

Original Research Article

Cardiovascular manifestation in hypothyroid patient: a cross-sectional study

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ABSTRACT

Background: Hypothyroidism exerts widespread physiological effects, including significant cardiovascular alterations. Both overt and subclinical hypothyroidism can impair cardiac function, although the severity and pattern of abnormalities may differ. The aim of the study was to evaluate the spectrum of cardiovascular manifestations among hypothyroid patients attending a tertiary care hospital.

Methods: A total of 100 adults with newly diagnosed or previously known overt or subclinical hypothyroidism were enrolled. Patients with secondary hypothyroidism, major comorbidities, congenital or structural heart disease, chronic systemic illnesses, pregnancy, or relevant drug exposures were excluded. Clinical examination, ECG, and echocardiography were performed by trained cardiology specialists. Data were analyzed using SPSS-24.

Results: The mean age of the patients was 38.89±9.98 years, and 81% were female. Overt hypothyroidism was present in 67% of participants. Common cardiovascular symptoms included dyspnoea (21%), ankle swelling (16%), and chest pain (4%). Bradycardia (36%), hypertension (27%), pedal edema (19%), and diminished heart sounds (23%) were notable clinical signs. ECG abnormalities included bradycardia (41%), low-voltage complexes (38%), flat or inverted T waves (25%), and ST-segment changes (26%). Echocardiographic findings showed LVDD (21%), RWMA (20%), pericardial effusion (12%), systolic dysfunction (9%), and reduced ejection fraction (11%). ST-segment changes (p=0.021) and systolic dysfunction (p=0.022) were significantly more frequent in overt hypothyroidism.

Conclusions: Cardiovascular manifestations are common in hypothyroidism, with overt cases demonstrating more pronounced structural and functional abnormalities. Early detection and appropriate management are essential to prevent long-term cardiac complications.

Keywords: Hypothyroidism, Overt hypothyroidism, Subclinical hypothyroidism, Cardiovascular manifestations, ECG abnormalities

INTRODUCTION

Hypothyroidism is characterized by decreased thyroid hormone production by the thyroid gland.¹ Mild and subclinical hypothyroidism are conditions of moderate

thyroid failure characterized by serum levels of thyroid hormones within their reference range and elevated serum thyroid-stimulating hormone (TSH) concentrations.² Subjects with mild hypothyroidism have serum TSH between 4.5 and 10 mIU/l, whereas in patients with subclinical hypothyroidism, the serum TSH is above 10

mIU/l.^{1,2} Hypothyroidism is a common disorder, arising more often in women than men and increasing in incidence with age, especially after the onset of middle life. Because primary hypothyroidism is much more frequent than secondary hypothyroidism (about 1000 to 1) in both sexes at all ages, serum thyrotropin measurement can be used to estimate the prevalence of hypothyroidism in populations.¹ In a community survey in the UK, the Whickham study recorded an abnormally high serum thyrotropin concentration in 7.5% of women and 2.8% of men.³ In the recent NHANES III survey of 17 353 Americans representing US demographics, 4.6% had raised thyrotropin: 0.3% with overt hypothyroidism and 4.3% with mild hypothyroidism.⁴ In individuals aged 65 years and older, 1.7% had overt hypothyroidism and 13.7% had mild hypothyroidism. Similarly, in women older than 60 years of age in a Birmingham general medical practice, overt and mild hypothyroidism was present in 2.0% and 9.6%, respectively.⁵ In women and men aged older than 74 years screened at a Colorado health fair, the prevalence of hypothyroidism (defined as a serum thyrotropin greater than 10 mU/l) was even higher: 21% and 16%, respectively.⁶ In the NHANES III survey, the prevalence of hypothyroidism was higher in whites than in Hispanics and African-Americans (5.1%, 4.1%, and 1.7%, respectively). Hypothyroidism causes several effects to various system of the body as well as to cardiovascular system. Overt and subclinical hypothyroidism both causes the effect with some differences. The cardiovascular risk is increased in patients with overt hypothyroidism and several potential cardiovascular risk factors were similarly reported in patients with subclinical hypothyroidism.⁷ Subclinical hypothyroidism is associated with impaired left ventricular diastolic function at rest, systolic dysfunction on effort, and enhanced risk for atherosclerosis and myocardial infarction.^{7,8} On contrary, patients with overt hypothyroidism is associated with bradycardia, decreased ventricular filling, and decreased cardiac contractility, which lead to decreased cardiac output.⁹ The decrease in myocardial oxygen consumption is less than the decrease in cardiac work, making the heart less efficient.¹⁰ Besides these, impaired left ventricular diastolic function (characterized by slowed myocardial relaxation and impaired ventricular filling) is the most consistent cardiac abnormality in patients hypothyroidism.^{9,10} Impaired left ventricular diastolic function on effort was also documented by radionuclide ventriculography.¹¹ Studies performed by ultrasonic myocardial textural analysis suggest an altered myocardial composition in patients with mild hypothyroidism.^{7,8} A recent meta-analysis suggest that pulsed tissue Doppler analysis revealed that patients with mild hypothyroidism had may have detrimental effects on left ventricular (LV) diastolic function. And changes in myocardial time intervals in several left ventricular segments also noted.⁷ Finally, alterations in cardiac hemodynamic were documented by cardiac magnetic resonance imaging in presence of mild disease. Ripoli et al. suggest that subclinical hypothyroidism significantly decreased cardiac preload, whereas it increased afterload with a

consequent reduction in SV and cardiac output. Replacement therapy fully normalized the hemodynamic alterations.¹¹ There is also a tendency to increase diastolic blood pressure as a result of increased systemic vascular resistance.⁷

METHODS

It was a descriptive cross-sectional study which was carried out in Department of Medicine, Department of Endocrinology and Department of Cardiology in Dhaka Medical College Hospital after Six months, from January 2025 to June 2025. Total of 100 samples was included in this study. All adults suffering from old or new subclinical or overt Hypothyroidism attended in the study departments during study period.

Inclusion criteria

Patients with age >18 years, overt or sub-clinical hypothyroidism, all new cases, old under-controlled hypothyroid cases and those who provided informed consent.

Exclusion criteria

Under aged patients. Pregnant women, Secondary hypothyroidism. Those with congenital heart disease, rheumatic heart disease, hypertension, known IHD, diabetes mellitus, COPD, history of smoking and alcohol intake. Patients on lithium, oral contraceptives, steroids and amiodarone

Study procedure

All adult patients with old or new cases of overt or subclinical hypothyroidism were approached for this study. After describing the aim, purpose and procedure of the study, a total of 100 patients were finally enrolled who met the inclusion and exclusion criteria. ECG and Echocardiography will be done in dept of cardiology by same experts. Final diagnosis, clinical sign and investigation profile were collected from patient registry file. Following data collection, analysis was done by SPSS 24.

Data processing and analysis

Following data collection, entered into a password-protected Microsoft Access data entry platform. The entered data were assessed for completeness, accuracy and consistency before analysis was commenced. Data analysis was carried out by using SPSS version 24 (IBM Corp., Armonk, NY). Socio-demographic characteristics, laboratory parameters and cardiovascular manifestations were reported. Frequencies and percentages were calculated as summary measures for the qualitative variables. Arithmetic mean and standard deviation were used to describe the quantitative variables.

RESULT

The mean age of the study cases was 38.89±9.98 years. Among the study cases, 19% were in 18-30 years age group, 45% were in 31-40 years age group, 24% were in 41-50 years age group, 19% were in 52-60 years age group, 4% were in 61-70 years age group and 2% were in >70 years age group. Majority of the study cases were female (81%) with 1:4.26 males to female ratio. Majority of the study cases were housewives (59%), 17% were service holder, 15% were businessman, 6% had other professions and 3% were unemployed. Among the study cases, 71% were urban resident and 29% were rural resident. Among the study cases, 11% were illiterate, 14% were primarily educated, 22% were SSC passed, 25% were HSC passed, 24% were graduate and 4% had post-graduation degree.

The mean BMI of the study cases was 27.79±3.89 kg/m². Among the study cases, 26% had normal BMI, 43% were overweight and 31% were obese.

The mean FT3, FT4 and TSH level of the study cases were 1.29±0.63 pg/ml, 0.47±0.15 pg/ml and 13.70±10.33 µIU/ml, respectively. Among the study cases, 67% had overt hypothyroidism and 33% had subclinical hypothyroidism.

TG Ab was found positive among 54% of the study hypothyroidism cases. TPO Ab was found to be positive among 51% of the study cases.

Among the study cases, dyspnoea, chest pain and ankle swelling found in 21%, 4% and 16% cases respectively. Among the study cases, bradycardia, hypertension, pedal edema and diminished heart sound found in 36%, 27%, 19% and 23% cases respectively.

Among the study cases, flat or inverted T wave found in 25% cases, bradycardia found in 41% cases, low voltage

complex found in 38% cases and ST segment changes found in 26% cases. Among the study cases, LVDD found in 21% cases, pericardial effusion found in 12% cases, RWMA found in 20% cases, LVH found in 7% cases, systolic dysfunction found in 9% cases and reduced EF found in 11% cases.

Frequency of dyspnoea, chest pain and ankle swelling were relatively higher among overt hypothyroidism cases than subclinical hypothyroidism cases. Among overt hypothyroidism cases 23.88% had dyspnoea, 4.48% had chest pain and 17.91% had ankle swelling. Among subclinical hypothyroidism cases 15.15% had dyspnoea, 3.03% had chest pain and 12.12% had ankle swelling.

Frequency of bradycardia, hypertension, pedal edema and diminished heart sound were relatively higher among overt hypothyroidism cases than subclinical hypothyroidism cases. Among overt hypothyroidism cases 37.31% had bradycardia, 31.34% had hypertension, 20.90% had pedal edema and 25.37% had diminished heart sound. Among subclinical hypothyroidism cases 33.33% had bradycardia, 18.18% had hypertension, 15.15% had pedal edema and 18.18% had diminished heart sound.

Frequency of flat or inverted T wave, bradycardia, low voltage complex and ST segment changes were relatively higher among overt hypothyroidism cases than subclinical hypothyroidism cases. Among these four changes ST segment changes was statistically significantly higher in overt hypothyroidism group than subclinical group (p=0.021).

Frequency of LVDD, pericardial effusion, RWMA, LVH, systolic dysfunction and reduced ejection fraction were relatively higher among overt hypothyroidism cases than subclinical hypothyroidism cases. Among these changes systolic dysfunction was statistically significantly higher in overt hypothyroidism group than subclinical group (p=0.022).

Table 1: Age distribution of the patients (n=100).

Variables	Frequency	Percentage (%)
Age group (years)		
18-30	19	19
31-40	45	45
41-50	24	24
51-60	19	19
61-70	4	4
>70	2	2
Mean age (years)	38.89±9.98	
Gender		
Male	19	19
Female	81	81
Ratio	1:4.26	
Occupation		
Housewife	59	59
Service holder	17	17

Continued.

Variables	Frequency	Percentage (%)
Businessman	15	15
Other	6	6
Unemployed	3	3
Residence		
Urban	71	71
Rural	29	29
Education level		
Illiterate	11	11
Primary	14	14
SSC	22	22
HSC	25	25
Graduate	24	24
Post-graduate	4	4

Table 2: Thyroid hormone and hypothyroidism levels among patients (n=100).

Variables	Frequency	Percentage (%)
Types		
Overt hypothyroidism	67	67
Subclinical	33	33
Hormone (mean±SD)		
FT3 (pg/ml)	1.29±0.63	
FT4 (pg/ml)	0.47±0.15	
TSH (µIU/ml)	13.70±10.33	

Table 3: TG and TPO antibody status (n=100).

Variables	Frequency	Percentage (%)
TG Ab status		
Positive	54	54
Negative	46	46
TPO Ab status		
Positive	51	51
Negative	49	49

Table 4: Cardiac system related clinical symptoms and signs of the study patients (n=100).

Variables	Frequency	Percentage (%)
Symptoms		
Dyspnoea	21	21
Chest pain	4	4
Ankle swelling	16	16
Clinical profile of cardiac system		
Bradycardia	36	36
Hypertension	27	27
Pedal edema	19	19
Diminished heart sound	23	23

Table 5: Frequency of different cardiac manifestations (ECG changes and echocardiographic changes) among the study hypothyroidism cases (n=100).

Variables	Frequency	Percentage (%)
ECG changes among hypothyroidism cases		
Flat or inverted T wave	25	25
Bradycardia	41	41
Low voltage complex	38	38
ST segment changes	26	26

Continued.

Variables	Frequency	Percentage (%)
Echocardiographic changes among hypothyroidism cases		
LVDD	21	21
Pericardial effusion	12	12
RWMA	20	20
LVH	7	7

Table 6: Cardiac system related clinical symptoms of the study patients in relation to types of hypothyroidism (n=100).

Cardiac system related clinical symptoms		Types of hypothyroidism N (%)		P value
		Overt (n=67)	Subclinical (n=33)	
Dyspnoea	Yes	16 (23.88)	5 (15.15)	0.230
	No	51 (76.12)	28 (84.85)	
Chest pain	Yes	3 (4.48)	1 (3.03)	0.599
	No	64 (95.52)	32 (96.97)	
Ankle swelling	Yes	12 (17.91)	4 (12.12)	0.333
	No	55 (82.09)	29 (87.88)	

Table 7: Cardiac system related clinical signs of the study patients in relation to types of hypothyroidism (n=100).

Cardiac system related clinical signs		Types of hypothyroidism (%)		P value
		Overt (n=67)	Subclinical (n=33)	
Bradycardia	Yes	25 (37.31)	11 (33.33)	0.436
	No	42 (62.69)	22 (66.67)	
Hypertension	Yes	21 (31.34)	6 (18.18)	0.123
	No	46 (68.66)	27 (81.82)	
Pedal edema	Yes	14 (20.90)	5 (15.15)	0.345
	No	53 (79.10)	28 (84.85)	
Diminished heart sound	Yes	17 (25.37)	6 (18.18)	0.295
	No	50 (74.63)	27 (81.82)	

Table 8: Frequency of different cardiac manifestations (ECG changes) in relation to type of hypothyroidism among the study cases (n=100).

ECG changes among hypothyroidism cases		Types of hypothyroidism (%)		P value
		Overt (n=67)	Subclinical (n=33)	
Flat or inverted T wave	Yes	19 (28.36)	6 (18.18)	0.196
	No	48 (71.64)	27 (81.82)	
Bradycardia	Yes	29 (43.28)	12 (36.36)	0.330
	No	38 (56.72)	21 (63.64)	
Low voltage complex	Yes	28 (41.79)	10 (30.30)	0.186
	No	39 (58.21)	23 (69.70)	
ST segment changes	Yes	22 (32.84)	4 (12.12)	0.021
	No	45 (67.16)	29 (87.88)	

Table 9: Frequency of different cardiac manifestations (echocardiographic changes) in relation to type of hypothyroidism among the study cases (n=100).

ECG changes among hypothyroidism cases		Types of hypothyroidism (%)		P value
		Overt (n=67)	Subclinical (n=33)	
LVDD	Yes	17 (25.37)	4 (12.12)	0.100
	No	50 (74.63)	29 (87.88)	
Pericardial effusion	Yes	9 (13.43)	3 (9.09)	0.393
	No	58 (86.57)	30 (90.91)	
RWMA	Yes	15 (22.39)	5 (15.15)	0.284
	No	52 (77.61)	28 (84.85)	

Continued.

ECG changes among hypothyroidism cases		Types of hypothyroidism (%)		P value
		Overt (n=67)	Subclinical (n=33)	
LVH	Yes	5 (7.46)	2 (6.06)	0.579
	No	62 (92.54)	31 (93.94)	
Systolic dysfunction	Yes	9 (13.43)	0 (00)	0.022
	No	58 (86.57)	33 (100)	
Reduced ejection fraction	Yes	10 (14.93)	1 (3.03)	0.067

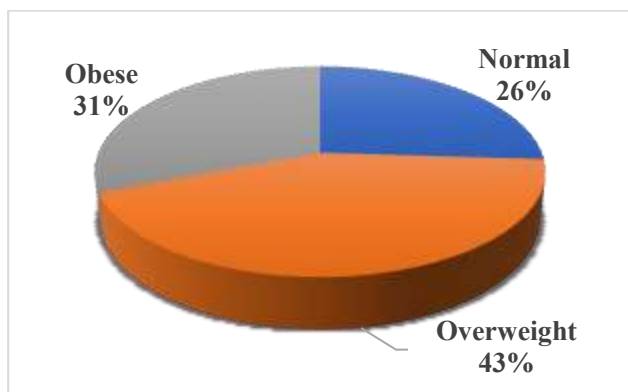


Table 1: BMI status of the patients (n=100).

DISCUSSION

Thyroid hormones are essential for growth, development, reproduction and energy metabolism.¹² This hormone virtually affects every organ system in the body including the cardiovascular system, central nervous system, autonomic nervous system, gastrointestinal system, bone, and metabolism.¹³ Thyroid hormones influence every structure of the heart and its specialized conducting system. Hypothyroidism has profound effects on cardiac functions including cardiac contractility, cardiac rhythm, vascular resistance and blood pressure.¹² This study was aimed to assess the cardiovascular manifestation of hypothyroid patient. The average age of the hypothyroid cases was 38.89±9.98 years. Majority of the study cases were in 31-40 years age group followed by 41-50 years age group (24%), 18-30 years age group (19%), 51-60 years age group (6%), 61-70 years age group (4%) and >70 years age group (2%).

Study conducted by Hannan et al found mean age of their study hypothyroid cases 36.1±11 years; Sayed et al found mean age of their study hypothyroid cases 34.5±14.1 years and Sethi et al found mean age of their study hypothyroid cases 41.1±14.01 years.¹⁴⁻¹⁶ All these findings are nearly consistent to the finding of this study. Clear female preponderance was noticed with 1:4.26 male-female ratio. Among the study cases 81% were female and 19% were male. Majority of the study cases was urban resident (71%) and housewife (59%). About 17% were service holder, 15% were businessman. Majority of the study cases were HSC passed (25%) followed by graduate (24%), SSC passed (22%), primarily educated (14%) and post graduate (4%). About 11% of the patients were illiterate. Consistent to the finding of this study Sethi et al also found maximum of their study cases urban resident (86.86%) and Sayeed et

al found majority of their study cases housewives (52%).^{14,16} About 74% hypothyroid cases were overweight or obese and the average BMI of the study cases was 27.79±3.89 kg/m². Study conducted by Nair et al also found 89.40% of their study hypothyroid cases obese or overweight.¹⁷ The mean FT3, FT4 and TSH level were found 1.29±0.63 pg/ml, 0.47±0.15 pg/ml and 13.70±10.33 µIU/ml respectively. Study conducted by Sharmeen et al found mean FT4 and TSH level of their study hypothyroid cases 1.10±0.90 µg/dl, 13.9±10.4 µIU/ml respectively.¹⁸ Sethi et al found mean TSH level of their study cases 14.20±46.57 µIU/ml which is also consistent to the findings of this study.¹⁶ Auto antibody (TG Ab and TPO Ab) was found positive among 63% cases. TG Ab and TPO Ab were found positive among 54% and 51% cases respectively. Study conducted by Islam et al also found positive auto antibody among their 68% study hypothyroid cases.¹⁹

Consistent to the finding of this study Unnikrishnan and Menon also found positive TPO Ab among their 53% hypothyroidism cases.²⁰ Among the study cases physical symptoms like dyspnoea, chest pain and ankle swelling were present in 21%, 4% and 16% cases respectively. Study conducted by Shah et al also found dyspnoea and chest pain among their 23.33% and 5% cases respectively.²¹ However, study conducted by Islam et al found dyspnoea, ankle swelling and chest pain among their 30%, 21% and 32.85% cases respectively.²² ECG showed flat or inverted T wave in 25% cases, bradycardia in 41% cases, low voltage complex in 38% cases and ST segment changes in 26% cases. Echocardiography showed LVDD in 21% cases, RWMA in 20% cases, pericardial effusion in 12% cases, reduced EF in 11% cases, systolic dysfunction in 9% cases and LVH in 7% cases. Al-farttoosi and his colleagues found bradycardia, flator inverted T wave and low QRS complex among their 47.80%, 27.80% and 33.30% cases respectively.²³ Study conducted by Islam et al found Bradycardia, low voltage ECG, and T wave changes in 40%, 35.71% and 27.14% cases respectively (on ECG). They also found pericardial effusion among their 25.71% cases and systolic dysfunction among their 7.10% cases (on echocardiogram).²² Biondi also found LVDD Shah et al found sinus bradycardia, low voltage complex, ST-T changes among their 36.60%, 21.67% and 18.33% cases respectively.²¹

Among the study hypothyroidism cases, 67% had overt hypothyroidism and 33% had subclinical hypothyroidism. Frequency of different cardiac system related clinical features like dyspnoea, chest pain, ankle swelling,

bradycardia, hypertension, pedal edema and diminished heart sound were relatively higher among hypothyroidism cases than subclinical cases. Different ECG changes like flat or inverted T, bradycardia and low voltage complex, and Echocardiographic changes like LVDD, pericardial effusion, RWMA, LVH, systolic dysfunction and reduced ejection fraction were found more frequently among overt hypothyroidism cases than subclinical cases. Among these changes ST segment change (in ECG) and systolic dysfunction (in echocardiography) had statistically significant higher frequency ($p=0.021$ and 0.022 respectively). LVDD was the most frequent changes in Echocardiography both in overt and subclinical group. Study conducted by Biondi also found LVDD was the most frequent Echocardiographic changes both in overt and subclinical group.²⁴ Study conducted by Ravishankar et al also found overt hypothyroidism among their 82% cases and subclinical hypothyroidism among their 18% cases. However, they didn't found any statistically significant difference in the frequency of different ECG and Echocardiographic changes between two groups ($p>0.05$).²⁵

Limitations

Sample size was small. Sample was taken purposively, so randomization was not done. Study was conducted in a selected hospital. So, the study population might not represent the whole community.

CONCLUSION

This study found that dyspnoea, chest pain and ankle swelling were the cardiac symptoms of hypothyroidism patients, while bradycardia, hypertension, pedal edema and diminished heart sound were the common cardiac signs. Abnormal ECG findings were flat or inverted T wave, bradycardia, low voltage complex and ST segment changes, while LVDD, pericardial effusion, RWMA, LVH, systolic dysfunction and reduced EF were the common echocardiographic features in hypothyroidism patients. ST changes and systolic dysfunction rate were significantly higher in overt hypothyroidism patients. However, further larger study is needed to corroborate my research findings.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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