

Cardiovascular Alterations in Newly Identified Hypothyroid Cases: A Cross-Sectional Study

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Abstract:

Background and Objectives: Numerous clinical manifestations in both hypothyroidism and subclinical hypothyroidism stem from the thyroid hormones' capacity to influence cardiovascular structural and hemodynamic characteristics. The aim of this study was to assess cardiovascular alterations in recently diagnosed hypothyroid patients.

Materials and Methods: This cross-sectional study involved a total of 76 patients. TSH, T4, and T3 levels were measured using radio-immunoassay. Electrocardiograms (ECGs) were recorded for all patients in all 12 leads at a paper speed of 25mm per second with normal standardization. A PR interval greater than 0.2 seconds was considered prolonged, and QRS complexes less than 5mm in limb leads and less than 10mm in chest leads were deemed as low voltage complexes. Echocardiograms were performed on all participants. Each case underwent specific screening for cardiovascular manifestations, such as pericardial effusion and ventricular dysfunction.

Results: The most prevalent findings on general physical examination were skin changes, followed by oedema and delayed ankle jerk. Approximately half of the subjects displayed no abnormalities. ST and T wave changes, sinus bradycardia, low voltage complexes and pericardial effusion were also observed in the subjects.

Conclusion: Cardiovascular symptoms are less frequently linked with recently identified hypothyroidism. The incidence of pericardial effusion in hypothyroidism is significantly associated with the duration of the disease, emphasizing the importance of early hypothyroidism diagnosis.

Keywords: Pericardial Effusion, Hypothyroidism, Electrocardiography, Ventricular Dysfunction.

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Introduction

Cardiovascular manifestations encapsulate the most profound and replicable clinical observations linked to thyroid disease. Overt hypothyroidism is well-recognized for presenting characteristic features such as a dilated cardiac silhouette, pericardial effusion, low electrocardiographic voltage, and a slow, indolent heart action.

Meanwhile, subclinical hypothyroidism, characterized by variably increased serum TSH alongside normal serum free T4 and T3 levels, affects 10 to 15% of the general population. Although the clinical presentation of subclinical hypothyroidism is often subtle, it has been substantiated to impact several metabolic and organ function indices over time. The heart, as a vital organ, is notably affected, and advanced echocardiographic techniques have elucidated the mechanism of altered myocardial contractile

function in both clinical and subclinical thyroid dysfunction [1-3]. The clinical features of hypothyroidism arise directly from the diminished or absent exposure of end organs to thyroid hormones, given the presence of thyroid hormone receptors in nearly all cells in the body. Consequently, symptoms and signs of hypothyroidism are nonspecific and can manifest across various organ systems.

In adults, hypothyroidism often has an insidious onset, leading to delayed diagnosis by months or even years. Cardiovascular manifestations may go unnoticed or present as subclinical, exhibiting individual variations where gross deficiency may be associated with minor clinical features and vice versa. Thus, a meticulous history and a high index of suspicion are crucial for early diagnosis [4-5]. Despite the lower myocardial oxygen demand in

overt hypothyroidism, the myocardial mechanical work efficiency is compromised compared to euthyroid controls.

The increase in peripheral vascular resistance and arterial stiffness contributes to elevated cardiac afterload, a significant determinant of myocardial oxygen consumption. This disproportionate increase in myocardial oxygen uptake relative to cardiac performance might explain why overt hypothyroidism can precipitate or worsen angina in patients with suspected or known ischemic heart disease. Notably, some patients experience an improvement in angina symptoms after initiating thyroid hormone replacement [6].

Thyroid hormone plays a crucial role in normal cardiovascular function. In hypothyroidism, insufficient thyroid hormone affects both the contraction and relaxation phases of the heart muscle, leading to weakened pumping ability and reduced blood ejection per heartbeat. Additionally, abnormal relaxation between heartbeats may result in diastolic dysfunction [7,8]. Prompt identification of clinical or subclinical thyroid diseases is imperative for effective treatment and the prevention of cardiovascular damage before systemic manifestation. Hormone replacement therapy stands as a simple, affordable, and effective approach to treating hypothyroidism. This study was undertaken to investigate cardiovascular changes in newly diagnosed hypothyroid patients.

Material and Methods

This cross-sectional investigation was carried out with a total cohort comprising 76 patients. All cases of newly diagnosed hypothyroidism, confirmed through clinical assessment and serum TSH, T4, and T3 level measurements were included. Secondary hypothyroidism cases, individuals with a history of long-term treatment for hypothyroidism, and those exhibiting substantial use of specific medications including beta-blockers, oral contraceptive pills, amiodarone, glucocorticoids, and antineoplastic drugs were excluded.

Additionally, patients with concurrent medical conditions such as diabetes, hypertension, pernicious anemia, collagen disorders, primary cardiac disorders, and other endocrine disorders (such as hypoparathyroidism, hypogonadism, etc.) were excluded from the study. Pregnant individuals were also excluded as part of the stringent criteria to ensure a focused cohort for the investigation. Laboratory investigations included a comprehensive set of tests to diagnose hypothyroidism and assess the associated cardiac profile: Complete blood count, Estimation of blood glucose levels, Estimation of Serum FT3, FT4, TSH, Lipid profile, Fine Needle Aspiration Cytology of the thyroid

gland (if indicated), Chest X-ray, Electrocardiogram, Echocardiogram, Treadmill test.

Thyroid Profile:

A radioimmunoassay technique was employed for the measurement of TSH, T4, and T3 concentrations, and a combination of elevated TSH and low T4 was indicative of primary hypothyroidism.

Electrocardiogram (ECG):

ECG recordings were conducted in all patients using 12 leads, with parameters such as a PR interval of >0.2 seconds considered prolonged, and QRS complexes of less than 5mm in limb leads and less than 10mm in chest leads classified as low voltage complexes.

Echocardiogram:

In all study participants, echocardiograms were performed using 2-D mode and Doppler to screen for cardiovascular manifestations like pericardial effusion and ventricular dysfunction.

Statistical Analysis:

Data collected was tabulated in an Excel sheet under the guidance of a statistician. Means and standard deviations were utilized for statistical analysis (SPSS 20.00 for Windows; SPSS Inc, Chicago, USA), and differences between groups were assessed using the chi-square test, with a significance level set at $p < 0.05$.

Results

Majority subjects belonged to 41-50 years age group (Table 1). With the exception of skin changes and pain in muscles and joints, all symptoms were found to be notably and statistically more prevalent among males in comparison to females. The most frequently observed signs during a general physical examination were skin changes, followed by edema and delayed ankle jerk. Pallor and thyroid swelling were significantly more prevalent in females, whereas edema, a thickened tongue, and delayed ankle jerk were significantly more prominent in males (Table 2).

Table 3 provides a comprehensive overview of the lipid profile within the study cohort. The average deceleration time, isovolumetric relaxation time (IVRT), and the ratio of early to late diastolic filling (E/A ratio) for the study participants were 193.50 ± 12.40 , 97.20 ± 6.80 , and 1.10 ± 0.10 , respectively. Additionally, the mean ejection fraction (EF) among the study subjects was 53.92. Notably, pericardial effusion was identified in 20 (26.32%) individuals, as outlined in Table 4. Table 5 illustrates that 9% of the study participants exhibited a positive treadmill outcome.

Table 1: Age distribution of study population

Age Group (in Years)	n	%
<40	6	7.89
41–50	29	38.16
51–60	26	34.21
>61	15	19.74

Table 2: Signs and symptoms among study subjects

Parameter	Males (n=20)		Females (n=56)		p value
	n	%	n	%	
Symptoms					
Generalised weakness	20	100.00	47	83.93	<0.05
Puffiness in face	15	75.00	30	53.57	<0.05
Hoarseness of voice	14	70.00	21	37.50	<0.05
Cold intolerance	11	55.00	9	16.07	<0.05
Weight gain	3	15.00	12	21.43	<0.05
Cutaneous changes	12	60.00	35	62.50	0.23
Muscular and joint pain	15	75.00	41	73.21	0.18
Constipation	5	25.00	6	10.71	<0.05
Slow physical activities	8	40.00	5	8.93	<0.05
Signs					
Pallor	3	15.00	21	37.50	<0.05
Oedema	15	75.00	24	42.86	<0.05
Skin changes	12	60.00	32	57.14	0.19
Thick Tongue	6	30.00	12	21.43	<0.05
Thyroid swelling	2	10.00	15	26.79	<0.05
Delayed ankle jerk	9	45.00	17	30.36	<0.05

Table 3: Lipid Profile among study subjects

Parameter	Mean \pm SD
LDL	111.20 \pm 20.20
HDL	52.75 \pm 6.20
Triglycerides	179.50 \pm 39.45
Cholesterol	245.12 \pm 37.80

Table 4: Cardiac findings among study subjects

ECG Changes	n	%
No Abnormality	41	53.95
ST and T changes	9	11.84
Sinus Bradycardia	9	11.84
Low Voltage Complex	8	10.53
T wave changes	5	6.58
RBBB	3	3.95
ST changes	3	3.95
Atrial Ectopic	2	2.63
Ventricular Ectopics	2	2.63
Axis Deviation	2	2.63
LVH	2	2.63
RBBB+T wave changes	2	2.63
Prolonged QTc	0	0.00
Changes in Echo	Mean \pm SD	
Deceleration Time	193.50 \pm 12.40	
E/A Ratio (Ratio of Early to Late Diastolic Filling)	1.10 \pm 0.10	
EF (Ejection Fraction)	53.92 \pm 2.68	
IVRT (Isovolumetric Relaxation Time)	97.20 \pm 6.80	
IVS Thickness (Interventricular Septum Thickness)	9.75 \pm 0.92	
LVPW Thickness (Left Ventricular Posterior Wall Thickness)	8.15 \pm 1.05	
Pericardial Effusion	n	%
Present	20	26.32
Absent	56	73.68

Table 5: Treadmill Test outcome among study subjects

Treadmill Test	n	%
Positive	7	9.21
Negative	69	90.79

Discussion

Thyroid hormones exert significant effects on the cardiovascular system. Many symptoms and signs observed in individuals with hypothyroidism stem from the altered influence of thyroid hormones on the heart and vascular system, leading to associated hemodynamic disturbances.

Hypothyroidism, a prevalent endocrine disorder, arises from an insufficient production of thyroid hormone, primarily due to the thyroid gland's inability to generate adequate amounts. The cardiovascular manifestations of thyroid disease represent some of the most profound and clinically relevant findings observed in both hyperthyroidism and hypothyroidism [9].

Historically, characteristic signs and symptoms of thyroid disease are well-known outcomes of thyroid hormone actions on the heart and cardiovascular system. However, there is a limited number of studies conducted in our country to evaluate cardiovascular parameters in hypothyroid patients. In this study, we aimed to assess cardiovascular parameters in new hypothyroid patients using ECG and Echocardiography [10].

Our investigation indicated a predominance of females, aligning with the findings of Shrivastava P et al [11], where 90% of the total study population comprised female patients, and the majority fell within the age range of 41-60 years, consistent with their reported age distribution. Regarding lipid profiles, comparable to our study, Shende P et al [12] reported elevated serum cholesterol levels in 17.8% of patients, while 55.6% exhibited high serum triglyceride levels.

In our sample, subjects also displayed variations in ECG findings, with approximately half showing no abnormalities. Consistent with other studies [12], our observations included ST and T wave changes, sinus bradycardia, low voltage complexes, and pericardial effusion.

ECG changes, as reported by Shrivastava P et al [11] and Shende P et al [12], showed similarities in findings such as sinus bradycardia, low voltage complexes, and T wave inversion. Diastolic dysfunction was identified as the most common echocardiographic abnormality in our study, echoing the findings of Shrivastava P et al [11]. Additionally, pericardial effusion incidence in our study correlated with previous reports [13], but it was higher compared to other studies [11,14,15]. Our study underscores the importance of evaluating cardiovascular changes in primary hypothyroidism

patients for timely interventions to enhance clinical outcomes.

It also advocates screening for hypothyroidism in cases of unexplained pericardial effusion and recommends assessing all patients with reported ECG and echocardiographic changes for hypothyroidism presence.

Conclusion

Hypothyroid patients often present with nonspecific symptoms, emphasizing the need for a high suspicion index for early diagnosis. While cardiovascular symptoms are less common, the occurrence of pericardial effusion is linked to disease duration.

Early diagnosis, preferably through echocardiography, is crucial due to its association with altered lipid profiles. Recognizing and correcting hypothyroidism early is vital to minimize its impact on the cardiovascular system.

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