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THYROID DYSFUNCTION IN HEART FAILURE AND ITS ASSOCIATION WITH THE SEVERITY OF HEART FAILURE

General Medicine

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ABSTRACT

This study explores the relationship between thyroid dysfunction and the severity of chronic heart failure (CHF), Heart failure is a complex clinical syndrome resulting from structural and functional impairment of ventricular filling or ejection of blood. Thyroid hormones, particularly thyroxine (T4) and triiodothyronine (T3), are critical regulators of cardiovascular function, influencing heart rate, vascular resistance, and myocardial contractility. Disruptions in these hormone levels can impact the progression and severity of heart failure. The research was conducted on 101 participants, 66.33% male and 33.67% female, with a mean age of 57 years. The majority of participants (87.13%) were in stage C of heart failure. Thyroid function was assessed through measurements of thyroid-stimulating hormone (TSH), free T3 (fT3), and free T4 (fT4) levels. Results revealed that elevated TSH levels were frequently observed in patients with more advanced stages of CHF, showing a small but significant positive correlation between TSH levels and heart failure severity ($r = 0.243$, $p = 0.014$). However, no significant correlations were found between fT3 and fT4 levels and heart failure severity, indicating that these thyroid hormones may not be as strongly associated with CHF progression. Additionally, when examining the New York Heart Association (NYHA) classification, no significant correlation was observed between thyroid hormone levels and NYHA class, further suggesting that fT3 and fT4 may play a lesser role in heart failure severity. The findings emphasize the importance of monitoring thyroid function, especially TSH levels, in CHF patients, as early detection and management of thyroid abnormalities could potentially improve outcomes in managing heart failure.

KEYWORDS

Thyroid dysfunction, chronic heart failure, TSH, fT3, fT4.

INTRODUCTION

Heart failure is a complex clinical syndrome characterized by structural and functional impairment of the heart, leading to inadequate blood ejection or filling, resulting in elevated cardiac filling pressure and insufficient oxygen delivery to the body's tissues. Chronic heart failure(CHF) refers to long-standing symptoms, persisting for months or years. Thyroid hormones play a crucial role in cardiovascular regulation, influencing the myocardium, peripheral vasculature, and conduction system. Alterations in thyroid hormone levels are common in heart failure patients and can serve as early prognostic indicators of disease progression. However, there is limited research on thyroid dysfunction in heart failure patients within the Indian population [1,2].

Thyroid dysfunction is increasingly recognized as a significant factor in the pathophysiology of CHF. The thyroid gland plays a critical role in regulating metabolic processes, cardiovascular function, and overall energy homeostasis through the secretion of thyroid hormones, primarily thyroxine (T4) and triiodothyronine (T3). These hormones influence cardiac output, vascular tone, and myocardial contractility, making their dysregulation a potential contributor to the progression and severity of heart failure. Recent research has focused on understanding how alterations in thyroid hormone levels, even subtle deviations, may impact patients with CHF, leading to worsened clinical outcomes [3,4].

CHF, is a leading cause of morbidity and mortality worldwide. It has a complex etiology, often involving structural heart damage, hypertension, and ischemic heart disease. However, non-cardiac factors, such as metabolic abnormalities, also play a role in the development and exacerbation of heart failure. Among these, thyroid dysfunction has emerged as an area of growing interest. Hypothyroidism and hyperthyroidism are well-known contributors to cardiovascular disease, but even milder forms of thyroid abnormalities, such as subclinical hypothyroidism or euthyroid sick syndrome, may have profound effects on heart failure patients [5,6].

Thyroid dysfunction exacerbates CHF through multiple mechanisms. Low levels of circulating thyroid hormones can lead to a reduction in heart rate, diminished myocardial contractility, and increased vascular resistance, all of which contribute to a worsening of cardiac function. On the other hand, hyperthyroidism can increase cardiac workload through elevated heart rate and contractility, potentially leading to arrhythmias and exacerbation of heart failure symptoms. [7,8,9].

Emerging evidence suggests that the severity of thyroid dysfunction is associated with the progression of CHF. Various studies have demonstrated a correlation between altered thyroid hormone levels and the worsening of heart failure symptoms, higher rates of hospitalization, and increased mortality. These findings highlight the importance of routine thyroid function screening in patients with CHF, as early identification and management of thyroid abnormalities could potentially improve patient outcomes. However, the relationship between thyroid dysfunction and CHF remains complex, and further research is needed to elucidate the underlying mechanisms and optimal therapeutic approaches. Understanding this interplay may open new avenues for managing CHF, particularly in tailoring treatment to the metabolic needs of the patient [10,11,12].

The objectives of this study are to estimate thyroid function in patients with CHF and to analyze the levels of thyroid-stimulating hormone (TSH), free triiodothyronine (fT3), and free thyroxine (fT4) among patients with chronic heart failure across stages A, B, C, and D.

MATERIAL AND METHODS

This cross sectional study was conducted at the Department of General Medicine, Bengaluru from August 2022 to January 2024 after taking Ethical approval from the Ethical Approval Committee of ESIC- MC &PGIMSR Model hospital Bengaluru.

The study was conducted on 101 CHF patients, after informed consent, with history of heart failure for over a month, left ventricular ejection fraction (LVEF) less than 40%, and age over 18 years. Exclusion criteria included unwillingness to participate, use of thyroid-affecting drugs, clinical sepsis, renal failure, severe systemic illness, or known

thyroid disorders. Assessment involved detailed clinical history, physical examination, thyroid function tests, and relevant laboratory investigations. Thyroid-stimulating hormone (TSH) levels were compared with heart failure stage and severity of symptoms.

The collected data were entered and compiled in Microsoft Excel. The chi-square test or Fischer exact test was used to compare qualitative data, depending on the sample size. Quantitative data were compared using the t-test, with a significance level set at $P < 0.05$.

RESULTS

In the study involving 101 participants, 66.33% were male and 33.67% were female. The age distribution showed that the majority of participants were between 51-60 years old (34.65%), followed by those aged 61-70 years (23.76%) and 41-50 years (21.78%). 11.88% were seen in the age groups 71-80 years , 5.94% in 31-40 years, and 0.99% in 21-30 and 81-90 age group. The mean age was 57 years, with ages ranging from 29 to 82 years.

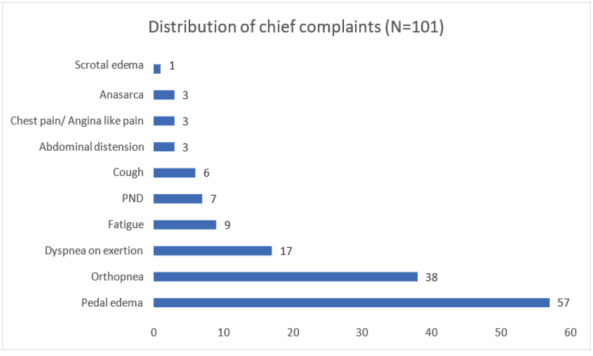

Figure 1: Distribution Of Chief Complaints

In the study, 57% presented with pedal edema, 38% with orthopnea and the least common was scrotal edema with 0.99%.

In the study, 16.83% presented with NYHA class 1 symptoms, 26.73% presented with NYHA class 2 symptoms, 17.82% presented with NYHA class 3 symptoms, 38.61% presented with NYHA class 4 symptoms.

In the study, 6.93% presented in stage B of HF, 87.13% presented in stage C of HF, and 5.94% presented in stage D of HF.

In the study, 61.38% had T2DM, 69.3% had hypertension and 61.3% had IHD. In the study, 51.48% had no habits, 26.73% had history of both alcohol consumption and smoking, 17.82% had history of only smoking and 3.96% had history of only alcohol consumption.

The thyroid function test results for the 101 participants showed a median TSH level of 3.57 microIU/mL, with an interquartile range (Q1-Q3) of 1.73-5.97. The median FT3 level was 2.31 pg/mL (Q1-Q3: 1.88-2.8), and the median FT4 level was 1.29 ng/dL (Q1-Q3: 1.1-1.71).

Regarding other laboratory parameters, the median urea level was 37 mg/dL (Q1-Q3: 27-45), and the median creatinine level was 1.1 mg/dL (Q1-Q3: 0.8-1.2). The median hemoglobin level was 11.1 g/dL (Q1-Q3: 9.95-12.85), and the total count was 8100 (Q1-Q3: 6895-9885). The platelet count median was 2.52 (Q1-Q3: 2-3.1). Electrolytes such as sodium, potassium, and chloride had medians of 138 mEq/L, 4.1 mEq/L, and 102 mEq/L, respectively. Lipid profile medians were: total cholesterol at 146 mg/dL, LDL at 84 mg/dL, HDL at 33 mg/dL, and triglycerides at 137 mg/dL. The median random blood sugar level was 147 mg/dL (Q1-Q3: 110-223.5).

Table 1: Stage Of CHF And Distribution Of TFT

		Stage B	Stage C	Stage D	Total
TSH	Below normal	0	1	1	101
	Within normal limits	6	59	1	
	Above normal	1	28	4	
FT3	Below normal	2	45	3	101
	Within normal limits	5	43	3	
	Above normal	0	0	0	
FT4	Below normal	2	7	1	101
	Within normal limits	5	60	2	
	Above normal	0	21	3	

Table 2: Correlation Between TSH And Stage Of CHF

Parameter	Value
Pearson correlation coefficient (r)	0.2433
r^2	0.05922
P-value	0.0142
Covariance	0.4448
Sample size (n)	101
Statistic	2.4963

Results of the Pearson correlation indicated that there is a significant small positive relationship TSH and stage of CHF, ($r(99) = 0.243$, $p = 0.014$) OR Higher TSH is associated with increased stage of chronic heart failure.

Results of the Pearson correlation between fT3 and stage of CHF indicated that there is a non-significant very small negative relationship between them, ($r(99) = 0.0145$, $p = 0.885$).

Results of the Pearson correlation between fT4 and stage of CHF indicated that there is a non-significant small positive relationship between them, ($r(99) = 0.12$, $p = 0.232$).

Results of the Pearson correlation between TSH and NYHA Class indicated that there is a non-significant small positive relationship between them, ($r(99) = 0.135$, $p = 0.177$).

DISCUSSION

In a study conducted at ESIC PGIMSR involving 101 patients with CHF, thyroid function was evaluated across various stages of heart failure. The population included 67 males and 34 females, with a mean age of 57 years, predominantly in the 51-60 age group. The most common comorbidities were hypertension (70 patients), diabetes (62 patients), and ischemic heart disease (59 patients). A significant portion of patients denied smoking or alcohol consumption, while others reported a positive history of these habits [13,14].

In line with findings from other studies, the demographic characteristics of this study reflect common trends in CHF. CHF predominantly affects older adults, especially those over 65, and is often accompanied by comorbidities such as hypertension, diabetes, and ischemic heart disease. Additionally, gender-specific risk factors for heart failure were observed, with traditional cardiovascular risks like hypertension and diabetes potentially having a stronger impact on women [15,16,17].

The study found that 16.83% of patients had NYHA class I symptoms, 26.73% had class II, 17.82% had class III, and 38.61% had class IV symptoms. Most patients presented in stage C heart failure (87.13%), with smaller groups in stages B (6.93%) and D (5.94%).

Thyroid function tests (TFTs) revealed that among patients in stages C and D, 28 and 4 patients, respectively, had elevated TSH levels. Additionally, fT3 levels were lower than normal in 45 patients in stage C and 3 in stage D, while fT4 levels were higher than normal in some patients. A small positive correlation between TSH levels and the stage of CHF was found, though no significant relationship was noted for fT3 and fT4. Similarly, no significant association between NYHA class and TFT values was observed [18]

The findings are supported by other studies, which have shown that elevated TSH levels are linked to worsening heart failure. Thyroid hormones regulate cardiovascular functions, such as blood pressure, cardiac contractility, and cardiac output. Subclinical hypothyroidism, characterized by elevated TSH, has been associated with lower left ventricular stroke volume and higher systemic vascular resistance. Conversely, hyperthyroidism alters heart hemodynamics, leading to increased heart rate and cardiac output, which can result in high-output cardiac failure in severe cases [19].

The early detection and management of thyroid dysfunction are critical in CHF patients to improve outcomes. Both hypothyroidism and hyperthyroidism can exacerbate heart failure, making thyroid function monitoring essential for comprehensive management. Medications like thyroid hormone replacement or antithyroid drugs can help mitigate cardiovascular risks, though further research is needed to fully explore the therapeutic potential of thyroid hormones in

preventing or treating heart failure [20].

The study has several limitations, including the lack of differentiation between subclinical and overt hypothyroidism, which may affect the interpretation of thyroid dysfunction's impact on heart failure. Additionally, the small sample size limits the generalizability of the findings. As the study is hospital-based, it may not be representative of the broader population, potentially introducing selection bias [21].

CONCLUSION

Heart failure is a growing global health challenge, with thyroid hormones playing a crucial role in regulating cardiovascular functions. In this study, higher TSH levels were associated with advanced stages of chronic heart failure, though no significant correlation was found between low fT3 and heart failure stage or between thyroid function tests and NYHA class. Addressing modifiable risk factors and treating thyroid abnormalities can improve cardiac function, highlighting the need for further research into the therapeutic potential of thyroid hormones in heart failure management.

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