

# A Study of Cardiovascular Changes in Newly Detected Hypothyroid Patients

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## Abstract

**Background and Objectives:** Hypothyroidism has significant cardiovascular manifestations. Overt and sub clinical hypothyroidism both are associated with cardiovascular dysfunction and with an increased risk of cardiovascular disease. This study was done to recognize cardiovascular changes associated with newly detected hypothyroid patients.

**Methods:** Based on the symptoms, clinical examination and hormonal assay, newly detected hypothyroid patients were subjected to detailed cardiovascular examination, blood tests, electrocardiography and echocardiography. Patients were investigated, before the thyroid hormone replacement therapy. **Results:** Hypothyroidism was newly diagnosed more in females and maximum in age group 18-48 years (77.8%) of age group. Out of 45 patients, 62.2% had symptoms less than 3 months duration. Cardiovascular symptoms were present in less number of patients. Bradycardia was observed in 6.6% of the patients. Stage 1 hypertension was noticed in 17.8% (diastolic blood pressure). Low voltage complexes in electrocardiogram were present in 40% study group. Pericardial effusion was present in 16.6% patients. Systolic and diastolic dysfunction was noticed respectively in 4.5% and 2.2% study group. Altered lipid profile was present in 60% (S. cholesterol) and 94.7% (S. Triglycerides). **Interpretation and Conclusion:** Hypothyroidism is common in females, maximum between 18-48 years age group. Majority of the patients did not have any cardiovascular changes. Observed cardiovascular changes were ECG abnormalities, pericardial effusion and diastolic blood pressure. Systematic study was done to know the early effects of hypothyroidism on cardiovascular system. The identification of patients with hypothyroidism is an important individual and public health issue. Hence, early detection and initiation of hormone replacement therapy can minimize associated cardiovascular changes.

**Keywords:** Cardiovascular Changes, Diastolic Blood Pressure, Hypothyroidism, Pericardial Effusion

## 1. Introduction

Thyroid disorders are one of the most prevalent endocrinopathies across the world. An estimated 200 million individuals worldwide suffer from this disease<sup>1</sup>. The prevalence of spontaneous hypothyroidism is between 1 and 2% of all the thyroid disorders in the world<sup>2</sup>. In India thyroid disorders are the second most common glandular disorder of the endocrine system and are increasing predominantly among women. With a population of 1.21 billion, an estimated 108 million people suffer from endocrine and metabolic disorders. Of these 108 million, 42 million suffer from thyroid disorders. According to the

survey done by the Indian Government the prevalence of hypothyroidism is 5.4%<sup>3</sup>.

The most common cardiovascular signs and symptoms of hypothyroidism are diametrically opposite to hyperthyroidism and may include bradycardia, mild hypertension (diastolic), narrowed pulse pressure, cold intolerance, and fatigue<sup>4,5</sup>. The cardiac output in hypothyroidism may decrease by 30% to 50%<sup>6</sup>. Overt hypothyroidism affects 3% of the adult female population and is associated with increased Systemic Vascular Resistance, decreased cardiac contractility, decreased cardiac output, and accelerated atherosclerosis and coronary artery disease<sup>5,7,8</sup>.

The changes in the hyperthyroidism are dramatic but the above mentioned subtle changes in the cardiovascular system in a hypothyroid status are also important therefore this study regarding pathological and physiological changes is carried out. To study physiological and pathological effects on cardiovascular system and to study socio-demographic factors and clinical features in newly detected patients of hypothyroidism are the objectives of the study.

## 2. Materials and Method

- Study Design- Cross sectional
- Study Setting- Department of Medicine of Tertiary Care Teaching Hospital.
- Duration of Study- December 2014 to December 2016.
- Study Participants
- Sample Size- 45
- Eligibility Criteria
  - Inclusion Criteria:

All the newly detected hypothyroidism patients including subclinical hypothyroidism of the age more than 18yrs diagnosed by clinical evaluation and confirmed by serum TSH, total T<sub>3</sub>, and total T<sub>4</sub> levels attending the medicine outpatient and indoor departments. Serum TSH concentration more than 10mIU/L and T<sub>3</sub> level less than 60ng/dL and T<sub>4</sub> less than 4.5µg/dL is referred as clinical hypothyroidism or overt thyroidism, whereas TSH level between 4.3 to 10mIU/L with thyroid hormone level that remain within the reference range is referred as subclinical hypothyroidism<sup>9</sup>.

- Exclusion Criteria:
- Secondary hypothyroidism
- Patients having underlying known cardiac disease and other associated diseases like diabetes, hypertension, pregnancy and conditions which themselves may cause cardiovascular manifestations.
- Chronic alcoholic more than 2units/day for more than 1year.
- Chronic intake of drugs like beta-blockers, oral contraceptive pills, amiodarone, glucocorticoids and antineoplastic drugs.

### 2.1 Methodology

Present study was conducted in the Department of medicine at a Tertiary Care Teaching Hospital. A total number of 45 patients were included in the present study after satisfying inclusion and exclusion criteria. Written informed consent was taken from the participants after explaining the study in local language to the best of their satisfaction. Data was collected from these 45 patients belonging to both out-patient and in-patient departments during this period. Clinical history and examination findings were entered in pre-designed proforma

### 2.2 Source of Data

Cases of newly detected primary hypothyroidism were selected for this study. Those patients who were biochemically found to have hypothyroidism or those suspected to be suffering from hypothyroidism on clinical evaluation and confirmed by serum TSH, T<sub>4</sub> and T<sub>3</sub> levels were included in the study. Such 45 patients satisfying inclusion and exclusion criteria were included in the study.

### 2.3 Method of Collection of Data

The data for the purpose of the study were collected in a predesigned and pretested proforma which includes various socio-demographic parameters like age, sex, occupation, religion etc. The analysis of data was arranged on the basis of the important statistical parameters. About 45 cases were selected on the basis of the simple random sampling method. The analysis of data was made on the basis of the important statistical parameters like the mean deviation, standard error, the t-test and the proportion test.

## 3. Results

### Cardiovascular symptoms

The study of cardiovascular symptoms the effort intolerance in (18.2%) male patients and (4.3%) in female patients, chest pain was reported in only 2 male patients (18.2%), breathlessness in only one female patient (2.9%) and palpitations seen in only one female patient (2.9%).

Pulse

**Table 1.** Cardiovascular symptoms in the study population (n=45)

Sl. No.	Symptoms	Male	%	Female	%	Total	%	p value	Inference
1	Chest pain	02	18.2	0	0	02	4.4	<0.001	SIG
2	Breathlessness	0	0	01	2.9	01	2.2	<0.001	SIG
3	Effort intolerance	02	18.2	01	2.9	03	6.7	<0.001	SIG
4	Palpitations	0	0	01	2.9	01	2.2	<0.001	SIG

**Table 2.** Pulse rate in the study population (n=45)

Sl. No.	Beats/min	Male	%	Female	%	Total	%
1	40-49	00	0	1	2.9	01	2.2
2	50-59	0	0	2	5.9	02	4.4
3	60-69	10	90.9	15	44.1	25	55.5
4	70-79	01	9.0	11	32.3	12	26.6
5	80-89	0	0	5	14.7%	05	11.11

**Table 3.** Table showing the mean pulse rate and SD (beats/m) according to sex

Sex	Mean (b/m)	SD (b/m)
Male	68.55	6.314
Female	69.03	11.800

Mean 68.91 SD 10.655 P < 0.05 significant (S) 0.863

The mean pulse rate among male 68.55±6.314; while the mean age of female 69.03±11.800. By applying unpaired t test there is no statistically significant difference among mean pulse rate of gender with p = 0.863

The difference in the mean pulse rate was NOT significant.

In this study 3 out of 45 patients had pulse rate (<60/min) i.e., bradycardia. Maximum number of patients 35 out of 45 (i.e., 55.5%) had pulse rate in the range of 60-69 per minute. Twelve out of 45 (26.6%) in rang of 70-79. Only 11.1% patients had a pulse rate of above 80/min.

### Hypertension

As per JNC 8 criteria<sup>10</sup>

**Table 4.** Prevalence of the hypertension (n=45)

Sl. No.	JNC 8 BP criteria	Systolic BP				Total	
		M	%	F	%	Total	%
1	Normal (<120)	08	72.7	11	32.4	19	42.2
2	Pre-hypertension (120-139)	03	27.9	21	61.7	24	53.3
3	Hypertension stage-1 (140-159)	0	0	02	5	02	4.5
4	Hypertension stage-2 (>160)	0	0	0	0	0	0
5	<b>Total</b>	<b>11</b>	<b>100</b>	<b>34</b>	<b>100</b>	<b>45</b>	<b>100</b>

Sl. No.	JNC 8 BP criteria	Diastolic BP				Total	
		M	%	F	%	Total	%
1	Normal (<80)	07	63.6	10	29.4	17	37.8
2	Pre-hypertension (80-89)	04	36.3	16	47.1	20	44.4
3	Hypertension stage-1 (90-99)	00	0.0	08	23.5	08	17.8
4	Hypertension stage-2 (> 100)	0	0	0	0	0	0
	<b>Total</b>	<b>11</b>	<b>100</b>	<b>34</b>	<b>100</b>	<b>45</b>	<b>100</b>

In this present study Pre-hypertension (systolic) was present in 24 patients (53.3%) out of 45. In this 3 were males and 21 were females. Pre-hypertension (Diastolic) was present in 20 out of (44.4%) 45 patients. In this 4 were males and 16 were females. Hypertension Stage 1 (systolic) was present in 2 females and not found in males. Hypertension stage1 diastolic was present in 8 patients out of 45 patients in that 8 patients were females and not found in males.

**Table 5.** Lipid profile in the study participant

Sl. No.	Serum level (mg/dl)	Male	Female
1	Total Cholesterol	36.4	41.2
2	Serum Triglycerides	91.4	85.3
3	Serum LDL	36.4	29.4
4	Serum HDL	0	32.4

In the present lipid profile study of 45 patients serum cholesterol of 10 patients (22.2%) had border line high cholesterol levels, 8 patients (17.8%) had high serum cholesterol levels. 27 patients (60%) had normal serum level.

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. 27 patients (60%) were in the normal serum LDL levels.

In the sample study of serum HDL-C was high in 8 patients (17.8%). The majority of the patients (57.8%) it was between 40-60mg/dL. In 11 patients (24.4%) HDL was low.

**Table 6.** Cardiovascular changes in the study group (n=45)

Sl No	Cardiovascular changes	(%) male	(%) female
1	Bradycardia	0	8.8
2	Systolic blood pressure	0	5.9
3	Diastolic blood pressure	0	23.5
4	Low voltage complexes	45.5	50
5	ST segment and T-wave changes	2.9	26.5
6	Right Bundle Branch Block	27.3	0
7	Pericardial effusion	18.2	11.8
8	Systolic dysfunction	18.2	2.9
9	Diastolic dysfunction	9.1	0

## 4. Discussion

The incidence of bradycardia in the present study is 6.7%

which correlates with the incidence reported by Wayne in 1960<sup>11</sup> which is 8% and the incidence of bradycardia reported by William FC et al<sup>12</sup>(13.3%) and Anilkumar et al.,<sup>13</sup>(14.3%) is more than the present study.

**Table 7.** Mean pulse rate with Standard Deviation (SD)

Anil kumar et al., <sup>13</sup>		A. Gupta et al., <sup>14</sup>		Present study	
M	SD	M	SD	M	SD
67*	7	67.72*	5.24	68.91	10.66

The data from the present study is correlates well with both the studies mentioned above.

#### 4.1 Incidence of Hypertension Reported in Different Studies

The incidence of hypertension in the present study is 17.8% which correlates with the incidence reported by Watanakunakorn et al.,<sup>15</sup> which is 18%. Incidence reported by Saito I et al.,<sup>16</sup> (14.8%) is less than present study and incidence reported by Klein I<sup>17</sup> (21%) is more than the present study.

**Table 8.** Comparative study of lipid profile

Lipid Profile (mg/dl)	A Gupta et al (1996) <sup>14</sup>		S.K. Rajan (2003) <sup>22</sup>		Present study	
	Mean	SD	Mean	SD	Mean	SD
Cholesterol	231.27	68.30	235.5	-	206.7	30.9
Triglycerides	235.59	137.53	166.3	-	206.2	50.78
LDL	126.09	54.09	145.0	-	108.63	28.17
HDL	-	-	46.3	-	54.12	6.26

#### 4.2 Incidence of Low Voltage Complexes in ECG

The incidence of low voltage complexes in ECG in the present study (48.9%) is more than Watanakunakorn et al (1965)<sup>15</sup> (36.25%), William F.C. et al.,<sup>12</sup> (40%) and Tajiri J. et al.,<sup>18</sup> (32.14%).

#### 4.3 Incidence of Pericardial Effusion (PE) in different studies

The incidence of pericardial effusion in the present study correlates with the incidence reported by Gupta M.M. et al.,<sup>19</sup> which is 15%. Incidence of pericardial effusion reported by R Varma et al.,<sup>20</sup> (22.75%) and Saritha Bajaj et al., (30.3%)<sup>21</sup> are more than the present study.

Mean serum lipid levels in the two studies i.e., A Gupta et al., and S.K. Rajan are fairly comparable.

## 5. Conclusion

- Cardiovascular changes are less commonly associated with newly detected hypothyroidism.
- Low voltage complexes on electrocardiogram are found in large percentage of patients but pericardial effusion occurs in a low percentage of patients.
- Pericardial effusion is significantly related to the duration of illness hence there is need for early diagnosis in hypothyroidism.
- Lipid profile was altered in significant number of patients. These patients can be advised the treatment for the same.
- Few patients were found to have hypertension but quite significant number of patients was in pre-hypertension group. Various life style modifications can be advised preventing them going for Stage 1 hypertension.
- Systolic and diastolic dysfunction was less commonly seen in patients with newly detected hypothyroidism.
- Early diagnosis and correction of hypothyroidism is necessary; so that early effects on cardiovascular system can be minimized.

## 6. References

1. Jha S, Ahmad N. Prevalence of thyroid dysfunction in the patients visiting tertiary health care hospital, Faridabad, Haryana. *International Journal of Scientific Research*. 2013; 2(10).
2. Vanderpump MPJ. The epidemiology of thyroid disease. *British Medical Bulletin*. 2011; 99:39–51. <https://doi.org/10.1093/bmb/ldr030> PMID:21893493.
3. Kochupillai N. Clinical endocrinology in India. *Current Science*. 2000; 79:1061–7.
4. Demers LM, Spencer CA. Laboratory medicine practice guidelines: Laboratory support for the diagnosis and monitoring of thyroid disease. *Thyroid*. 2003; 13:3–126. <https://doi.org/10.1089/105072503321086962> PMID:12625976.
5. Crowley WF Jr, Ridgway EC, Bough EW, Francis GS, Daniels GH, Kourides IA, Myers GS, Maloof F. Noninvasive evaluation of cardiac function in hypothyroidism. Response to gradual thyroxine replacement. *N Engl J Med*. 1977; 296:1–6. <https://doi.org/10.1056/NEJM197701062960101> PMID:830262.
6. Danzi S, Klein I. Thyroid hormone and the cardiovascular system. *Minerva Endocrinologica*. 2004;29:139–150. PMID:15282446
7. Klein I. Endocrine disorders and cardiovascular disease. Zipes DP, Libby P, Bonow R, Braunwald E, editors. *Braunwald's heart disease: A textbook of cardiovascular medicine*. 10th ed. Philadelphia, PA: WB Saunders; 2015. p. 1793–808.

8. Steinberg AD. Myxedema and coronary artery disease: A comparative autopsy study. *Ann Intern Med.* 1968; 68:338-44. <https://doi.org/10.7326/0003-4819-68-2-338> PMID:5713917.
9. Bashir H, Farooq R, Majid S. Increased prevalence of sub-clinical hypothyroidism in females in mountain valley of Kashmir. *Indian J. Endocrinology Metabolism.* 2013 Mar-Apr; 17(2):276-80. <https://doi.org/10.4103/2230-8210.109709> PMID:23776902 PMCid:PMC3683204.
10. Carter BL, James PA, Oparil S, et al. Report from the members appointed to the eighth Joint National Committee: The JNC 8 report. *JAMA.* 2014; 311(5):507-20. PMID:24352797.
11. Wayne EJ. Clinical and metabolic studies in thyroid disease. *British Heart J.* 1960; 78-85. <https://doi.org/10.1136/bmj.1.5165.1>.
12. Crowley F, Willam, et al. Noninvasive evaluation of cardiac function in hypothyroidism. *The New England Journal of Medicine.* 1977; 296:1-6. <https://doi.org/10.1056/NEJM197701062960101> PMID:830262.
13. Kumar A, et al. Torsade de Pontes and marked QT prolongation in association with hypothyroidism. *Annals of Internal Medicine.* 1987; 106(5):712-3. <https://doi.org/10.7326/0003-4819-106-5-712> PMID:3565970.
14. Gupta A, Sinha RSK. Echocardiographic changes and alterations in lipid profile in cases of sub-clinical and overt hypothyroidism. *JAPI.* 1996; 44(8):546-53. PMID:9251429.
15. Watanakunakorn C, Robert EH, Titus CE. Myxoedema. *Arch Intern Med.* 1965; 116:183-9. <https://doi.org/10.1001/archinte.1965.03870020023008> PMID:14318476.
16. Saito I, Ito K, Saruta T. Hypothyroidism as a cause of hypertension. *Hypertension.* 1983; 5(1):112-5. <https://doi.org/10.1161/01.HYP.5.1.112> PMID:6848458.
17. Klein J. Thyroid hormone and the cardiovascular system. *Am J Med.* 1990; 88(6):631-7. [https://doi.org/10.1016/0002-9343\(90\)90531-H](https://doi.org/10.1016/0002-9343(90)90531-H).
18. Tajiri J, et al. Lactate dehydrogenase isozyme and hypothyroidism. *Arch Intern Med.* 1985; 145(10):1929-30. <https://doi.org/10.1001/archinte.145.10.1929b> PMID:4037958
19. Gupta MM, Doomra M, et al. Heart in hypothyroidism: An echocardiographic study. *JAPI.* 2001; 49:141.
20. Varma R, Jain AK, Ghose T, et al. Heart in hypothyroidism. An echocardiographic study. *JAPI.* 1996; 44(6):390-2. PMID:9282558.
21. Bajaj S, Saxena PC, Sharma GP, et al. Cardiovascular assessment of hypothyroidism before and after treatment. *IJEM.* 2003; 5(1):23-30.
22. Rajan SK, Pachaiyappan P, et al. Lipoprotein (a) levels and lipid profile in sub-clinical and overt hypothyroidism. *JAPI.* 2003; 136:278.