Section: Miscellaneous

Original Research Article

TO ASSESS THE ELECTROCARDIOGRAPHIC FINDINGS, NECK ULTRASONOGRAPHY (USG), AND ECHOCARDIOGRAPHY IN INDIVIDUALS WITH HYPOTHYROIDISM

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Abstract

Background: Hypothyroidism arises due to inadequate production of thyroid hormones by the thyroid gland or the complete cessation of its functionality. The prevalence of hypothyroidism is progressively rising in relation to other endocrine disorders. **Aim:** To assess the Electrocardiographic findings, neck Ultrasonography (USG), and Echocardiography in individuals with hypothyroidism. **Materials and Methods:** The present study was conducted within the Department of General Medicine, following the requisite approval from the institutional ethical review board. The study incorporated a total of 80 individuals who were diagnosed with hypothyroidism. The researchers employed a non-probability convenient sampling technique to select patients who met the predetermined criteria. **Results:** Approximately 50% of the patients exhibited moderate hypothyroidism, while 31.25% displayed severe hypothyroidism, and the remaining 18.75% presented with mild hypothyroidism. The predominant electrocardiographic abnormality observed in the study population was sinus bradycardia, which was present in 32.5% of the patients. This was followed by ST-T changes, which were observed in 18.75% of the patients. Additionally, 18.75% of the patients exhibited a normal electrocardiogram. The neck ultrasonography findings were within normal limits in 26.25% of the patients. Thyroiditis was identified as the most prevalent abnormal finding in neck ultrasonography (USG), accounting for 31.25% of cases within the study population. The echocardiographic findings in 26.25% of the patients were determined to be within normal parameters. Within the cohort under investigation, it was observed that diastolic dysfunction accounted for 41.25% of the abnormal 2D echo reports, thus emerging as the prevailing finding in this particular study population. **Conclusion:** Fifty percent of the patients exhibited moderate hypothyroidism, while 31.25% presented with severe hypothyroidism, and the remaining 18.75% displayed mild hypothyroidism. The evaluation of patients with primary hypothyroidism for cardiovascular changes is of significant importance in order to implement appropriate interventions that can enhance clinical outcomes.

INTRODUCTION

Thyroid functional disorders, namely hypothyroidism and hyperthyroidism, exhibit notable cardiovascular alterations that bear clinical significance. Thyroid hormones exert positive chronotropic and inotropic effects on cardiac function. Hyperthyroidism is characterised by heightened metabolic activity and heightened oxygen requirements in peripheral tissues, leading to an elevation in cardiac output and heart rate. Consequently, there is an augmentation in blood circulation to various organs, including the skin, muscles, brain, thyroid gland, and kidneys.[1] The expansion of blood volume and the subsequent increase in cardiac output result in the elevation of maximum velocity of fibre shortening, myocardial excitability, and widening of pulse pressure. Hyperthyroidism has been found to be linked with various cardiovascular disorders, such as atrial

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tachyarrhythmias, mitral valve dysfunction, and heart failure.[2] Hypothyroidism is associated with a reduction in myocardial contractility, the accumulation of fluid in the pericardial space, an increase in the mass of the left ventricle, and an elongation of the duration of both contraction and relaxation. According to the cited source, there is only a slight reduction observed in both the ejection fraction and cardiac reserve. Multiple clinical studies have demonstrated that both the subclinical manifestation of hypothyroidism and hyperthyroidism are correlated with alterations in various cardiac parameters.[2,4,5] The existing body of literature pertaining to cardiac involvement in subclinical hypothyroidism consistently demonstrates that individuals with this condition commonly present with resting left ventricular diastolic dysfunction, which is characterised by delayed relaxation. Additionally, these patients often exhibit impaired systolic function during physical exertion, leading to reduced exercise capacity.[6] Hypothyroidism typically exhibits a progressive nature and is generally considered to be an irreversible condition. The treatment, nevertheless, is typically highly effective and enables patients to lead a fully functional life. The early observers erroneously hypothesised that thyrotoxicosis originated from the heart due to the significant magnitude of the cardiac-related findings. Currently, there exists compelling evidence that supports the notion of direct effects exerted by thyroid hormones on the myocardium, in addition to their indirect effects. The initial depiction of thyrotoxicosis encompassed mention of the prompt and sporadically irregular cardiac rhythm, elevated body temperature, forceful arterial pulses, and heightened precordial activity.[7] Hypothyroidism exerts contrasting effects on the cardiovascular system, albeit with similar magnitudes. There is a potential correlation between hypothyroidism and various cardiac manifestations, including bradycardia, low voltage complexes, ST-T wave alterations, as well as atrioventricular and intraventricular conduction abnormalities. The occurrence of extrasystoles and tachyarrhythmias, originating from both the atria and ventricles, has been documented in cases of hypothyroidism. Specifically, ventricular tachyarrhythmias have been observed in conjunction with a prolonged QT interval.[8] Ultrasonography (USG) is widely regarded as the most essential imaging technique for assessing the thyroid gland. The indications for thyroid ultrasonography (USG) encompass the assessment of a detectable thyroid nodule or suspected thyroid enlargement, as well as the investigation of thyroid nodules incidentally identified. In addition to its capability for detecting and characterising nodules, ultrasonography (USG) offers valuable guidance for performing fine needle aspiration biopsy (FNAB). Despite certain limitations, FNAB continues to be regarded as the preferred method for characterising thyroid nodules.[6] The current study aimed to evaluate the electrocardiographic, USG neck, and echocardiography findings in individuals with thyroid disorders and examine their potential correlation.

MATERIALS AND METHODS

The present study was conducted within the Department of General Medicine, following the requisite approval from the institutional ethical review board. The study incorporated a total of 80 individuals who were diagnosed with hypothyroidism. The researchers employed a non-probability convenient sampling technique to select patients who met the predetermined criteria. The study excluded individuals who were hemodynamically unstable, had lung disease (such as chronic obstructive pulmonary disease, asthma, or pleural disease), had known cardiovascular disease, had pacemakers or metallic intravascular devices, had any malignant disease, were pregnant, or had known diabetes.

Methodology

Following the acquisition of informed written consent and obtaining clearance from the institutional scientific and ethical committee, all enrolled patients underwent a comprehensive evaluation including a detailed clinical history, thorough clinical examination, and various blood investigations such as blood group analysis, complete blood count assessment, renal function test, liver function test, thyroid function test, as well as electrocardiography (ECG), two-dimensional echocardiography (2D echo), and ultrasound examination of the neck. The utilisation of the third generation TSH assay is considered essential in meeting contemporary standards of healthcare. The TSH testing was conducted using automated platforms that employed sophisticated immunometric assay techniques. However, it is important to note that there is presently a lack of an internationally recognised standard for the quantification of thyroid-stimulating hormone. By employing a multichannel electrocardiogram (ECG) device. The electrocardiogram (ECG) was obtained using a machine set to a calibration of 10 mm and a recording speed of 25 mm/s. The USG neck scans were conducted utilising Siemens Acuson X 300 and Siemens Acuson X 600 ultrasound machines, equipped with a linear array high frequency transducer (3-12 MHz) capable of colour Doppler imaging. Observations were made regarding sonography characteristics such as thyromegaly, echogenicity, vascularity, and the presence of any nodules in the thyroid gland. If the presence of nodules was detected, they were subsequently categorised as either singular or multiple, and their respective sizes were measured. Nodules with a diameter less than 5mm were not subjected to characterization. Nodules with a diameter exceeding 5mm were assessed in terms of their echogenicity,

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nodule shape, nodule margins, nodule contents, calcifications within the nodule, and vascularity within the nodule. The individuals who presented with thyroid lesions underwent fine-needle aspiration cytology (FNAC) after providing informed written consent. The study included the evaluation of patients with various thyroid conditions, namely Thyroiditis, Colloid goitre, Multinodular goitre, Carcinoma, Multinodular goitre with thyroiditis, and Normal. The application of 2-dimensional echocardiography (2DECHO) was employed to conduct a comprehensive assessment of each case, with particular emphasis on identifying systolic and diastolic dysfunction, pericardial effusion, and interventricular thickness. The evaluation of diastolic dysfunction was conducted using the Canadian consensus criteria. The patients were classified into five groups based on the fulfilment of at least four of the specified criteria. The assessment of systolic dysfunction was conducted by examining the systolic time intervals, similar to previous research endeavours. The pre-ejection period (PEP) refers to the temporal interval that occurs between the R wave on the electrocardiogram (ECG) and the initiation of the aortic valve opening. The cardiac electromechanical delay refers to the temporal gap between the initiation of electrical depolarization and the subsequent mechanical contraction of the heart. The PEP duration is less than 105 milliseconds in males and less than 110 milliseconds in females. A diagnosis of systolic dysfunction is determined when the value exceeds 0.76. The patients were classified into two distinct groups based on the presence or absence of systolic dysfunction.

Statistical analysis

The statistical data was analysed using SPSS Inc., a statistical programme commonly used for social science research, developed by the company based in Chicago, IL, USA. The specific version utilised for the analysis was 24.0. The qualitative variables were represented using frequency and percentage. The chi-square test was employed to assess the association between categorical variables. The study employed multivariate analysis and logistic regression techniques to establish correlations between various risk factors. The presentation of quantitative variables was in the form of mean plus or minus standard deviation. The level of significance, denoted as "P" value, was assessed, with a threshold of $P < 0.05$ being deemed statistically significant.

RESULTS

The current investigation aimed to examine the electrocardiographic findings, neck ultrasonography (USG), and echocardiography results in a cohort of 80 patients diagnosed with hypothyroidism.

Table 1: Demographic profile of the patients

	Number	Percentage
Gender		
Male	10	12.5
Female	70	87.5
Age Group(in years)		
Below 20	6	7.5
20-30	20	25
30-40	28	35
40-50	15	18.75
Above 50	11	13.75
Mean Age	36.85±3.48	
Co morbidity		
Diabetic	7	8.75
Hypertension	12	15
BMI		
18.5-24.9	7	8.75
25-29.9	58	72.5
>30	15	18.75

The proportion of females in the overall population was approximately 87.5%, resulting in a female-to-male ratio of 7:1. The majority of cases were observed within the age group of 30-40 years, accounting for 35% of the total. This was followed by the age group of 20-30 years, which accounted for 25% of the cases. The age group of 40-50 years accounted for 18.75% of the cases, while those below 50 years accounted for 13.75%. Lastly, the age group above 20 years accounted for 7.5% of the cases. The average age score was 36.85±3.48 years. The majority of individuals within the study population exhibit a BMI that falls within the overweight category (72.5%), with a smaller percentage falling into the obese category (18.75%) and an even smaller percentage classified as normal weight (8.75%). Approximately 50% of the patients exhibited moderate hypothyroidism, while 31.25% displayed severe hypothyroidism, and the remaining 18.75% presented with mild hypothyroidism.

Table 2: Severity of hypothyroidism

Serverity of hypothyroidism	Number	Percentage
Mild	15	18.75
Moderate	40	50

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Severe	25	31.25

Table 3: ECG of the patients

ECG Findings	Number	Percentage
Normal	15	18.75
Sinus bradycardia	26	32.5
Low voltage	11	13.75
Prolonged Qtc	2	2.5
ST-T changes	15	18.75
VPC'S	11	13.75

The predominant electrocardiographic abnormality observed in the study population was sinus bradycardia, which was present in 32.5% of the patients. This was followed by ST-T changes, which were observed in 18.75% of the patients. Additionally, 18.75% of the patients exhibited a normal electrocardiogram.

Table 4: USG neck of the patients

USG neck Findings	Number	Percentage
Normal	21	26.25
Thyroiditis	25	31.25
Colloid goitre	17	21.25
Multinodular goitre	2	2.5
Carcinoma	7	8.75
Multinodular goitre with thyroiditis	8	10

The neck ultrasonography findings were within normal limits in 26.25% of the patients. Thyroiditis was identified as the most prevalent abnormal finding in neck ultrasonography (USG), accounting for 31.25% of cases within the study population.

Table 5: 2D echocardiography of the patients

Findings	Number	Percentage
Normal	21	26.25
Systolic dysfunction	8	10
Pericardial effusion	16	20
Diastolic dysfunction	33	41.25
IVS thickness	2	2.5

The echocardiographic findings in 26.25% of the patients were determined to be within normal parameters. Within the cohort under investigation, it was observed that diastolic dysfunction accounted for 41.25% of the abnormal 2D echo reports, thus emerging as the prevailing finding in this particular study population.

DISCUSSION

The proportion of females in the population was approximately 87.5%, resulting in a female-to-male ratio of 7:1. The majority of cases were observed within the age group of 30-40 years, accounting for 35% of the total. This was followed by the age group of 20-30 years, which accounted for 25% of the cases. The age group of 40-50 years accounted for 18.75% of the cases, while those below 50 years accounted for 13.75%. Lastly, the age group above 20 years accounted for 7.5% of the cases. The average age score was 36.85±3.48 years. The present study revealed statistically significant findings in relation to age and sex distribution. The findings of this study are consistent with the research conducted by Bagcchi et al. (2019), which revealed that individuals between the ages of 46 and 54 exhibited the highest prevalence of hypothyroidism at 13.1%. In contrast, individuals aged 18 to 35 years were less affected, with a prevalence rate of 7.5%. A study conducted by Unnikrishnan et al.[10] revealed that the prevalence of hypothyroidism in the Indian population was 10.95%. The study also found a significantly higher proportion of females (15.86%) compared to males (5.02%) affected by this condition. The prevalence of subclinical hypothyroidism (SCH) in the population was found to be 8.02%.In a study conducted by Velayutham et al. (2011).[11] The study found that the general occurrence of elevated thyroid-stimulating hormone (TSH) was 11%, with 9.7% of individuals experiencing a mild elevation in TSH levels. The study population exhibited a prevalence rate of 1.3% for low thyroid-stimulating hormone (TSH) levels, leading to the conclusion that thyroid dysfunction is prevalent among young women in southern India. Thyroid dysfunction was observed in approximately 12.5% of young women, with mild elevation of thyroid-stimulating hormone (TSH) being the prevailing abnormality. The research conducted by Shashikanth. M et al.[12] revealed that among the sample of 50 participants, a majority of patients fell within the age range of 31-40. Furthermore, there was a prevailing higher proportion of females across all age groups. The proportion of females in the population was approximately 76%, with a female-to-male ratio of

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3:1. The concept of a comparable demographic profile has been referenced in numerous medical textbooks, including the 20th edition of Harrison's Textbook of Internal Medicine. The majority of individuals in the study population exhibit a BMI that falls within the overweight category (72.5%), with a smaller proportion falling into the obese category (18.75%) and an even smaller proportion falling into the normal category (8.75%). The study conducted by Milionis et al.[13] involved a sample of 736 euthyroid individuals, consisting of 616 females and 118 males. The findings revealed that approximately 70.9% of the participants were classified as overweight or obese, with a body mass index (BMI) exceeding 25. Furthermore, 39% of the subjects were identified as obese, with a BMI exceeding 30, while 17% were categorised as morbidly obese, with a BMI exceeding 35. The research conducted by Nyrnes et al.[14] examined a sample size of 6,164 individuals (2,813 males) who participated in the fifth Tromsø study in 2001. Additionally, the study included 1,867 individuals (873 males) who attended both the fourth Tromsø study in 1994/1995 and the fifth Tromsø study. The findings of this study demonstrated a statistically significant positive correlation between serum thyroid-stimulating hormone (TSH) levels within the normal range and body mass index (BMI). This association was observed in both a cross-sectional analysis and a longitudinal analysis. The investigation conducted by Nils K et al.[15] involved a total of 4649 participants, out of which 4082 individuals were deemed eligible for the subsequent analyses. The exclusion process revealed a significant correlation between obesity, defined as having a body mass index (BMI) exceeding 30 kg/m2, and serum thyroid-stimulating hormone (TSH) levels. Approximately 50% of the patients exhibited moderate hypothyroidism, while 31.25% displayed severe hypothyroidism, and the remaining 18.75% presented with mild hypothyroidism. The research conducted by Shashikanth et al.+ demonstrated that among the 50 participants who were enrolled in the study, 25 individuals (50%) exhibited moderate hypothyroidism. Out of the total sample size, 20 individuals (40%) exhibited mild hypothyroidism, while 5 individuals (10%) displayed severe hypothyroidism. The predominant electrocardiogram (ECG) abnormality observed in this study was sinus bradycardia, with a prevalence of 32.5%. This was followed by ST-T changes, which were present in 18.75% of the patients. Additionally, 18.75% of the patients exhibited a normal ECG.

This finding aligns with the study conducted by Shashikanth M et al, which demonstrated that 18 patients (35%) exhibited normal electrocardiogram (ECG) results. According to the research conducted by Verma et al. (2016), sinus bradycardia was identified as the prevailing observation, accounting for 30% of the cases. The research conducted by Tiwari A et al.[17] revealed that sinus bradycardia in electrocardiogram (ECG) was observed in 35.5% of the cases, low voltage complexes in 16.6% of the cases, T wave inversion in 7.8% of the cases, right bundle branch block (RBBB) in 4.4% of the cases, and QTc prolongation was identified in 2.2% of the cases. The examination of the USG neck in the study population revealed that a normal condition was observed in 26.25% of the patients. Thyroiditis was found to be the most prevalent abnormality among the ultrasound scans (USG) conducted on the neck region, comprising 31.25% of the study population. This study was found to be consistent with the study conducted by Anupriya et al.[18], which demonstrated that ultrasound is a highly effective modality for the diagnosis of benign conditions such as thyroiditis, multinodular goitre, and malignant conditions. The study conducted by Kratky J et al and Sharma G et al.[19,20] demonstrated that in individuals with hypothyroidism, the utilisation of thyroid ultrasonography (USG) could result in cost savings. Specifically, if a characteristic autoimmune pattern is observed on the thyroid ultrasound, there may be no need to measure antithyroid antibodies for the diagnosis of Hashimoto's thyroiditis. The research conducted by Hanushraj R et al.[21] revealed that diffuse thyromegaly was the prevailing radiological observation in ultrasonography. The second most frequently observed finding was multinodular goitre. Malignant characteristics were observed in 6.67% of the cases. The examination of the 2D echocardiogram findings in the study population revealed that a normal result was observed in 26.25% of the patients. Within the subset of atypical 2D echocardiogram reports, diastolic dysfunction accounted for 41.25% of the overall study population. This particular finding was observed to be the most prevalent among the study population, and it exhibited a correlation with the investigation conducted by Shashikanth M et al.[12] According to the research conducted by Tiwari A et al.[17], a significant proportion of the study participants, specifically 35%, exhibited normal echocardiographic parameters. The research conducted by Qari et al.[22] revealed a significant correlation between hypothyroidism and echocardiographic abnormalities, such as cardiomyopathy and pericardial effusion.

CONCLUSION

Fifty percent of the patients exhibited moderate hypothyroidism, while 31.25% presented with severe hypothyroidism, and the remaining 18.75% displayed mild hypothyroidism. The predominant electrocardiographic abnormality observed in this study was sinus bradycardia, which accounted for 32.5% of the cases. Thyroiditis accounted for 31.25% of the abnormal ultrasound (USG) findings in the neck, making it the most prevalent abnormality observed in the study population.

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Within the cohort under investigation, diastolic dysfunction was observed in 41.25% of the abnormal 2D echo cases, making it the prevailing finding in this particular study population. The evaluation of patients with primary hypothyroidism for cardiovascular changes is of significant importance in order to implement appropriate interventions that can enhance clinical outcomes.

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