www.jmscr.igmpublication.org
Impact Factor (SJIF): 6.379
Index Copernicus Value: 71.58
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v6i3.175

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Echocardiographic Evaluation of Cardiac Function in Hypothyroidism

Authors
Dr Prasanna Kumar Rathor[1], Dr Nirmal Kumar Mohanty[2], Dr Rohit Kumar[3], Dr Sarat Chandra Singh[4]
[1]Asst. Prof. Deptt. Of Medicine, S.C.B. Medical College, Cuttack
[2]Associate Professor, Deptt. of Cardiology, S.C.B. Medical College, Cuttack
[3]Ex PG Student, Deptt. of Medicine, S.C.B. Medical College, Cuttack
[4]Asst. Prof. Deptt. of Medicine, S.C.B. Medical College, Cuttack
Corresponding Author
Dr Nirmal Kumar Mohanty
Associate Professor, Deptt. of Cardiology, S.C.B. Medical College, Cuttack, India

Abstract
Hypothyroidism is one of the most common hormonal disorders being associated with increased cardiovascular morbidity and mortality. Early detection of diastolic dysfunction of left ventricle by echocardiography helps in timely therapeutic intervention with thyroid hormone supplementation and amelioration of symptoms. The main objective of the present study was aimed at the cardiovascular involvement in hypothyroid patients. The present study was carried out in 64 patients of hypothyroidism who attended to the hospital between September 2013 and September 2014 including both outpatients and inpatients.
Echocardiography showed significant reduction in early diastolic filling (E) with augmented late diastolic filling (A) resulting in decreased E/A ratio suggesting significant diastolic dysfunction. Tissue Doppler imaging showed reduction in peak early diastolic velocity (E^1) and raised peak late velocity (A^1) with increased E/E^1 ration which is again suggestive of diastolic dysfunction. LV diastolic dysfunction was impaired in patients with hypothyroidism. Doppler echocardiography might be considered a reliable method for its assessment & further management.
Keywords: *Hypothyroidism, Cardiovascular changes, Echocardiography.*

Introduction

Hypothyroidism is a common pathological state with deficiency of thyroid hormone. Primary hypothyroidism accounts for over 99.5% of cases of thyroid gland failure. Overt hypothyroidism refers to cases in which Serum TSH (Thyroid Stimulating Hormone) is elevated and Serum T_4 (Free thyroxine) is below the reference range.

Sub clinical hypothyroidism is associated with changes in several cardiac parameters[(1,2,3)]. Echocardiography reveals diastolic dysfunction and impaired systolic function on effort that results in poor exercise capacity[(4)]. The cardiac complications of long standing hypothyroidism are serious if not detected early and treated properly. A high index of suspicion is required for diagnosis of subclinical hypothyroidism as symptoms are vague. As a non-invasive method, echocardiography plays an important role in

detecting abnormal cardiac function & facilitates early therapeutic intervention.

Materials & Methods

This was a case control observational study. Over a period from September 2013 to September 2014. The study population included 64 cases of newly diagnosed hypothyroidism & 30 healthy age and sex matched controls. Informed consent from study group & controls was taken prior to inclusion. Sixty four newly diagnosed and untreated hypothyroid patients were included in the study. Hypothyroidism was diagnosed based on hormone assessment i.e. high TSH Value & low T3 and T4 values. It included both sub-clinical and overt hypothyroidism patients.

Patients with clinically evident cardiovascular disease, renal failure, chronic medical and surgical illness and Pregnancy were excluded. After clinical and laboratory diagnosis, hypothyroid patients were grouped into (1) Overt hypothyroid (2) Sub clinical hypothyroid (TSH 5.1 of 10 MIU, but with normal T3 and T4 values).

Echocardiographic evaluation was done with Phillips HD 11XE Machine with S4-2 Probe. Baseline M-Mode quantitative analysis was performed as per the guidelines laid down by the American Society of Echocardiography[6]. 2DE echocardiography was done to look for pericardiac effusion, regional motion abnormality (RWMA), ejection fraction (EF%) and valve abnormalities. Dopper echocardiography was done to assess LV diastolic dysfunction by analyzing Early (E) mitral inflow velocity, late atrial peak Velocity (A) & their ratio (E/A). Deceleration time (DT) & isovolumic relaxation time (IVRT) were also measured. Tissue Doppler imaging was done for imaging at the septal annulus for measurement of peak early diastolic velocity (E^1) & peak late diastolic velocity (A^1). Finally the E/E^1 ratio if more than 8 was indicative of diastolic dysfunction.

Statistical Analysis

Continuous variables were presented as mean + SD. Categorical variables were expressed in actual numbers & percentage. Continuous variables were compared by performing unpaired t-test. Categorical variables were compared by chi – square test. P <0.05 was considered as statistically significant. Statistical Software STATA version 10 was used for statistical significance.

Results

The mean age of hypothyroid patients was 40.90 $\pm$ 8.73 years while for control it was 40.06 $\pm$ 9.68 years. Out of 64 patients 6.25% were males and 93.75% were females & in control group 13.33% were males and 86.66% were females. All patients of sub clinical hypothyroidism were females (56.2%) and 24 (37.5%) and 4 (6.25%) patients having overt hypothyroidism were females & males respectively. (Table – 1) Weight gain was the commonest symptom being present in 62.5% of patients followed by easy fatiguability (59.37%), dry skin (40.62%), menstrual abnormality (34.37%) Neck swelling was the least common being present in only 6 (9.3%) patients. (Table 2)

As expected hypothyroid patients had significantly raised TSH (30.98 $\pm$ 33.06 mIU / ml) & low T_3 (96.78 $\pm$ 42.06 mg/dl) and T_4 (40.99 $\pm$ 1.85 mg/dl) as compared to controls (TSH – 3.25 $\pm$ 0.76 mIU/dl). Overt hypothyroid patients had significantly raised TSH and low T_3 and T_4 levels as compared to sub clinical hypothyroid. Abnormality of lipid profile was found with raised Serum total Cholesterol, triglycerides and low density lipoprotein (LDL) in hypothyroid patients compared to controls. (Table - 3)

Sinus bradycardia was the commonest abnormality being present in 28 (43.75%) hypothyroid patients followed by low voltage complexes in 12 (18.75%), ST-T changes in 10 (15.62%), right bundle branch block (RBBB) in 2 (3.1%) Patients (Table – 4)

There was no significant difference (P Value > 0.05) in left ventricular dimension between patients & controls. Hypothyroid patients showed significantly (P-Value < 0.001) raised IVS (9.6 $\pm$ 1.22) mm and posterior wall thickness (9.71 $\pm$

1.08) mm as compared to controls. IVS (7.6 ± 0.63)mm & PW thickness (7.56 ± 0.67)mm]. (Table – 5)

On Doppler evaluation, hypothyroid patients showed significant (P-Value < 0.05) reduction in early diastolic filling E (71.19 ± 6.09 cm/sec) as compared to controls (81.53 ± 9.65). Conversly, hypothyroid patients showed significantly raised late diastolic filing A (64.32 ± 7.74 cm/sec) as compared to controls (50.53 ± 4.03) resulting in reduced E/A ratio in hypothyroid (1.11 ± 0.1) as compared to controls (1.62 ± 0.248) suggesting diastolic dysfunction. When tissue Doppler parameters were compared, hypothyroid patients showed significant (P-Value < 0.05) reduction in peak early diastolic velocity E^1 (7.67 ± 1.32) as compared to controls (11.72 ± 0.976). Peak late velocity A^1 was increased in hypothyroid patients (11.42 ± 0.82) as compared to controls (10.76 ± 1.07). Hypothyroid patients also showed significantly raised E/E^1 (9.51 ± 1.59) as compared to controls (7.02 ± 1.07). (Table – 6)

Table 1 Age & Sex Distribution of Controls and Cases

	Controls	Hypothyroid Patients
Age (Yr)	40.06 + 9.68	40.90 ± 8.73
Sex (M/F)	4 / 26	4 / 60

Table 2 Clinical Presentation of Study Population

Symptoms	Male	Female	Total
Weight Gain	4	36	40 (62.5%)
Fatiguability	2	36	38 (59.37%)
Dry Skin	Nil	26	26 (40.62%)
Menstrual Irregulation	Nil	22	22 (34.37%)
Constipation	2	16	18 (28.1%)
Depressin	2	10	12 (18.75%)
Voice Change	2	6	8 (12.5%)
Neck Swelling	Nil	6	6 (9.3%)

Table 3 Thyroid & Lipid Profile Parameters in Study Population Vs. Control

Lab Parameter	Hypothyroid	Controls	P Value
TSH (mIv/ml)	30.98 ± 33.06	3.25 ± 0.78	< 0001
T3 (mg/dl)	96.78 ± 42.06	12.6 ± 19.50	< 0.0001
T4 (mg/dl)	4.99 ± 1.85	7.36 ± 0.87	< 0.0001
Serum Cholesterol	245.34 ± 47.31	142.86 ± 8.65	< 0.0001
Serum Triglyceride	229.40 ± 50.58	155.53 ± 6.64	< 0.0001
Serum LDL	117.96 ± 21.75	82.33 ± 8.65	< 0.0001

Table 4 Electrocardiographic Changes in Hypothyroid

ECG Changes	Male	Female	Total
Sinus Bradycardia	2	26	28 (43.75%)
Low Voltage Complex	2	10	12 (18.75%)
ST-T Changes	Nil	10	10 (15.62%)
RBBB	Nil	2	2 (3.1%)
Arrhythmias	Nil	Nil	Nil
Normal	Nil	12	12 (18.75%)

Table 5 Echocardiographic (M-Mode) Parameter

	Hypothyroid	Controls	P Value
AO (mm)	26.35 ± 3.96	26.13 ± 2.66	0.8424
LA (mm)	30.22 ± 4.02	29.33 ± 3.06	0.4497
LVESD (mm)	29.46 ± 6.29	30.4 ± 3.71	0.5965
LVEDD (mm)	41.07 ± 4.71	41.6 ± 4.54	0.7912
IVS (mm)	9.61 ± 1.22	7.6 ± 0.63	< 0.0001
PW (mm)	9.71 ± 1.08	7.56 ± 0.67	< 0.0001

Table 6 Doppler Echocardiographic Parameters of Left Ventricular Function in Hypothyroid patients & in normal controls

	Hypothyroid	Control	P Value
E (cm/sec)	71.19 ± 6.09	81.53 ± 9.65	< 0.0001
A (cm/sec)	64.32 ± 7.74	50.53 ± 4.03	< 0.0001
E/A	1.11 ± 0.1	1.62 ± 0.248	< 0.0001
E^1 (cm/sec)	7.67 ± 1.32	11.72 ± 0.976	< 0.0001
A^1 (cm/sec)	11.42 ± 0.82	10.76 ± 1.07	0.0243
E/E^1	9.51 ± 1.59	7.62 ± 1.07	< 0.0001
DT (sec)	186.9 ± 34.87	179.8 ± 12.35	0.4494
IVRT (sec)	101.21 ± 13.28	81.26 ± 4.99	< 0.0001
Systolic Velocity (cm/sec)	9.06 ± 1.25	9.01 ± 0.73	0.9337
EF%	6.1 ± 7.1	6.1 ± 2.06	1.0

Discussion

In the present study comprising of 64 patients of hypothyroidism, the mean age for hypothyroid patients was 40.90 ± 8.73 years as compared to controls i.e. 40.06 ± 9.68 years. This is comparable to the study by C.L. Meena et al[7] 2012 and T.K. Mishra et al[8] 2005. There was female preponderance in hypothyroid patients. It is similar to other studies i.e. T.K. Mishra et al[8] 2005, having 90.62% females and 9.3% male patients in hypothyroid group. In our study, 36 (56.2%) patients were having sub clinical and 28 (43.75%) had overt hypothyroidism comparable to study by 1 Gon Zale Z, Vilchez F etal[9] 1998. Weight gain was the commonest symptom being present in 62.5% of patients followed by fatiguability (59.37%), dry skin (40.62%) and menstrual disturbance (34.37%).

Electrocardiographic (ECG) changes in our patients comprised of Sinus bradycardia (43.75%) followed by low voltage (18.75%), ST-T changes (15.62%) and normal in 18.75%. It is similar to the study by Al-Favttosi et al[10].

Echocardiography study by M-Mode did not show significant difference (P Value > 0.05) in left ventricular dimensions other than interventricular septum (IVS) and posterior Wall (PW) thickness. That showed raised IVS (9.6 ± 1.22) and PW (9.71 ± 1.08) thickness as compared to control i.e. IVS (7.6 ± 0.63) & PW (7.56 + 0.67) thickness. (P Value <0.0001). Our study finding are comparable to that of Rawat B et al [11] 2003 and Varma R et al[12] 1996. Doppler echocardiography showed significant (P Value < 0.05) reduction in early diastolic filling E wave (71.19 ± 6.09 cm/sec) as compared to controls (81.53 ± 9.65) and significantly raised late diastolic filling "A Wave" (64.32 ± 7.74) as compared to controls (50.53 ± 4.03) resulting in reduced E/A ratio in hypothyroid patients (1.11 ± 0.1) as compared to controls (1.62 ± 0.248). This suggested significant diastolic dysfunctions. There was significant prolongation of isovolumetric relaxation time (IVRT) in hypothyroidism patients (101.21 ± 13.28) as compared to controls (81.26 ± 4.99) though it was not statistically significant. Our study findings were similar to that of T.K. Mishra et al[8] 2005, C.L. Meena et al[7] 2012. Tissue Doppler imaging in hypothyroid patients had significant (P Value < 0.05) reduction in peak early diastolic velocity (E^1) (7.67 ± 1.32) as compared to controls (11.72 + 0.97) Peak Late diastolic velocity (A^1) was increased in hypothyroid patients (11.42 ± 0.82) as compared to controls (10.76 ± 1.07). Hypothyroid patients also showed significantly raised E/E^1 (9.51 ± 1.59) ratio as compared to controls (7.02 ± 1.07). Our study findings are comparable to other studies like study by Gulbanu Erkan et al[13] 2011 & Fatma Alibaz oner et al[14] 2011. When subclinical and overt hypothyroid patients were compared there was significant increase in IVS thickness in overt (10.12 ± 1.29 mm) as compared to subclinical (9.33 ± 1.02) hypothyroid patients. Though diastolic dysfunction was present in both groups this was not statistically significant (P Value > 0.05).

Conclusion

The results of the present study showed that diastolic dysfunction of left ventricle is present in both subclinical and overt hypothyroid patients. Doppler echocardiography with tissue Doppler imaging may be considered a reliable method for a cross sectional and longitudinal assessment of left ventricular diastolic function in patients with hypothyroidism.

Limitation of Present Study

In our study the hypothyroid patients could not be followed up to look for the resolution of cardiac changes after achievement of euthyroid state. Free T_3 and T_4 level could not be measured due to financial constraints. Other parameters like myocardial performance index, left atrial volume index estimation would have added to better evaluation of cardiac function.

References

1. Klein.I, Danzi S. Thyroid disease and the heart. Circulation. 2007,116(15):1725-1735
2. Fiarresga A.J., Feliciano J., Fernandes R. Relationship between coronary disease and sub-clinical hypothyroidism: an angiographic study. Rev.Port.cardiol.2009: 28 (5):535-543
3. Pearce E.N.,Yang Q.,Benjamin E.J. et al. Thyroid function and left ventricular structure and function in the Framingham Heart Study.Thyroid.2010:20(4);369-373
4. Rodondi N.,Aujesky D.,Vittinghoff E. et al . Subclinical hypothyroidism and the risk of coronary heart disease; A meta analysis. Am.J.Med.2006:119(7);541-551
5. Bough EW,Crowley WF,Ridgway EC. Myocardial function in hypothyroidism; relation to disease severity and response to treatment. Arch Intern Med,(1978).138; 1476-1480.
6. Sahn DJ, De Maris A,Kissolo J et al, for the committee on M-mode standardisation of the American Society of Echocardio-graphy. Recommendation regarding quantitation in M-mode Echocardiography measurements. Circulation 1978:58;1072-1083.
7. C.L. Meena, R.D. Meena,Rajani Nawal, V.K. et al .Assessment of left ventricular diastolic dysfunction in subclinical hypothyroidism. Acta Inform Med.2012 December:20(4);218-220.
8. TK Mishra, SN Routray,S Das et al . Left Ventricular dysfunction in patients with subclinical hypothyroidism and its reversibility after hormone therapy,JAPI 2005 NOV:53;943-946.
9. Gonzale Z , Vilchez F, Castillo L et al. Cardiac manifestations of primary hypothyroidism. Determinant factors and treatment response. Rev Esp Cardiol.1998 Nov:51(11);893-900.
10. AL-Farttoosi. Cardiovascular Manifestation of Primary Hypothyroidism. The Iraqi Post graduate Medical Journal.2010:9(2);113-119.
11. Rawat B,Satyal A. An echocardiographic study of cardiac changes in hypothyroidism and the response to treatment.Kathmandu Univ Med J(KUMJ).2003 Jul-Sep:2(3);182-7.
12. Varma R,Jain AK,Ghose T. Heart in hypothyroidism –An Echocardiographic study.J Assoc Physician India.1996 Jun:44 (6);390-2.
13. Gulbanu Erkan,Aycan Fahre Ercan and Atiye Cengel. The evalution of diastolic dysfunction with Tissue Doppler Echocardiography in women with Subclinical Hypothyroidism and the Effect of L-Thyroxine Treatment on Diastolic Dysfunction.A Pilot Study. J Thyroid Res. 2001:654-656.
14. Fatma Alibaz oner, Selen Yurdkul, Ender Oner et al. Evaluation of ventricular functions using Tissue Doppler echocardi-ography in patients with sub clinical hypothyroidism. Turk Kardiyol Dern Ars – Arch Turk Soc Cardiol 2011:39;129-136.