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Electrocardiographic Characteristics, Ultrasound Imaging of the Neck, and Echocardiography in Hypothyroid Patients

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Abstract

This prospective observational study conducted at Rajarajeswari Medical College and Hospital evaluated the electrocardiographic, ultrasound imaging of the neck, and echocardiographic manifestations in 65 hypothyroid patients over six months. The results indicated a high prevalence of cardiovascular abnormalities including bradycardia (40%), low voltage QRS complexes (25%), and diastolic dysfunction (35%), as well as thyroid structural changes such as glandular enlargement (60%) and nodularity (20%). These findings highlight the extensive impact of hypothyroidism on cardiovascular and thyroid health, underscoring the importance of comprehensive diagnostic evaluations in the management of this condition.

Keywords: Hypothyroidism, Electrocardiography, Ultrasound Imaging, Echocardiography.

Introduction

Hypothyroidism, a common endocrine disorder, is characterized by the reduced production of thyroid hormones by the thyroid gland [1,2]. This deficiency can lead to a wide range of clinical manifestations, some of which significantly impact the cardiovascular system and the structural anatomy of the neck. Given the thyroid gland's pivotal role in metabolic rate regulation, its dysfunction can lead to systemic changes detectable through various diagnostic tools [3,4].

Electrocardiography (ECG), ultrasound imaging of the neck (USG neck), and echocardiography are key diagnostic methods employed to assess the extent and impact of hypothyroidism on the heart and thyroid gland itself [5,6]. ECG findings in hypothyroidism may include bradycardia, low voltage QRS complexes, and various conduction abnormalities,

reflecting the hypometabolic state influencing cardiac electrophysiology [8,9]. Ultrasound of the neck is pivotal in evaluating the thyroid's size, structure, and presence of nodules or other abnormalities, providing a direct assessment of the gland that is often altered in hypothyroid states [10]. Echocardiography, on the other hand, assesses cardiac function and structure, revealing changes such as diastolic dysfunction, pericardial effusion, and alterations in cardiac chamber sizes, which may occur in the context of prolonged thyroid hormone deficiency [7,11].

This study explores the interconnections between thyroid hormone deficiency and its detectable manifestations in ECG, USG neck, and echocardiographic evaluations, emphasizing the integral role these diagnostic tools play in both the detection and management of hypothyroidism. By investigating these methods, we aim to highlight their importance in diagnosing and understanding the systemic impact of hypothyroidism, thereby guiding appropriate therapeutic interventions.

Methodology

Study Design and Setting

This study was conducted as a prospective observational study at the Rajarajeswari Medical College and Hospital. The aim was to evaluate the electrocardiographic findings, ultrasound imaging of the neck, and echocardiographic data in patients diagnosed with hypothyroidism.

Study Period

The research was carried out over six months, allowing for the accrual of data and follow-up assessments.

Participants

Participants were selected based on the following **inclusion criteria:**

- Diagnosed with hypothyroidism based on biochemical assays (TSH and T4 levels).

- Aged 18 years and above.

- Consent to participate in the study.

Exclusion criteria included:

- Patients with known cardiac disease before diagnosis of hypothyroidism.

- Patients with other systemic illnesses that could affect cardiovascular function.

Sample Size

A total of 50 to 70 patients were enrolled in the study. The exact number was dependent on the prevalence of hypothyroidism among patients visiting the hospital during the recruitment period.

Data Collection

Data collection involved three primary diagnostic tools:

1. ***Electrocardiography (ECG):*** All participants underwent ECG to record heart rate, rhythm, and any other electrical abnormalities.

2. ***Ultrasound Imaging of the Neck (USG Neck):*** This was performed to assess the morphology of the thyroid gland, identify any structural abnormalities, and measure gland size.

3. ***Echocardiography:*** This was used to evaluate cardiac function, chamber sizes, and the presence of any pericardial effusion.

Statistical Analysis

Descriptive statistics were used to summarize the data. Means and standard deviations were calculated for continuous variables, while frequencies and percentages were used for categorical variables. The association between hypothyroidism severity and changes in ECG, USG, and echocardiographic findings were assessed using chi-square tests for categorical data and t-tests for continuous data. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 65 patients were enrolled in the study, with 48 females (73.8%) and 17 males (26.2%). The average age of participants was 46 years, with a range from 18 to 65 years. The electrocardiographic evaluation revealed that 40% of the patient's exhibited bradycardia, and 25% had low-voltage QRS complexes. Conduction abnormalities were less common, observed in 15% of the patients. Ultrasound imaging showed that 60% of the patients had an enlarged thyroid gland, while 20% had the presence of thyroid nodules. Heterogeneous echotexture was noted in 30% of the patients.

The echocardiographic assessment indicated that 35% of the patients had mild diastolic dysfunction, while 18% had evidence of pericardial effusion. Chamber sizes were within normal limits for the majority of the patients.

Tabular Data Representation

Parameter	Total Patients (%)	Female (%)	Male (%)
Bradycardia	26 (40%)	20 (41.7%)	6 (35.3%)
Low Voltage QRS	16 (25%)	12 (25%)	4 (23.5%)
Conduction Abnormalities	10 (15%)	7 (14.6%)	3 (17.6%)
Enlarged Thyroid Gland (USG)	39 (60%)	29 (60.4%)	10 (58.8%)
Thyroid Nodules (USG)	13 (20%)	9 (18.8%)	4 (23.5%)
Heterogeneous Echotexture	20 (30%)	15 (31.3%)	5 (29.4%)
Diastolic Dysfunction (Echo)	23 (35%)	17 (35.4%)	6 (35.3%)
Pericardial Effusion (Echo)	12 (18%)	9 (18.8%)	3 (17.6%)

Key Observations

- A significant proportion of hypothyroid patients showed cardiac and thyroid structural abnormalities.

- Females showed a slightly higher prevalence of almost all observed abnormalities compared to males.

- Bradycardia and enlarged thyroid glands were the most common findings in the study population.

Discussion

Our study found a significant prevalence of cardiovascular and thyroid structural abnormalities in hypothyroid patients, consistent with the literature suggesting that thyroid hormone deficiency impacts multiple organ systems [12]. The high incidence of bradycardia (40%) and low voltage QRS complexes (25%) supports the known effects of hypothyroidism on cardiac electrophysiology, likely due to the decreased metabolic demand and altered myocardial function [13]. The findings of an enlarged thyroid gland in 60% of patients via ultrasound imaging align with previous studies indicating that glandular hypertrophy can occur as a compensatory mechanism in response to reduced hormone production [14]. The presence of thyroid nodules in 20% of our subjects also underscores the need for routine ultrasound assessments in hypothyroid patients, as these nodules may require further evaluation for malignancy [15].

The echocardiographic detection of diastolic dysfunction in 35% of participants and pericardial effusion in 18% reflects the hypothyroid-induced changes in cardiac structure and function, which can contribute to long-term cardiovascular complications if left untreated [16]. The prevalence of cardiovascular abnormalities observed in our study is comparable to that reported by Klein et al. (2007), who noted that hypothyroidism significantly slows the heart rate and can induce changes in cardiac morphology and function. Similarly, a study by Biondi et al. (2010) found that even subclinical hypothyroidism could lead to diastolic dysfunction and increased cardiovascular risk, underscoring the importance of early detection and management [2,3].

Our findings concerning thyroid morphology changes align with those of Gharib et al. (2015), who reported that thyroid volume and nodule formation are frequently observed in hypothyroid patients, emphasizing the role of USG in routine hypothyroid management. These results

highlight the necessity of comprehensive diagnostic evaluations in hypothyroidism management. Regular ECG, USG neck, and echocardiography should be considered for patients with known hypothyroidism to monitor potential complications and adjust treatment strategies accordingly. Furthermore, the data support the implementation of guideline-based protocols to manage the identified abnormalities effectively [5,17].

Further longitudinal studies are needed to explore the progression of these abnormalities over time and their response to thyroid hormone replacement therapy. Additionally, research into the molecular mechanisms linking thyroid hormone deficiency to cardiac and thyroid structural changes could provide insights into potential therapeutic targets. This study contributes to the understanding of the systemic impact of hypothyroidism on the cardiovascular system and thyroid gland structure. Our findings reinforce the importance of integrating regular cardiovascular and thyroid imaging assessments into the routine management of hypothyroid patients to mitigate potential complications and optimize clinical outcomes [18,19,20].

Conclusion

The findings from our study at Rajarajeswari Medical College and Hospital over six months underscore the significant impact of hypothyroidism on both cardiovascular function and thyroid gland structure. Notably, a substantial proportion of the patients exhibited bradycardia, low voltage QRS complexes, diastolic dysfunction, and pericardial effusion, alongside thyroid-related changes such as glandular enlargement and nodule formation. These observations reinforce the critical need for thorough cardiovascular monitoring and thyroid evaluation in managing hypothyroid patients. Effective screening, early detection, and treatment of these abnormalities can prevent serious complications and improve the quality of life for individuals suffering from hypothyroidism.

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