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2D Echocardiographic features in low T3 syndrome in chronic heart failure

N. Arun Kumar[1], Y. L. Shivamurthy[2], V. Mohan Kumar[3], S. S. Ramesh[4], A. G. Ravi Shankar[4], M. M. Basavaraju[4], S. K. Yathish[1], S. M. Manjunatha[5]

[1]Senior Resident, Dept. of General Medicine, ESIC MC & PGIMSR, Bangalore, [2]Manipal Hospital, Bangalore, [3]Vaatsalya Hospital, Mandya,[4]Mysore Medical College,[5]NRS Medical College, Kolkata

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ABSTRACT

Background: Thyroid abnormalities are common in chronic heart failure. Severity of heart failure rises by several fold in patients with thyroid dysfunction. **Objectives:** The purpose of this prospective study is to determine the correlation between low T3 syndrome and chronic heart failure with 2D echocardiography features & predicting the severity of chronic heart failure. **Methods:** In this descriptive, prospective cross sectional study, all patients who presented to the department of medicine with chronic heart failure during this study period of 12 months from January 2010-December 2011 in K.R.Hospital, Mysore were included. Patients were grouped into Low T3 chronic heart failure, hypothyroid chronic heart failure and chronic heart failure. **Results:** Mean age of low T3 chronic heart failure patients was higher than other two groups [60.50 ± 6.15(SD) years, Systolic dysfunction on 2D Echo was more in low T3 dilated cardiomyopathy (20%), Diastolic dysfunction on 2D Echo was more in low T3 dilated cardiomyopathy group (30%), Pericardial effusion was seen in more number of patients with low T3 dilated cardiomyopathy (10%).Global hypokinesia was seen in more number of patients with low T3 dilated cardiomyopathy (30%).Segmental hypokinesia was seen in more number of patients with low T3 dilated cardiomyopathy (3%). Mean ejection fraction was seen in more number of patients with low T3 dilated cardiomyopathy [36.78 ± 5.08 (SD) %]. Mean ejection fraction was lower in low T3 dilated cardiomyopathy [34.8 ± 3.293 (SD) %].The high pulmonary artery systolic pressure was seen in more number of patients in low T3 dilated cardiomyopathy (70%).**Conclusion:** There is significant percentage of chronic heart failure patients having low T3 alone as biochemical parameter. It is important to recognize patients with chronic heart failure as it is associated with increased severity of heart failure.

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Key words: Chronic heart failure, Low T3 syndrome, Dilated cardiomyopathy, 2D-echocardiography, Ejection fraction

INTRODUCTION

Clinical and experimental evidences have shown that T3 plays a major role in modulating heart rate and cardiac contractility as well as arterial peripheral resistance. T3 actions are carried out by binding with specific nuclear receptors that regulate responsive genes encoding for structural and functional cardiac proteins; direct, extra-nuclear, non transcriptional effects have also been described.[1,2]

The cardiovascular system is one of the most important targets on which thyroid hormones act. More than 80% of the biologically active hormone tri-iodothyronine (T3) derives from peripheral conversion of pro-hormone thyroxine (T4) secreted by the thyroid gland.[3]

A typical pattern of altered thyroid hormone metabolism characterized by low T3 circulating levels has been described in patients with acute myocardial infarction and heart failure and in adults and children after cardiopulmonary bypass.[4,5] The principal pathophysiological mechanism underlying low circulating T3 is the reduced enzyme activity of 5' monodeiodinase responsible for converting T4 into T3 in peripheral tissues.[6-10]

Address for Correspondence:
Dr. N. Arun Kumar, B-192, 10th block, C.P.W.D quarters, Domlur, Bangalore - 560071
E-mail: dreamfullofcream@gmail.com; **Mobile:** +09986929708, **Phone:** +08025359594

This low-T3 syndrome has commonly been interpreted by the medical community as a euthyroid sick syndrome, an adaptive compensatory and thus beneficial response that decreases energy consumption in diseased states. This interpretation, however, has recently been questioned. Although clinical data documented the benefit gained from treating patients with synthetic thyroid hormones. [11-14]

A new study in rats is giving researchers hope that more aggressive treatment of hypothyroidism and borderline hypothyroidism will result in a reduction of chronic heart failure in human beings.[15-17]

While further research is needed, results from a recent study entitled, "Low thyroid function leads to cardiac atrophy with chamber dilation, impaired myocardial blood flow, loss of arterioles, and severe systolic dysfunction," suggest that low thyroid function has the potential to cause heart failure. [18,19]

Low thyroid function alone induced in rats eventually can cause heart failure. "It was also discovered that low thyroid function severely impaired cardiac blood flow due to a dramatic loss of the hearts small blood vessels (arterioles). Within six weeks after inducing low thyroid function in rats, half of the heart's small arterioles were gone." hypothyroidism led to severe, progressive contractile dysfunction, chamber enlargement, and ventricular wall thinning despite a reduction in cardiac mass. Hypothyroidism induced in the rats also resulted in impaired myocardial blood flow due to a dramatic loss of arterioles. As a result, it identified two new mechanisms by which low thyroid function may lead to heart failure.[20]

The results suggested that individuals with borderline hypothyroidism may also have similar cardiac changes. Clearly more research is needed to determine if these detrimental cardiac changes occur in humans and if treatment of heart patients with borderline hypothyroidism will lead to improved outcomes.[20]

METHODOLOGY

Study design: Prospective study. **Sample Size:** 50 cases over a span of 12 months from January 2010-December 2011 in K.R.Hospital, Mysore.

Method of collection of data

The data for the purpose of the study was collected in a predesigned and pretested proforma, ethical committee clearance and consent was obtained. Proforma included various socioeconomic parameters like age, sex, occupation, religion, etc. About 50 cases were selected on the basis of the simple Random sampling method.

Statistical analysis

Data was analyzed ANOVA, factor analysis and Chi-square test. Data were entered into Microsoft Excel 2007, and statistical analysis was performed using the statistical package for social sciences (SPSS) version 20 (SPSS Inc. Chicago,USA). Data were presented as Mean±SD.

Inclusion criteria

Patients with chronic heart failure.

Exclusion criteria

Included clinical evidence of sepsis or cachexia or Concomitant presence of any predominant severe systemic disease including severe anaemia Hb% < 5g%.Other major surgical procedures performed before or within 6 months after the time of thyroid sampling.

Routine investigations, to assess thyroid function and to clinically diagnose chronic heart failure. Investigations are as follows:The thyroid function profile: After rapid centrifugation of a venous sample, Total T3 (TT3), fT3, Total T4 (TT4), fT4 and TSH was measured. Patient was physically assessed, radiographic investigations were carried out & 2D echocardiography was done for diagnosing & characterizing chronic heart failure.

All these methods, however, have major limitations when used independently. Scoring systems that combine several of the measures discussed below have been developed for use in population-based studies for chronic heart failure.

RESULTS

In this study titled "2D ECHOCARDIOGRAPHIC FEATURES IN LOW T3 SYNDROME IN CHF" A descriptive, prospective cross sectional study comprising of 50 CHF patients admitted to KR hospital, Mysore who are studied under three groups namely Hypothyroid CHF, Low T3 CHF & CHF only.

Table 1 shows among 50 CHF patients 29 patients (58%) are hypothyroid CHF, 10 patients (20%) have low T3 CHF alone and 11 patients (22%) are CHF only in present study.

Table 2 shows mean age for Low T3 CHF patients was 60.50 ± 6.15(SD) years which was higher when compared to mean age of CHF only patients which was 59.91± 5.99 (SD) years and 54.9± 5.49 (SD) years for hypo thyroid CHF patients in the present study which shows that low T3 CHF occurs in more elderly patients with CHF. The mean age of CHF patients in the present study was 58.43±5.87 (SD) years.

Table 3 shows that systolic dysfunction was seen in more number of patients of hypothyroid CHF group (31.03%), when compared to 20% in low T3 CHF group & 9.09% in CHF only group in present study, which was statistically not significant (p<0.333).

Table 3 shows that diastolic dysfunction was seen in more number of patients in low T3 CHF group (30%), when compared to hypothyroid CHF group in whom it was 17.24%, and CHF only group in whom it was 9.09% in present study, which was statistically not significant (p<0.455).

Table 3 shows that pericardial effusion was seen in more number of patients in low T3 CHF group (10%), when compared to 9.09% in CHF only group & none in hypothyroid CHF group in present study, which was statistically not significant (p<0.236).

Table 3 shows that Global hypokinesia was seen in more number of patients in hypothyroid CHF group (48.28%), when compared to 45.45% in CHF only group and 30% in low T3 CHF group in present study, which was statistically not significant (p<0.6).

Table 3 shows that segmental hypokinesia was seen in more number of patients with hypothyroid CHF group (51.72%), when compared to 45.45% in CHF only group and 30% in Low T3 CHF group in present study, which was statistically not significant (p<0.490).

Table 3 shows that high pulmonary artery systolic pressure in low T3 group CHF group was seen in more number of patients (70%), when compared to 10.34% in hypothyroid CHF group and 9.09% in CHF only group in present study, which was statistically significant (P<0.000). This shows that pulmonary hypertension was seen in more number of patients with low T3 CHF.

Table 4 shows that patients with Low T3 CHF had a low mean EF of [34.8± 3.293 (SD) %] when compared 36.66± 5.563 (SD) % in hypothyroid CHF group & 38.91± 4.592 (SD) % in CHF Only group in present study, which was statistically not significant (p<0.178). The mean EF of patients with CHF in present study was 36.78 ± 5.08 (SD) %.

Table 5 shows majority of patients with hypothyroid CHF were within the age group of 55-60yrs (34.48%) and patients with hypothyroid CHF had low mean EF 36.6±5.5 (SD) % with age group of 60-65yrs in the present study.

There was equal distribution of patients with low T3 CHF in age group 55-60yrs (30 %), 60-65yrs (30%) & 65-70yrs (30%), patients with low T3 CHF had low mean EF 32± 2.3(SD) % with age group of 50-55yrs in the present study.

Majority of patients with CHF only are within age group of 60-65yrs (36.36%). The patients with CHF only had low mean EF 34±3 (SD) % with age group of 65-70yrs in the present study.

The mean EF of patient with low T3 was lower [34.8± 3.2 (SD) %] when compared to 36.66± 5.5 (SD) % in hypo thyroid CHF and 38.9± 5 (SD) % in CHF alone in the present study which was statistically not significant (p<0.178).

Table 1: Prevalence of hypothyroidism, low T3 and CHF only in present study

Group	Number of patients	Percentage (%)
Hypothyroid	29	58
Low T3	10	20
CHF only	11	22
Total	50	100

Table 2: Mean age and duration of symptoms in present study

Parameter	Hypothyroid (n=29) Mean	Low T3 (n=10) Mean	CHF only (n=11) Mean	P value
Mean Age (years)	54.90±5.49 (SD)	60.50±6.15 (SD)	59.91±5.99 (SD)	<0.01
Duration of symptoms (months)	2.80±2.24 (SD)	3.85±1.63 (SD)	5.64±6.63 (SD)	

Table 3: 2D-Echo changes in different groups in present study

2D-Echo Changes	Hypothyroid (n=29), No (%).	Low T3 (n=10), No(%).	CHF only (n=11), No (%).	P value
Systolic dysfunction	9 (31.03%)	2 (20%)	1 (9.09%)	<0.333
Diastolic ysfunction	5 (17.24%)	3 (30%)	1 (9.09%)	<0.455
Pericardial effusion	0 (0%)	1 (10%)	1 (9.09%)	<0.236
Global hypokinesia	14 (48.28%)	3 (30%)	5 (45.45%)	<0.60
Segmental hypokinesia	15 (51.72%)	3 (30%)	5 (45.45%)	<0.49
High pulmonary artery systolic pressure	3 (10.34%)	7 (70%)	1 (9.09%)	<0.00

Table 4: Mean EF in different groups in present study

Groups	Mean EF (in %)
Hypothyroid (n=29)	36.66±5.563 (SD)
Low T3 (n=10)	34.8±3.293 (SD)
CHF Only (n=11)	38.91±4.592 (SD)
Total (n=50)	36.78±5.08 (SD)

(p<0.178)

Table 5: Correlation of age with mean EF in present study

Age group in years	Hypothyroid (n=29)		Low T3 (n=10)		CHF only (n=11)	
	No (%)	Mean EF (in %)	No (%)	Mean EF (in %)	No (%)	Mean EF (in %)
45-50	6 (20.69%)	36.3±4.3 (SD)	-	-	1 (9.09)	40±1.8 (SD)
50-55	7 (24.13%)	40.1±4.2 (SD)	1 (10%)	32±2.3 (SD)	1 (9.09)	44±2.2 (SD)
55-60	10 (34.48%)	36.7±7.1 (SD)	3 (30%)	35.3±4.2 (SD)	3 (27.27)	38±5.8 (SD)
60-65	4 (13.79%)	36.2±6.6 (SD)	3 (30%)	35.3±4.6 (SD)	4 (36.36)	41±4.3 (SD)
65-70	2 (6.89%)	41±1.8 (SD)	3 (30%)	34.6±1.4 (SD)	2 (18.18)	34±3 (SD)
Total	29	36.66±5.5 (SD)	10	34.8±3.2 (SD)	11 (100)	38.91±4.592 (SD)

DISCUSSION

Low thyroid hormone concentrations, in particular low serum T3 concentrations, are a common finding in patients with non thyroidal illnesses, including cardiac disorders. Its pathophysiological role is not well understood, although the common belief is in favor of an adaptive mechanism to preserve energy. Nonetheless, based on the knowledge of the fundamental actions of T3 on both the heart and vessels, a direct relationship between low circulating levels of T3 and adverse prognosis of cardiac patients has represented an attractive hypothesis in the last few years. In this respect, it has been postulated that the low T3 state may produce a hypothyroid-like syndrome that contributes to the worsening or exacerbation of the intrinsic cardiac disease.[1]

The low T3 circulatory levels were found in 20% of patients with CHF in the present study. Mean age for Low T3 CHF patients was 60.50 ± 6.15(SD) years which was higher when compared to mean age of CHF only patients which was 59.91±5.99 (SD) years and 54.9± 5.49 (SD) years for hypo thyroid CHF patients in the present study which shows that low T3 CHF occurs in more elderly patients with CHF. The mean age of CHF patients in the present study was 58.43±5.87 (SD) years which was comparable to Joao Paulo Solano, George Marzouka and ACC 2011.[2-5]

The systolic dysfunction on 2D Echo was more in low T3 CHF (20%) when compared to CHF only group (9.09%) but was lesser than hypothyroid CHF group (31.03%). The diastolic dysfunction was more in low T3 CHF (30%) when compared to other two groups. Pericardial effusion was seen in more number of patients with low T3 CHF (10%) when compared to other two groups. The global hypokinesia was seen in less number of patients with low T3 CHF group (30%) when compared to other two groups. The segmental hypokinesia was seen in less number of patients with low T3 CHF group (30%) when compared to other two groups.

The mean ejection fraction of patients with CHF in the present study was [36.78±5.08 (SD)%] which was comparable to Deborah and Joa Paulo Solano, George Marzouka.[2-5]

Table 6 shows the mean ejection fraction was lower in patient with low T3 CHF [34.8±3.293 (SD) %] when compared to other two groups.

This showed that the severity of heart failure was higher in patients with low T3 CHF and incidence of IHD in the form of global hypokinesia and segmental hypokinesia was lesser in patients with low T3 CHF.

The high pulmonary artery systolic pressure was seen in more number (70%) of patients with low T3 CHF group when compared to other two groups; this shows increase in severity of right heart failure in patients with low T3 CHF in the present study.

CONCLUSION

There is significant percentage of CHF patients having low T3 alone as biochemical parameter. It is important to recognize this condition in patients with CHF as it is associated with increased severity of heart failure.

Key message

- Low T3 circulatory levels were found in 20% of patients of CHF in present study.
- Mean age of CHF patients in present study was 58.43±5.87 (SD) years.
- Mean age of low T3 CHF patients was higher [60.50±6.15(SD) years] when compared to other two groups.
- Systolic dysfunction on 2D Echo was more in low T3 CHF group (20%)
- Diastolic dysfunction on 2D Echo was more in low T3 CHF group (30%)
- Pericardial effusion was seen in more number of patients with low T3 CHF (10%).
- Global hypokinesia was seen in more number of patients with low T3 CHF (30%).
- Segmental hypokinesia was seen in more number of patients with low T3 CHF (3%).
- Mean ejection fraction was seen in more number of patients with low T3 CHF [36.78±5.08(SD)%].
- Mean ejection fraction was lower in low T3 CHF [34.8±3.293(SD)%].

- The high pulmonary artery systolic pressure was seen in more number of patients in low T3 CHF (70%).

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Authors Contribution:
AKN – designed the study, performed the laboratory tests and drafted the manuscript; **SYL –** analysed the data and drafted the manuscript; **MKV –** designed the experiments and reviewed the manuscript; **RSS –** contributed to the study design; **RSA –** contributed to the study design; **MMB –** contributed to the study design; **VSK –** contributed to the study design; **MSM –** designed the experiments and reviewed the manuscript.

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