

A study of electrocardiographic changes in thyroid disorders

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Abstract

Introduction: Thyroid plays an important role in the orchestration of various metabolic functions in the body and thus thyroid dysfunction can produce dramatic cardiovascular effects, often mimicking primary cardiac disease. **Aims:** The aim was to study the spectrum of electrocardiographic (ECG) changes in hypothyroidism and hyperthyroidism. **Materials and Methods:** The present study included 26 cases of hypothyroidism and 24 cases of hyperthyroidism conducted in Department of Medicine, Chirayu Medical College and Hospital, Bhopal. 20 age- and sex-matched euthyroid controls were also included in the study for comparison. Serum free T3, T4, and thyroid-stimulating hormone were done using sensitive chemiluminescence technology. Twelve lead ECG was done in each patient. **Results:** The predominant abnormality found on ECG study of hypothyroid cases was sinus bradycardia that was found in 16 (61.5%) cases ($P < 0.05$). ST-T changes in the form of T-wave inversion or ST segment depression and flattening was present in 7 cases (26.9%). Sinus tachycardia was the commonest abnormality in hyperthyroidism seen in 19 (79.2%) cases. Atrial fibrillation was seen in three (12.5%) cases and ST-T changes in 2 (8.3%) cases. **Conclusion:** Sinus bradycardia is the commonest ECG change in hypothyroidism and sinus tachycardia was the predominant ECG change in hyperthyroidism. Therefore, electrocardiography is a sensitive tool to detect cardiac manifestations in thyroid disorders.

Keywords: Electrocardiography, Hypothyroidism and Hyperthyroidism.

Introduction

Thyroid plays an important role in orchestration of various metabolic functions in the body and thus thyroid disorders affect each and every organ out of which heart is particularly sensitive to its effects. Therefore, it is not surprising that thyroid dysfunction can produce dramatic cardiovascular effects, often mimicking primary cardiac disease [1].

Hypothyroidism is a clinical syndrome resulting from a deficiency of thyroid hormones which in turn results in generalized slowing down of metabolic processes [2].

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%). The prevalence of subclinical hypothyroidism in the developed world is about 4-15% [4,6]. Subclinical hypothyroidism (SCH) was observed in 8.02% of the population.

Cardiovascular complications are some of the most profound and reproducible clinical findings associated with thyroid disease [3,4,5]. The identification of patients with hypothyroidism is an important individual and public health issue. The completely reversible nature of these complications is well known.

Hence, early detection and initiation of hormone replacement therapy can minimize associated cardiovascular changes. In the present study, electrocardiography was done in patients with thyroid dysfunction to determine its cardiac effects.

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Material and Methods

The study was done over a period of one year from February 2014 to February 2015 at Chirayu Medical College and Hospital.

Cases: 50 patients with thyroid dysfunction were enrolled. The age of study subjects was between 13 years to 40 years.

Controls: Twenty age and sex matched euthyroid controls were included in the study for comparison. Healthy subjects matched for age and sex not satisfying inclusion criteria of study group and having no evidence of hypertension, cardiovascular disease and diabetes.

Inclusion criteria

- 1) Newly diagnosed patients with deranged thyroid profile either hypothyroidism or hyperthyroidism.
- 2) Detected patients not on treatment.
- 3) Patients on levothyroxine for less than 4 months.

Exclusion criteria

- 1) Patients with known cardiac disease.
- 2) Patients with COPD, severe anemia, diabetes mellitus or any other endocrinal disorders.

Results

The study comprises of 50 patients suffering from thyroid dysfunction of which 26 cases were hypothyroid and 24 cases were of hyperthyroidism. Observations were made in terms of their age, sex, clinical presentations, biochemical profile, electrocardiographic and echocardiographic parameters. To compare the findings, 20 age and sex matched euthyroid controls were selected.

The mean age of study subjects was 33.9 years (range 13 to 40 years). Amongst the 26 hypothyroid patients, 7 were males and 19 were females. While in the hyperthyroid group, 5 were males and 19 were females. The control group included 4 males and 16 females.

In patients suffering from hypothyroidism, fatigue and weakness (73%) were the commonest symptoms, whereas weight loss and heat intolerance (83.3%) were the commonest symptoms in hyperthyroidism. The most common sign was bradycardia (61.5%) in hypothyroidism and tachycardia (91.6%) in hyperthyroidism. (Table 1,2) Goiter was present in 50% cases. Sinus bradycardia (61.5%) was the predominant ECG finding in the hypothyroid patients. In the hyperthyroid group, sinus tachycardia (79.2%) was the commonest ECG finding. (Table 4, 5)

Table 1: Symptoms in Hypothyroidism and Hyperthyroidism

Hypothyroidism			Hyperthyroidism	
S No	Symptoms	Number (%)	Symptoms	Number (%)
1.	Fatigue	19 (73%)	Weight Loss	20(83.3%)
2.	Weight gain	18 (69.2%)	Heat Intolerance	20(83.3%)
3.	Cold intolerance	14 (53%)	Increased appetite	18 (75%)
4.	Anorexia	15 (57.7%)	Palpitations	14 (58.3%)
5.	Constipation	10 (38.4%)	Thyroid swelling	9 (37.5%)
6.	Dyspnea	9(34.6%)	Tremors	6(25%)
7.	Edema	7 (27%)	Dyspnea	5(20.8%)

Table 2: Physical signs in hypothyroidism and hyperthyroidism

Hypothyroidism			Hyperthyroidism	
S No	Physical signs	Number (%)	Physical Signs	Number (%)
1.	Bradycardia	16(61.5%)	Tachycardia	22(91.6%)
2.	Edema	7 (26.9%)	Thyroid swelling	12(50%)
3.	Thyroid swelling	6(23.07%)	Tremors	10 (41.6%)
4.	Poor tendon reflexes	5 (19.2%)	Eye Signs	8 (33.3%)
			Skin changes	5 (20.8%)

Table 3: Abnormal findings in cardiovascular system

Hypothyroidism			Hyperthyroidism	
S No	Findings	Number (%)	Findings	Number (%)
1.	Apex not localized	5 (19.2%)	Loud S1	10 (41.66%)
2.	Muffled heart sounds	4(15.3%)	Hyperdynamic apex	6 (25%)
3.	Cardiomegaly	1(3.8%)	Cardiomegaly	3(12.5%)
4.	S3	1 (3.8%)	Systolic murmur	2(8.3%)
5.	S4	-	Loud P2	1(4.17%)

Table 4: Electrocardiographic changes in hypothyroidism

S No	ECG finding	No. in cases	Percentage	No. in control	Percentage
1.	Sinus bradycardia	16	61.5%	-	-
2.	ST-T changes	7	26.9%	2	10%
3.	Low voltage complexes	4	15.3%	-	-
4.	Prolonged QTc interval	1	3.8%	-	-
5.	LVH	1	3.8%	-	-
6.	Abnormal rhythm	-	-	-	-

Table 5: Electrocardiographic changes in hyperthyroidism

S No	ECG finding	No. in cases	Percentage	No. in control	Percentage
1.	Sinus tachycardia	19	79.2%	1	5
2.	Left ventricular Hypertrophy	4	16.7%	-	-
3.	Atrial fibrillation	3	12.5%	-	-
4.	ST-T changes	2	8.3%	2	10
5.	Right atrial enlargement	1	4.2%	-	-

Discussion

The manifestations of thyroid dysfunction are protean. The advent of better investigative modalities and sensitive chemiluminescence assays has made possible the early detection of thyroid diseases. The present study was undertaken to investigate the effect of thyroid disorders on cardiac status. Patients were examined clinically, biochemically and cardiac status was

assessed by electrocardiography. It was compared with euthyroid controls and results of other studies.

Electrocardiographic changes in hypothyroidism

In the present study, the predominant abnormality found on electrocardiography in hypothyroid cases was sinus bradycardia(61.5%) . Sinus bradycardia is most

common manifestation, in hypothyroidism (Fahr 1925) [6]. Douglas and Samuel (1960) in his study found heart rate varied from 42 to 90/min in cases of hypothyroidism [7]. In the present study heart rate varied from 46 to 98/min, this is in accordance with the result of the study by Douglas and Samuel. The other common electrocardiographic abnormalities observed were ST-T changes and low voltage complexes. ST-T changes in the form of T wave inversion or ST segment depression and flattening was present in 7 cases (26.9%). T wave abnormalities were noticed not only in inferior leads but also in precordial leads. Low voltage complexes were found in 4 cases (15.3%). These observations were also similar with the study conducted by Douglas et al. QT interval may be prolonged in patients of hypothyroidism which is a well known risk factor for the development of ventricular arrhythmias. It was found to be prolonged in 46% of patients in a study conducted by Douglas et al but QTc interval was normal in most of the patients. In the present study, prolonged QTc interval was present in one patient.

Electrocardiographic changes in hyperthyroidism:

Many electrocardiographic abnormalities have been described in hyperthyroidism including sinus tachycardia, atrial and ventricular extrasystoles, atrial fibrillation, A-V blocks and abnormal ventricular repolarisation. Ventricular tachycardia and fibrillation are rare. Sinus tachycardia is the common finding in hyperthyroidism. Northcote et al studied 10 thyrotoxic patients, their mean heart rate was 104.45 bpm [8]. Trivalle et al have reported an incidence of 71% in patients greater than 70 years of age and 96% in patients below 50 years of age [9]. The incidence of sinus tachycardia was 79.2% in the present study in which age of patient ranged from 10-60 years. The finding of present study is at par with other studies. Left ventricular hypertrophy was found in 4 patients (16.7%)

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in present study. Sandler et al and Goel and Hanson et al found increased amplitude of QRS complex and left ventricular hypertrophy in hyperthyroidism [10,11]. Atrial fibrillation is commonly reported in patients of hyperthyroidism and it is reported in 10 % to 22% of hyperthyroid patients. Gordan and Soley et al found atrial fibrillation in 20 (14.2%) of the 140 patients of hyperthyroidism they studied. The prevalence of thyrotoxic atrial fibrillation increases with age and is more common in men. In the present study, atrial fibrillation was found in 3 (12.5%). Thus the results of present study is similar to the study of Gordan and Soley et al [12].

T wave inversion or flattening in one or the other leads may occur in hyperthyroidism. In some patients, T wave abnormalities disappeared after the treatment of thyrotoxicosis and this has been attributed to thyrotoxic interstitial myocarditis. In the present study, two patients had ST-T changes including T wave inversion and ST-T depression. One patient had changes of right atrial enlargement secondary to pulmonary hypertension.

Conclusion

Cardiovascular manifestations are common in thyroid disorders. Electrocardiography is a cheap easily available tool to assess cardiac status of patients with thyroid dysfunction.

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