Original Article

Status of Serum FT_3 & TSH in Patients with Heart Failure

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Abstract:

Background: Heart failure is undoubtedly one of the most challenging health problems. In critical illness, thyroid hormone dysregulation occurs in heart failure patients without apparent thyroid disease, ultimately decrease in tri iodothyronine level which accelerates poor prognosis of the patients.

Objective: To determine the status of serum FT_3 & TSH in patients with heart failure.

Methods: This was a cross-sectional analytical study, carried out in the Department of Biochemistry, Sir Salimullah Medical College, Dhaka from March 2022 to February 2023. A total number of 110 clinically diagnosed heart failure subjects who were admitted within 6 hours at Cardiology department of SSMC&MH and NICVD, according to inclusion and exclusion criteria were included in this study. Serum FT_3 and serum TSH were determined.

Results: Heart failure prevalence increases from 61-70 years and almost two third of patients were male. Serum FT_3 level was significantly lower among heart failure patients but serum TSH was normal in all study subjects.

Conclusion: Low FT_3 is associated with heart failure and contributes to the worsening or exacerbation of heart failure.

Key words: Heart failure patients, serum FT_3, serum TSH.

Introduction:

Heart failure is the most relevant issue in public health with ageing populations.[1] It occurs when the heart cannot pump as well as it should. This may happen when heart muscles become weak or stiff.[2]

An estimated 64.3 million people are living with heart failure worldwide.[3] In united states, heart failure affects about 6.2 million adults, with an incidence approaching 21 per 1000 population after 65 years. Projections estimate that by 2030 more than 8 million people will be affected by heart failure.[4] In developing countries, the prevalence of known heart failure is estimated at 1% to 2% and the rate is higher among people who lead an urban lifestyle.[3]

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The thyroid gland synthesizes and secretes thyroid hormone that is regulated by hypothalamus-pituitary-thyroid axis. This gland primarily synthesizes and secretes thyroxine that is approximately 85% of thyroid hormone and a smaller amount of triiodothyronine. Biologically active hormone triiodothyronine (T3) derives from peripheral conversion of thyroxine (T4) by 5'-monodeiodination.[5] T4 must be deiodinated to T3 because T3 has higher affinity to the thyroid hormone nuclear receptor. Thyroid hormone is essential for normal growth and development as well as regulate metabolism and body temperature.

The cardiovascular system is one of the most important targets on which thyroid hormone acts.[6] Clinical and experimental evidence are showing that triiodothyronine (T3) plays major role in modulating myocardial contractility and hemodynamics.[5] Several studies are demonstrating that thyroid hormone metabolism is altered in heart failure patients without

thyroid disease, characterized by low circulating T3 level with normal thyroxine and thyroid stimulating hormone. Which occur due to reduced enzyme activity of 5'-monodeiodinase D1 and D2 that reduced peripheral conversion from T4 to T3 and stimulate expression of deiodinase enzyme D3 that convert T3 to 3,3' diiodothyronine (T2) and prevent activation of T4 by converting it into reverse triiodothyronine (rT3).[7-9] The extent of the changes is related to the duration of the disease, as well as the severity of the illness. So, the magnitude of this decrease in T3 is related to the worse prognosis in heart failure patients.[5]

Considering these facts, the current study has planned to evaluate the status of serum FT3 in patients with heart failure. It may give an idea about the prognosis of the patient population. So, this study may be valuable predictors of long-term outcome of heart failure patients and will help take proper measures that may reduce hospital stay, morbidity and mortality with improvement in the quality of life of heart failure patients.

Materials & Methods:

This was a cross-sectional analytical study carried out in the Department of Biochemistry of Sir Salimullah Medical College, from March 2022 to February 2023. A total of 110 clinically diagnosed heart failure subjects who were admitted within 6 hours in the department of cardiology in SSMC & MH and NICVD were included in this study. Patient with previously diagnosed case of thyroid disorders or treated with thyroid medication, subject with history of taking dopamine or steroids, renal impairment & dialysis, liver cirrhosis, cancer, severe infection (sepsis), pulmonary hypertension or other lung problems with patients age >74 years were excluded. Purposive type of sampling technique was used. Before starting the data collection, all patients were described about the study objective and details procedure of the study. They were clearly informed that this participation is voluntary and had the freedom to withdraw themselves from the study at any stage. Written informed consent was taken from all respondents. On admission patients' medical history and data from physical examination were recorded on a standard questionnaire by the investigator. Blood samples were collected & analysis of FT3, TSH and NT-proBNP were done. After estimation of NT-proBNP grouping of the study subjects were done. Group 1 included heart failure subjects with NT-proBNP > 2000 pg/ml and group 2 included heart failure subjects with NT-proBNP 125-2000 pg/ml. FT3 levels was observed between these two groups. At the end of data collection, all the data were rechecked, coded, and entered in standard statistical software, database using SPSS software (Version-22). The Chi square test was done to observe age, gender distribution, status of serum FT3 between the study subjects. An unpaired t test was performed to show any significant difference between the mean values of serum TSH between the study groups. The p-value of <0.05 was considered statistically significant.

Results:

Table I: Distribution of the study patients according to age (N=110).

Age(years)	Group- I (n=55)		Group-II (n=55)		P-value
	n	%	n	%	
≤40	2	3.6	2	3.6	0.327^{ns}
41-50	4	7.3	4	7.3	
51-60	11	20.0	13	23.6	
61-70	15	27.3	23	41.8	
>70	23	41.8	13	23.6	

Results are expressed as frequency, percentage.
p value determined by Chi-square test, ns= not significant.
Group I - Heart failure patients with NT-proBNP> 2000 pg/ml.
Group II - Heart failure patients with NT-proBNP 125-2000 pg/ml.

The Chi-square test was done to measure the level of significance. It was observed that almost half (41.8%) of patients belonged to age >70 years in group 1 and 41.8% of patients belongs to age 61-70 years in group 2. The difference was not statistically significant (p>0.05) between two groups.

Table II: Gender distribution of the study subjects (n=110)

Gender	Group-I (n=55)		Group- II (n=55)		P-value
	n	%	n	%	
Male	33	60.0	40	72.7	0.157^{ns}
Female	22	40.0	15	27.3	

Results are expressed as frequency and percentage.
P-value determined by Chi-square test, ns= not significant.
The Chi-square test indicates the gender distribution of study subjects among groups. It was observed that almost two third (60.0%) of patients were male in group 1 and 72.7% in group 2. The difference was not statistically significant (p>0.05) between two groups.

Table III: Status of serum TSH among the study groups (n=110).

Serum TSH (mIU/L) Normal (0.55-4.78)	Group- I (n=55)	Group-II(n=55)	P-value
	Mean±SD	Mean±SD	
Mean±SD	3.07±1.0	3.39±0.62	0.046[s]
Range (Min-Max)	1.04-4.72	1.84-4.32	

Results are expressed as Mean±SD.
p value was determined by Unpaired-t test, s= significant.
An unpaired-t test was done to measure the mean serum TSH was 3.07±1.0 mIU/L in group 1 and 3.39±0.62 mIU/L in group 2. All (100.0%) of patients had belonged to normal (0.55-4.78 mIU/L) serum TSH level in both groups. But the difference was statistically significant (p<0.05) between two groups.

Table IV: Comparison of Serum FT_3 between study subjects (n=110).

Serum FT_3 (pg/ml)	Group- I (n=55)		Group- II (n=55)		p-value
	n	%	n	%	
Low (<2.3)	19	34.5	9	16.4	0.028[s]
Normal (2.3-4.1)	36	65.5	46	83.6	

Results are expressed as frequency and percentage.
P-value determined by Chi-square test, ns= not significant.
The Chi-square test was done to measure the level of significance. It was observed that more than one third (34.5%) of patients had low serum FT3 (<2.3 pg/ml) in group 1 and 16.4% in group 2. The difference was statistically significant (p<0.05) between two groups.

Discussion:
This cross-sectional analytical study was carried out on heart failure patients without prior thyroid dysfunction. A total of 110 subjects were included based on predefined enrollment criteria. Among them 55 were heart failure patients with NT-proBNP > 2000 pg/ml and 55 were HF patients with NT-proBNP 125-2000 pg/ml. This study was conducted in the department of Biochemistry, Sir Salimullah Medical college, to assess the condition of FT3 in patients with heart failure.

In the present study, nearly half (41.8%) of the participants belong to age> 70 years in group 1 and half of the subjects were belongs to 61-70 years in group 2. It was evident from the current study that heart failure prevalence increases from middle to old age.[10-12]

In this study, almost two third (60.0%) of patients were male in group 1 and 72.7% in group 2.[5,13] Probably female in our society is neglected to any sorts of health issue and thereby admission in the hospitals. That's why male was predominant.[13]

In accordance with the present study the mean value of serum TSH was 3.07±1.0 in group 1 and 3.39±0.62 mIU/L in group 2. It was observed that all the patients had belonged to normal TSH (0.55-4.78) level in both groups.[14-16] Normal TSH levels were common in patients with non-thyroidal illnesses.

The current study showed that low serum free triiodothyronine (<2.3 pg/ml) was observed more than one third (34.5%) of patients in NT-proBNP >2000 pg/ml than 16.4% in patients with NT-proBNP 125-2000 pg/ml.[5,8,9,17-19] Low thyroid hormone concentration, mainly low serum FT3 concentration, is a common finding in patients with non-thyroidal illnesses, including cardiac diseases like heart failure. The pathophysiology behind this in human peripheral thyroid hormone metabolism is regulated by three iodothyronine deiodinases (D1, D2 and D3). D3 decreases the serum T3 level.[5] Low triiodothyronine state may produce a hypothyroid-like-syndrome that contributes to the worsening or exacerbation of the intrinsic cardiac diseases.

Conclusion:
In conclusion, low FT_3 appears to be a powerful independent prognostic marker. Although the present study may be used for risk stratification of heart failure patients, additional study is needed to determine the correlation, prognosis and specific treatment that should be prioritized in high-risk heart failure patients.

Limitation of the study:
The study population was selected from a few selected hospitals in Dhaka city with limited time span, so the results of the study may not reflect the exact picture of the country. In this study only the status of FT_3 was observed. Due to time limitation correlation, prognosis and treatment response with thyroid hormone supplementation was not observed.

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