

# Cardiovascular Manifestations in Patients with Hypothyroidism in Rural South India – A Prospective Study

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## ABSTRACT

**Introduction:** Hypothyroidism is a common problem that varies in severity from barely detectable to chronic and life-threatening involvement of multiple organ systems. Thyroid hormone plays an important role in the heart concerning its structure and function. Whether the increased cardiovascular risk is due to functional, structural or metabolic derangements affecting cardiac function is not demonstrated. Thyroid hormone has a profound effect on many metabolic processes in virtually all tissues. Study aimed to study the cardiovascular manifestations with the thyroid hormone levels of the hypothyroid patients.

**Material and Methods:** This study was conducted at Rajah Muthiah Medical College and Hospital which is located at Chidambaram, South India. It is situated in rural area of Chidambaram. In this study, a group of 41 patients with hypothyroidism was examined prospectively with an aim to determine its effect on cardiac status correlating the thyroid levels of the patients with the emphasis on the cardiovascular manifestations.

**Results:** 50% of the hypothyroid patients had ECG changes. The most common abnormality noted was sinus bradycardia (22%). Other ECG abnormalities observed were atrial ectopics, RBBB, ventricular ectopics. Diastolic dysfunction was seen in 51% of the hypothyroid patients characterized by altered E/A ratio, prolonged DT, and prolonged IVRT.

**Conclusion:** The early detection and initiation of treatment of hypothyroidism may revert the changes in the heart caused by hypothyroidism, stressing stronger emphasis on the role of preventive medicine.

**Keywords:** Thyroid, Hypothyroidism, Free Triiodothyronine – FT3, Free Thyroxine – FT4, Thyroid Stimulating Hormone – TSH, Electro Cardiogram – ECG.

subjects showed an overall prevalence of hypothyroid as 5.4%.<sup>4</sup> Pathology of the thyroid gland (primary hypothyroidism) accounts for over 99.5% of cases of thyroid gland failure and <0.5% result from the disorder of pituitary gland or hypothalamus (central hypothyroidism).<sup>5</sup> Thyroid hormone exerts direct cellular effects on almost all tissues of the body. It causes multi-organ dysfunction secondary to deranged metabolism. The cardiac dysfunction ranges from functional systolic/diastolic dysfunction to overt failure and coronary artery disease. This is as a result of the direct effect of the disease. Hypothyroidism is also typically characterized by hypercholesterolemia and a marked increase in low-density lipoprotein and apolipoprotein B. This occurs significantly to a decreased fractional clearance of low-density lipoproteins by a reduced number of low-density lipoprotein receptors in the liver. Peripheral vascular resistance is also remarkably increased in hypothyroidism.<sup>5,6</sup> It has been suggested that patients with hypothyroidism are at increased risk of developing atherosclerosis as it is associated with significant changes in lipid metabolism. Thus hypercholesterolemia and hypertriglyceridemia, which are associated with the development of premature coronary artery disease, are found in patients with hypothyroidism.<sup>7</sup> Ecg changes include sinus bradycardia and prolongation of the QT interval. The P wave amplitude is usually very low. Hypothyroid patients have reduced ejection fraction.<sup>8,9</sup> Gratteinger J.S et al. showed that Hypothyroid patients had reduced cardiac output, stroke volume and blood and plasma volumes.<sup>10,11</sup>

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.<sup>13</sup> In hypothyroidism, the heart muscle is weakened in both contraction phase and also in the relaxation phase.<sup>14</sup> This indicates that the heart cannot pump as forcefully as it should, and the amount of blood it ejects with each heartbeat

## INTRODUCTION

Hypothyroidism can be defined as a syndrome characterized by the clinical and biochemical manifestations of thyroid hormone deficiency in the target tissues of the thyroid hormone.<sup>1</sup> Hypothyroidism denotes deficient thyroid gland production of thyroid hormone which may be caused by an abnormality in the thyroid gland itself (Primary Hypothyroidism) or insufficient thyroid stimulating hormone (TSH) stimulation of the thyroid gland because of an abnormality in the pituitary gland or hypothalamus (secondary Hypothyroidism).<sup>1</sup> thyroid disorders are the prevalent among all the endocrine disorders In India and hyperthyroidism and hypothyroidism are more frequent in women.<sup>2,3</sup> Nearly 108 million people in India suffer from endocrine and metabolic disorders.<sup>4</sup> Studies of the goitrous

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is reduced.<sup>15</sup>

In addition, because heart muscle does not relax normally in between heartbeats, diastolic dysfunction may result.<sup>16</sup>

Study aimed to study the cardiovascular manifestations with the thyroid hormone levels of the hypothyroid patients.

## MATERIAL AND METHODS

The study was conducted on patients attending general medicine outpatient department of Rajah Muthiah Medical College and Hospital. Patients with clinical symptoms and signs of hypothyroidism were segregated from the patients attending the general medicine outpatient department and were subsequently made to undergo a thyroid function test. The patient group comprised of forty one (n = 41) individuals who were proven hypothyroid biochemically and with clinical symptoms. Asymptomatic patients were not taken for the study. The age and sex matched (n=20) healthy volunteers are taken as controls.

### Exclusion criteria

1. Asymptomatic patients
2. Patients with co-existent primary cardiac disorder
3. Patients with hypertension or diabetes mellitus
4. Patients with chronic illness
5. Patients on drugs like carbimazole, propylthiouracil, amiodarone, lithium, beta blockers, oral contraceptives, glucocorticoids, etc.
6. Patients with collagen vascular disorder
7. Patients who are pregnant
8. Patients who are known hypothyroid and on thyroxine.

A detailed history regarding age, sex, past history of hypothyroidism, diabetes mellitus, hypertension, other endocrine diseases, any cardiac disease or any chronic illness were obtained. The detailed general examination was performed. Thyroid status was assessed by estimation of FT3, FT4, TSH. ECG was also done systematically. A complete hemogram, urine routine examination, random blood sugar, urea, creatinine, electrolytes, lipid profile, liver function test, serum protein were also done.

## STATISTICAL ANALYSIS

All the above test were done on age and sex matched twenty (20) healthy volunteers. All the results were statistically analysed by students 't' test, and 'P' values of <0.05 were taken as significant.

## RESULTS

78% of the patients in this study group were females, showing female preponderance in hypothyroidism. 64% of the hypothyroid patients fall in the age group of 40 – 60 years (table-1,2).

Most of the patients were symptomatic in relation to cardiovascular symptoms with the most common clinical presentation was fatigue (68%), followed by dyspnoea, chest pain, palpitation and pedal oedema. 48% of the patients were found to be overweight but not obese (table-3).

22% of the patients had bradycardia, of which group 2 and 3 had 90% of the patients. This shows the relationship of

Age	Number of patients	%
Below 40	4	10
41 – 50	15	36
51 – 60	14	32
Above 61	8	22
Total	41	100

**Table-1:** Age distribution of hypothyroid patients

Gender	Number of patients	%
Male	9	22
Female	32	78
Total	41	100

**Table-2:** Sex distribution of hypothyroid patients

Symptoms	Number of patients	%
Dyspnea	28	68
Chest pain / tightness	5	12
Palpitation	1	3
Cough	1	3
Oedema	4	10
Fatigue	36	88
Syncope	1	3

**Table-3:** Main cardiovascular symptoms seen in hypothyroid patients

Sub group	Number of patients	%
Group 1 TSH level >6 less than 10	10	25
Group 2 TSH level between 10 – 20	17	41
Group 3 TSH level more than 20	14	24
Total	41	100

**Table-4:** Subgrouping of patients according to tsh level

ECG abnormalities	Number of patients	%
Atrial ectopics	1	2
Low voltage complex	5	12
RBBB	2	4
Ventricular ectopics	1	2
ST segment change	2	4
T wave change	2	4
ST and T wave change	6	14
Sinus bradycardia	7	16
Axis deviation	1	2
LVH	1	2
QTC prolongation	0	0
RBBB with T wave changes	1	2
No abnormality	21	50

**Table-5:** ECG abnormalities in hypothyroid patients

bradycardia with increasing severity of hypothyroidism. 19% of the study group had systolic BP > 140 mmHg, which was newly detected during the study. Table 4 shows subgrouping of patients according to TSH level. Table 5 shows ECG abnormalities in hypothyroid patients.

50% of the hypothyroid patients had ECG changes. The most common abnormality noted was sinus bradycardia (22%). Other ECG abnormalities noted were atrial ectopics,

S. No	Parameter	Value for controls	Value for hypothyroid patients	T value	P value	
1	BMI	21.25 ± 1.52	24.05 ± 2.59	2.86	0.01	
2	Systolic BP	117.10 ± 6.07	124.27 ± 19.65	1.55	0.027	
3	Diastolic BP	77.50 ± 4.44	81.95 ± 10.75	1.32	0.02	
4.	Cholesterol	157.3 ± 12.5	239.6 ± 38.0	7.98	0.001	
5.	Triglycerides	139.4 ± 19.2	185.2 ± 41.95	3.50	0.02	
Echocardiographic changes						
1.	LVPW thickness	5.81 ± 0.35	7.76 ± 1.06	6.947	0.001	
2.	IVS thickness	6.85 ± 0.3	9.42 ± 1.2	7.475	0.001	
3.	EF	57.95 ± 4.49	54.93 ± 2.76	0.197	0.18	
4.	Diastolic dysfunction	Deceleration time	183.3 ± 4.22	192.7 ± 14.39	2.998	0.007
		IVRT	80.6 ± 6.47	98.17 ± 6.57	8.048	0.001
		E/A RATIO	1.56 ± 0.17	1.06 ± 0.17	9.824	0.001
<b>Table-6:</b> Comparison of BMI, BP, Cholesterol, triglycerides and echocardiographic changes with control group and hypothyroid patients						

RBBB, ventricular ectopics. Diastolic dysfunction was seen in 51% of the hypothyroid patients characterized by altered E/A ratio, prolonged DT and prolonged IVRT. The pattern of diastolic dysfunction was predominantly the stage of impaired relaxation. It has been documented that 30 – 40% of heart failure syndromes are secondary to impaired diastolic dysfunction (table-6). Therefore, the diastolic dysfunction observed in this study could be the prelude to more serious limitation of cardiac function and physical performance.

## DISCUSSION

64% of the hypothyroid patients fall in the age group of 40 – 60 years. 78% of the hypothyroid patients in this study are females. This proves that hypothyroid is more incident in older females. This is also similar to the studies conducted by Mahmood et al. at Al-Kahdmiya teaching hospital, Baghdad.<sup>12</sup> The clinical diagnosis of hypothyroidism can be difficult because of the non specific nature of the symptoms and signs and the marked diversity of findings. Most of the patients were symptomatic in relation to cardiovascular symptoms. The important symptoms pertaining to cardiovascular system seen in the study group were fatigue (88%), dyspnoea (69%), chest pain / tightness (12%), oedema (10%), palpitation (3%), cough (3%), syncope (3%). The most common presenting symptom in the hypothyroid study group was fatigue (88%), dry, coarse skin (50%), weight gain (48%). Fatigue is the most common symptom of hypothyroidism as stated by Kavther et al.<sup>19</sup>

TSH level in this study, 25% of the patients had TSH levels between 6 – 10  $\mu$ Iu/ml, 41% of the patients had TSH levels between 10 – 20  $\mu$ Iu/ml and 24% of the patients had TSH levels more than 20  $\mu$ Iu/ml. TSH levels correlate to the severity of hypothyroidism as per journal of Mayo clinic Proceedings.<sup>20</sup>

In this study group of 41 hypothyroid patients, 50% (n = 20) had notable ECG abnormalities. The most common abnormality noted was sinus bradycardia in 16% (n = 7), ST segment and T-wave depression in 14% (n = 6). The next common abnormality was low voltage complexes in 12% of patients (n = 5)

One of the classical findings of hypothyroidism is weight

gain, despite a poor appetite.<sup>17</sup> In this study, 48% of the hypothyroid patients were overweight with BMI between 25 – 30 kg/m<sup>2</sup>. but none were in obese level.

Systolic / diastolic Blood Pressure in this study, 8 hypothyroid patients who are in group3 had systolic bp > 140, and 8 patients had diastolic BP > 90. There is a serial increase in patients with systolic and diastolic suggests the association of both systolic and diastolic hypertension with increasing severity of hypothyroidism.<sup>19</sup>

In this study, n = 19 patients had cholesterol > 250 mg%. this proves that there is a serial increase in the number of patients with cholesterol > 250 mg% with increasing severity of hypothyroidism similar to studies by Elder et al.<sup>7</sup>

75% (n = 30) of the hypothyroid patients had triglycerides > 160 mg%. thus hypercholesterolemia and hypertriglyceridemia as associated with the development of CAD and are found in patients with hypothyroidism.<sup>7</sup>

In this study, there was a significant increase in LVPW thickness compared to the control group and statistically found to be highly significant. There is a proportional increase in LVPW thickness with increasing severity of hypothyroidism.<sup>17</sup>

There were 6 patients (16%) with IVS thickness more than 11 mm. it was found that 5 out of 6 patients belong to Group3 (TSH > 20  $\mu$ IU/ ml). comparative increase in IVS thickness is seen as TSH increases. The severity of hypothyroidism correlates with the thickening of IVS.<sup>17</sup>

On comparing with the control group, the ejection fraction was not found to be significant.

In this study, diastolic dysfunction was assessed by deceleration time, isovolumetric relaxation time and E/A ratio. 51% of the patients had diastolic dysfunction with E/A ratio  $\leq$  1, prolonged DT, prolonged IVRT, 75% of hypothyroid patients had prolonged IVRT alone similar to studies by Grossman.<sup>18</sup>

## CONCLUSION

Thyroid hormone has significant actions on the heart, and thyroid dysfunction can cause significant adverse cardiovascular effects. The early detection and initiation of treatment of hypothyroidism may revert the changes in the

heart caused by hypothyroidism, stressing stronger emphasis on the role of preventive medicine.

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