Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(3), 3040-3046 | ISSN:2251-6727

The Study of Thyroid Function Tests in Chronic Heart Failure & To Also Know the Correlation Between Tft and Troponins I and T/Bnp And Nt-Pro Bnp

[1]Dr. Arthi PS, [2] Dr. N. Abhigna, [3]Dr. Anbarasu Duraisamy, [4]Dr. Jayannan Jayasenan

Associate Professor,Department of General Medicine, Meenakshi Medical college Hospital and Research Institute, Meenakshi Academy of Higher Education & Research (Deemed to be university), Kanchipuram

Mail id:dr.arthips@gmail.com Phone no:9487545393

Corresponding author and junior resident,,Department of General Medicine, Meenakshi Medical college Hospital and Research Institute, Meenakshi Academy of Higher Education & Research (Deemed to be university), Kanchipuram

Mail id:abhignanara409@gmail.com Phone no:8919171420

Assistant Professor, Department of General Medicine, Meenakshi Medical college Hospital and Research Institute, Meenakshi Academy of Higher Education & Research (Deemed to be university), Kanchipuram

Mail id : jay.cool29@gmail.com Phone no:9791379250

Professor and Head of Department of General Medicine, Meenakshi Medical college Hospital and Research Institute, Meenakshi Academy of Higher Education & Research (Deemed to be university),kanchipuram

Mail id: dr.anbarasu.md@gmail.com Phone no:9443335083

(Received: 08 February 2024 Revised: 11 March 2024 Accepted: 08 April 2024)

Keywords

thyroid function tests, chronic heart failure, Troponins I, T/BNP, NT-PRO BNP

Abstract:

Background: Thyroid hormone regulates cardiovascular functions by impacting the myocardium, conduction system, and peripheral vasculature. Its deficiency can lead to hyperlipidemia and ventricular arrhythmias, while excess can cause atrial arrhythmias, hypertension, and heart failure. However, treating the underlying thyroid condition can typically reverse these abnormalities. Patients with subclinical thyroid dysfunction often have FT4 levels within the reference range, but abnormal TSH levels, indicating that the amount of thyroid hormone present is not optimal for that individual.

Materials & Methods: This is hospital based cross sectional observational study which was conducted in the Department of general medicine of Private medical college with study period of 6 months. The total sample size of the study was 50 patients. The collected data was entered in Microsoft Excel. Coding of the variables was done. Analysis was done using SPSS software (Version 27, IBM).

Results: Among the 50 patients, (30%) were males and (75%) were females. Age between 51 and 60 years 40%, 41 to 50 years, 26%. Patients over 60 years account for 16%, while 14% are in the 31 to 40 years age, 30 years, represents only 4%. Comorbidities were 40% of hypertension, 30% diabetes mellitus, and 18% hyperlipidemia and 12% have chronic kidney injury

Conclusion: Our study shows that subclinical hypothyroidism with a TSH level of ≥7 mIU/L and low T3 syndrome are negative prognostic factors for ambulatory heart failure patients. This underscores the need to explore the potential therapeutic benefits of T4 and T3 administration in heart failure patients.

INTRODUCTION:

Thyroid hormone plays a crucial role in regulating cardiovascular functions by directly affecting the myocardium, the conduction system, and the peripheral vasculature[1]. A deficiency in thyroid hormone can result in hyperlipidemia and ventricular arrhythmias, while an excess can cause atrial arrhythmias[2]. These conditions can lead to hypertension and heart failure. However, appropriate treatment for the underlying thyroid condition can typically reverse these cardiac abnormalities[3]. Patients with subclinical thyroid dysfunction often have FT4 levels within the reference range, but abnormal TSH levels, indicating that the

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(3), 3040-3046 | ISSN:2251-6727

amount of thyroid hormone present is not optimal for that individual[4].

Several cohort studies have investigated the relationship between thyroid function, both within and outside the reference range, and the development of atrial fibrillation, heart failure, and coronary heart disease. Subclinical hypothyroidism characterized by TSH levels greater than 10 mIU/L, has been associated with an increased risk of ischemic heart disease, and subclinical hypothyroidism with TSH levels greater than 7 mIU/L has been linked to higher cardiovascular mortality.[4] Additionally, subclinical thyroid dysfunction with TSH values greater than 10 mIU/L or less than 0.1 mIU/L has also been associated with a higher risk of incident heart failure. Low levels of T3 with normal levels of TSH and FT4, known as the low T3 syndrome, have also been linked to an increased mortality risk[5,6].

However, the consequences of thyroid dysfunction can differ based on the heart health of the patient. In particular, subtle changes in thyroid function may have a more significant impact on individuals with pre-existing heart failure[7]. Additionally, acute illness can affect thyroid function testing, which restricts the conclusions that can be drawn from studying patients with heart failure. Despite the American Heart Association's recommendations to evaluate thyroid function in all heart failure patients, no comprehensive studies have been conducted to investigate the role of thyroid hormone abnormalities in exacerbating heart failure in the outpatient setting[8]. Therefore, this study aims to examine the link between markers of chronic heart failure, such as Troponins-I and T/BNP and NT-PRO BNP, and thyroid function tests.

MATERIALS & METHODS:

- This is hospital-based cross-sectional observational study that was conducted admitted in general medicine department of Meenakshi Medical College Hospital and research institute with a study period of 6 months. The total sample size of the study was 50 patients.

INCLUSION CRITERIA:

- 1) All diagnosed patients with symptoms of chronic heart failure

2) Age>18 years.

- **EXCLUSION CRITERIA –**

1) Age<18 years

2) Small no.of participants taking medications interfering with thyroid function tests - Methimazole/Propylthiouracil & Liothyronine, Thyroid hormone extract, Lithium/ Chronic Intravenous Dobutamine are excluded. The study was approved by Institutional Ethics Committee of the private medical college. A written informed consent was obtained from all the patients.

- **Data collection method:** Each participant is provided written & informed consent
- The study is conducted on patients diagnosed with Chronic heart failure admitted in the ward/ICU at Meenakshi Medical College, Hospital & Research Institute.
- At the time of study entry standardized questionnaires are given to participants to obtain detailed clinical data as described previously.
- Detailed history & physical examination will be done.
- Thyroid function tests like TSH, Free T3, and Free T4 will be done for patients with Chronic heart failure along with Troponins I and T/BNP/NT-PRO BNP.

The collected data was entered in Microsoft Excel. Coding of the variables was done. Analysis was done using SPSS software (Version 27, IBM). Descriptive statistics was used. Association between categorical tests. The outcomes of the treatment groups were compared using a test to reach the hypothesis, a P value less than 0.5 was considered significant.

RESULTS:

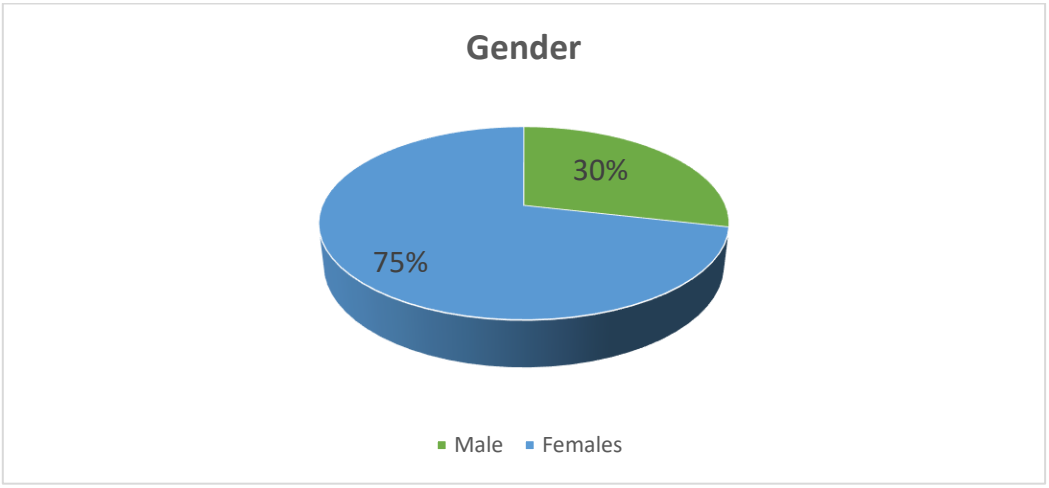
This is hospital-based cross-sectional observational study which was conducted on patient admitted in the general medicine department of Meenakshi medical college hospital and research institute with study period of 6 months. The total sample size of the study was 50 patients.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(3), 3040-3046 | ISSN:2251-6727

Chart 1: Gender distribution among the study participants



Among the study patients, (30%) were males and (75%) were females. (**Chart 1)**

Table 1: Age distribution among the study participants

Age	**Frequency (n)**	**Percentage (%)**
< 30 years	2	4%
31 – 40 years	7	14%
41 – 50 years	13	26%
51 – 60 years	20	40%
>60 years	8	16%

The age distribution of patients in this study reveals that the majority are between 51 and 60 years old, comprising 40% of the sample. This is followed by those aged 41 to 50 years, making up 26%. Patients over 60 years account for 16%, while 14% are in the 31 to 40 years age range. The youngest group, under 30 years, represents only 4% of the total. **(Table 1).**

Table 2: Co morbidities

Co morbidities	**Frequency (n)**	**Percentage (%)**
Hypertension	20	40%
Diabetes Mellitus	15	30%
Hyperlipidaemia	9	18%
Chronic kidney injury	6	12%
BMI	30.25±3.38	

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(3), 3040-3046 | ISSN:2251-6727

The study population exhibits a high prevalence of comorbidities, with 40% of patients having hypertension, 30% suffering from diabetes mellitus, and 18% experiencing hyperlipidemia. Additionally, 12% have chronic kidney injury. The average BMI of the patients is 30.25±3.38, indicating a trend towards obesity. This highlights the significant burden of comorbid conditions among patients with cholelithiasis, emphasizing the need for comprehensive management strategies that address these concurrent health issues.

Table 3: NYHA class

NYHA class	Frequency (n)	Percentage (%)
I	23	46%
II	17	34%
III	11	22%
IV	6	12%
Atrial fibrillation	2	4%
Ejection fraction, %, mean (SD)	34.99±2.33	

The study assessed patients' cardiac function using the NYHA classification, revealing that 46% fall into Class I, indicating no symptoms during ordinary activities. Class II includes 34% of patients with slight limitations, while 22% are in Class III with marked limitations. Class IV, indicating severe limitations and discomfort with any physical activity, accounts for 12%. Additionally, 4% of patients have atrial fibrillation. The mean ejection fraction is 34.99±2.33%, reflecting a reduced cardiac output in this cohort. This highlights the varying degrees of heart failure severity among the patients.

Table 4: Table 3: Mean ± SD of thyroid profile

Thyroid profile	Mean	Standard deviation	P value
T3	3.138600	0.869199	0.001
T4	1.264500	0.372063	0.000
TSH	4.492460	11.853027	0.000

The thyroid profile of the study participants shows a mean T3 level of 3.14±0.87, a mean T4 level of 1.26±0.37, and a mean TSH level of 4.49±11.85. The significant p-values (0.001 for T3 and 0.000 for both T4 and TSH) indicate notable differences in thyroid hormone levels among the patients, suggesting a strong association between thyroid function and the conditions being studied.

Table 5: Details on Cardiomarker

Cardiomarker	Mean	Standard deviation	P value
Troponins-I	0.253	1.369	0.000*
T/BNP	99.2425	5.2789	0.000*
NT-PRO BNP	350.2544	78.2741	0.000*

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(3), 3040-3046 | ISSN:2251-6727

Profile assessment reveals significant cardiac biomarkers among the patients. The mean Troponin-I level is 0.253±1.369 with a p-value of 0.000, indicating a strong statistical significance. Similarly, the mean T/BNP level is 99.24±5.28, and the mean NT-PRO BNP level is 350.25±78.27, both with p-values of 0.000. These results underscore a significant association between thyroid dysfunction and elevated cardiac biomarkers, suggesting an increased risk of cardiac events in this patient population.

DISCUSSION:

An analysis of the Third National Health and Nutrition Examination Survey III supports our finding of an association between subclinical hypothyroidism and mortality in patients with heart failure.Participants with self-reported heart failure with subclinical hypothyroidism had higher mortality than their euthyroid counterparts, whereas there was no association between subclinical hypothyroidism and mortality in patients without self-reported heart failure at baseline[9,10]. There were insufficient participants with preexisting heart failure to stratify by severity of subclinical hypothyroidism. Studies have also been performed in inpatients admitted with acute forms of cardiac disease and heart failure showing associations between subclinical thyroid dysfunction and mortality. However, acute illness affects the thyroid axis and leads to thyroid testing abnormalities, and, therefore, these findings may not extrapolate to chronic heart failure in the outpatient setting. Cohorts selectively recruiting patients with heart failure are required to examine questions related to pre-existing disease. Of 14879 participants analyzed in the Third National Health and Nutrition Examination Survey cohort, only 470 had preexisting heart failure, and that was determined by self-report, without assessment of severity. Similarly, of 25390 participants included in the meta-analysis of thyroid dysfunction and heart failure, only 440 had preexisting heart failure.5 Our analysis of 1365 ambulatory patients with chronic heart failure is the largest and best-characterized cohort to examine thyroid function. clearly shows an association between hypothyroidism in outpatients and progression of heart failure as indicated by the need for VAD, a heart transplant, or mortality. Furthermore, sufficient power to perform stratified analyses by degree of subclinical hypothyroidism, showing that highest risk of adverse events was in participants with TSH levels of 7 mIU/L or higher. Although this is an observational study, these findings refine the group of patients with heart failure who should undergo additional study to assess potential benefits from treatment with thyroid hormone. Production of thyroid hormone is controlled by the pituitary gland, which, in the setting of insufficient thyroid hormone levels, releases TSH to stimulate the thyroid to produce thyroid hormone[11,12]. The thyroid axis operates as a classic negative feedback loop, in which thyroid hormone feeds back to decrease TSH production and maintain an individualized pituitary-thyroid set point. It follows that outcomes associated with higher TSH levels should also be associated with lower FT4 and TT3 levels[13]. The associations between higher TSH levels and lower TT3 levels and adverse outcomes in our study are consistent with anticipated effects of thyroid hormone insufficiency on the failing heart[14]. The associations with FT4 are not as easily explained. Concordant w, prior population-based cohort studies have demonstrated associations between higher FT4 levels in the euthyroid range and incident atrial fibrillation incident heart failure and sudden cardiac death[15]. Higher FT4 levels may reflect lower peripheral deiodination of T4 to T3 because of increases in cytokines, free fatty acids, and cortisol, leading to inadequate T3 because of unavailability of T4 precursor[16].

In patients with heart failure, low T3 levels have been associated with myocardial fibrosis and abnormalities in myocardial perfusion and metabolism.The low T3 syndrome, defined as a low T3 level with levels of TSH and FT4 in the reference range, is present in 20% to 30% of patients with heart failure. The prevalence of low T3 syndrome in our study was 14%. In studies of hospitalized patients with heart failure, low T3 syndrome was independently associated with higher all-cause mortality. Similar study validates this association in outpatients with chronic heart failure.[17,18,19,20]

CONCLUSION:

In summary, our research has revealed that subclinical hypothyroidism with a TSH level of ≥7 mIU/L and low T3 syndrome serve as negative prognostic factors for ambulatory patients with heart failure. This highlights the importance of further investigating the potential therapeutic benefits of T4 and T3 administration in heart failure patients.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(3), 3040-3046 | ISSN:2251-6727

Acknowledgment: We are thankful to the entire study participants for their participation and full cooperation. We acknowledge the Department of General Medicine faculties for encouraging and supporting us.

Financial support and sponsorship: Nil

Conflicts of interest: Nil

REFERENCES:

[1] Gerdes AM, Iervasi G. Thyroid replacement therapy and heart failure. Circulation. 2010;122:385–393. doi: 10.1161/CIRCULATIONAHA.109.917922

[2] Cappola AR, Fried LP, Arnold AM, Danese MD, Kuller LH, Burke GL, Tracy RP, Ladenson PW. Thyroid status, cardiovascular risk, and mortality in older adults. JAMA. 2006;295:1033–1041. doi: 10.1001/jama.295.9.1033

[3] Collet TH, Gussekloo J, Bauer DC, den Elzen WP, Cappola AR, Balmer P, Iervasi G, Åsvold BO, Sgarbi JA, Völzke H, Gencer B, Maciel RM, Molinaro S, Bremner A, Luben RN, Maisonneuve P, Cornuz J, Newman AB, Khaw KT, Westendorp RG, Franklyn JA, Vittinghoff E, Walsh JP, Rodondi N; Thyroid Studies Collaboration. Subclinical hyperthyroidism and the risk of coronary heart disease and mortality. Arch Intern Med. 2012;172:799–809. doi: 10.1001/archinternmed.2012.402

[4] Rodondi N, den Elzen WP, Bauer DC, Cappola AR, Razvi S, Walsh JP, Asvold BO, Iervasi G, Imaizumi M, Collet TH, Bremner A, Maisonneuve P, Sgarbi JA, Khaw KT, Vanderpump MP, Newman AB, Cornuz J, Franklyn JA, Westendorp RG, Vittinghoff E, Gussekloo J; Thyroid Studies Collaboration. Subclinical hypothyroidism and the risk of coronary heart disease and mortality. JAMA. 2010;304:1365–1374. doi: 10.1001/jama.2010.1361

[5] Gencer B, Collet TH, Virgini V, Bauer DC, Gussekloo J, Cappola AR, Nanchen D, den Elzen WP, Balmer P, Luben RN, Iacoviello M, Triggiani V, Cornuz J, Newman AB, Khaw KT, Jukema JW, Westendorp RG, Vittinghoff E, Aujesky D, Rodondi N; Thyroid Studies Collaboration. Subclinical thyroid dysfunction and the risk of heart failure events: an individual participant data analysis from 6 prospective cohorts. Circulation. 2012;126:1040– 1049. doi: 10.1161/CIRCULATIONAHA.112.096024

[6] Cappola AR, Arnold AM, Wulczyn K, Carlson M, Robbins J, Psaty BM. Thyroid function in the euthyroid range and adverse outcomes in older adults. J Clin Endocrinol Metab. 2015;100:1088–1096. doi: 10.1210/jc.2014-3586

[7] Åsvold BO, Vatten LJ, Bjøro T, Bauer DC, Bremner A, Cappola AR, Ceresini G, den Elzen WP, Ferrucci L, Franco OH, Franklyn JA, Gussekloo J, Iervasi G, Imaizumi M, Kearney PM, Khaw KT, Maciel RM, Newman AB, Peeters RP, Psaty BM, Razvi S, Sgarbi JA, Stott DJ, Trompet S, Vanderpump MP, Völzke H, Walsh JP, Westendorp RG, Rodondi N; Thyroid Studies Collaboration. Thyroid function within the normal range and risk of coronary heart disease: an individual participant data analysis of 14 cohorts. JAMA Intern Med. 2015;175:1037–1047. doi: 10.1001/jamainternmed.2015.0930

[8] Chaker L, Heeringa J, Dehghan A, Medici M, Visser WE, Baumgartner C, Hofman A, Rodondi N, Peeters RP, Franco OH. Normal thyroid function and the risk of atrial fibrillation: the Rotterdam study. J Clin Endocrinol Metab. 2015;100:3718–3724. doi: 10.1210/jc.2015-2480

[9] Yancy CW, Jessup M, Bozkurt B, Butler J, Casey DE Jr, Colvin MM, Drazner MH, Filippatos GS, Fonarow GC, Givertz MM, Hollenberg SM, Lindenfeld J, Masoudi FA, McBride PE, Peterson PN, Stevenson LW, Westlake C. 2017 ACC/AHA/HFSA Focused Update of the 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Failure Society of America. Circulation. 2017;136:e137– e161. doi: 10.1161/CIR.0000000000000509

[10] Ky B, Kimmel SE, Safa RN, Putt ME, Sweitzer NK, Fang JC, Sawyer DB, Cappola TP. Neuregulin-1 beta is associated with disease severity and adverse outcomes in chronic heart

failure. Circulation. 2009;120:310–317. doi: 10.1161/CIRCULATIONAHA.109.856310

[11] Chaker L, Baumgartner C, den Elzen WP, Ikram MA, Blum MR, Collet TH, Bakker SJ, Dehghan A, Drechsler C, Luben RN, Hofman A, Portegies hypothyroidism and the risk of stroke events and fatal stroke: an individual participant data analysis. J Clin Endocrinol Metab. 2015;100:2181–2191. doi: 10.1210/jc.2015-1438

[12] Jabbar A, Pingitore A, Pearce SH, Zaman A, Iervasi G, Razvi S. Thyroid hormones and cardiovascular disease. Nat Rev Cardiol. 2017;14:39–55. doi: 10.1038/nrcardio.2016.174

[13] Brent GA. Mechanisms of thyroid hormone action. J Clin Invest. 2012;122:3035–3043. doi: 10.1172/JCI60047

[14] Bozkurt B, Colvin M, Cook J, Cooper LT, Deswal A, Fonarow GC, Francis GS, Current diagnostic and treatment strategies for specific dilated cardiomyopathies: a scientific statement from the American Heart Association. Circulation. 2016;134:e579–e646. doi: 10.1161/CIR.0000000000000455

[15] Wang W, Guan H, Fang W, Zhang K, Gerdes AM, Iervasi G, Tang YD. Free triiodothyronine level correlates with myocardial injury and prognosis in idiopathic dilated cardiomyopathy: evidence from cardiac MRI and SPECT/ PET imaging. Sci Rep. 2016;6:39811. doi: 10.1038/srep39811

[16] Ascheim DD, Hryniewicz K. Thyroid hormone metabolism in patients with congestive heart failure: the low triiodothyronine state. Thyroid. 2002;12:511–515. doi: 10.1089/105072502760143908 2

[17] Iervasi G, Pingitore A, Landi P, Raciti M, Ripoli A, Scarlattini M, L'Abbate A, Donato L. Low-T3 syndrome: a strong prognostic predictor of death in patients with heart disease. Circulation. 2003;107:708–713.

[18] Pingitore A, Landi P, Taddei MC, Ripoli A, L'Abbate A, Iervasi G. Triiodothyronine levels for risk stratification of patients with chronic heart failure. Am J Med. 2005;118:132–136. doi: 10.1016/j.amjmed.2004.07.052

[19] Passino C, Pingitore A, Landi P, Fontana M, Zyw L, Clerico A, Emdin M, Iervasi G. Prognostic value of combined measurement of brain natriuretic peptide and triiodothyronine in heart failure. J Card Fail. 2009;15:35–40. doi: 10.1016/j.cardfail.2008.08.008

[20] Frey A, Kroiss M, Berliner D, Seifert M, Allolio B, Güder G, Ertl G, Angermann CE, Störk S, Fassnacht M. Prognostic impact of subclinical thyroid dysfunction in heart failure. Int J Cardiol. 2013;168:300–305. doi: 10.1016/j.ijcard.2012.09.064