormality (RWMA)-Anterior Wall	2	4
Dilated Cardiomyopathy (DCM)	1	2
Eccentric LVH	2	4
Left Ventricular Diastolic Dysfunction (LVDD)	9	18
LVH	2	4
Left Ventricular Systolic Dysfunction (LVSD)	4	8
Moderate Pericardial Effusion	2	4

78%, respectively. Most of the study patients had elevated triglyceride levels (96%) while, ECG and ECHO abnormalities were detected in 30%. Low voltage complex was the most commonly noted ECG abnormality (8%) followed by inverted T waves and LVH (4%). LVDD was the most common ECHO abnormality (18%) followed by LVSD (8%).

Tayal *et al.* [12] in their large cross-sectional study of hypothyroidism patients, the mean age was measured to be 52 ± 17 years. Kumar *et al.* [13] study patients with hypothyroidism had a mean age of mean age 43.24 ± 10.80 years and majority of them were females (85.6%). Present study patients had a similar and comparable demographic profile. Khatri *et al.* [14] study comprising 71 patients reported that 58 of them had overt hypothyroidism (81.7%). Deshmukh *et al.* [15] also documented in their research article that the prevalence of subclinical hypothyroidism was 11.3% among those without a family history of thyroid disease. Marwaha *et al.* [16] observed amongst their study patients that the prevalence of subclinical hypothyroidism was 14.7%. Concordant proportion of patients had subclinical hypothyroidism in the present study as well.

Evaluation of lipid profile in the study by Behera *et al.* [17] noted that high serum cholesterol was in 16.7%, had high serum triglyceride in 53.4% and high LDL in 10%. Satpathy *et al.* [11] also documented in their research findings that hypothyroid patients had higher total cholesterol, triglycerides and LDL levels. Comparable observations were noted in the present study findings as well.

ST segment and T wave changes were the most common changes (34%) observed in ECG amongst patients with hypothyroidism as reported by Satpathy *et al.* [11]. It was also reported in their study results that 23% of the hypothyroid patients had sinus bradycardia. Tayal *et al.* [12] study results denoted that both subclinical and overt hypothyroidism patients had low voltages on evaluation with ECG. Furthermore, it was also found that subclinical hypothyroidism patients had longer PR interval while patients with overt hypothyroidism had short QRS duration. Ohal *et al.* [18] study further strengthened this evidence, where it was found that patients with hypothyroidism had longer PR interval and whereas those under treatment with levothyroxine had normal ranges. Similarly, previous research has found low voltage complex and ST segment/T wave changes in newly diagnosed hypothyroid patients, but not in those who were under treatment, which is consistent with the findings of the present study [11,14,17,19]. In Khatri *et al.*'s study, 2/3 of the patients had abnormalities in ECHO, with diastolic dysfunction being the most common finding [14]. Behera *et al.* reported that diastolic dysfunction and pericardial effusion were the most common findings on ECHO observed in 26.6% of the patients [17]. Satpathy *et al.* found that fractional shortening and ejection fraction were significantly lower in hypothyroid patients compared to those diagnosed with hyperthyroidism [11]. Additionally, Vasudevan *et al.* studied 84 patients and noted that those with clinical hypothyroidism (moderate and severe) were more likely to have abnormal left ventricle posterior wall thickness, abnormal interventricular septal wall thickness, and diastolic dysfunction than those with subclinical hypothyroidism [19]. These results are in agreement with the present study's findings on ECHO among patients with hypothyroidism. One possible limitation of the present study is the relatively small sample size; however, appropriate sample size calculations were carried out to achieve the primary objective of the study.

6. Conclusion

Based on the findings of the study, it can be concluded that overt hypothyroidism is the most prevalent type among newly diagnosed hypothyroid patients. Additionally, a considerable proportion of these patients exhibit ECG and ECHO abnormalities, with low voltage complexes and left ventricular diastolic dysfunction being the most common, respectively. These results highlight the importance of routine ECG and ECHO examination in the management of newly diagnosed hypothyroid patients to detect and manage potential cardiovascular complications. Therefore, it is recommended that healthcare providers should incorporate these tests as part of their routine assessment in the management of patients newly diagnosed with hypothyroidism.

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Conflicts of Interest: "Authors declare that they do not have any conflict of interests."

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