Dilated Cardiomyopathy and Wilson's syndrome – A study of ECG and 2D echocardiography

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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 (Wilson's syndrome) and dilated cardiomyopathy (DCM) and to determine the ECG and 2D-echocardiography changes with severity of chronic heart failure.

Methods: In this descriptive, prospective, cross sectional study, all patients who presented to the department of medicine with dilated cardiomyopathy during this study period April 2012- April 2013 were included. Patients were divided into three groups viz, 1. Hypothyroid DCM, 2. Low T3 DCM, 3. DCM only groups.

Results: There was a significant percentage of DCM patients having low T3 alone as biochemical parameter. It is important to recognize this condition in patients with chronic heart failure as it is associated with increased severity of heart failure, increased evidence of renal failure which may need additional support of thyroid hormone administration to have a better outcome in patients with chronic heart failure.

Keywords: Chronic heart failure; dilated cardiomyopathy; low T3; renal failure; systolic blood pressure; PR interval.

Introduction

Clinical and experimental evidence 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.[6-8]

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.[9,10] 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]

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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 heart's 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]

The purpose of this prospective study is to determine the correlation between low T3 syndrome (Wilson's syndrome) and dilated cardiomyopathy (DCM) and to determine the ECG and 2D-echocardiography changes with severity of chronic heart failure.

Materials and Methods

Study Design: Cross sectional study.

Sample Size: 50 cases over a span of 1year from April 2012- April 2013 in Mysore Medical College & Research Institute, Mysore, Karnataka, India.

Method of Collection of Data: The data was collected in a predesigned and pretested proforma; ethical committee clearance and consent were 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. The statistically data was analyzed by ANOVA, factor analysis and Chi-square test.

Inclusion Criteria: Patients with dilated cardiomyopathy- chronic heart failure.

Exclusion Criteria: Concomitant presence of any predominant severe systemic disease including severe anemia Hb% <5g%; clinical evidence of sepsis or cachexia; other major surgical procedures performed before or within 6 months after the time of thyroid sampling.

The following investigations were carried out in venous sample of blood:

1. Total T3 and Total T4 (TT3 and TT4),
2. Free T3 and free T4 (fT3, fT4),
3. Thyroid stimulating hormone (TSH)

Patient was physically assessed, radiographic investigations were carried out & 2D echocardiography was done for diagnosing & characterizing chronic heart failure. Scoring systems that combine several of the measures discussed below have been developed for use in population-based studies for chronic heart failure.

Results

A descriptive, prospective cross sectional study comprising of 50 dilated cardiomyopathy patients admitted to KR hospital, Mysore, were studied under three groups namely Hypothyroid DCM, Low T3 DCM and DCM only.

29 patients (58%) were hypothyroid dilated cardiomyopathy, 10 patients (20%) had low T3 dilated cardiomyopathy alone and 11 patients (22%) had dilated cardiomyopathy only in the present study (Table 1).

The mean PR Interval is more prolonged in low T3 dilated cardiomyopathy patients 0.21± 0.023 sec when compared to 0.16± 0.027 sec in hypothyroid dilated cardiomyopathy group and 0.15 ± 0.022 sec in DCM only group (Table 2), which was statistically significant ($p<0.0001$).

Table 1. Proportion of hypothyroidism DCM, low T3 DCM and DCM only in the present study

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

Table 2. PR Interval in different groups of dilated cardiomyopathy (DCM)

PR Interval	Mean PR interval (in seconds)
Hypothyroid DCM (n=29)	0.16± 0.027 (SD)
Low T3 DCM (n=10)	0.21± 0.023 (SD)
DCM Only (n=11)	0.15± 0.022 (SD)

Systolic dysfunction was seen in more number of patients of hypothyroid dilated cardiomyopathy group (31.03%), when compared to 20% in low T3 dilated cardiomyopathy group and 9.09% in DCM only group, which was statistically not significant (p<0.333). Diastolic dysfunction was seen in more number of patients in low T3 dilated cardiomyopathy group (30%), when compared to hypothyroid dilated cardiomyopathy group in whom it was 17.24%, and DCM only group in whom it was 9.09%, which was statistically not significant (p<0.455) (Table 3).

Pericardial effusion was seen in more number of patients in low T3 dilated cardiomyopathy group (10%), when compared to 9.09% in DCM only group and none in hypothyroid dilated cardiomyopathy group in present study, which was statistically not significant (p<0.236). Global hypokinesia was seen in more number of patients in hypothyroid dilated cardiomyopathy group (48.28%), when compared to 45.45% in DCM only group and 30% in low T3 dilated cardiomyopathy group in present study, which was statistically not significant (p<0.6). Segmental hypokinesia was seen in more number of patients with hypothyroid dilated cardiomyopathy group (51.72%), when compared to 45.45% in DCM only group and 30% in Low T3 dilated cardiomyopathy group in present study, which was statistically not significant (p<0.490) (Table 3).

High pulmonary artery systolic pressure, in low T3 group dilated cardiomyopathy group, was seen in more number of patients (70%), when compared to 10.34% in hypothyroid dilated cardiomyopathy group and 9.09% in DCM only group in present study, which was statistically significant (P<0.000). Pulmonary hypertension was seen in more number of patients with low T3 dilated cardiomyopathy had a low mean EF of 34.8± 3.293 (SD) % when compared 36.66± 5.563 (SD) % in hypothyroid dilated cardiomyopathy group and 38.91± 4.592 (SD) % in DCM only group in present study, which was statistically not significant (p<0.178).

Table 3. 2D-Echo changes in different groups of dilated cardiomyopathy (DCM)

2D-Echo Changes	Hypothyroid DCM (n=29), No (%).	Low T3 DCM (n=10),No(%).	DCM Only (n=11),No (%).	P Value
Systolic dysfunction	9 (31.03%)	2 (20%)	1 (9.09%)	<0.333
Diastolic dysfunction	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

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

Table 4. Ejection fraction (EF) in different groups of dilated cardiomyopathy (DCM)

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

Table 5. Correlation of age with mean ejection fraction (EF)

Age group In years	Hypothyroid DCM (n=29)		Low T3 DCM (n=10)		DCM 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)

Majority of patients with hypothyroid dilated cardiomyopathy were within the age group of 55-60 yrs (34.48%) and patients with hypothyroid dilated cardiomyopathy had low mean EF of 36.6± 5.5 (SD) % in the age group of 60-65yrs. There was equal distribution of patients with low T3 dilated cardiomyopathy in age group 55-60yrs (30 %), 60-65yrs (30%) and 65-70yrs (30%), patients with low T3 dilated cardiomyopathy had low mean EF 32± 2.3(SD) % in the age group of 50-55yrs in the present study. Majority of patients with dilated cardiomyopathy only are within age group of 60-65yrs (36.36%). The patients with DCM only had low mean EF 34±3 (SD) % within the age group of 65-70yrs in the present study. Mean EF of patients with low T3 was lower 34.8± 3.2 (SD) % when compared to 36.66± 5.5 (SD) % in hypothyroid dilated cardiomyopathy and 38.9± 5 (SD) % in DCM alone, which was statistically not significant (p<0.178) (Table 5).

The mean age for low T3 dilated cardiomyopathy patients was 60.50 ± 6.15(SD) years which was higher when compared to mean age of dilated cardiomyopathy only patients which was 59.91± 5.99 (SD) years and 54.9± 5.49 (SD) years for hypo thyroid dilated cardiomyopathy patients in the present study.

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. The low T3 circulatory levels were found in 20% of patients with chronic heart failure-dilated cardiomyopathy in the present study.

The mean PR interval was more prolonged in low T3 dilated cardiomyopathy 0.21±0.023 sec when compared to other two groups. The mean PR interval in dilated cardiomyopathy in present study was 0.17±0.034 sec which was comparable to Veronique L.Roger (0.18±0.11sec) and H M Shankar (0.20±0.012).

Low T3 dilated cardiomyopathy occurs in more elderly patients with chronic heart failure. The mean age of dilated cardiomyopathy patients in the present study was 58.43±5.87 (SD) years which was comparable to Joao Paulo Solano, George Marzouka and ACC 2011.[2,3,4,5] The mean ejection fraction of patients with dilated cardiomyopathy in the present study was 36.78± 5.08 (SD) % which was comparable to Deborah and Joa Paulo Solano, George Marzouka.[2,3,4,5] (Table6).

Table 6. Comparison of mean age and ejection fraction in dilated cardiomyopathy with other studies

	Deborah D. Ascheim, 2002	Joao Paulo Solano, 2006	George marzouka, 2004	ACC 2011	Present study
Mean age in yrs	67±8	55± 10	57±11	56.4±12	57 ± 5.8
EF in %	35±6.6%	42±6	24±9%	24±9	36± 4.3

The mean ejection fraction was lower in patient with low T3 dilated cardiomyopathy when compared to other two groups. This showed that the severity of heart failure was higher in patients with low T3 dilated cardiomyopathy and incidence of IHD in the form of global hypokinesia and segmental hypokinesia was lesser in patients with low T3 dilated cardiomyopathy.

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

Conclusion:

There is significant percentage of DCM patients having low T3 alone as biochemical parameter. It is important to recognize this condition in patients with chronic heart failure as it is associated with increased severity of heart failure, increased in evidence of renal failure which may need additional support of thyroid hormone administration to have a better outcome in patients with chronic heart failure.

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