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ORIGINAL RESEARCH

To compare the cardiac functions in hypothyroidism and subclinical hypothyroidism before and after treatment

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ABSTRACT

Aim: To compare the cardiac functions in hypothyroidism and subclinical hypothyroidism before and after treatment

Materials and Procedures: A prospective observational research with 50 untreated overt hypothyroid and 50 subclinical hypothyroid patients was conducted. This research includes untreated newly diagnosed overt hypothyroid and subclinical hypothyroid individuals ranging in age from 16 to 62 years.

Results: The mean heart rate before therapy was 67.5±4.4 and 79.5± 2.5 after treatment (p value 0.01). Hypertensives were substantially older than normotensives (mean age 48.5 ± 4.7 years). Interventricularseptal thickness (dIVST) was reduced statistically significantly (from 11.9± 0.9 mm to 10.8± 0.7 mm* p<.001). Left ventricular posterior wall thickness (dLVPWT) was substantially higher in pretreatment individuals (11.8± 0.8mm) and significantly lower after therapy (9.5± 0.7mm), p <0.01. Despite a change in left ventricular end diastolic (LVEDD) and end systolic (LVESD) diameters after therapy, it was not statistically significant (p>0.05). E/A was considerably lower in pretreatment patients (1.45 ± 0.3), but rose to 1.69± 0.2 after therapy (p<0.01). TSH was 10.9± 2.4 in the pretreatment group. TSH returned to normal following therapy, at 1.9 ± 0.8. (p<0.01 statistically significant decrease) T3, T4 levels were normal although on the low side. T3 and T4 levels increased significantly after therapy (from 102.1± 5.5 ng/dl and 6.8 ±1.5g/dl to 145.3± 1.9 ng/dl and 8.8± 0.7g/dl). (p<0.01).

Conclusion: Early diagnosis and treatment of cardiac problems in hypothyroidism helps to avoid lasting structural heart issues. Doppler echocardiography is a straightforward, dependable, and repeatable technique for assessing heart functioning in hypothyroidism.

Keywords: Doppler echocardiography, TSH

Introduction

Subclinical hypothyroidism (SCH) is a biochemical condition characterised by high blood thyroid-stimulating hormone (TSH or thyrotropin) levels in the presence of normal peripheral thyroid hormone levels (thyroxine and triiodothyronine). 1 Mild grade 1 SCH (TSH 9.9 mIU/L upper limit) may be distinguished from more severe grade 2 SCH (TSH ≥10 mIU/L), with around 80–90% of SCH patients falling into the grade 1 group. [1-3] SCH is most usually caused by autoimmune thyroiditis, however it may also be caused by other factors. Laboratory results from thyroiditis recovery, medicine, and the elderly are comparable to SCH2 and may confound the choice to treat with levothyroxine.

SCH symptoms include tiredness, cold sensitivity, weight gain, and constipation, as well as a decrease in mood, quality of life, cognitive function, and memory.[1] Individuals with SCH often have milder clinical symptoms than those with overt hypothyroidism. They may be absent in people with grade 1 SCH and are expected to increase in frequency and severity as serum TSH levels rise. [1,2] The reported prevalence of SCH varies from 0.4–16.9 percent in one study to as high as 19.7 percent and 20 percent in other studies, depending on age, gender, race/ethnicity, and region. The frequency of SCH

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rises with age and is greatest among women, the elderly, and those who live in iodine-deficient areas. [5-7]

The annual chance of progression from SCH to overt hypothyroidism is 3.3–11.4%. Those with grade 2 SCH (as opposed to grade 1 SCH), positive blood thyroid peroxidase (TPO) antibody titers, female sex, high baseline serum TSH levels, and baseline free T4 (FT4) values at the lower end of the reference interval proceed at a faster pace. [8,9]

Materials and Procedures

A prospective observational research with 50 untreated overt hypothyroid and 50 subclinical hypothyroid patients was conducted. This research includes untreated newly diagnosed overt hypothyroid and subclinical hypothyroid individuals ranging in age from 16 to 62 years. Patients with known heart disorders, hypertension, diabetes, renal failure, pregnancy, and non-reproducible TSH, T3, and T4 levels were excluded from the research.

Methodology

All included patients were subjected to clinical assessment, thyroid profile, 12 lead EGG, standard M-mode 2 D echo and Doppler echocardiography before and 6 months after LT4 replacement therapy with biochemical euthyroidism after informed written consent was obtained from the patients and institutional scientific and ethical committee clearance. Blood samples were taken in the morning following an overnight fast to examine thyroid function. TSH (0.3-4.5mIU/L), FT4 (1.0-3.0ng/ml), and FT3 (0.25-0.65ng/ml) were considered normal thyroid profile values. T4 (52-127ng/ml) and T3 (0.7-2.15ng/ml). Diagnosis of hypothyroidism was confirmed by 1.FT3< 0.25ng/ml, 2.T4< 52ng/ml, 3.TSH>15mIU/ml. TSH> 5mIU/ml and Normal T3, T4 levels confirmed the diagnosis of subclinical hypothyroidism. 2DEchocardiographic measures and techniques: Echocardiography in M-Mode: Using conventional M-mode echocardiography, the following parameters were evaluated:

LVEDD (mm): The distance at end diastole between the left side of the IVS and the posterior left ventricular endocardium at the level of the chorda tendinae. LVESD (mm): Left ventricular end-systolic distance. Diastolic. IVST (mm): The distance between the front edges of the right and left ventricular septalendocardial surfaces during diastole. Diastolic LVPWT (mm): The vertical distance between the anterior edge of the endocardial surface and the anterior edge of the epicardial surface of the left ventricular posterobasal wall at the end of diastole and the end of systole.

Results

The majority of the study population (50%) was between the ages of 35 and 45, with a mean age of 37.5 6.5 years. The majority of the study population was female, accounting for 70%, with men accounting for 30%. Overt Hypothyroidism: All of the patients were biochemically hypothyroid at the time of diagnosis, with different clinical characteristics such as overall weakness, weariness, weight gain, and dry skin. Almost all symptoms vanished after using thyroxine. The mean heart rate before therapy was 67.5±4.4 and 79.5± 2.5 after treatment (p value 0.01). Hypertensives were substantially older than normotensives (mean age 48.5 ± 4.7 years). They were not on antihypertensive treatment.

Above Table 3 demonstrates low voltage complexes in 12 patients which got normalised following therapy in all of them. Four patients who became upright had generalised T-wave inversion. In three instances, nonspecific T-wave alterations and left anterior hemiblock remained following therapy. In one instance, QT prolongation was seen, but it returned to normal following therapy.

Interventricularseptal thickness (dIVST) was reduced statistically significantly (from 11.9± 0.9 mm to 10.8± 0.7 mm* p<.001). Left ventricular posterior wall thickness (dLVPWT) was substantially higher in pretreatment individuals (11.8± 0.8mm) and significantly lower after therapy (9.5± 0.7mm), p <0.01. Despite a change in left ventricular end diastolic (LVEDD) and end systolic (LVESD) diameters after therapy, it was not statistically significant (p>0.05). In 25 individuals, there was mild to severe pericardial effusion. Severe pericardial effusion was seen in 5 individuals, three of whom developed tamponade and needed pericardiocentesis. Pericardial effusion disappeared in 25 individuals after treatment, although moderate pericardial effusion persisted in the remaining four patients who had extremely high TSH levels at the start of therapy.

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 04, 2022

E/A was considerably lower in pretreatment patients (1.45 ± 0.3), but rose to 1.69± 0.2 after therapy (p<0.01).

The time required for isovolumetric relaxation (IRT) was "substantially extended in pretreatment patients." After therapy, IRT decreased statistically significantly from 89.5 ±4.8 to 80.5± 3.1 (p<0.01). In overt hypothyroidism, the above two measurements directly represent reduced diastolic functioning.

Subclinical Hypothyroidism: Patients with subclinical hypothyroidism often experienced exhaustion, weight gain, and failure to decrease weight. The majority of patients reported a decrease in symptoms after therapy. The mean heart rate was 76.1± 4.3 before therapy and 78.8± 2.1 after treatment, which was not statistically significant. Blood pressure was observed in a similar manner.

TSH was 10.9± 2.4 in the pretreatment group. TSH returned to normal following therapy, at 1.9 ± 0.8. (p<0.01 statistically significant decrease) T3, T4 levels were normal although on the low side. T3 and T4 levels increased significantly after therapy (from 102.1± 5.5 ng/dl and 6.8 ±1.5g/dl to 145.3± 1.9 ng/dl and 8.8± 0.7g/dl). (p<0.01). The pretreatment group had a mean E/A of 1.35 + 0.2, which rose to 1.66 + 0.6 following hormone therapy (significant "p" value 0.001). Isovolumetric relaxation time was considerably extended in individuals with subclinical hypothyroidism, although it was reduced following therapy (93.2± 1.1 vs. 82.5± 2.5) (p=0.001).

Table 1. Demographic profile of the patients

Gender	**Number**	**%**
Male	30	30
Female	70	70
Age		
Below 25	4	4
25-35	25	25
35-45	50	50
45-55	12	12
Above 55	9	9

Table 2 Mean heart rate

Mean heart rate	Before treatment	After treatment
	67.5 ± 4.4	79.5 ± 2.5

Table 3: Electrocardiographic Changes in Overt Hypothyroidism

Parameter	Number	%
WNL	9	9
Low voltage complexes	12	12
Generalized T wave inversions	4	4
Nonspecific T wave changes	3	3
LAHB	3	3
AV blocks	0	0

Table 4:

	Before treatment	After treatment
Interventricularseptal thickness	11.9 ± 0.9 mm	10.8 ± 0.7 mm
Left ventricular posterior wall thickness (dLVPWT)	11.8 ± 0.8mm	9.5 ± 0.7mm

Table 5: Thyroid Profile Before and After Treatment

	Before Treatment	**After Treatment**	**p Value**
TSH	10.9 ± 2.4	1.9 + 0.8	P< 0.01
T4	102.1 ± 5.5	145.3 ± 1.9	P< 0.01
T3	6.8± 1.5	8.8 ± 0.7	P< 0.01

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 04, 2022

Discussion

Morbidity and mortality from cardiovascular disease, It has an impact on heart architecture, function, and cardiovascular haemodynamics. Cardiac symptoms in hypothyroidism may be attributed to pericardial effusion (which generally develops slowly), increased atherosclerosis risk, and decreased heart rate and myocardium contractile states.

Hypothyroidism Visible

Female patients predominated in the study population. Thyroid functions returned to normal after starting thyroxine replacement medication. Bradycardia, pericardial effusion, and aberrant ECG abnormalities were common in these individuals. Vermaet al.[10] noted substantial bradycardia in overt hypothyroid individuals before to therapy, which markedly improved following treatment. In the current research, pretreatment heart rate was substantially lower (p0.01) than posttreatment heart rate. In hypothyroid individuals, both bradycardia and lower stroke volume contribute for decreased cardiac output. Thyroid hormone supplementation enhanced cardiac output when both heart rate and stroke volume rose, as indicated by Kralet al[11] and Rawat et al[12]. Low voltage QRS complex was the most prevalent result in the current investigation of aberrant ECG alterations induced by numerous variables such as hypothyroidism severity and duration, significant pericardial effusion, and ageing. Twelve of the 13 patients with low voltage complexes who were significantly hypothyroid had concomitant pericardial effusion, however only three were beyond the age of 50. Following therapy, all patients exhibited normal voltage complexes. In a study of 33 hypothyroid patients, Sarithaet al[13] found similar findings: 10 individuals who were openly hypothyroid had low voltage complexes, and one patient had low voltage complexes that remained after restoration of thyroid function and elimination of pericardial effusion. Pericardial effusion was discovered in 32 of 50 participants in the current investigation. After 6 months of medication, it remained in 5 individuals, all of whom were significantly hypothyroid. Pericardial effusions were observed to disappear without sequelae after hormone replacement therapy. A prolonged term of therapy may result in the effusion completely disappearing. Hypothyroidism has long been linked to problems in heart anatomy and function. Cardiac systolic and diastolic functions are a sensitive indicator of myocardial abnormalities. In terms of structural abnormalities, different investigations have shown alterations in cardiac wall thickness in hypothyroid individuals. Rawatet al[12] also discovered an increase in the thickness of IVS and LVPW. The initial signs of increasing thyroid insufficiency may be increased interventricularseptal thickness and diastolic dysfunction. 13 Vermaet al14 and Rawat et al[12] found no variations in LV size between hypothyroid individuals. In the current study, IVS and LVPW thickness decreased after treatment from 11.9± 0.9 mm to 10.8± 0.7 mm and 11.8± 0.8mm to 9.5± 0.7 mm, respectively, a significant ($p<0.01$) improvement in overtly hypothyroid patients compared to euthyroid patients as observed by Varma et.al, Santos AD, miller et.al,15,16, but LVEDD and LVESD did not differ between pre and post Although FS rose from 35.5± 1.7 to 36.1± 3.1 and EF improved from 65.3 ±1.1 to 68.5± 2.5 in the current research, these changes were not statistically significant. Rawat et al[12] found no significant change in systolic function parameters, whereas Monzani et al[15] found that fractional shortening and thus LV systolic function significantly improved after treatment, similar to Fazio, Biondi et al[17] who found decreased fractional shortening in overtly hypothyroid patients that improved after treatment, and Sarith Bajaj, PC Saxena et al[13] who found no change in FS In the current investigation, diastolic dysfunction, as shown by lower E/A and higher IRT, was seen in all patients and improved significantly following therapy ($p<0.01$). Saritha Bajaj et al.[13], who evaluated hypothyroid individuals three months following hormone replacement, found that although improvement in diastolic dysfunction was insufficient, it was considerable. Rajanet al[18] discovered substantial changes in IVRT in hypothyroid patients. Both 'E' and 'A' wave velocities rose considerably following treatment, but there were no significant changes in the E/A ratio. Tielenet al.[19] discovered a rise in 'E' wave velocity, whereas Virtanen et al.[14] discovered a considerable increase in E/A ratio. Santos Ad, Miller et al[16] previously showed rapid improvement in cardiac functions after thyroxine substitution.

Hypothyroidism in Subclinical Form: Although subclinical hypothyroidism may not cause anatomical problems, it does cause functional issues. These individuals exhibit resting LV diastolic dysfunction, as shown by delayed relaxation, as well as impaired systolic dysfunction on exertion, resulting in low exercise capacity. When euthyroidism is restored, these modifications will be reversed. Noninvasive approaches have previously been used to examine cardiac function in people with subclinical hypothyroidism. Previously, systolic time intervals were examined to get insight into cardiac function.

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[20,21]We discovered no abnormalities in LV systolic function in this trial as well. The EF, an indicator of LV systolic function, was similar in individuals before and after therapy. Some writers found subclinical hypothyroidism with longer systolic time intervals that improved with thyroxine medication. Tseng et al[22], on the other hand, discovered that in individuals with subclinical hypothyroidism, the isovolumic contraction time, the pre ejection period, and the ratio of pre ejection period to LV ejection time were all normal. Arem et al[23] discovered normal cardiac structure and function, as well as a moderate extension of the pre-ejection interval during exercise and slightly decreased LV diastolic dimensions at rest, using Doppler echocardiography at rest and during exercise in eight individuals with subclinical hypothyroidism. Bell et al[24] discovered that individuals with subclinical hypothyroidism had normal ejection fraction at rest, with a slight (but substantial) increase in LV ejection fraction after maximum exercise following thyroxine treatment using radionuclide ventriculography. Forfar et al25 similarly found a reduced rise in ejection fraction after exercise, with a marked improvement following thyroxine replacement treatment. Foldeset al[26] discovered a reduced ejection fraction in persons with subclinical hypothyroidism, both at rest and after physical activity. The disparities in previous investigations of cardiac involvement in subclinical hypothyroidism may be due to differences in patient selection (age, inclusion of patients with prior hyperthyroidism, examination of patients with acute or unstable subclinical hypothyroidism) and diagnostic criteria (too-large range of TSH levels). Ridgway et al[27] found a prolonged LV pre-ejection period (PEP) and an increase in the ratio of PEP to LV ejection time (LVET). During exercise, Bell et al[24] observed a reduction in LV ejection fraction (EF). This EF anomaly was corrected with thyroxine medication. Aremet al23, on the other hand, discovered normal cardiac function in individuals with SH both at rest and during activity. We excluded individuals with confounding conditions, notably those impacting the cardiovascular system, from the current study's stringent selection of patients with stable subclinical hypothyroidism. The fact that this group of individuals has reduced diastolic function shows that subclinical hypothyroidism is a condition of limited tissue hypothyroidism rather than a compensated state. If this is the case, all individuals with subclinical hypothyroidism should be considered candidates for thyroxine treatment. Only mean aortic acceleration was substantially lowered in the group of individuals with subclinical hypothyroidism among the markers of systolic function. As a result, this indicator seems to be the most sensitive to changes in thyroid hormone levels. Furthermore, SVR was considerably lowered in groups of patients with subclinical hypothyroidism treated with replacement thyroxine treatment, confirming a directvasodilatory impact of thyroid hormone. In this investigation, we did not estimate mean aortic acceleration. Subclinical hypothyroidism may affect diastolic function directly by decreasing sarcoplasmatic calcium ATPase activity, resulting in impaired ventricular diastolic performance. [26,27]The current investigation found a broad spectrum of LV relaxation abnormalities associated with extended DT, IVRT, and a lower E/A ratio. Similar findings have been reported by Biondiet al[17], Vitale et al[28] who studied LV diastolic function using both conventional Doppler and tissue Doppler echocardiography and found significant abnormalities. Though tissue Doppler echocardiography was more valuable in finding subtle abnormalities, they concluded that regional E/A ratio was a reliable parameter to detect diastolic properties of LV walls. We discovered that diastolic function deficits were reversible 6 months after starting thyroxine medication; Biondiet al[17] reported comparable results. Diastolic characteristics are determined by cytosolic calcium concentration, which is controlled by the sarcoplasmic reticulum and is ATP dependent. Thyroid hormones regulate calcium transport.

Conclusion

Early diagnosis and treatment of cardiac problems in hypothyroidism helps to avoid lasting structural heart issues. Doppler echocardiography is a straightforward, dependable, and repeatable technique for assessing heart functioning in hypothyroidism.

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ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 04, 2022

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