



Original Article

Evaluation of Cardiovascular Status in Thyroid Disorders

Authors

**Dr Subodh Banzal¹, Dr Abhishek Singhai², Dr Nikhil Bakhtar³,
Dr Sourabh Singh Dudve⁴, Dr Rajesh Kumar Jha⁴**

¹DM Endocrinology, Professor, Division of Endocrinology, Department of Medicine, Sri Aurobindo Medical College, Indore, India

²MD General Medicine, Associate Prof., Dept of Medicine, Sri Aurobindo Medical College, Indore, India

³Postgraduate Student, Department of Medicine, Sri Aurobindo Medical College, Indore, India

⁴MD General Medicine, Senior Resident, ESI Hospital, Indore, India

⁵MD General Medicine, Prof. & Head, Dept of Medicine, Sri Aurobindo Medical College, Indore, India

Corresponding Author

Dr Abhishek Singhai

Department of Medicine, Sri Aurobindo Medical College & PGI, Indore (M.P.)

Phone numbers: 9926597070, Email: drabhisheksinghai@gmail.com

Abstract

Context: *Thyroid disorders (hypothyroidism and hyperthyroidism) are associated with clinically significant cardiovascular changes. In the present study, patients with various types of thyroid disorders examined clinically and biochemically. Their cardiovascular status assessed by electrocardiography, radiologically and echocardiographically, and compared with controls with an aim to determine the effect of thyroid disease on the cardiac status.*

Methods and Material: *This is a case control study, conducted at a tertiary care centre for two years. This study included 80 cases, comprised of 40 cases of hyperthyroidism and 40 cases of hypothyroidism. 40 healthy age and sex matched subjects were also included in the study as a control for comparison.*

Statistical analysis used: Pearson's Chi-Square test was used for qualitative data to observe the association of the thyroid diseases with cardiovascular abnormalities in hyperthyroid, hypothyroid patients and controls subjects.

Results: *Among hyperthyroid patients, sinus tachycardia was the predominant ECG abnormality while, sinus bradycardia was the most common findings among hypothyroid cases. Diastolic dysfunction was seen in 10% of hyperthyroid subjects and 5% of hypothyroid subjects. Systolic dysfunction was seen in 14% of hyperthyroid subjects and 17% of hypothyroid subjects. Interventricular septum thickness was increased in 17.5% of hypothyroid cases in our study. Serum cholesterol and triglycerides levels were significantly higher in hypothyroidism subjects.*

Conclusions: *The cardiovascular signs and symptoms of thyroid disease are some of the most profound and clinically relevant findings that accompany both hyperthyroidism and hypothyroidism. Echocardiography is a very valuable tool in evaluation of the effects of hypothyroidism on heart and can detect earliest changes.*

Key-words: *Hypothyroidism, hyperthyroidism, echocardiography.*

Introduction

Thyroid disorders (hypothyroidism and hyperthyroidism) are associated with clinically significant cardiovascular changes. Thyroid hormones have positive chronotropic and inotropic effect on the heart.^[1,2] Increased metabolism and demand for oxygen in peripheral tissues in hyperthyroidism result in increase in cardiac output and heart rate.^[3,4] Hypothyroidism produces a decrease in myocardial contractility, cardiac output, cardiomegaly, pericardial effusion and myocardial ischemia. Numerous clinical studies have shown that even subclinical forms of hypothyroidism or hyperthyroidism are associated with changes in several cardiac parameters.^[5,6]

Several mild cardiac abnormalities, such as impairment of left ventricular diastolic function at rest and impairment of systolic function on effort have been described in subclinical form of hyperthyroidism. Most of the cardiac manifestations are reversible with adequate and timely thyroid hormone replacement therapy.

In the present study, patients with various types of thyroid disorders examined clinically and biochemically. Their cardiovascular status assessed by electrocardiography, radiologically and echocardiographically, and compared with controls with an aim to determine the effect of thyroid disease on the cardiac status.

Subjects and Methods

Study Design: This is a case control study.

Study Setup: This study is conducted at Department of General Medicine of a tertiary care centre.

Study Duration: The duration of study was two years; January-2014 to December-2015.

Sampling: Purposive sampling technique is used for selection of desired samples according to inclusion criterion.

Inclusion criteria: All adults with symptoms, signs and biochemical evidence of hyperthyroidism or hypothyroidism were included in the study.

Exclusion criteria: Patients with history of hypertension, diabetes mellitus, chronic alcoholism, coronary artery disease or any other known cardiac illness were excluded from the study.

Methods

120 residents of Indore city who gave informed consent and met the inclusion criteria were selected as subjects. A total of 120 subjects were available for the study, equally divided into three groups. This study included 80 cases, 40 cases of hypothyroidism and 40 cases of hyperthyroidism. 40 healthy age-sex matched subjects were also included in the study as a control for comparison. Detailed history was taken and physical examination was done. Following investigations were done in all patients: Hb, ESR, T&D, PS, urine R/M, blood urea, blood sugar, serum T3, T4, TSH, Electrocardiogram, skiagram chest, Lipid profile, Echocardiography and Ultrasound of thyroid gland if needed.

Ethical Consideration

Prior to conduct of the present study, the protocol of the study was submitted to ethical and scientific committee of hospital. After getting due approval from these two committees, the present study was initiated. Also prior to conduct of study related procedure / investigation, a voluntary written informed consent was taken from the patient /legally acceptable representative.

Statistical Technique

The demographic data of 120 subjects was analysed by statistical software, SPSS version 17.0. Results of continuous measurements are presented on Mean±SD and results of categorical measurements are presented in numbers (%).

The Non-parametric test, Pearson's Chi-Square test has been used for qualitative data to observe the association of the thyroid diseases with lipid profile in both hyperthyroid, hypothyroid patients and controls group. The probability value $p < 0.05$ was considered as statistically significant.

Results

Mean age (\pm SD) of patients in hypothyroid group was 37.73 ± 9.93 years and in hyperthyroid group 36.38 ± 7.90 years. The maximum number of subjects in this study was in the age group of 31-40 years which was followed by age group of 21-30 years and 41-50 years.

Table 1. Demographic Characteristics of All Subjects

Demographic Characteristics	Hyperthyroid Group	Hypothyroid Group	Control Group	p Value
Number	40	40	40	-
Mean Age \pm SD	36.38 ± 7.90	37.73 ± 9.93	36.33 ± 9.97	NS
Female (%)	65%	70%	57.5%	NS

It was observed that tremors and heat intolerance were the commonest symptoms (57.5% cases) in hyperthyroid group which were present in 23 (57.5%) cases, while weakness (70.0%), sluggishness (65.0%) and weight gain (65.0%) were commonest symptoms in hypothyroid group. Sinus tachycardia was the predominant ECG abnormality in 35 (87.5%) cases of hyperthyroidism. Sinus bradycardia was the most common finding detected in 32 (80.0%) cases of hypothyroidism.

Cardiomegaly was the main radiological feature (65%) in hyperthyroidism while 2 (5.0%) cases had radiologic features of pulmonary congestion. In hypothyroid group, 3 (7.5%) cases had an increased cardiothoracic ratio suggestive of

Both hyperthyroidism and hypothyroidism were much more common in females than in males. 65% and 70% female subjects were selected in group of hyperthyroidism and hypothyroidism respectively.(Table 1)

cardiomegaly while 1 case (2.5%) had radiological evidence of pulmonary congestion.

Cardiac parameters are shown in table 2. Left ventricular internal diameter diastole (LVIDD) was not significantly associated ($p > 0.05$) with thyroid disorder in this study. The left ventricular internal diameter systole (LVIDS) in hypothyroid subjects was significantly increased. ($p < 0.001$) The LVIDS greater than 29 mm was reported in 17 (42.5%) cases of hypothyroid, 14 (35.0%) cases of hyperthyroid and none of control subjects.

Interventricular septum (IVS) thickness was significantly higher in hypothyroid subjects. ($p < 0.03$) Ejection fraction (EF) and posterior wall (PW) thickness was not significantly associated with any thyroid disorders. (Table 2)

Table 2. Cardiac Parameters of All Subjects

Cardiac Parameters	Hyperthyroid Group	Hypothyroid Group	Control Group	p Value
LVIDD (> 52 mm)	4 (10%)	2 (5%)	0 (0%)	$p > 0.05$
LVIDS (> 29 mm)	14 (35%)	17 (42.5%)	0 (0%)	$p < 0.001$
IVS (> 11 mm)	2 (5%)	7 (17.5%)	0 (0%)	$p < 0.03$
PW thickness (> 11 mm)	2 (5%)	5 (12.5%)	0 (0%)	$p > 0.05$
EF ($< 50\%$)	6 (15%)	4 (10%)	2 (5%)	$P > 0.05$

Serum cholesterol levels of more than 250 mg/dl was obtained in 19 (47.5%) subjects with hypothyroidism while none of hyperthyroid and

control subjects had hypercholesterolemia. Triglycerides levels were also significantly higher in hypothyroid subjects. (Table 3)

Table 3. Lipid Parameters of All Subjects

Lipid Parameter	Hyperthyroid Group	Hypothyroid Group	Control Group	p Value
Serum Cholesterol (250 mg/dl)	0 (0%)	19 (47.5%)	0 (0%)	$p < 0.001$
LDL (> 159 mg/dl)	2 (5%)	5 (12.5%)	0 (0%)	$p > 0.05$
HDL (< 30 mg/dl)	2 (5%)	4 (10%)	2 (5%)	$p < 0.05$
TG (> 160 mg/dl)	0 (0%)	18 (45%)	0 (0%)	$p < 0.001$

Discussion

The present study was undertaken to investigate the left ventricular function by means of echocardiography in various types of thyroid disorder. These patients were examined clinically, biochemically, electrocardiographically and radiologically and their cardiac function assessed by echocardiography. It was then compared with the control population with an aim to determine the effect of thyroid disease on the cardiac function. Another observation studied was the effect of thyroid dysfunction on serum lipid profile. The later was studied in both hyperthyroid and hypothyroid patients and compared with control groups and with the results of various other studies.

In this study mean age for the patients with hyperthyroidism and hypothyroidism were found to be 36.38 ± 7.90 and 37.73 ± 9.93 years respectively while for control subjects it was 36.33 ± 9.97 years. Similar age incidence has been reported by Nixon et al^[7] and Watankunakorn et al.^[8]

In this study it was seen that 65.0%, 70.0% and 57.5% female subjects were selected in group of hyperthyroidism, hypothyroidism and controls respectively. Watanakunakorn et al.^[8] reported a female to male ratio of 4.8:1 in their study and Nixon et al^[7] have reported a definite female preponderance in cases of hyperthyroidism.

In hyperthyroid patients, sinus tachycardia was the predominant ECG abnormality in 35 (87.5%) cases followed by left ventricular hypertrophy in 3 (7.5%) cases, left atrial enlargement in 3 (7.5%) cases and biatrial enlargement in two cases. Cardiomegaly was detected in 26 (65.0%) cases on radiological examination among hyperthyroid group. In a study by Kerber et al^[9], 13 out of 33 patients showed cardiomegaly on Chest X- Ray and six patients showed pericardial effusion on echocardiography. Kahaly et al^[10] reported that complicating atrial fibrillation may dominate the clinical feature in elderly hyperthyroid patients. Northcote et al^[11] studied electrocardiographic changes in thyrotoxic patients and found

supraventricular premature complexes are more common than ventricular.

Among hypothyroid cases, sinus bradycardia was the most common findings detected in 32 (80.0%) cases. Low voltage complexes were recorded in 4 (10.0%) cases. These cases were later found to have pericardial effusion. K Ramesh et al^[12] in his study on hypothyroid patients found higher incidence of low voltage pattern and sinus bradycardia.

Echocardiographic study was done in all the patients included in this study. Diastolic dysfunction was seen in 10% of hyperthyroid subjects and 5% of hypothyroid subjects. In a study by R. Verma in 1995 it was seen that 27% of patients had diastolic dysfunction.^[13] Systolic dysfunction was seen in 14% of hyperthyroid subjects and 17% of hypothyroid subjects. Forfar JC, et al.^[14] and others have described low systolic function indices in hypothyroid patients. However, Smallridge et al.^[15] have argued that this could be related to relatively elderly patients included in the above studies and they also found no such alterations in systolic function in their younger patients (aged 20- 48 years). This was further supported by Forfar JC et al.^[14], Yamada H et al.^[16] and R. Verma et al.^[13] who did not find any evidence of systolic dysfunction in hypothyroid patients. Rawat et al.^[17] showed no systolic dysfunction in hypothyroid subjects. IVS thickness was found in 17.5% of hypothyroid cases in our study. There were 12.5% hypothyroid cases of LVPW thickness in our study. Rawat et al.^[17] also reported significant increase in LVPW in hypothyroid subjects. Bello et al.^[18] and Monzani et al.^[19] did not find similar incidence.

Serum cholesterol levels were significantly higher in hypothyroidism subjects, while none of hyperthyroid and control subjects had hypercholesterolemia. Triglycerides levels were also significantly higher in hypothyroid subjects. Yazbeck et al.^[20] found hypercholesterolemia in 57% (2001) in hypothyroid cases. Gupta et al.^[21] found significant rises in serum cholesterol level in hypothyroid patients.

Conclusion

The cardiovascular signs and symptoms of thyroid disease are some of the most profound and clinically relevant findings that accompany both hyperthyroidism and hypothyroidism. On the basis of the understanding of the cellular mechanisms of thyroid hormone action on the heart and cardiovascular system, it is possible to explain the changes in cardiac output, cardiac contractility, blood pressure, vascular resistance, and rhythm disturbances that result from thyroid dysfunction. The importance of the recognition of the effects of thyroid disease on the heart also derives from the observation that restoration of normal thyroid function most often reverses the abnormal cardiovascular hemodynamics. Echocardiography is a very valuable tool in evaluation of the effects of hypothyroidism on heart and can detect earliest changes.

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