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ABSTRACT

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ECHOCARIOGRAPHIC CORRELATION OF CARDIAC FUNCTION IN PATIENTS OF HYPOTHYROIDISM

Objective: The aim of the current study was to identify the echocardiographic changes in patients with hypothyroidism and correlation of these echocardiographic changes with the severity of hypothyroidism.

Method: A cross-sectional, and observational study was conducted on 60 treatment naïve patients of 18 to 60 years with hypothyroidism for 15 months from March 2021 to July 2022. The clinical demographic, treatment, ECG and echocardiographic profile were assessed in all patients. The association between categorical findings was determined using the chi-square test. Percentages and frequencies were also used for every parameter.

Results: 36.6% of the patients belonged to the age group 31 to 40 years. The mean age was 37.2±10.67 years and the majority of patients were females (76.67%). 33.3% of patients were overweight. 21.67% were obese and 45% had normal BMI. 21.67% had mild hypothyroidism, 56.67% had subclinical and 8.33% had severe hypothyroidism. There was a significant association between BMI and severity of hypothyroidism (p=0.0167). Abnormal lipid profile was seen in 61.67% of patients and a significant association was observed between total cholesterol and the severity of hypothyroidism (p=0.0031). LVPW thickness was normal in 78.33% of patients. Abnormal interventricular septal thickness was seen in 28.33% of patients. The cardiac chamber was more than 5.4cm in 3.33% of patients. Pericardial effusion was observed in 12 patients. There was a significant association between LVPW thickness, interseptal thickness, cardiac chamber size, ejection fraction, E/A ratio, and severity of hypothyroidism.

Conclusion: Increased interventricular septal and left ventricular posterior wall thicknesses with diastolic dysfunction are one of the earliest heart changes noted in patients with hypothyroidism. Early diagnosis in patients with hypothyroidism will definitely reduce the

extent of cardiac complications that accompany it. ECG and echocardiography are useful noninvasive tools in assessing the response to thyroid replacement therapy. The study suggests screening of all patients with hypothyroidism using electrocardiography and ECG as most of the patients show impairment in cardiac functions, so that appropriate intervention can be taken earlier.

Keywords: echocardiography, hypothyroidism, interseptal thickness, diastolic dysfunction.

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INTRODUCTION / ВСТУП

Thyroid diseases are among the most common hormonal disorders worldwide with India being no exception. Early diagnosis and treatment remains the cornerstone of thyroid disorders treatment. Hypothyroidism occurs due to low levels of thyroid hormones with varied etiology and clinical features. Iodine deficiency is the commonest cause of hypothyroidism globally. Due to the lack of awareness about the disease, facilities or screening programs to treat patients in endemic areas, there is often a delay in diagnosis.

The prevalence of hypothyroidism in India is around 11% [1]. The prevalence of subclinical hypothyroidism was found to be 9.4%. The prevalence was more in women – at 11.4% and among men, it was 6.2% [2].

Hypothyroidism occurs due to low levels of thyroid hormones. Hypothyroidism increases systemic vascular resistance, reduces arterial compliance and causes atherosclerosis. Lack of proper muscle relaxation, reduced heart rate and stroke volume will lead to heart failure. Subclinical hypothyroidism is also found to cause Ischemic heart diseases (IHD) and raised cardiovascular mortality. Treatment of hypothyroidism provides a beneficial effect on various parameters of heart function, especially among younger individuals.

Hypothyroidism is associated with impaired relaxation of blood vessels and reduced availability of Nitric oxide of endothelium. This causes more arterial stiffness that leads to raised Systemic vascular resistance. This is due to increased expression of sarcoplasmic reticulum Ca^{2+}ATPase and phospholamban, which inhibits ATPase [3]. Hypothyroidism leads to left ventricular diastolic dysfunction because of slow relaxation and defective left ventricular early filling.

Hypothyroidism causes increase in the left ventricular mass/size.

Researchers identified a significant relationship between subclinical hypothyroidism and prevalence of IHD [4].

A meta-analysis with 11 prospective cohorts in 5 continents identified that subclinical hypothyroidism is associated to raised risk of IHD and mortality with raised TSH levels [6].

Preshant Shrivastava [7] study aimed to study cardiovascular parameters in hypothyroid patients using electrocardiography and echocardiography. Around 65% subjects had clinically significant cardiovascular changes. The most common finding in ECG was sinus bradycardia seen in 35.5% and in echocardiography was diastolic dysfunction in 20% patients.

In a study done by Baladi IH et al study depicts that the frequency of electrocardiographic changes such as sinus tachycardia was high in patients with primary hyperthyroidism. Study emphasized the importance of thyrotoxicosis as a cause of cardiac morbidity and mortality in patients with thyrotoxicosis [8].

The purpose of the current study was to know the echocardiographic changes in the heart in patients with hypothyroidism which are usually reversible with proper intervention. Study also designed correlate these echocardiographic changes with the severity of hypothyroidism.

MATERIALS AND METHODS

Type of study: Cross-sectional, and observational study.

Study setting: Department of General Medicine, Apollo Health City, Jubilee Hills, Hyderabad, India.

Study period: 15 months from March 2021 to July 2022.

The study is cross-sectional as data was collected at single point of time, without any follow up and study participant's clinical environment was not changed so the study is an observational study.

Source of data: After getting approval from Institutional Ethics Committee, hypothyroidism patients from OP and IP units of the General Medicine department and other departments were taken as study sample.

Sampling procedure: Convenience sampling.

It is a kind of non-probability sampling procedure, in which the sample is taken from a group of people who are easy to reach. It is also known as Grab or Availability sampling.

Sample size calculation: As per Unnikrishnan et al study, the prevalence of hypothyroidism in India was 3.9% [9].

$N=Z^2PQ/E^2$; N: sample size; P: Prevalence; Q = 1-P; E - Error: 5%;

Z-Confidence levels: 95%; N = 58. The minimum sample size is 58.

So, we included 60 patients and the data was complete.

All 60 patients provided informed consent to participate in the study.

INCLUSION CRITERIA:

1. Males and females of ages 18-60 years.
2. Newly or previously diagnosed Sub-clinical hypothyroidism patients (TSH > 5 mU/L and normal free T_3 and T_4 levels).
3. Patients with TSH more than 10mU/L with low T_4 or normal T_4

EXCLUSION CRITERIA:

1. Patients with known Heart diseases, chronic obstructive lung diseases, Diabetes mellitus, severe anemia, other known endocrinal disorders.
2. Pregnant and lactating women.
3. Patients taking drugs like beta blockers, lithium, oral contraceptives, steroids
4. Alcoholics
5. Patients who were already on thyroxine therapy.

Exclusion criteria was assessed mainly through oral history, medical records, to rule out the above mentioned conditions.

Methodology: Free T_3, free T_4 and TSH was done for all patients initially as a screening test to confirm the presence of hypothyroidism. History was taken from all the participants. A full assessment including clinical evaluation, measurement of lipids, ECG and echocardiography was done.

Parameters assessed: Age**,** Gender**,** Residence**,** Pulse rate, Blood Pressure**,** BMI**,** symptoms and signs, Serum free T_4 T_3 levels**,** Serum TSH**,** Lipid profile**,** ECG**,** echocardiography.

Definitions:

Normal range of serum total T_4 was taken as 0.8 to 2 ng/dl. Serum TSH Normal Range was taken as 0.34 – 5 mIU/mL measurement of free T_3 and T_4 and TSH was done by electrochemiluminescence (ECLIA) method.

TSH and categories of hypothyroidism:

Mild – TSH from 5 to 20 mIU/ml; **Moderate**-TSH levels of 20 to 50 mIU/ml; **Severe:** TSH above 50 mIU/ml.

Subclinical – 5 to 10 mIU/ml with normal Free T_3 and T_4 levels.

BMI: BMI was assessed as per WHO classification, as shown below.

Under weight: <18.5 kg/m^2

Normal range: 18.5 – 24.9

Overweight: 25.0-29.9

Obese: ≥30

Obese class I: 30.0- 34.9

Obese class II: 35.0-39.9

Obese class III: ≥ 40

Hyperlipidemia or abnormal lipid profile: Increase in total cholesterol of more than 200 mg/dl or LDL of above 150 mg/dl was considered abnormal lipid profile.

The following parameters were noted in echocardiography:

1. Chamber dimensions: In 'M-Mode (motion mode) transthoracic echocardiogram' the left ventricular internal diameter (diastolic), interventricular septal wall thickness, posterior wall thickness were measured. Reference values for left ventricular linear dimensions were as per the American Society of Echocardiography (ASE) committee recommendations. Asymmetric hypertrophy is found to be present if a ratio of interventricular septal thickness and left ventricular posterior wall thickness was more than 1.3 (Table 1).

2. Diastolic function: Assessed by Peak E/A wave velocity ratio. Grades of diastolic dysfunction based on the E/A ratio is as follows

3. Systolic function: Assessed with Fractional shortening (not used now),

EF = (End Diastolic Volume - End systolic volume/End diastolic volume)*100

i) Mild left ventricular dysfunction - EF 45 to 55 %

ii) Moderate left ventricular dysfunction – EF 35 to 45%

iii) Severe left ventricular dysfunction – EF < 35%

4. Pericardial effusion: Assessed and quantified by the amount of Echo free space between 2 layers of pericardium around heart.

Trivial or Minimal PE: less than 10mm echo free space; Moderate PE: 10 to 20 mm; Severe or Massive or Large: >20 mm echo free space.

Statistical analysis: The data collected was processed in MS Excel 2019 and analysis was carried out using Microsoft excel and statistical software called EPI INFO free version. 7.2.5.0. P-value of <0.05 was considered statistically significant. Frequencies and percentages were also used. Mean and SD were used. Categorical findings were assessed using chi-square test.

Table 1 – Chamber dimensions in males and females

	Females				**Males**			
	Value	**Mild-abnormal**	**Moderate**	**Severe**	**Value**	**Mild**	**Moderate**	**Severe**
Septal thickness, cm	0.6–0.9	1.0–1.2	1.3–1.5	>1.6	0.6-1	1.1–1.3	1.4–1.6	>1.7
Posterior wall thickness, cm	0.6–0.9	1.0–1.2	1.3–1.5	>1.6	0.6-1	1.1–1.3	1.4–1.6	>1.7
Left ventricular diastolic diameter	3.9–5.3	5.4–5.7	5.8–6.1	≥6.2	4.2–5.9	6.0–6.3	6.4–6.8	≥6.9

Table 2 – Types of hypothyroidism

TSH & TYPE	**Frequency**	**Percent**
Mild (5 to 20)	13	21.67%
Moderate (20 to 50)	8	13.33%
Subclinical (5-10)	34	56.67%
Severe (more than 50)	5	8.33%
Total	60	100.00%

Ethical considerations: Permission from the Institutional ethical committee attached to AIMSR, Jubilee Hills, Hyderabad, Telangana was taken before conducting the study. Every patient was explained the whole process and advantages of availing their data for the study. Patients were also told that their information will be kept confidential. Informed consent form was taken in local/understandable language and a signature or a thumb impression was taken. They were assured that their doubts, if any to be clarified at any time.

RESULTS

Ages ranged from 18 to 60 years. The majority (36.67%) were in the age group of 31-40 yrs, followed by 23.33% in 21-30 yr age group. The mean age was 37.2±10.67 years. Most of the patients (76.67%) were females. 21.67% patients showed mild hypothyroidism, 56.67% had subclinical and 8.33% had severe hypothyroidism.

33.3% of patients were overweight, 21.67% were obese and 45% cases show normal BMI. There is a significant association between BMI and severity of hypothyroidism (p=0.0167). Out of the 13 obese patients 8 were subclinical hypothyroidism patients.

Lipid profile and hypothyroidism: Abnormal lipid profile was seen in 61.67% of patients. Total cholesterol levels and severity of hypothyroidism: 4 out of the 5 severe hypothyroidism and 22 of the 34 subclinical hypothyroidism patients showed abnormal cholesterol levels. There is a significant association between Total cholesterol levels and the severity of hypothyroidism (p=0.0031).

Table 3 – Association between severity of hypothyroidism and total cholesterol levels, LVPW thickness, interseptal thickness, cardiac chamber size, ejection fraction, E/A ratio and pericardial involvement

	Severity of hypothyroidism				**Chi-Square**	**P value**
	MILD (5 to 20)	**Moderate (20 to 50)**	**Severe (> 50)**	**Sub clinical**		
Total cholesterol						
Borderline	5	4	1	17	19.7177	0.0031
Elevated	1	2	3	5		
Normal	7	2	1	12		
BMI						
Normal	9	4	0	14	15.5082	0.0167
Obese	0	1	4	8		
Overweight	4	3	1	12		
LVPW thickness						
Abnormal	2	3	4	4	13.4727	0.0037
Normal	11	5	1	30		
IVS thickness						
Abnormal	3	4	4	6	10.5117	0.0147
Normal	10	4	1	28		
Cardiac chamber size						
Less than 5.4	13	7	4	34	8.0172	0.0457
More than 5.4	0	1	1	0		
Ejection fraction						
< 55%	0	1	2	0	4.85	0.02
> 55%	13	7	3	34		
E/A ratio						
Less than 1	4	3	4	4	12.1406	0.0069
More than 1	9	5	1	30		
Pericardial involvement						
Mild PE	1	2	1	3	2.6	>0.05
Moderate PE	0	1	3	0		
Massive or severe PE	0	0	1	0		

LVWT and hypothyroidism severity: left ventricular wall thickness was found to be abnormal in 21.67% (n=13) of patients. Abnormal left ventricular posterior wall thickness was seen in 13 patients. There is a significant association between left ventricular posterior wall thickness and the severity of hypothyroidism. (P=0.003). Almost 4 subclinical hypothyroidism patients also showed abnormal LVPW thickness.

IVST and hypothyroidism severity: Inter Ventricular septal thickness was abnormal in 28.33% (n=17) of patients. Abnormal interseptal thickness was seen in 17 patients. Significant association was seen between interseptal thickness and severity of hypothyroidism (P=0.01).

Cardiac chamber size and hypothyroidism severity: Cardiac chamber was more than 5.4 cm in 3.33% (n=2) of patients. There is significant

association between cardiac chamber size and severity of hypothyroidism (p=0.0457). It was >5.4cm in 1 Severe hypothyroid patient.

Left ventricular systolic function and hypothyroidism: ejection fraction was less than 55% in 5% (n=3) of patients. Ejection fraction is less than 55% in 3 subjects. There is a significant association between EF and severity of hypothyroidism (p=0.02).

Diastolic function: E/A ratio was more than 1 in 75% of patients. There is a significant association between E/A ratio and the severity of hypothyroidism (p=0.006). E/A ratio is less than 1 in 15 subjects. Among them, 4 had severe hypothyroidism, 3 had moderate hypothyroidism and 4 had sub clinical hypothyroidism.

Pericardial involvement in hypothyroidism: Pericardial effusion was seen in 12 patients overall. Among 4 patients with moderate effusion 3 had severe hypothyroidism. Mild effusion was seen 3 of the subclinical hypothyroid patients. Large effusion was seen in 1 severe hypothyroidism patient.

Age and LVPW thickness: Among 22 patients in age group 31 to 40 years, and 18 cases had normal LVPW thickness. There was no significant association found.

There is no significant association between age and interseptal thickness (Table 4).

Table 4 – Age and LVPW thickness, and IVS thickness

	LVPW thickness		**Chi-Square**	**P-value**
Age group	Abnormal	Normal		
18-20	1	2	5.8142	0.2135
21-30	4	10		
31-40	4	18		
41-50	4	6		
51-60	0	11		
TOTAL	13	47		
	IVS thickness			
	Abnormal	Normal		
18-20	0	3	4.11	<0.05
21-30	5	9		
31-40	6	16		
41-50	4	6		
51-60	2	9		

Age and severity of hypothyroidism: Among 22 patients in the 31 to 40 years age group, 16 patients subclinical hypothyroidism.

Pulse rate: 71.6% of patients had normal pulse rate and the most common finding was bradycardia (Heart rate <60/min) seen in 25% of cases.

Symptoms: 48.33% of patients were asymptomatic. Fatigue/Easy fatiguability was the common symptom seen in 16.67% of patients.

Table 5 – Age and severity of hypothyroidism

	Severity of hypothyroidism				
Age group	**Mild**	**Moderate**	**Severe**	**SUB**	**Total**
18-20	0	0	0	3	3
21-30	4	3	2	5	14
31-40	2	1	3	16	22
41-50	3	1	0	6	10
51-60	4	3	0	4	11
TOTAL	13	8	5	34	60

Table 6 – Symptoms among patients

Symptom	Frequency	Percent	Cumulative Percent
Cold intolerance alone	3	5.00%	5.00%
Constipation alone	1	1.67%	6.67%
Drowsiness, Myxedema	1	1.67%	8.33%
Fatigue	10	16.67%	25.00%
Menstrual irregularities	5	8.33%	33.33%
Nil	29	48.33%	81.67%
SOB	5	8.33%	86.67%
SOB and chest pain	1	1.67%	88.33%
Weight gain	5	8.33%	100.00%
Total	60	100.00%	100.00%

Blood Pressure among patients: BP was normal in 65% of patients. Isolated diastolic hypertension was seen in 21.67% of patients (Table 6).

Treatment among patients: 100% of subjects were not on treatment in the current study for their hypothyroidism.

ECG changes: Normal ECG was seen in 43.33% of the patients. The most common finding was sinus bradycardia seen in 25% of the patients followed by low voltage complexes seen in 21.67% of the patients.

Table 7 – Blood pressure among patients

Blood pressure	Frequency	Percent	Cumulative Percent
Diastolic HTN	13	21.67%	21.67%
HTN	7	11.67%	33.33%
Hypotension	1	1.67%	35.00%
NORMAL	39	65%	100.00%
Total	60	100.00%	100.00%

Table 8 – ECG changes among patients

ECG changes	Frequency	Percent	Cumulative Percentage
BBB	4	6.67%	6.67%
Bradycardia	15	25.00%	31.67%
Low voltage	13	21.67%	53.33%
Normal	26	43.33%	96.67%
Rhythm change	2	3.33%	100.00%
Total	60	100.00%	100.00%

DISCUSSION

The current study was done on patients with confirmed hypothyroidism who came to OP and IP in AIMSR, Hyderabad, Telangana a tertiary care center with well-equipped facilities.

Treatment naïve patients aged 18 to 60 years with hypothyroidism, fulfilling the eligibility criteria were included. Based on the sample size calculation, 58 is the minimum sample size. So, we included 60 patients in the current study. The clinical

demographic, treatment, ECG and echocardiographic profile were assessed for all patients. Association between categorical findings was determined using the chi-square test. Percentages and frequencies were also used for every parameter.

36.6% of the patients belonged to the age group 31 to 40 years, followed by 21 to 30 years (23.33%). Age ranged from 18 to 60 years. The mean age was 37.2±10.67 years. This indicates that hypothyroidism is commonly detected during 21 to 40 years of age. 76.67% of subjects were females in the current study. This indicates that hypothyroidism is more common among females.

In T Zhai study, [10] among them, 21.8% of patients had hypothyroidism. The overall mean age was 57.5 years. The mean age of patients with hypothyroidism was 59.6 years. Among 463 patients with hypothyroidism, 41% of the subjects were males and 59% the of subjects were females. Male preponderance was similar to the current study.

Serum TSH levels are mainly used to screen for primary hypothyroidism. In overt hypothyroidism TSH levels are high (>5 mIU/l) and free T4 levels are low. In subclinical hypothyroidism, TSH levels are elevated (>5 mIU/l) and free T4 levels are normal.

In the case of central hypothyroidism, TSH is biologically inactive and so the diagnosis is based on free T4 rather than TSH.

Some patients may have associated hyperlipidemia, increased creatinine kinase, liver enzymes and anemia. Ultrasound (USG) of the neck is not commonly recommended for hypothyroidism. 21.67% of subjects had mild hypothyroidism, 56.67% of subjects had subclinical and 8.33% of subjects had severe hypothyroidism. No patient was taking treatment in our study.

BMI & waist circumference in hypothyroidism

33% of patients were overweight. 21.67% were obese and 45% had normal BMI.

There is a significant association between BMI and severity of hypothyroidism (P=0.01). Most of the obese patients had severe hypothyroidism. Among 20 overweight patients, 12 cases had subclinical hypothyroidism.

A study done by Rios Prego et al. shows that untreated thyroid dysfunction is not associated with BMI. Normalization of thyroid levels changed the BMI, but most of the remaining patients were within overweight ranges [11].

The mean age was 55.7 years, which was much higher compared to the current study. There is no significant difference in baseline BMI in hypothyroid and hyperthyroid patients before treatment. After treatment, the BMI of hypothyroidism patients reduced. The mean BMI initially was 27 kg/m^2; after treatment, the BMI was 23.99 kg/m^2.

Hypertension in hypothyroidism

BP was normal in 65% of patients. HTN was seen in around 35% of patients. Isolated diastolic hypertension was seen in 21.67% of patients. Hypotension was seen in 1.67% of patients in our study.

T Zhai et al. [12] showed hypertension in 35% of cases of hypothyroidism. This finding was almost similar to the current study finding. Cardiac contractility and output reduce in hypothyroidism, leading to a narrowed pulse pressure. Hence, there will be increased renal sodium reabsorption, expansion of blood volume and rise in blood pressure [5].

Hyperlipidemia in hypothyroidism

Abnormal lipid profile was seen in 61.67% of patients.

There is a significant association noted between total cholesterol levels and the severity of hypothyroidism (P=0.0031).

Among 10 patients with elevated total cholesterol, 3 had severe hypothyroidism. Among 27 patients with borderline total cholesterol, 4 had moderate hypothyroidism in our study. 22 sub-clinical hypothyroid patients had abnormal lipid profiles.

ECG Changes in hypothyroidism

In Tayal B et al study [13] investigated the associations of both overt and subclinical thyroid dysfunction with ECG parameters in primary healthcare population. Hypothyroidism was associated with a slower heart rate and shorter QTc in women. Longer P-wave duration, longer PR interval and low voltage were observed in patients with subclinical and overt hypothyroidism. Both overt and subclinical thyroid disorders were associated with significant changes in ECG parameters. Age and gender have significant impact on the association of thyroid dysfunction particularly on heart rate and QTc interval. Most of the patients were females, similar to the current study.

This shows that thyroid disorders were common among females. 73% of hypothyroid patients had high or borderline high total serum cholesterol. There is a significant difference in the serum total

cholesterol, triglycerides, HDL cholesterol and LDL cholesterol between patients with hypothyroidism and hyperthyroidism.

Normal ECG was seen in 43.33% of patients. sinus bradycardia was seen in 25%, low voltage complexes in 21.67%, Rhythm changes in 3.33% and Bundle branch blocks were seen in 6.67% of patients in our study.

Khambalkar D [14] et al, among 32 patients with hypothyroidism, 14 patients had sinus bradycardia, 6 patients had low voltage complexes, 5 patients had non-specific ST- T wave changes, bundle branch block was seen in 1 patient.

No patient had ectopics, similar to the current study. The most common finding was sinus bradycardia and the least common finding was bundle branch block, similar to the current study.

Preshant Shrivastava et al, 90 patients with hypothyroidism were included. The study was conducted at a medical college in India. Ages ranged from 15 to 65 years. 90% of the subjects were females. Female preponderance was similar to the current study. More than 65% of subjects had clinically significant cardiovascular changes in ECG. This finding was similar to the current study, in which ECG abnormalities were seen in 68% of the subjects included. The most common ECG finding was Sinus bradycardia, seen in 35.5% of patients, low voltage complexes in 16.6% of subjects, T Wave inversions in 7.8% of subjects, BBB in 4.4% of subjects, and QT prolongation was seen in 2.2% of subjects.

In a study done by **Ramesh et a**l [15], the incidence of sinus bradycardia was found to be 40%. Bradycardia was reported as 30% by **Shashikanth** [16].

In the study of **Bupender Tayal et al [13],** subclinical hyperthyroidism was linked to low heart rate among females and males. Hypothyroidism was linked to bradycardia and shorter QTc in females. Prolonged P-wave, PR interval and low voltage complexes were seen in patients with both subclinical and overt hypothyroidism. The presence of low voltage was less common in older patients.

Pericardial effusion

Pericardial effusion was seen in 12 patients overall. Among them, 1 patient had mild hypothyroidism, 3 had moderate and 5 had severe hypothyroidism. 3 patients with subclinical hypothyroidism showed mild pericardial effusion.

A study by Mirwais S [18] reported a case of a 68-year-old male with a history of Graves' disease treated with radioiodine ablation and consequent hypothyroidism, and presenting with moderate pericardial effusion.

No patient had pericardial thickening or constrictive physiology, similar to the current study.

Echocardiographic changes in hypothyroidism

LVPW thickness was normal in 78.33% of patients. Abnormal left ventricular posterior wall thickness was seen in 13 patients. Among them, 4 patients had severe hypothyroidism and 3 had moderate hypothyroidism. There is a significant association between left ventricular posterior wall thickness and the severity of hypothyroidism. (P=0.003).

Abnormal interseptal thickness was seen in 17 patients. Among them, 4 patients had severe hypothyroidism and 4 had moderate hypothyroidism.

There is a significant association between interseptal wall thickness and the severity of hypothyroidism. (P=0.01).

Cardiac chamber was more than 5.4cm in 3.33% of patients. There is a significant association between cardiac chamber size and severity of hypothyroidism (p=0.0457). The size is less than 5.4 in 58 subjects, and more than 5.4 cm in 2 subjects. Among these 2 subjects, 1 had severe hypothyroidism.

Ejection fraction is less than 55% in the 3 subjects. Among them, 2 had severe hypothyroidism, 1 had moderate hypothyroidism.

E/A ratio was more than 1 (normal) in 75% of patients. There is a significant association between E/A ratio and the severity of hypothyroidism (p=0.006). E/A ratio is less than 1 in 15 subjects. Among them, 4 had severe hypothyroidism, 3 had moderate hypothyroidism 4 had mild hypothyroidism and 4 had sub-clinical hypothyroidism.

Among 22 patients in the age group 31 to 40 years, 18 had normal LVPW thickness.

There is no significant association between age and interseptal thickness. Among 22 patients in age group 31 to 40 years, 16 had normal IVS thickness.

Among 22 patients in 31 to 40 years age group, 16 patients had subclinical hypothyroidism in our study.

A study by Mahanta Anindita et al identified that the prevalence of overt hypothyroidism was 10.9% and subclinical hypothyroidism in 13.1% in the northeastern state of India. Among the cases of overt hypothyroidism, 92.5% were adult hypothyroids, 5.62% were juvenile hypothyroids, and 1.8% were cretins. Uncommon modes of presentation were pleural and pericardial effusion, low body weight, frequent motions, and palpitations. Post-thyroidectomy and drug-induced hypothyroidism accounted for 2.3% of cases each and postpartum

hypothyroidism for 3.7% of subjects. 13% of cases presented with goiter and the prevalence of anti-TPO antibodies was 8.4%.

Increased LVPW thickness was significantly associated with increasing severity of disease by the Chi-squared test. The P value is 0.0013. This finding was similar to the current study.

Abnormal septal wall thickness was seen in 1 patient with mild hypothyroidism. It was seen in 9 patients with moderate hypothyroidism and 18 patients with severe hypothyroidism. It was seen only in 5 patients with subclinical hypothyroidism. The occurrence of increased septal wall thickness was significantly associated with the severity of the disease (p=0.0007). This finding was similar to the current study.

The cardiac chamber size was normal in the study population. There is no statistically significant association between cardiac chamber size and the severity of hypothyroidism.

Only 2 patients with severe hypothyroidism and 1 patient with moderate hypothyroidism had reduced ejection fraction of below 55%.

The ejection fraction is not significantly correlated with the severity of the disease, as the p value is >0.05. This was different from the current study. The LV systolic functions like ejection fraction and fractional shortening were not associated with the severity of hypothyroidism.

Diastolic dysfunction was found in 1 patient with mild hypothyroidism and 2 patients with moderate hypothyroidism. It was seen in 9 patients with severe hypothyroidism and 3 patients with subclinical hypothyroidism.

There is a significant association between LVPW, IVSW and E/A with the severity of hypothyroidism. There is significant association between age and TSH or severity of hypothyroidism. The study also found a significant association between age and LVPW. These findings were different from the current study.

In the study of **Khambalkar Sunita [14],** there was no significant statistical difference in basic Echocardiographic parameters between patients with hypothyroidism and control group. There is a significant reduction in E/A ratio and raised E/E' in patients with overt and subclinical hypothyroidism. There is increased interventricular septal and posterior wall thickness in overt hypothyroid patients along with pericardial effusion compared to patients with subclinical hypothyroidism and controls. There was no significant difference in ejection fraction and systolic velocity between patients with hypothyroidism and controls.

In a study of **Yang G et al [20],** it was shown that both subclinical hypothyroidism and subclinical hyperthyroidism were associated with adverse prognosis in patients with heart failure. Subclinical thyroid dysfunction is useful and promising predictor for the long-term prognosis in heart failure cases.

Jabbar A et al [21] study evaluated the effect of levothyroxine treatment on left ventricular function in patients with acute myocardial infarction and subclinical hypothyroidism. Study results show that among the 95 cases, 69.1% had ST-segment elevation myocardial infarction. The mean left ventricular ejection fraction at baseline and at 52 weeks was 51.3% and 53.8%, in the levothyroxine group compared with 54.0% and 56.1% in the placebo group. There were 33.3% and 36.7% cardiovascular adverse events in the levothyroxine and placebo groups.

There was a significant increase in the mean LVEF and E/A ratio in hypothyroid patients after treatment. This indicates normalization of hormonal status. A thyroid dysfunctional state was not associated with impaired diastolic function. This could be due to the short duration of thyroid dysfunction and the intake of timely and successful replacement therapy.

But systolic function was significantly decreased in hypothyroid patients but later improved after replacement therapy. An early diagnostic approach in patients with thyroid problems is vital for avoiding cardiac complications.

In the study of T Zhai et al, there were no significant differences in the mean interseptal thickness, LVPW and ejection fraction between normal, euthyroid patients and hypothyroidism patients.

Strengths of this study:

- The current study assessed cardiac profile of patients with hypothyroidism. This can help to frame secondary prevention strategies.
- The study helped to identify various risk factors and treatment profiles of hypothyroidism patients.
- It helps to improve clinical outcomes and prevent various complications (advice on appropriate treatment).
- Counselling on diet, exercise was given to the patients.

Economic coverage to patients:

- A part of travel expenses was reimbursed to all subjects for travelling to our institution.
- All the lab investigations were done free of cost to all subjects.

Perspectives for further research

Comparison of the efficacy and safety of various treatment regimens should be done with a multi-centric mode with populations of different backgrounds, rural/urban areas and from various socioeconomic statuses.

Limitations of the current study

In this study, the sample size was 60, indicating that the study sample was small, and the primary limitation was the interpretation of results. Results for small studies are less reliable compared to larger studies. Larger studies with more subjects produce narrow confidence intervals (95% to 99%) and more accurate results. Renal failure patients, patients with COPD and serious medical illnesses were not included. Patients were not followed up (as it was a cross-sectional study).

CONCLUSIONS / ВИСНОВКИ

Increased interventricular septal and left ventricular posterior wall thicknesses with diastolic dysfunction are some of the earliest heart changes noted in patients with hypothyroidism. Lipid changes and impairment of left ventricular diastolic function in patients with subclinical hypothyroidism patients warrant the use of hormone replacement even without any signs/symptoms. Early diagnosis in patients with hypothyroidism will definitely reduce the extent of cardiac complications that accompanies it. ECG and echocardiography are useful noninvasive tools in assessing the response to thyroid replacement therapy. The study suggests screening all patients of hypothyroidism with electrocardiography and ECG as most of the patients show impairment in cardiac functions, so that appropriate intervention can be taken earlier.

CONFLICT OF INTEREST / КОНФЛІКТ ІНТЕРЕСІВ

The authors declare no conflict of interest.

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None.

AUTHOR CONTRIBUTIONS / ВКЛАД АВТОРІВ

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