Cardiac manifestations in untreated hypothyroid patients

Karthik Meruva, Thrivikram T., Suresh I.

Department of General Medicine, Kamineni Academy of Medical Sciences, LB Nagar, Hyderabad, Telangana, India

Abstract

Background: It is well known that the hypothyroidism affects the heart function. These abnormalities of the cardiovascular system attract the investigations. Few research data are available on the cardiac manifestation in untreated hypothyroid patients

Objectives: To study cardiac manifestation in untreated hypothyroid patients

Methods: A hospital based cross sectional study was carried out among 30 cases of hypothyroidism who were not previously treated over two years. Clinical evaluation, thyroid profile, ECG, 2D ECHO and other relevant investigations were carried out. The data was presented as proportions.

Results: Majority of the study subjects belonged to the age group of 31-40 years with overall female preponderance (73.3%). Mean age of the study subjects was 34.6 years. Weight gain (73.3%) and lethargy (66.7%) were the most common presenting symptoms noted among these cases. Dry skin (76.7%) was the most common finding on general examination and diminished heart sound was (26.7%) on systemic examination. Deranged lipid profile was found commonly in most of the study subjects. One third of the cases had normal ECG and ECHO findings. 40% were found to have bradycardia and 33% with low voltage complexes on ECG. 26.7% had pericardial effusion and same number had diastolic dysfunction on ECHO. Most of the study subjects were found to have mild type of diastolic dysfunction.

Conclusion: The important cardia manifestations of hypothyroidism in untreated cases were bradycardia, low voltage complexes, pericardial effusion and diastolic dysfunction. Hypothyroid state has been found to have significant impact on cardiac structure/function.

Key words: Hypothyroidism, ECG, ECHO, morbidity, mortality

Introduction

Hypothyroidism is a clinical syndrome. It is due to the thyroid hormone's deficiency. Over the period of time, there is slowing down of the metabolic processes in the body due to hypothyroidism. Females are affected more than males (2% vs. 0.1-0.2%). The effect of the thyroid hormones is directly at the cellular level. Thus, they exert their action on all tissues of human body. As hypothyroidism affects metabolism, hence all organs in the body are affected.[1]

The most important complications of the hypothyroidism are on the cardiovascular system. If left untreated, the morbidity and mortality is high in such untreated hypothyroid cases. There can be systolic dysfunction, diastolic dysfunction and there can be even heart failure as well as coronary artery disease.[2]

In cardiovascular complications, hypothyroidism can not only cause atherosclerosis but also can make a person prone to the risk of atrial fibrillation.[3]

The thyroid and the heart and the circulatory system are linked to each other right from embryonic stages. The thyroid hormone not only has an effect on the heart but also exerts its effects on the blood vessels and also the blood. This is as per defined by the flow law.[4]

Cardiac output is indirectly dependent on the metabolic needs of the tissue. It is modulated by vasoconstriction and dilatation of the arterioles of the periphery as well as volume of the blood and capacity of the venous system. As discussed above, hypothyroidism is known to affect the metabolic processes of all the tissues in the body and hence

Corresponding Author:

Dr. Thrivikram T.

Department of General Medicine, Kamineni Academy of Medical Sciences,
LB Nagar, Hyderabad, Telangana, India
E-mail: thiruvoipatithrivikram@gmail.com

when metabolism slows down in the hypothyroidism, indirectly it starts affecting the cardiac output and thus slowly affects the heart and the cardiovascular system.[5]

As mentioned above, a hypothyroid person can be at risk of atrial fibrillation. But it is now known that such persons can also be prone to ventricular dysrhythmias[4].

Few research data are available on the cardiac manifestation in untreated hypothyroid patients. There is need for more data and studies throwing light on cardiac manifestations in untreated hypothyroid patients. Hence present study was carried out to study the various cardiac manifestations in untreated hypothyroid patients who were not on treatment for more than two years.

Material and Methods

Source of Data: This was a Cross sectional study of 30 Cases of untreated hypothyroid patients presented to Department of General Medicine, KIMS.

ECG and ECHO were done on these patients and studied for ECG changes like Low Voltage complexes, Bradycardia, ST-T changes, Right Bundle Branch Block and Left Bundle Branch Block. ECHO changes like Systolic dysfunction, Diastolic dysfunction, Pericardial Effusion, Interventricular septum thickness.

Sample Size: 30 Cases of Untreated hypothyroidism. During the study period we could get 30 cases of untreated hypothyroidism as per the inclusion and exclusion criteria laid down for the present study and also depending upon the informed consent given by the eligible patients.

Study duration: October 2015 to September 2017

Study design: Hospital based Cross sectional clinical study

Ethical considerations: The Institution Ethics Committee permission was obtained. Informed consent was taken from all eligible participants and then only they were included.

Inclusion Criteria:

1. Newly diagnosed cases of hypothyroidism
2. Not taken any sort of treatment for hypothyroidism over two years

Exclusion criteria:

1. Co-existent morbidities like cardiac disease, chronic obstructive pulmonary disease, diabetes, anemia-severe, other endocrine disorders
2. Patients using beta blockers, steroids, alcohol, steroids, oral contraceptive pills
3. Already on hypothyroidism treatment

Investigations:

Thyroid profile, complete blood picture, random blood sugar, urine-routine, gross and microscopy, blood urea, serum creatinine, lipid profile, A standard 12 lead ECG, 2D-ECHO were carried out for all patients using 3 ml of early morning fasting samples containing plain clotted blood are collected and sent for T3, T4, TSH estimation. The hormone estimation was done by chemiluminescence assay.

Echocardiography

2D-Echocardiograph with Colour Doppler, continuous wave Doppler with transoesophageal facility and having a transducer of 2.5 MHz with VCR, printer, ECG gating facility of Hewlett Packard make. Various modes used in ECHO were the following:

1. M Mode ECHO
2. Two-dimensional ECHO
3. Doppler ECHO
   a Pulse waves
   b Continuous Doppler
4. Color Doppler.

By using ECHO each case was specially screened for systolic and diastolic dysfunction and pericardial effusion. Diastolic dysfunction was assessed by means of the Canadian consensus criteria. Patients were grouped under the following 5 groups if at least 4 of the criteria have been met.[6]

Table 1: Canadian consensus for diastolic dysfunction

Grade	Transmittal flow rates			PVF	
	E/A	Dt	S/D	AR	AR-A
Normal	1-2	150-200	> 1	< 0.35	< 20
Mild	< 1	> 200	> 1	< 0.35	< 20
Mild-moderate	< 1	> 200	> 1	> 0.35	> 20
Moderate	1-2	150-200	0.5-1	> 0.35	> 20
Severe	> 2	< 150	< 0.5	> 0.35	> 20

Systolic Dysfunction

"It is evaluated using the systolic time intervals as in other studies by workers like Edward W Bough.[7] PEP or the pre-ejection period is the time between the R wave on ECG and the opening of the aortic valve. It is the time interval between the electrical and mechanical activation of the heart. PEP is <105 msec in males and <110msec in females. LVET is the time between the opening and closure of the aortic valve. LVET values range from 320-340 in males and 330-350 in females. PEP/LVET ratio is a heart rate and sex

independent that is 0.34±0.42."[7]

"A value>0.76 is taken as the diagnosis of systolic dysfunction. Patients were categorized into two groups, either with or without systolic dysfunction."[7]

Statistical Methods:

The data was entered in the Microsoft Excel worksheet and analysed using proportions and other statistical measures. Chi square test was applied using free software available i.e. https://www.socscistatistics.com/tests/chisquare2/default2.aspx unpaired t test was applied using openepi software available from: https://www.openepi.com/Mean/t_testMean.htmp value < 0.05 was taken as statistically significant.

RESULTS

Table 2: Age and sex distribution of the study subjects

Age (years)	Male		Female		Total	
	Number	%	Number	%	Number	%
21-30	2	25	8	36.6	10	33.3
31-40	3	37.5	10	45.5	13	43.3
41-50	2	25	2	9.1	4	13.3
51-60	1	12.5	2	9.1	3	10
Total	8	26.7	22	73.3	30	100
Mean+SD	38+8.66		34.6+5.52		35.5+4.47	

Females were more (73.3%) compared to males (26.7%). Most commonly affected age group was 31-40 years (43.3%) followed by 21-30 years (33.3%). Mean age of males (38±8.66 years) was more than that of females (34.6±5.52 years). (Table 2)

Table 3: Distribution of study subjects as per symptoms and signs

Clinical features		Number	%
Presenting Symptoms	Weight gain	22	73.3
	Lethargy	20	66.6
	Dry skin	19	63.3
	Menstrual symptoms	13	59.1
	Hoarseness	16	53.3
	Constipation	15	50
	Cold intolerance	15	50
	Dyspnoea	9	30
	Depression	8	26.6
General examination findings	BMI > 25 kg/m2	23	76.6
	Dry skin	19	63.3
	Pulse < 60/min	12	30
	Pallor	8	26.6
	Hypertension	7	23.3
	Edema	6	20
	Goitre	3	10
Systemic examination findings	Delayed ankle jerk	20	66.7
	Hoarse voice	16	53.3
	Diminished heart sounds	8	26.7
	Cardiomegaly	2	6.7

Weight gain (73.3%) and dry skin (63.3%) were the most common presenting symptoms in the hypothyroid cases. On general examination overweight and obesity was the most common seen in 76.6% of the cases followed by dry skin in 63.3% of the cases. On systemic examination, delayed ankle jerk was seen in 66.7% of the cases followed by hoarse voice in 53.3% of the cases. (Table 3)

Table 4: Mean values of lipid profile across various grades of hypothyroidism

Lipid parameters (mean+SD)	Mild hypothyroidism (TSH=0.5-20 Mu/l) (N=10)	Moderate hypothyroidism (TSH=20-50 Mu/l) (N=13)	Severe hypothyroidism (TSH>50 Mu/l) (N=7)	T value (for difference between means of mild and severe cases)	P value	P value interpretation
Total cholesterol	185+22.3	190.70+24.98	192.48+28.86	1.457	0.590	Not significant
HDL	36.17+6.17	35.06+5.16	34.34+6.58	1.1373	0.8274	Not significant
LDL	122.90+27.43	123.50+22.72	130.22+30.29	1.2194	0.7571	Not significant
VLDL	36.03+4.78	38.04+3.45	39.22+6.28	1.726	0.443	Not significant
TGL	197.50+30.66	202.30+31.55	226.66+28.28	1.1754	0.874	Not significant

HDL=high density lipoprotein, LDL=low density lipoprotein, VLDL=very low-density lipoprotein, TGL=triglycerides

As the severity of the hypothyroidism increased, the mean values of lipid profile also deranged. Total cholesterol increased from 185 to 192.48, LDL increased from 122.90 to 130.22; VLDL increased from 36.03 to 39.22; triglycerides increased from 197.5 to 226.66 and HDL decreased from 36.17 to 34.34. but these differences were not found to be statistically significant ($p > 0.05$) (Table 4)

Table 5: ECG and ECHO findings of the study subjects

Variable		Number	%
ECG findings	Bradycardia	12	40
	Low voltage complexes	10	33.3
	Normal	9	30
	STT changes	8	26.7
	RBBB	3	10
	LBBB	2	6.7
ECHO findings	Normal	10	30
	Pericardial effusion	8	26.7
	Mild diastolic dysfunction	7	23.3
	Systolic dysfunction	2	6.7
	IVS thickness	2	6.7
	Moderate diastolic dysfunction	1	3.3
	Severe diastolic dysfunction	0	0

30% each of the cases had normal ECG and ECHO findings. Most common abnormal ECG findings was bradycardia in 40% of the cases. Most common abnormal ECHO finding was pericardial effusion in 26.7% of the cases followed by mild diastolic dysfunction in 23.3% of the cases.

Table 6: Severity of hypothyroidism and pericardial effusion in patients of hypothyroidism

Severity of hypothyroidism	Number	Patients with pericardial effusion				
			Pericardial effusion present			
		No	Mild	Moderate	Severe	Total
Mild	10	9 (90%)	1	0	0	1 (10%)
Moderate	13	8 (61.5%)	3	2	0	5 (38.5%)
Severe	7	4 (57.1%)	0	2	1	3 (42.9%)

Chi square=2.899; p=0.2346; not significant

The prevalence of pericardial effusion increased from 10% in mild hypothyroidism to 38.5% in patients with moderate hypothyroidism and 42.9% in patients with severe hypothyroidism. But this trend was not found to be statistically significant ($p > 0.05$)

Discussion

Females were more (73.3%) compared to males (26.7%). Most commonly affected age group was 31-40 years (43.3%) followed by 21-30 years (33.3%). Mean age of males (38 ± 8.66 years) was more than that of females (34.6 ± 5.52 years).

Weight gain (73.3%) and dry skin (63.3%) were the most common presenting symptoms in the hypothyroid cases. On general examination overweight and obesity was the most common seen in 76.6% of the cases followed by dry skin in 63.3% of the cases. On systemic examination, delayed ankle jerk was seen in 66.7% of the cases followed by hoarse voice in 53.3% of the cases.

23% of the patients had blood pressure of more than 140/90. Klein I et al studied the data of 907 patients with hypothyroidism and found that 21% of the cases were having hypertension.[8] Bradycardia and decreased stroke volume both account for decreased cardiac output in patients of hypothyroidism which is comparable to the findings of the present study. KralJ et al[9] noted that the 35% of the cases of hypothyroidism had hypertension in their study which is slightly higher than in the present study.

Lambert EH et al[10] reported similar findings comparable to the present that the delayed relaxation of the ankle jerk as the most common central nervous system finding. Rawat B et al[2] and Anusha K et al[11] reported a very high incidence of pericardial effusion in patients with hypothyroidism. We also found that 26.7% of the cases had pericardial effusion.

As the severity of the hypothyroidism increased, the mean values of lipid profile also deranged. Total cholesterol increased from 185 to 192.48, LDL increased from 122.90 to 130.22; VLDL increased from 36.03 to 39.22; triglycerides increased from 197.5 to 226.66 and HDL decreased from 36.17 to 34.34. but these differences were not found to be statistically significant ($p > 0.05$); similar findings were reported by Turnbridge WMG et al.[12]

30% each of the cases had normal ECG and ECHO findings. Most common abnormal ECG findings was bradycardia in 40% of the cases. Verma R et al[13] also reported similar findings but they did not report any conduct disturbances.

ECG is normal in 9 patients (30%). Among abnormal ECG which constitutes 70% of the patients, low voltage complexes present in 33.33% of patients. On ECG the most common findings were bradycardia, present in 40% of cases. LBBB & RBBB found in 6.66% & 10% respectively. Nikoo MH et al[14] also noted that many patients had abnormal ECG findings like prolongation of QT interval and sinus tachycardia. They also reported presence of ventricular tachycardia but we did not find that same in the present study. We noted that 30% of the patients had normal ECG. Anusha K et al[11] found that normal ECG was seen in 36% of the cases in their study. Similarly, Shashikanth M et al[15] noted that 33% of their cases had normal ECG. Both these authors reported findings which are similar to the present study findings.

We noted that 30% of the cases had normal ECHO and 26.7% of the cases had pericardial effusion. Verma R et al[13] found a very high prevalence of pericardial effusion in their study of the order of 30% but similar to the findings of the present study. Rawat B et al[2] on the other had found a very low prevalence of pericardial effusion compared to the present study.

We found that the 26.7% of the cases had diastolic dysfunction and most of them had mild form. Verma R et al[13] also noted similar finding of 27% of cases having diastolic dysfunction in their study. We noted that 6.7% had systolic dysfunction. Rawat B et al[2] on the other had found no case was having systolic dysfunction. We found that two cases had thickness of interventricular septum. Shashikanth M[15] also reported similar findings

Strengths of the present study:

Present study in one of the few studies which tries to study the cardiac manifestations in patients who were not treated for about two years.

Limitations of the study:

The sample size in the present study is less due to the inclusion and exclusion criteria and limited period of study.

Conclusion

Most common ECG abnormality was bradycardia. Most common ECHO abnormality was pericardial effusion. The changes in cardiovascular system are directly proportional to their return to euthyroid state. Thus, hypothyroid state, which has significant impact on cardiac structure/function was associated with increased CVS morbidity and mortality.

References:

1. *Jameson LJ, Mandel SJ, Weetman PA. Disorders of thyroid gland. In: Harrison's Principles of Internal Medicine, 19th ed. McGraw-Hill 2015;2:2283-93.*
2. *Rawat B, Satyal A. An Echocardiographic Study of Cardiac Changes in Hypothyroidism and the Response to Treatment. Kathmandu University Medical Journal 2003; 2 (3) :182-1872*
3. *Klein I, Danzi S. Thyroid disease and the heart. Circulation. 2007; 116:1725–1735.*
4. *Klein I. Chapter 86: Endocrine disorders and cardiovascular disease In Braun Wald's. In: Bonow RO, Mann DL, Zipes DP, Libby P, editors. Heart Disease. 9th ed. Vol. 2. Elsevier; Saunders: 2012. pp. 1833–1841.*
5. *Guyton's Arthur C. Circulatory Physiology: Cardiac output and its regulation. W. B. Saunders Company; Philadelphia: 1963.*
6. *Yamada H. Prevalence of Left Ventricular Diastolic Dysfunction by Doppler Echocardiography: Clinical applications of the Canadian Consensus Guidelines. J Am Soc Echocardiography 2002; 15: 1238-44*
7. *Bough EW, Crowly WF, Ridgeway EC. Myocardial function inhypothyroidism: Relation to disease severity and response to treatment. Arch Intern Med1978; 138:1476-8*
8. *Klein I, Levey G.S. New perspective on thyroid hormones, catecholamines and the heart. Am J Med 1984; 76:167-172*
9. *Kral J, Hradec J, Limanova J. Heart in thyroid disease corvasa.1992;34(2):1081-4*
10. *Lambert EH, Underdahl LO, Beckett S, Mederos LO. A study of the ankle jerk in myxoedema. J Clin Endocrinol 1951; 11:1186*
11. *Anusha K, Kumar R. Electrocardiographic and Echocardiographic Evaluation of Heart in newly diagnosed hypothyroid patients. Ann Int Med Den Res 2016; 2(1): 377-82*
12. *Turnbridge WMG, Evered DC, Hall R. Lipid profile and cardiac diseases in the Wickham area with particular reference to thyroid failure, Clin Endocrinol 1977;7:495-508*
13. *Verma R, Jain AK, Ghose T. Heart in hypothyroidism-An Echocardiographic study. JAssoc Physicians India 1996;44(6): 390-392*
14. *Nikoo MH. Cardiovascular manifestations of hypothyroidism. Shiraz E Med J. 2000;2(1):1-14.*
15. *Shashikanth M. Study of cardiac dysfunction in hypothyroidism.Int JBiological Med Res 2015;4(2):111-116*

Conflict of interest: Nil
Source of funding: Nil

Date of submission: June 23rd 2020
Date of acceptance: December 9th 2020