

A study of cardiovascular manifestations of thyroid disorders

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Abstract

Background: Dysfunction and anatomic abnormalities of the thyroid gland are among the most common diseases of the endocrine glands. The study has been undertaken with the aim to assess the different cardiovascular manifestations in patients of hypothyroidism and hyperthyroidism in Manipur and find out any correlation of it with age, sex, type of thyroid disorder and BMI. **Materials and Method:** The study was a cross sectional study of patients who were diagnosed as hypothyroid or hyperthyroid in the Department of Medicine, Regional Institute of Medical Sciences(RIMS), Imphal, Manipur. Clinical parameters including history and clinical examination were recorded including thyroid function testing, ECG, chest X-ray, trans-thoracic echocardiography. **Results:** Among 59 patients of thyroid disorder studied, 38 patients were found to be hypothyroid and 21 patients hyperthyroid. The average BMI in hypothyroid patient was 27.25. The average BMI in hyperthyroid patients was 25.41 which were lower than hypothyroid. Diastolic hypertension was found in 44.7% of hypothyroid patients. Sinus bradycardia and sinus tachycardia were the most common ECG findings in hypothyroid and hyperthyroid patients respectively. 15.8% had cardiomegaly on chest x-ray in hypothyroid patients while 9.5% had cardiomegaly in hyperthyroid patients. On echocardiographic evaluation, 13.1% and 9.5% had pericardial effusion in hypothyroid and hyperthyroid groups respectively.

Key Words: Hyperthyroid, hypothyroid, tachycardia, bradycardia

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INTRODUCTION

Thyroid hormones have profound effects on a number of metabolic processes in virtually all tissues including the heart. The thyroid gland and the heart share a close relationship arising in embryology. The action of thyroid hormones on the heart can be grouped into three broad

categories: (1) direct cardiac effect (2) effects mediated by thyroid hormone on the sympathetic nervous system and (3) effects secondary to hemodynamic changes. Thyroid hormone exerts most of its direct effect on cardiac contractility by regulating calcium cycling through the (Sarcoendoplasmic reticulum calcium²⁺ ATP-ase) SERCA- Phospholamban system both transcriptionally and post transcriptionally. Thyroid hormone enhances catecholamine sensitivity with increased beta-1 adrenergic receptors on cardiac myocyte. The thyroid hormone exerts its hemodynamic alteration by decreasing systemic vascular resistance of the arterioles of the peripheral circulation. There is a decrease in mean arteriolar pressure and an increase in renal sodium reabsorption. The increase in plasma volume coupled with an increase in erythropoietin leads to an increase in blood volume and a rise in cardiac preload. Cardiac output may increase more than double in

hyperthyroidism and conversely may decrease by as much as 30-40 percent in hypothyroidism².

MATERIALS AND METHODS

The study was a cross sectional study of patients who were diagnosed as hypothyroid or hyperthyroid on thyroid function testing. The study was carried out in the Department of Medicine, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur. The study was done during the period of one and half year period starting from August 2008 till January 2010. 59 patients whose ages were above 18 years irrespective of sex, religion and socio-economic status with thyroid disorder were included in the study. Cases attending Medicine OPD and Cardiac clinic and inpatients in Medical ward including ICCU whose thyroid function testing met the criteria given below were included in the study:-
Hyperthyroidism/Thyrotoxicosis:- T3 Level > 2.02 ng/mL, T4 Level > 11.6 µg/dL and TSH level < 0.39 µIU/mL.
Hypothyroidism:- T3 Level < 0.69 ng/mL, T4 Level < 4.4µg/dL and TSH level > 6.16 µIU/mL. Patient

with known congenital heart disease or rheumatic valvular heart disease and any patient who is having severe illness, physical trauma, psychological or physiological stress and pregnant women which may induce changes in one or more aspect of thyroid hormone economy, leading to finding referred to as the sick euthyroid syndrome (SES) were excluded from the study. The determination of thyroid profile was done by quantitative determination of T3 and T4 in human serum by ELISA microtiter reader and for TSH by classical sandwich ELISA technique photometrically. ECG, chest X-ray PA view, trans-thoracic echocardiographic examination were taken on every patient according to standard techniques. Prior permission was taken from the Research Ethics Board RIMS, Imphal before the study was conducted. Informed consent of the participants of the study was taken as per ethical committee guidelines.

STATISTICS

Data from all the patients considered in the study were used in the analysis. SPSS 16.0 version was used for statistical analysis.

RESULTS

Distribution of thyroid disorder: A total of 59 thyroid disorder patients were randomly selected from the medical wards, medicine out-patient department and cardiology clinic, RIMS, Imphal. In this study, there were 38 cases of hypothyroidism patients and 21 hyperthyroidism patients.

Sex and age distribution: Out of 38 cases of hypothyroidism patients, 11 cases were male(28.9%) and 27 cases were female(71.1%); while in 21 cases of hyperthyroidism, 11 cases were male(52.38%) and 10 cases were female(47.62%).

Table 1: Showing the age and sex distribution of hypothyroidism and hyperthyroidism

Age Group	Hypothyroidism			Hyperthyroidism		
	Male	Female	Total (%)	Male	Female	Total (%)
21-40	3	9	12 (31.6)	4	4	8 (38.1)
41-60	2	14	16 (42.1)	1	5	6 (28.6)
61-80	6	3	9 (23.7)	5	1	6 (28.6)
81-100	0	1	1 (2.6)	1	0	1 (4.7)
Total	11	27	38 (100)	11	10	21 (100)

CLINICAL PRESENTATION

A) SYMPTOMOLOGY IN HYPOTHYROID PATIENTS:-

In hypothyroid patients, weakness was found to be the most common presenting symptom 89.5% (overall) followed by weight gain 65.8%, cold intolerance 63.2%, dyspnoea 39.5%, fatigue 39.5, dizziness 31.6%, palpitation 15.8%, chest pain 10.5% and syncope 2.6%.

Table 2: Showing the distribution of symptoms by hypothyroid patients

Presenting symptoms	Number of patients(N=38)	%
Palpitation	6	15.8
Dyspnoea	15	39.5
Fatigue	15	39.5
Weakness	34	89.5
Chest pain	4	10.5
Dizziness	12	31.6
Syncope	1	2.6
Cold-intolerance	24	63.2
Weight-gain	25	65.8

Table 3: Showing the distribution of symptoms by hyperthyroid patients

Presenting symptoms	Number of patients(N=20)	%
Palpitation	15	71.4
Dyspnoea	8	38.1
Fatigue	15	71.4
Weakness	21	100
Chest pain	3	15
Dizziness	4	19
Syncope	1	4.8
Heat-intolerance	17	81
Weight-loss	16	76.2

Table 4: Showing the distribution of clinical signs at presentation

Signs	Hypothyroidism	Hyperthyroidism
Pallor	6 (15.8%)	3 (14.3%)
Dehydration	0	2 (9.5%)
Cyanosis	2 (5.2%)	0
Oedema	7 (18.4%)	0
Raise JVP	4 (10.5%)	1 (4.8%)

Table 5: Showing the distribution of systemic examination findings in hypothyroid patients

Systemic examination	Number (n=38)	Percentage(%)
Cardiovascular system		
Diminished heart sound	6	15.79
Cardiomegaly	2	5.26
Central nervous system		
Delayed ankle reflex	26	68.42
Hoarseness of voice	19	50

Hyperthyroid patients: Systemic examination of hyperthyroid patients revealed tremor in 66.7%.

Table 6: Showing the mean BMI \pm standard deviation (SD) in thyroid disorder patients

	Hypothyroid	Hyperthyroid
BMI	27.25 \pm 2.855(SD)	25.41 \pm 1.944(SD)

Table 7: Showing the distribution of pulse rhythms in thyroid disorders

Pulse rhythm	Hypothyroidism (%)	Hyperthyroidism (%)
Normal	28 (73.7%)	9 (42.9%)
Bradycardia	6 (15.8%)	0
Tachycardia	2 (5.3%)	8 (38.1%)
Irregularly irregular	1 (2.6%)	4 (20%)
Regularly irregular	1 (2.6%)	0

BLOOD PRESSURE (BP)

SYSTOLIC BP:

The mean systolic blood pressure in hypothyroid patient was 119.19 \pm 16.75(SD) and hyperthyroid patient was 118.19 \pm 14.03(SD). Most of the hypothyroid patients had maximum systolic blood pressure in the range of 111-130mmHg which accounts 47.4% followed by 91-110mmHg in 26.3%, 131-150mmHg in 21.1% and 71-90mmHg in 5.3%. In hyperthyroid patients, most of them are in 111-130mmHg (52.4%) followed by 91-110mmHg (28.6%) and 71-90mmHg as well as 131-150mmHg had 9.5% each.

DIASTOLIC BP:

The mean diastolic blood pressure in hypothyroid patients was 85.42 \pm 12.86(SD) and in hyperthyroid patient was 68.67 \pm 8.49(SD). In hypothyroid patients, most of the patients i.e.44.7% had diastolic BP in the range of 91-110mmHg followed by 36.8% in 71-90mmHg, 15.8 in 51-70mmHg and 2.6% in 31-50mmHG. In hyperthyroid patients, 66.7% had diastolic BP in the range of 51-70mmHg followed by 28.6% in 71-90mmHg and 4.8% in 31-50mmHg.

Table 8: Showing the ECG findings in hypothyroid and hyperthyroid patients

ECG Findings	Hypothyroidism		Hyperthyroidism	
	No.(N=38)	%	No.(N=21)	%
Normal	26	68.4	9	42.9
Sinus Bradycardia	7	18.4	0	0
Sinus Tachycardia	1	2.6	8	38.1
Atrial Fibrillation	1	2.6	4	19
Ventricular Tachycardia	1	2.6	0	0
Atrial Bigeminy	1	2.6	0	0

CHEST X-RAY EXAMINATION

In hypothyroid patients, 13.2% had cardiomegaly without lung lesion and 2.6% had cardiomegaly with lungs lesion. In hyperthyroid patients, 9.5% had cardiomegaly without lung lesion.

ECHOCARDIOGRAPHIC EXAMINATION:

Echocardiography of hypothyroid patients showed 76.3% normal echo, 10.5% revealed pericardial effusion, 5.3% left ventricular diastolic dysfunction, 2.6% had dilated cardiomyopathy (DCM) with left ventricular systolic dysfunction, 2.6% DCM with left ventricular systolic dysfunction and pericardial effusion and lastly 2.6% had concentric left ventricular hypertrophy. 75% of pericardial effusions were found in female sex and 60% of pericardial effusions were found in age group 41-60 years. The mean ejection fraction (EF) and fractional shortening (FS) in hypothyroid patient were 59 ± 9.458 (SD) and 27.97 ± 8.716 (SD) respectively. In hyperthyroid patients 85.7% had normal echo followed by 9.5% with pericardial effusion and 4.8% had left ventricular diastolic dysfunction. All the pericardial effusions were found in female and in the age group 41-60 years. In case of hyperthyroid, EF was 65.14 ± 7.532 (SD) and FS 34.29 ± 4.649 (SD).

DISCUSSION

Primary thyroid disorder mainly results either in excess or inadequate secretion of thyroid hormones i.e. T3 and T4 with resultant change in TSH secretion from anterior pituitary. TSH level in the blood increase when thyroid hormones fall down and decrease when thyroid hormones rise up in the blood. TSH stimulate the thyroid gland to synthesize more T3 and T4 and ultimately to its release in the bloodstream. TSH secretion is controlled by hypothalamus through thyrotropin-releasing hormone (TRH) through a negative feedback loop of which the set-point is established by TSH. Thyroid hormone deficiency or excess results in clinical manifestations involving almost all the major organs or systems. The most profound and characteristic symptoms and signs of hypothyroidism or hyperthyroidism are those relating to the cardiovascular system. In the present study, there were 38 cases of hypothyroidism patients and 21 hyperthyroidism patients. The maximum patients of

hypothyroidism and hyperthyroidism were in the age group 41-60 years (42.1%) and 21-40 years (38.1%) respectively. The state of Manipur lies in the iodine depleted region of the world³. Almost all consume iodine fortified common salt due to government policy to allow selling of only iodised salt. Most of the population can be considered iodine sufficient at present. In the present study, there were 11 males (28.9%) and 27 females (71.1%) in hypothyroid group and the ratio is 1:2.4. In hyperthyroid group, there was 11 males (52.38%) and 10 females (47.62%) and the ratio is 1.1:1. Most studies report 2 to 8 times higher prevalence of both hypothyroidism as well as hyperthyroidism in female than male. The Framingham study found hypothyroidism (TSH >10 mIU/L) in 5.9% of women and 2.4% of men older than 60 years⁴. The present study had more hypothyroid female than male. In the present study, the number of hyperthyroid male (11) and female (10) patients was more or less equal. The finding may be incidental as the numbers of patients were less and study period was short and hospital based. The present study, the most common presenting symptoms of hypothyroid patient was weakness 89.5% (overall) followed by weight gain 65.8%. In hyperthyroid patients, the most common symptoms at presentation was weakness 100%(overall) followed by heat intolerance 81%, weight-loss 76.2%. Most patients with hypothyroidism have few symptoms related directly to cardiovascular system. Impaired cardiac function have been attributed for lack of energy, fatigue, exertional dyspnea and exercise intolerance but they are more likely to be due to psychological and skeletal muscle dysfunction⁵. In the present study, the most common presenting sign of hypothyroid patients on general physical examination was oedema in 18.4% (overall) which was followed by pallor 15.8%. For hyperthyroid patients, pallor account 15%, followed by dehydration 10%. In the hyperthyroid patients, systemic examination revealed tremor in 65%. In a prospective cohort study, out of 50 patients with thyrotoxicosis under 50 years of age, 42 (84%) had a tremor, as compared with 15 (44%) of 34 patients over 70 years of age⁶. In hypothyroid patients, 26.3% were found to have pulse rhythm abnormality, bradycardia was observed in 15.8% followed by tachycardia 5.3% and

both irregularly irregular as well as regularly regular 2.6% each respectively. In hyperthyroid patients, 57.1% presented with pulse rhythm abnormality, of which the most common was tachycardia 38.1% and followed by irregularly irregular in 20%. Bradycardia may result from a loss of the chronotropic action of thyroid hormone directly on the sinoatrial pacemaker cells in hypothyroid patients. Heart rate analysis reveals changes in both sympathetic and parasympathetic tone in both hypothyroid and hyperthyroid patients⁷. Tachycardia is the most common of all abnormal findings on examination of thyrotoxicosis patients. The heart rate is fast and often the pulse in large arteries is bounding due to widened pulse pressure with high systolic and low diastolic blood pressure⁸. In the present study, the mean systolic blood pressure in hypothyroid patient was 119.19±16.75(SD) and hyperthyroid patient was 118.19±14.03(SD). From 20% to 40% of patients with hypothyroidism have hypertension and the relative increase in diastolic pressure is increased more than that of systolic pressure. The increase in diastolic pressure is mainly due to increase in systemic vascular resistance⁹. In the present study, ECG abnormality in hypothyroid patients comprised mainly of sinus bradycardia in 18.4% and followed by sinus tachycardia, AF, VT and atrial bigeminy in 2.6% each respectively. In hypothyroidism, the syndrome of torsade de pointes which is characterised by long QT interval in ECG and ventricular tachycardia can occur in some case and disappear with T4 treatment alone¹⁰. Other ECG abnormalities which might be found are low voltage, nonspecific ST wave changes. Occasionally ECG changes suggestive of myocardial ischemia might be found which are more likely to disappear during treatment with T4 than with antianginal drug therapy¹¹. The present study, the most common ECG abnormality in hyperthyroid patients was sinus tachycardia in 35% and atrial fibrillation in 20%. Sinus tachycardia at rest, during sleep, and during exercise is the most common finding in patient with thyrotoxicosis¹². Echocardiography examination of hypothyroid patients showed 76.3% normal echo, 10.5% reveal pericardial effusion, 5.3% left ventricular diastolic dysfunction. The mean ejection fraction (EF) in hypothyroid patient was 59±9.458(SD). Most of the measurement for left ventricular contractility and cardiac workload are decreased in patients of hypothyroidism. These include systolic time interval, isovolumic filling and compliance¹³. In thyrotoxicosis, there is increase in cardiac output, left ventricular ejection fraction, cardiac systolic and diastolic performance at resting condition¹⁴.

CONCLUSION

Disorder of the thyroid gland function is a very common disease affecting the human population across all age and sex. It is the second most common endocrine disorder after diabetes mellitus. Hypothyroidism and hyperthyroidism affect females 2 to 8 times more than males in adult. The prevalence of both goes on increasing with age above 40 years. Thyroid disorders affect almost all the major systems in the body. Cardiovascular system involvement is one of the most important manifestations of thyroid function disorder which recovers fully if diagnosed and treated in early period. Long and untreated thyroid disorder results in increase morbidity and mortality of the patients. Cardiovascular complications from prolonged and undiagnosed thyroid disorders may lead to many permanent and irreversible state requiring lifelong medications or invasive/intervention procedure to correct it.

REFERENCES

1. Larsen PR, Davies TF, Schllumberger MJ, Hay ID. Thyroid physiology and diagnostic evaluation of patients with thyroid disorders. In: Larsen, Kronenberg, Melmed, Polonsky, editors. Williams' Text book of endocrinology. 10th ed. Philadelphia: Saunder; 2003. p. 331.
2. Klein I. Endocrine disorders and cardiovascular. In: Zipes, Libby, Bonow, Braunwald, editors. Braunwald's Heart disease. 7th ed. Philadelphia: Saunders; 2005. p. 2056-59.
3. Park K. Park's textbook of preventive and social medicine. 20th ed. Jabalpur: Bhanot; 2009. p. 557.
4. Sawin CT, Castelli WP, Hershman JM, McNamara P, Bacharach P. The aging thyroid. Thyroid deficiency in the Framingham Study. Arch Intern Med 1985 Aug; 145 (8):1386-8.
5. Klein I, Mantell P, Parker M. Resolution of abnormal muscle enzymes in hypothyroidism. Am J Med Sci 1980; 279:159.
6. Trivalle C, Doucet J, Chassagne P, *et al.* Differences in the signs and symptoms of hyperthyroidism in older and younger patients. J Am Geriatr Soc 1996; 44:50.
7. Inukhai T, Takanashi K, Kobayashi H, *et al.* Power spectral analysis of heart rate in hyperthyroidism and hypothyroidism. Horm Metab Res 1998; 30:531.
8. Graettinger JS, Muenster JJ, Selverstone LA, *et al.* A correlation of clinical and hemodynamics studies in patients with hyperthyroidism with and without heart failure. J Clin Invest 1959; 19:1316.
9. Danzi S, Klein I. Thyroid hormone and blood pressure regulation. In: Current hypertension Rep 2003; 5:513.
10. Fredlund B, Olsson SB. Long QT interval and ventricular tachycardia of "Torsade de pointes" type in hypothyroidism. Acta Med Scand 1983; 213:231.
11. Myerowitz P, Kamienski R, Swanson D, *et al.* Diagnosis and management of the hypothyroid patient with chest pain. J Thorac Cardiovas Surg 1983 Jul; 86:57.

12. Cacciatori V, Bellavere F, Pezzarossa A, *et al.* Power spectral analysis of heart rate in hyperthyroidism. *J Clin Endocrinol Metab* 1996; 81:2828.
13. Wieshammer WF Jr, Keck F, Waitzinger J, *et al.* Acute hypothyroidism slows the rate of left ventricular diastolic relaxation. *Can J Physiol Pharmacol* 1988; 67:1007.
14. Mintz G, Pizzarello, Klein I. Enhanced left ventricular diastolic function in hyperthyroidism: noninvasive assessment and response to treatment. *J Clin Endocrinol Metab* 1991; 73:146.

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