



## Study of Cardiac Dysfunction in Hypothyroidism

### KEYWORDS

Hypothyroidism, Diastolic dysfunction, Dyslipidemia, ECG Abnormalities

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### ABSTRACT Background:

Hypothyroidism is one of the most common endocrine problem encountered in clinical practice. Many thyroid disorders manifest as various cardiovascular symptoms and signs. At cellular level thyroid hormones act on cardiomyocytes and modifies **cardiovascular** functions like preload, afterload, myocardial contractility and excitability and oxygen consumption. Cardiac dysfunction can be assessed with the help of investigations like ECG, 2D ECHO and lipid profile in association with clinical symptoms and signs Restoration of euthyroid state in hypothyroidism restores cardiac function reducing cardiovascular morbidity and mortality.

### Results:

In our study consisting of 42 patients, the age range was from 31-60 yrs. There was an overall female preponderance. Most common symptoms were of weight gain, lethargy, dry skin, and hoarseness of voice and bradycardia and hyper-tension. Common ECG abnormalities were low voltage QRS, non specific ST T changes and QTc dispersion 2 D ECHO showed pericardial effusion, cardiac tamponade and diastolic LV dysfunction.

### Conclusion:

Among 42 new cases of hypothyroidism, pericardial effusion was found in 19.42% patients. Diastolic dysfunction was seen in 26.56% patients. Thus any unexplained pericardial effusion should be screened for hypothyroidism. ECG abnormalities like low voltage QRS complex, QTc dispersion should be taken into consideration during therapeutic interven-tions.

### Introduction

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. Both hyperthyroidism and hypothyroidism produce changes in cardiac contractility, myocardial oxygen consumption, cardiac output, blood pressure, and systemic vascular resistance (SVR). Although it is well known that hyperthyroidism can produce atrial fibrillation, it is less well recognized that hypothyroidism can predispose to ventricular dysrhythmias. In almost all cases these cardiovascular changes are reversible when the underlying thyroid disorder is recognized and treated. Thyroid disease is quite common. Current estimates suggest that it affects as many as 9% to 15% of the adult female population and a smaller percentage of adult males. This gender-specific prevalence almost certainly results from the underlying autoimmune mechanism for the most common forms of thyroid disease, which include both Graves' and Hashimoto's disease. However, with advancing age, especially beyond the eighth decade of life, the incidence of disease in males rises to be equal to that of females. Recent study by AG Unnikrishnan showed prevalence of hypothyroidism in Indian population was 10.95%, with significantly higher proportion of female Vs male (15.86% vs 5.02%). Subclinical hypothyroidism (SCH) was observed in 8.02% of the population.

### Materials & Methods:

A cross sectional study consisting of 42 new patients of hypothyroidism who presented to Smt. Kashibai Navale Medical College and General Hospital, Pune from 1-6-2014 to 31-12-2015 were studied to asses cardiac function by ECG and 2D Echo. They were clinically evaluated and underwent relevant investigations, including thyroid pro-

file estimation, lipid profile, cardiac evaluation using ECG, 2D ECHO and Doppler. Newly diagnosed hypothyroid patients on treatment of L Thyroxine of less than 4 months were included in the study. Patients with known cardiac disease, COPD, severe anemia, diabetes mellitus or any other endocrinal disorder were excluded from the study. Patients taking medications that alter the thyroid function like beta blockers, lithium, OCP's, steroids & alcohol were excluded from the study.

All patients were investigated for Sr. T3, Sr. T4 and Sr. TSH, Complete blood count (CBC), Random blood sugar, Urine routine – sugar, albumin, microscopy, Blood urea, Serum creatinine, Lipid profile, standard 12 lead ECG, 2D Echo and Doppler. 3 ml of early morning fasting samples containing plain clotted blood were collected and sent for T3, T4, TSH estimation. The hormone estimation is done by chemiluminescence assay. All patients were subjected to 2D echo m – mode and Doppler study. Various parameter like inter ventricular septal thickness (IVS), left ventricular end diastolic and end systolic diameter (LVEDD/LVESD) Ejection Fraction (EF) to asses diastolic LV function, deceleration time (DT), iso-volumic interventricular relaxation time (IVRT), E/A ratio were estimated as per American society of echo cardiography guidelines. Magnitude of pericardial effusion was assessed.

### RESULTS :

#### Clinical symptoms in hypothyroidism

Symptom	No. Of cases	Percentage
fatigue	19	45.23
Weight gain	18	42.85
Cold intolerance	14	33.33
Anorexia	15	35.71
Constipation	10	23.80

Dyspnea	9	21.42
Edema	7	16.66

#### Age and sex distribution of patients of hypothyroidism

Age	Male	Female
12 – 20	0	1
21 – 30	3	8
31 – 40	4	12
41 – 50	2	6
51 – 60	1	4
>60	0	1

#### Lipid Profile and Hypothyroidism

Lipid parameters (mean $\pm$ SD)	Levels
Total cholesterol	220.24 ( $\pm$ 58.61)
HDL	33.70 ( $\pm$ 5.6)
LDL	146.15 ( $\pm$ 15.6)
TGL	170.40 ( $\pm$ 20.40)

Lipid analysis showed increase of TC, LDL, TGL and decrease of HDL in mild, moderate and severe cases.

#### Severity of hypothyroidism according to TSH levels

Severity of hypothyroidism	TSH levels (mU/L)	No.of cases
Mild	0.5 – 20	20
Moderate	20-50	18
Severe	>50	4

#### ECG finding

ECG	No.of cases	Percentage
Normal	14	33.33
Bradycardia	12	28.57
Low voltage complexes	8	19.04
ST-T changes	11	26.19
LBBB	3	7.14
RBBB	4	9.52
APC	1	2.38
VPC	2	4.76
QTc prolongation	9	21.42

Torsades de pointes	0	0
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Normal ECG was found in 14 patients (33.33%). Bradycardia is most common finding seen in 12 (28.57%). A low voltage complex is seen in 8 patients(19.04%). ST-T changes were found in 11 patients (26.19%). LBBB was found in 3 patients (7.14%). RBBB was found in 4 patients(9.52%). APC was found in 1 patient (2.38%). VPC was found in 2 patients (4.76%). QTc prolongation was found in 9 patients (21.42%). Torsades de pointes in no patient.

#### ECHO findings

Echo findings	No.of cases	Percentage
Normal	20	47.61
Systolic dysfunction	3	7.14
Pericardial effusion	8	19.42
Diastolic dysfunction		
Mild	8	19.42
Moderate	3	7.14
Severe	Nil	0
IVS thickness(>5mm)	4	9.52
Cardiac tamponade	1	2.38

Echo findings are normal in 20 patients (47.61%). Pericardial effusion is seen in 8 cases accounting to 19.42%. Diastolic dysfunction (mild - moderate) seen in 11 patients, majority of them being mild dysfunction in 8 patients (19.42%) and moderate in 3 patients (7.14%). No cases found to have severe diastolic dysfunction. Increased IVS thickness found in only in 4 cases (9.52%). Cardiac tamponade was found in 1 patient (2.38%).

#### Discussion:

The present study included 42 newly detected hypothyroid patient and it was conducted at Smt. Kashibai Navale Medical College and Gen. Hospital , Pune from 1-6-2014 to 31-12-2015, data analysis done and discussed here in comparison with previous studies. The age range of the patients included is between 12-60 years. Most patients belonged to the age groups of 31-40. There was an overall female preponderance. The female population constituted about 76.19% of the total with female : male ratio 3:1. Similar demographic profile was mentioned in most of medicine text books including Harrison text book of internal medicine.

On general examination most common findings are dry skin and weight gain in around 70% and 68% of patients respectively. Bradycardia seen in 30% of patients, hypertension is seen in 18% of the patients, other less common findings included edema, pallor, weight gain, cold intolerance, constipation. Delayed relaxation of the ankle jerk is the most common finding, which correlates well with the description in most standard textbooks of endocrinology<sup>1</sup> and in various studies by Lambert and Underdahl<sup>2</sup>.

On cardiovascular examination cardiomegaly is found in 2 patients which accounts for 4% of the patients, diminished heart sound in 11 patients accounting for 22% of the total indicating probability of pericardial effusion. The pathophysiologic derangements responsible for the collection of fluid in the serous cavities of hypothyroid patients are probably increased systemic capillary permeability and disturbances in electrolyte metabolism<sup>3</sup> Alexander first used the term "Gold Paint Effusion" to describe the golden brown appearance of the pericardial fluid due to the shimmering satin cholesterol crystals. The high cholesterol content of the fluid has been attributed to disturbances in lipid metabolism; possibly, a churning action of the heart plays a role in the precipitation of cholesterol from pericardial fluid or the poor absorptive capacity of the pericardium may be a major factor. V.C. Patil et al reported a case of pericardial effusion with cardiac tamponade<sup>4</sup>. In present study lipid analysis showed increase of TC, LDL, TGL and decrease of HDL in mild, moderate and severe cases. In overt hypothyroidism, thyroid hormone effects on LDL receptor expression and cholesterol absorption outweigh the effects of decreased hepatic cholesterol synthesis, leading to high serum levels of LDL, Intermediate Density Lipoprotein Cholesterol, and total cholesterol levels. LPL (Lipoprotein lipase) activity is decreased in hypothyroidism and results in higher triglycerides<sup>5</sup>. In present study normal ECG was found in 14 patients (33.33%). Bradycardia is most common finding seen in 12 (28.57%). A low voltage complex is seen in 8 patients (19.04%). ST-T changes were found in 11 patients (26.19%). LBBB was found in 3 patients (7.14%). RBBB was found in 4 patients (9.52%). APC was found in 1 patient (2.38%). VPC was found in 2 patients (4.76%). QTc prolongation was found in 9 patients (21.42%). Torsades de pointes in no patient. James ker reported occurrence of ventricular arrhythmias due to presence of ventricular late potentials in myocardium on signal averaged ECG. Prolongation of QT interval correlates with level of TSH<sup>6,7</sup>. Fabio Galetta et al demonstrated that hypothyroidism is associated with a decreased sympatho-vagal modulation of the heart rate and with an increased inhomogeneity of ventricular recovery times. The assessment of HRV and QT dispersion in patients with overt hypothyroidism may represent a useful tool in monitoring the cardiovascular risks<sup>8</sup>

In our study Echo findings are normal in 20 patients (47.61%). Pericardial effusion is seen in 8 cases accounting to 19.42%. Diastolic dysfunction (mild - moderate) seen in 11 patients, majority of them being mild dysfunction in 8 patients (19.42%) and moderate in 3 patients (7.14%). No cases found to have severe diastolic dysfunction. Increased IVS thickness found in only in 4 cases (9.52%). Cardiac tamponade was found in 1 patients (2.38%).

The decreased cardiac contractility associated with hypothyroidism results from changes in cardiac gene expression, specifically reduced expression of the sarcoplasmic reticulum Ca<sup>2+</sup>-ATPase, and increased expression of its inhibitor, phospholamban. These proteins function in intracellular calcium cycling and regulate diastolic function. These genomic changes explain the physiological changes such as the slowing of the isovolumic relaxation phase of diastolic function characteristic of hypothyroidism<sup>9</sup>

In hypothyroidism, endothelial dysfunction and impaired vascular smooth muscle relaxation lead to increased systemic vascular resistance<sup>10</sup>. These effects lead to diastolic hypertension in ≈30% of patients, and thyroid hormone replacement therapy restores endothelial-derived vasorelaxation and blood pressure to normal in most.<sup>11</sup>

## Conclusion :

Thyroid disorders involve multisystem affection. Cardiac dysfunction is one of the most important feature of overt hypothyroidism which manifests as various ECG abnormalities like QTc prolongation and various arrhythmias. It is also associated with 2D ECHO and Doppler abnormalities like pericardial effusion, cardiac tamponade, diastolic dysfunction etc. Awareness of spectrum of cardiac dysfunction in hypothyroidism is mandatory as these abnormalities respond very well to thyroid hormone supplementation.

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