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ORIGINAL RESEARCH

A STUDY OF CARDIOVASCULAR CHANGES IN NEWLY DETECTED HYPOTHYROID PATIENTS

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ABSTRACT

Aim: To analyse the cardio vascular changes in newly detected hypothyroid patients.

Material and methods: This cross sectional study was conducted among patients attending the medicine OPD over a period of one year and total number of 50 patients was taken. In the present study for the measurement of TSH, T4, T3 radio-immuno assay was employed. ECG was recorded in all patients, in all the 12 leads, at a paper speed of 25mm per sec. at normal standardisation, PR interval of >0.2 seconds was taken as prolonged, QRS complexes of less than 5mm in limb leads and less than 10mm in chest leads was taken as low voltage complexes. In all the patients in the study, echocardiogram was done on 2-D MODE and Doppler. Each case was specifically screened for cardiovascular manifestations like pericardial effusion, ventricular dysfunction.

Results: Most common signs on general physical examination was skin changes (58%) followed by oedema (52%) and delayed ankle jerk (34%). No abnormality was detected among 54% of the subjects. ST & T wave change and sinus bradycardia was reported among 12% of the subjects. Low voltage complex was revealed in 10% of the subjects. Pericardial Effusion (PE) was present among 13 (26%) subjects.

Conclusion: Cardiovascular symptoms are less commonly associated with newly detected hypothyroidism. The occurrence of pericardial effusion in hypothyroidism is significantly related to the duration of disease, hence the need for early diagnosis of hypothyroidism.

Keywords: Thyroid, Cardiovascular, Pericardial Effusion

INTRODUCTION

Cardiovascular features are sum of most profound and reproducible clinical findings associated with thyroid disease. Many of the clinical manifestations of hypo and subclinical hypothyroidism are due to ability of thyroid hormones to alter cardiovascular structural and hemodynamic characters.[1]The characteristic dilated cardiac silhouette, pericardial effusion,

low electrocardiographic voltage and slow indolent heart action are well recognized in overt hypothyroidism. Subclinical hypothyroidism characterized by variably increased serum TSH and normal serum free T4 and T3 levels occurs in 10 to 15% of the general population. Though the clinical presentation of subclinical hypothyroidism is nonspecific, and the symptoms are usually subtle, as compared with those of overt hypothyroidism, it is well proved to alter several metabolic and organ function indices which become clinically relevant over a period of time.[2] Heart is one of many important organs to be affected. With the advent of newer echocardiographic techniques, mechanism of altered myocardial contractile function in both clinical and subclinical thyroid dysfunction has been well delineated.[3]

The clinical features of hypothyroidism are due to the direct result of under or absent exposure of end organs to the action of thyroid hormones. Almost all the cells in the body have thyroid hormone receptors in their cytosol and respond to thyroid hormones to a greater or lesser degree. Hence most of the symptoms and sign of hypothyroidism are non-specific and can arise from any organ system.[4]

In adults, it has insidious onset, diagnosis can be delayed by months or years. Quite often cardiovascular manifestations go unrecognized or subclinical. Individual variations are there; gross deficiency may be associated with only minor clinical features of the disease and vice-versa. Hence a careful history and a high index of suspicious is the key for early diagnosis.[5]

Although overt hypothyroidism is associated with a lower myocardial oxygen demand, myocardial mechanical work efficiency is worse than in euthyroid controls, because the increase in peripheral vascular resistance and arterial stiffness in overt hypothyroidism contributes increased cardiac after load, one of the major factors determining myocardial oxygen consumption. The disproportionate increase in myocardial oxygen up take with respect to the level of cardiac performance may, therefore, explain at least in part why overt hypothyroidism may precipitate or worsen angina in patients with suspected or know ischemic heart disease and why some of these patients have an improvement in angina symptoms after thyroid hormone replacement is initiated.[6]

Hence thyroid hormone is necessary for normal cardiovascular function, so when not enough thyroid hormone is present neither in the heart nor the blood vessels function normally. In hypothyroidism, the heart muscle is weakened in both contraction phase and also in the relaxation phase. This indicates that the heart cannot pump as forcefully as it should, and the amount of blood it ejects with each heartbeat is reduced. In addition, because heart muscle does not relax normally in between heartbeats, diastolic dysfunction may result.[7]

Therefore, it is important to reveal clinical or subclinical thyroid diseases in time for the effective treatment and for stopping of the cardiovascular damages before manifestation of cardiovascular system. Hypothyroidism is treated by hormone replacement therapy; which is simple, affordable and effective. This study was undertaken to study the cardio vascular changes in newly detected hypothyroid patients.

MATERIAL AND METHOD

This cross sectional study was conducted among patients attending the department of medicine at Autonomous State Medical College & SNM Hospital Firozabad (U.P.) over a period of one year and total number of 50 patients was taken. This study has been approved by the Institutional Ethics Committee of the hospital. Written Informed consent was taken

from all the subjects, who were included in the study after explaining to them the nature and purpose of the study.
The patients were enrolled according to the following inclusion and exclusion criteria.

INCLUSION CRITERIA

- All the cases of newly detected hypothyroidism- diagnosed by clinical evaluation and confirmed by serum TSH, T4 and T3 levels.

EXCLUSION CRITERIA

1. Secondary hypothyroidism cases.
2. Hypothyroid patients who are already on treatment since long time.
3. Significant intake of drugs like beta-blockers, oral contraceptive pills, amiodarone, glucocorticoids and antineoplastic drugs.
4. Patients with other associated diseases like diabetes, hypertension, pernicious anaemia, collagen disorders, primary cardiac disorders and other endocrine disorders (hypoparathyroidism, hypogonadism, etc.) and pregnancy.

LABORATORY INVESTIGATIONS

The following investigations were done to diagnose hypothyroidism and with associated cardiac profile.

1. Complete blood count.
2. Estimation of blood glucose levels.
3. Estimation of Serum FT3, FT4, TSH.
4. Lipid profile
5. Fine Needle Aspiration Cytology of thyroid gland (if indicated).
6. Chest X-ray.
7. Electrocardiogram.
8. Echocardiogram.
9. Tread Mill test.

THYROID PROFILE

A combination of raised TSH concentration and a low T4 concentration has great diagnostic value for primary hypothyroidism. In the present study for the measurement of TSH, T4, T3 radio-immuno assay was employed.

ELECTROCARDIOGRAM (ECG)

ECG was recorded in all patients, in all the 12 leads, at a paper speed of 25mm per sec. at normal standardisation, PR interval of >0.2 seconds was taken as prolonged, QRS complexes of less than 5mm in limb leads and less than 10mm in chest leads was taken as low voltage complexes.

ECHOCARDIOGRAM

In all the patients in the study, echocardiogram was done on 2-D MODE and Doppler. Each case was specifically screened for cardiovascular manifestations like pericardial effusion, ventricular dysfunction.

Mild pericardial effusion: Echocardiography is very sensitive, specific, rapid and cost effective non-invasive investigation for diagnosing mild pericardial effusion. Pericardial fluid does not reflect echoes and therefore, produces a sonolucent area. Presence of echo free space between the two layers of pericardium throughout the cardiac cycle confirms the diagnosis. Normally also, there is small amount of fluid (5-15ml) in the pericardial sac. However, in normal persons, a clear space between the two layers of pericardium can be seen only during systole.

Mild effusion is usually seen behind left ventricular posterior wall.

Moderate pericardial effusion: Echocardiography is useful in confirming the diagnosis of pericardial effusion. Pericardial effusion usually tends to localise in the dependent portions like inferior surface or near apex.

Free pericardial effusion usually collects in the dependent part. In supine position (during echocardiographic examination) initial collection of fluid is seen along the posterior surface of heart in small effusions. Dimension of posterior echo-free space roughly correlates with amount of effusion. As the amount of fluid increases, fluid accumulates all around heart and may be visible anterior to heart during echocardiography.

Rough estimation about the amount of pericardial effusion is made by the size and extent of echo-free space. Echo free space of 1 cm or more that totally surrounds the hearts is considered a large effusion. Echo-free space of less than 1 cm that surrounds the heart suggests moderate pericardial effusion. Localized echo-free space of 1 cm or less suggests mild effusion. Other authors have used the criteria of less than 5 mm, 10-15 mm and more than 15mm to define mild, moderate and large effusion.

Tread mill test: TMT was performed in 50 patients.

STATISTICAL ANALYSIS

Data so collected was tabulated in an excel sheet, under the guidance of statistician. The means and standard deviations of the measurements per group were used for statistical analysis (SPSS 22.00 for windows; SPSS inc, Chicago, USA). Difference between two groups was determined using chi square test and the level of significance was set at $p < 0.05$.

RESULTS

Out of 50 subjects, 13 (26%) were males and 37(74%) were females. 8%, 38%, 34% and 20% of the subjects belonged to <40, 41–50, 51–60 and >61 years of age group respectively. General weakness, facial puffiness, hoarseness of voice, cold intolerance, weight gain, skin changes, pain in muscles and joints, constipation and slow in physical activities was reported among 88%, 60%, 46%, 26%, 20%, 62%, 74%, 14% and 16% of the subjects respectively. All these symptoms except skin changes and pain in muscles and joints was comparatively and significantly more among males as compared to females as $p<0.05$ (table 1).

Table 1: Symptomatology of the study population

Symptoms	Male (N=13)		Female (N=37)		Total (N=50)		p value
	N	%	N	%	N	%	
General weakness	13	100.00	31	83.78	44	88	0.004*
Facial puffiness	10	76.92	20	54.05	30	60	0.02*
Hoarseness of voice	9	69.23	14	37.84	23	46	0.002*
Cold intolerance	7	53.85	6	16.22	13	26	<0.01*
Weight gain	2	15.38	8	21.62	10	20	0.041*
Skin changes	8	61.54	23	62.16	31	62	0.19
Pain in muscles and joints	10	76.92	27	72.97	37	74	0.16
Constipation	3	23.08	4	10.81	7	14	0.03*
Slow in physical activities	5	38.46	3	8.11	8	16	0.003*

*: statistically significant

Most common signs on general physical examination was skin changes (58%) followed by oedema (52%) and delayed ankle jerk (34%). Pallor and thyroid swelling was found significantly more in females while oedema, tongue (thick) and delayed ankle jerk was significantly more in males as $p<0.05$ (table 1).

Table 2: Signs on general physical examination in the study population

Signs	Male (N=13)		Female (N=37)		Total (N=50)		p value
	N	%	N	%	N	%	
Pallor	2	15.38	14	37.84	16	32	0.004*
Oedema	10	76.92	16	43.24	26	52	<0.01*
Skin changes	8	61.54	21	56.76	29	58	0.16
Tongue (thick)	4	30.77	8	21.62	12	24	0.04*
Thyroid swelling	1	7.69	10	27.03	11	22	<001*
Delayed ankle jerk	6	46.15	11	29.73	17	34	0.02*

*: statistically significant

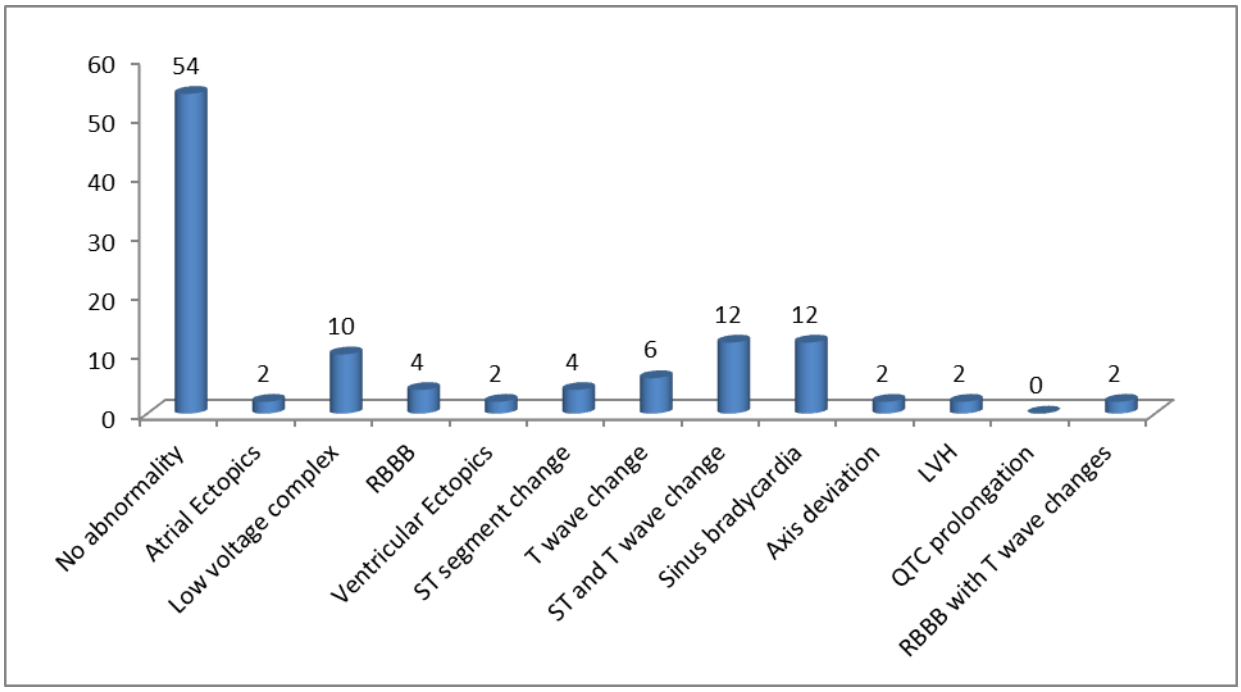
Mean cholesterol, HDL, LDL and Triglycerides among the study subjects was 242.63±37.39, 53.16±5.91, 109.89±20.84 and 182.97±38.94 respectively (table 3).

Table 3: Lipid profile among the study subjects

Parameter	Mean	SD
Cholesterol	242.63	37.39
HDL	53.16	5.91
LDL	109.89	20.84
Triglycerides	182.97	38.94

No abnormality was detected among 54% of the subjects. ST & T wave change and sinus bradycardia was reported among 12% of the subjects. Low voltage complex was revealed in 10% of the subjects. Axis deviation and LVH was found in one subjects each (graph 1).

Graph 1: ECG abnormalities in hypothyroid patients



Mean decelaration time, IVRT and E/A ratio among the study subjects was 191.79±12.88, 98.03±6.33 and 1.02±0.14 respectively. Mean EF was 54.74 among the study subjects (table 4).

Table 4: Echocardiograhic changes in hypothyroid patients

Echocardiograhic Changes	Mean	SD
LVPW thickness	7.93	1.17
IVS thickness	9.31	1.08
EF	54.74	2.48
Diastolic Dysfunction		
Decelaration time	191.79	12.88
IVRT	98.03	6.33
E/A Ratio	1.02	0.14

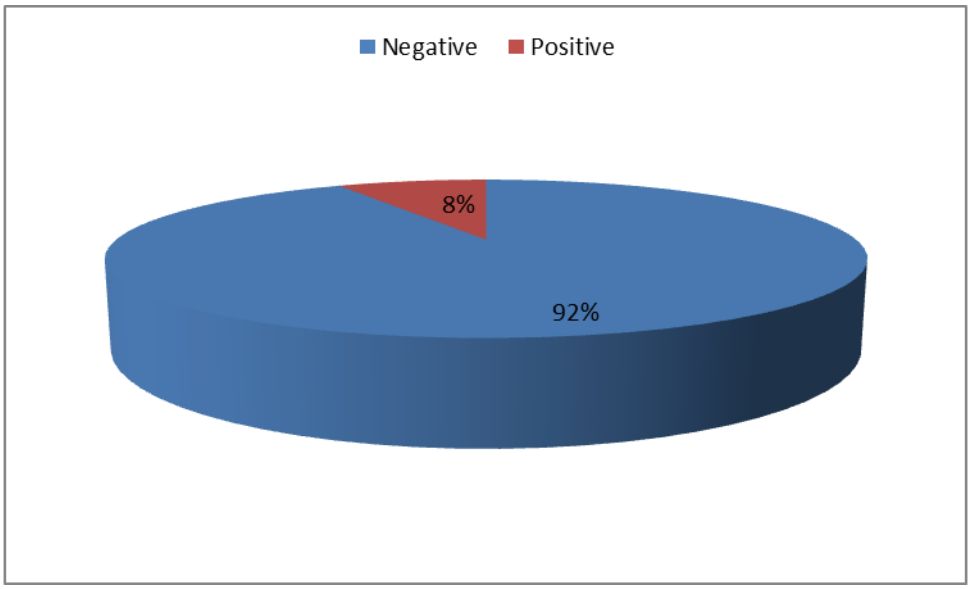
Pericardial Effusion (PE) was present among 13 (26%) subjects (table 5).

Table 5: Pericardial Effusion (PE) in the study population

Pericardial Effusion (PE)	N	%
Absent	37	74
Present	13	26
Total	50	100

Positive tread mill outcome was revealed among 8% of the subjects (graph 2).

Graph 2: Tread mill test outcome among the study population



DISCUSSION

Thyroid hormones have relevant effects on cardiovascular system. Many symptoms and signs recognized in patients with hypothyroidism are due to altered action of thyroid hormone on heart and vascular system, and the related hemodynamic derangements. Hypothyroidism is a common endocrine disorder resulting from deficiency of thyroid hormone. It usually is a primary process in which the thyroid gland is unable to produce sufficient amounts of thyroid hormone. The cardiovascular signs and symptoms of thyroid disease are some of the most profound and clinically relevant findings that accompany both hyperthyroidism and hypothyroidism.[8] It has long been recognized that some of the most characteristic and common signs and symptoms of thyroid disease are those that result from the effects of thyroid hormone on the heart and cardiovascular system. There are only few studies done in our country to assess the cardiovascular parameters in hypothyroid patients. This study was done to assess the CVS parameters in new hypothyroid patients by ECG and Echocardiography.[9]

In our study, out of 50 subjects, 13 (26%) were males and 37(74%) were females, hence showing female dominancy. Shrivastava P et al[10]in their study revealed that there was preponderance of female patients consisting of 90% of total study population, which is similar to our study.

8%, 38%, 34% and 20% of the subjects belonged to <40, 41–50, 51–60 and >61 years of age group respectively in the present study. Therefore maximum subjects belonged to 41-60 years. Shrivastava P et al[10]in their study reported similar age distribution.

In this study, LDL and Triglycerides among the study subjects was 242.63±37.39, 53.16±5.91, 109.89±20.84 and 182.97±38.94 respectively. In a study by Shende P et al[11], 8 patients (17.8%) had high serum cholesterol levels. Serum triglyceride was high in 25 patients (55.6%). In 14 patients (31.1%) there was border line high level whereas in 4 patients it was in the normal range. In the study of serum LDL of 45 patients, 4 patients (8.9%) had high LDL levels, 5 patients (11.1%) had borderline high LDL levels. 9 patients (20 %) are in the near optimal levels. In the sample study of serum HDL-C was high in 8 patients (17.8%).

No abnormality was detected among 54% of the subjects. ST & T wave change and sinus bradycardia was reported among 12% of the subjects. Low voltage complex was revealed in 10% of the subjects. Axis deviation and LVH was found in one subjects each in our study. In our study, incidence of Right Bundle Branch Block (RBBB) in patients of hypothyroidism was found to be 4%.Shende P et al[11]in their study reported similar results. Shrivastava P et al[10]in their study found that ECG changes observed were Sinus bradycardia in 35.5%, Low voltage complexes in 16.6%, T Wave inversion in 7.8%, RBBB in 4.4%, and QT prolongation in 2.2% cases. In a previous study by Ramesh K et al[12] sinus bradycardia was found to be 40%. Bradycardia reported in different studies have been 30% by Shashikanth et al[13], 14.3% by Kumar A et al[14] and 13.7% by Crowley et al[15]. Low voltage complex in a previous study by Ramesh K et al[12], was 30%, in a study by Rajasekhar et al[16], it was seen in 24% cases, while in a study by Shah SKD et al[17], it was seen in 33% cases.

This study suggests that it is very important to evaluate patients of primary hypothyroidism for cardiovascular changes so that prior interventions could be performed to improve the clinical outcomes. Any unexplained pericardial effusion should be screened for Hypothyroidism. Also, all patients found to have the ECG and Echocardiographic changes as reported above should be screened for the presence of hypothyroidism. In this study, mean decelaration time, IVRT and E/A ratio among the study subjects was 191.79±12.88, 98.03±6.33 and 1.02±0.14 respectively. Mean EF was 54.74 among the study subjects. Diastolic dysfunction was the commonest echocardiographic abnormality, seen in 9 (18%) cases. In a study by Shrivastava P et al[10], diastolic dysfunction was the commonest echocardiographic abnormality, seen in 20% cases. In a study by Verma R et al[18], it was seen that 27% of patients had diastolic dysfunction, whereas in a study by Shashikanth M[13], diastolic dysfunction was seen in 18% cases.

In this study, Pericardial Effusion (PE) was present among 13 (26%) subjects. The incidence of pericardial effusion in the present study correlates with the incidence of pericardial effusion reported by Verma R et al[18], (22.75%). The incidence of pericardial effusion in the present study is higher than the incidence reported by Gupta MM et al[19], which is 15%.In a study by Shrivastava P et al[10], pericardial effusion was found in 16.6% cases whereas it was 18% in a study by Shashikanth M[13].

This study suggests that it is very important to evaluate patients of primary hypothyroidism for cardiovascular changes so that prior interventions could be performed to improve the clinical outcomes. Any unexplained pericardial effusion should be screened for Hypothyroidism. Also, all patients found to have the ECG and Echocardiographic changes as reported above should be screened for the presence of hypothyroidism.

CONCLUSION

The hypothyroid patients present clinically with a myriad of symptoms and signs which are nonspecific. Hence a high index of suspicion is the key for early diagnosis of hypothyroidism. Cardiovascular symptoms are less commonly associated with newly detected hypothyroidism. The occurrence of pericardial effusion in hypothyroidism is significantly related to the duration of disease, hence the need for early diagnosis of hypothyroidism. X-ray chest is not a reliable tool for the diagnosis of peripheral effusion. Hence echocardiogram is the investigation of choice for the diagnosis of pericardial effusion.

Altered lipid profile was found in the hypothyroid patients. The identification of hypothyroid patients is an important individual and public health issue. Early diagnosis and correction of hypothyroidism is necessary, so that early effects on cardiovascular system can be minimized.

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