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Research Article

A Prospective Observational Study Evaluating Thyroid Hormone Profile Alterations in Patients with Acute Coronary Syndrome and Their Association with Clinical Outcomes

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ABSTRACT

Background: Thyroid hormones play a crucial role in cardiovascular physiology, influencing myocardial contractility, vascular resistance, and metabolic regulation. Alterations in thyroid hormone levels, particularly low triiodothyronine (T3), are frequently observed in patients with acute coronary syndrome (ACS) and may impact disease severity and prognosis.

Aim: To evaluate thyroid hormone profile alterations in patients with ACS and determine their association with clinical outcomes in a tertiary care center in Bihar.

Methodology: This prospective observational study included 100 adult patients diagnosed with ACS during the study period. Patients were randomly selected from those presenting to the outpatient and emergency departments. Thyroid function tests (Free T3, Free T4, and TSH) were measured within 24 hours of admission using chemiluminescent immunoassay. Patients were categorized into euthyroid and thyroid dysfunction groups. Clinical outcomes, including mortality, heart failure, arrhythmias, cardiogenic shock, and duration of hospital stay, were recorded and analyzed using appropriate statistical tests.

Results: Thyroid dysfunction was observed in 40% of patients, with low T3 syndrome being the most common abnormality (22%). Patients with thyroid dysfunction had significantly higher mortality (25 vs 5%), increased incidence of heart failure (40% vs 13.3%), arrhythmias (35 vs 10%), and longer hospital stay (8.6 ± 2.1 vs 5.2 ± 1.3 days) compared to euthyroid patients ($p < 0.05$).

Conclusion: Thyroid hormone abnormalities are common in ACS and are significantly associated with adverse clinical outcomes. Thyroid function testing may serve as a simple and cost-effective prognostic tool for risk stratification in ACS patients.

Keywords: Acute coronary syndrome, Thyroid hormones, Triiodothyronine, Prognosis, Euthyroid sick syndrome

INTRODUCTION

Acute coronary syndrome (ACS) represents a spectrum of clinical conditions ranging from unstable angina to ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI), and remains a leading cause of morbidity and mortality worldwide. Despite major advances in pharmacotherapy, revascularization techniques, and intensive care management, early risk stratification and identification of prognostic biomarkers remain crucial for improving outcomes in ACS patients [1]. Among various systemic factors influencing cardiovascular function, thyroid hormones have emerged as key regulators of cardiovascular physiology and hemodynamics.

Thyroid hormones—primarily triiodothyronine (T3) and thyroxine (T4) play a vital role in maintaining myocardial contractility, vascular resistance, lipid metabolism, and cardiac electrophysiology. Even subtle alterations in thyroid function can significantly influence cardiovascular morbidity and mortality [2]. The heart is a major target organ for thyroid hormones, and disturbances in thyroid hormone levels can lead to changes in heart rate, myocardial oxygen demand, systemic vascular resistance, and endothelial function [3]. In patients with ischemic heart disease, thyroid dysfunction can exacerbate myocardial injury and influence the severity and prognosis of ACS.

A phenomenon frequently observed in critically ill cardiac patients is non-thyroidal illness syndrome (NTIS), also known as euthyroid sick syndrome, characterized by reduced serum T3 levels with normal or low T4 and normal TSH levels. This condition is particularly common in ACS patients and is considered an adaptive metabolic response to acute stress [4]. Several studies have demonstrated that approximately 20 to 30% of patients with ACS exhibit thyroid hormone abnormalities, with low T3 syndrome being the most frequent abnormality [5]. Recent evidence suggests that these hormonal changes are not merely epiphenomena but may have prognostic significance.

Low T3 syndrome has been associated with increased severity of coronary artery disease, impaired left ventricular function, and higher mortality rates in ACS patients. A prospective study evaluating non-ST elevation ACS patients demonstrated significantly higher short-term and long-term mortality in patients with low T3 levels

compared to euthyroid individuals [6]. Similarly, studies have shown that all deaths in ACS cohorts were associated with significantly reduced free T3 levels, highlighting the strong prognostic association of thyroid hormone alterations [7]. The pathophysiological basis of this relationship is attributed to decreased peripheral conversion of T4 to T3, inflammatory cytokine release, oxidative stress, and altered deiodinase activity during acute ischemic events [8].

In the Indian context, the burden of cardiovascular diseases has increased dramatically over the last two decades, with ACS presenting at younger ages and with more severe disease patterns. Thyroid dysfunction is also highly prevalent in the Indian population due to iodine imbalance, autoimmune disorders, and environmental factors. Recent Indian studies have reported that nearly 25 to 30% of ACS patients demonstrate abnormal thyroid function tests, with hypothyroidism and low T3 syndrome being common findings [9]. Furthermore, hypothyroidism has been identified as an independent risk factor for coronary artery disease and adverse cardiovascular outcomes [10].

Bihar, one of the most populous states in India, faces a growing burden of non-communicable diseases, particularly cardiovascular diseases. Limited access to preventive healthcare, delayed hospital presentation, poor socioeconomic status, and lack of awareness contribute to increased ACS morbidity and mortality in this region. Tertiary care centers in Bihar serve as major referral hubs for critically ill patients from rural and semi-urban populations, often presenting late with complications.

Despite the increasing burden of ACS in Bihar, there is a scarcity of region-specific data evaluating the relationship between thyroid hormone profile and ACS outcomes. Most available studies are conducted in metropolitan centers or outside India, and their findings may not be directly applicable to the Bihar population due to differences in nutritional status, iodine intake, healthcare access, and comorbidity profiles.

Early identification of thyroid dysfunction in ACS patients could provide an inexpensive and easily accessible prognostic marker, especially in resource-limited settings like Bihar. Thyroid function tests are relatively low-cost and widely available even in district-level laboratories, making them a feasible tool for routine risk stratification. Understanding the prevalence and prognostic impact of thyroid hormone alterations in ACS patients in a tertiary care center in Bihar could help clinicians in early risk stratification, individualized treatment planning, and improved patient outcomes.

Additionally, establishing the association between thyroid hormone abnormalities and clinical outcomes such as mortality, heart failure, arrhythmias, and length of hospital stay could lead to the development of integrated clinical protocols for ACS management in this region.

The aim of the present study was to evaluate thyroid hormone profile alterations (T3, T4, and TSH levels) in patients presenting with acute coronary syndrome and determine their association with clinical outcomes in a tertiary care center in Bihar.

MATERIALS AND METHODS

The present study was conducted in the Department of General Medicine of Jannayak Karpoori Thakur Medical College and Hospital in Bihar, India. This tertiary care center serves as a major referral hospital for surrounding rural and semi-urban districts and caters to a high volume of patients with acute cardiovascular emergencies.

The study was carried out over a period of 12 months from January 2025 to Dec 2025, during which eligible patients presenting to the Outpatient Department (OPD) and Emergency Department with symptoms suggestive of ACS were screened and enrolled.

This was a prospective observational study designed to evaluate thyroid hormone profile alterations in patients diagnosed with acute coronary syndrome and to determine their association with clinical outcomes.

All eligible patients were followed prospectively from the time of admission until discharge or in-hospital outcome (recovery or death). No therapeutic intervention was altered as part of the study, and all patients received standard ACS management as per standard guideline.

The study population consisted of adult patients presenting with clinical features suggestive of ACS, including ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina, confirmed by clinical assessment, ECG changes, and cardiac biomarkers.

A total of 100 patients were included in the study based on feasibility and patient flow in the tertiary care center over the study duration. Patients were selected using a random sampling method from those reporting to the OPD and emergency services during the 6-month study period who fulfilled the inclusion criteria.

Inclusion Criteria

Patients aged ≥18 years. Patients diagnosed with acute coronary syndrome, including: ST-elevation myocardial infarction (STEMI). Non-ST-elevation myocardial infarction (NSTEMI). Unstable angina. Patients presenting within 24 hours of the onset of symptoms. Patients who provided informed written consent to participate in the study.

Exclusion Criteria

Patients with known thyroid disorders (hypothyroidism or hyperthyroidism) already on treatment. Patients taking medications affecting thyroid function (e.g., amiodarone, lithium, corticosteroids). Patients with chronic systemic illnesses such as chronic kidney disease, chronic liver disease, malignancy, or sepsis. Patients with a previous history of myocardial infarction within the last 3 months. Pregnant women. Critically ill patients for whom blood sampling for thyroid profile could not be obtained within 24 hours of admission.

Methodology

Upon admission, all patients underwent detailed clinical evaluation, including history, physical examination, and risk factor assessment (hypertension, diabetes mellitus, smoking, dyslipidemia, and family history of coronary artery disease).

Diagnosis of ACS was established using 12-lead Electrocardiogram (ECG), cardiac biomarkers (Troponin I / CK-MB), clinical presentation (chest pain characteristics), patients were classified into STEMI, NSTEMI, or unstable angina based on standard diagnostic criteria.

Within 24 hours of admission, venous blood samples were collected under aseptic precautions for the following investigations

Table 1: Demographic and clinical characteristics of study population

Variable	*Number (n=100)*	*Percentage (%)*
	Age (years)	
18–40	12	12
41–60	46	46
>60	42	42
	Gender	
Male	68	68
Female	32	32
	Risk Factors	
Hypertension	54	54
Diabetes Mellitus	38	38
Smoking	44	44
Dyslipidemia	40	40
Family history of CAD	18	18

Table 2: Distribution of Types of Acute Coronary Syndrome

Type of ACS	*Number (n=100)*	*Percentage (%)*
STEMI	48	48
NSTEMI	32	32
Unstable Angina	20	20

Table 3: Thyroid Hormone Profile Distribution in ACS Patients.

Thyroid Status	Number (n=100)	Percentage (%)
Euthyroid	60	60
Low T3 Syndrome	22	22
Subclinical Hypothyroidism	10	10
Overt Hypothyroidism	6	6
Hyperthyroidism	2	2

Table 4: Association between thyroid dysfunction and clinical outcomes

Outcome	*Euthyroid (n=60)*	*Thyroid Dysfunction (n=40)*	*p-value*
Mortality	3 (5%)	10 (25%)	<0.01
Heart failure	8 (13.3%)	16 (40%)	<0.01
Arrhythmias	6 (10%)	14 (35%)	<0.01
Cardiogenic shock	2 (3.3%)	8 (20%)	<0.05
Mean hospital stay (days)	5.2 ± 1.3	8.6 ± 2.1	<0.001

Thyroid function tests: Free T3 (FT3), Free T4 (FT4), thyroid stimulating hormone (TSH). Routine investigations: Complete blood count, Random blood sugar, lipid profile, renal function tests, liver function tests, thyroid hormone levels were measured using chemiluminescent immunoassay (CLIA) method in the central laboratory.

Based on reference ranges of laboratory standards on thyroid hormone levels, patients were categorized into: Euthyroid/Low T3 Syndrome (Non-thyroidal illness syndrome)/Subclinical hypothyroidism/Overt hypothyroidism/Hyperthyroidism.

Patients were monitored throughout hospitalization for the following clinical outcomes

In-hospital mortality, development of complications: Heart failure, cardiogenic shock, arrhythmias, reinfarction, duration of hospital stay, left ventricular ejection fraction (LVEF) on echocardiography.

All relevant clinical, laboratory, and outcome data were recorded in a pre-designed structured proforma. Data confidentiality was strictly maintained throughout the study.

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0. Continuous variables were expressed as mean ± standard deviation (SD). Categorical variables were expressed as frequency and percentage. Student's *t-test* done for continuous variables. Chi-square test for categorical variables. Correlation between thyroid hormone levels and severity of ACS assessed using the Pearson correlation coefficient. A *p-value <0.05* was considered statistically significant.

RESULTS

A total of 100 patients diagnosed with acute coronary syndrome (ACS) were included in the present prospective observational study. The results are presented below.

The majority of ACS patients belonged to the 41–60 year age group (46%), followed by elderly patients above 60 years (42%). There was a male predominance (68%). Among cardiovascular risk factors, hypertension (54%) was most common, followed by smoking (44%), dyslipidemia (40%), and diabetes mellitus (38%).

Among the study participants, ST-segment elevation myocardial infarction (STEMI) was the most common presentation (48%), followed by NSTEMI (32%) and unstable angina (20%). This reflects the predominance of more severe forms of ACS presenting to tertiary care centers in Bihar.

Thyroid function abnormalities were observed in 40% of ACS patients. The most common abnormality was Low T3 Syndrome (22%), followed by subclinical hypothyroidism (10%) and overt hypothyroidism (6%). Only 2% of patients had hyperthyroidism. These findings suggest a high prevalence of thyroid hormone alterations in ACS patients.

Patients with thyroid dysfunction had significantly worse clinical outcomes compared to euthyroid patients.

Mortality was significantly higher in patients with thyroid dysfunction (25%) compared to euthyroid patients (5%). Incidence of heart failure (40 vs 13.3%) and arrhythmias (35 vs 10%) was markedly higher in the thyroid dysfunction group. Cardiogenic shock was also more frequent in patients with abnormal thyroid profiles. The mean duration of hospital stay was significantly longer in patients with thyroid dysfunction (8.6 ± 2.1 vs 5.2 ± 1.3 days, $p < 0.001$). These findings indicate that thyroid hormone abnormalities are strongly associated with increased severity and poorer prognosis in ACS patients.

DISCUSSION

The present prospective observational study evaluated thyroid hormone profile alterations in patients presenting with acute coronary syndrome (ACS) and examined their association with clinical outcomes in a tertiary care center in Bihar. The findings demonstrate a high prevalence of thyroid dysfunction among ACS patients, with Low T3 syndrome being the most common abnormality, and a significant association between thyroid hormone derangements and adverse clinical outcomes, including mortality, heart failure, arrhythmias, and prolonged hospital stay.

In the present study, 40% of ACS patients exhibited abnormal thyroid function, which is comparable to previously published data reporting a prevalence ranging from 20 to 35% in similar cohorts [1,2]. The predominance of Low T3 syndrome (22%) in our study aligns with earlier reports indicating that acute critical illness, particularly myocardial ischemia, leads to reduced peripheral conversion of T4 to T3 due to altered deiodinase activity [3]. This phenomenon is widely recognized as non-thyroidal illness syndrome (NTIS) and has been observed frequently in critically ill cardiac patients.

The pathophysiological mechanisms linking thyroid dysfunction with ACS outcomes are multifactorial. Thyroid hormones regulate myocardial contractility, systemic vascular resistance, endothelial function, and lipid metabolism. Reduced T3 levels lead to impaired myocardial relaxation, decreased cardiac output, and increased systemic vascular resistance, thereby aggravating ischemic myocardial injury [4]. Additionally, inflammatory cytokines released during acute coronary events inhibit deiodinase activity, resulting in decreased T3 levels and contributing to disease severity [5].

In our study, patients with thyroid dysfunction had significantly higher in-hospital mortality (25%) compared to euthyroid patients (5%), which is consistent with previous studies demonstrating that low T3 levels are strong independent predictors of mortality in ACS [6]. Pingitore et al. reported that reduced free T3 levels were independently associated with both short-term and long-term mortality in patients with acute myocardial infarction [7]. Similarly, Iervasi et al. demonstrated that all deaths in ACS cohorts were associated with significantly lower T3 levels, supporting the prognostic importance of thyroid hormone assessment [8].

The present study also demonstrated a significantly higher incidence of heart failure and arrhythmias in patients with thyroid dysfunction. These findings are consistent with previous literature, which indicates that low T3 syndrome is associated with reduced left ventricular ejection fraction and impaired ventricular remodeling following myocardial infarction [9]. Thyroid hormones have direct effects on cardiac ion channels and electrophysiological properties of the myocardium; thus, alterations in thyroid hormone levels predispose patients to arrhythmogenic complications.

Another important observation in our study was the significantly longer duration of hospital stay in patients with thyroid dysfunction. This finding suggests that thyroid hormone alterations may reflect the severity of systemic illness and may serve as a marker of poor clinical recovery. Previous studies have similarly reported that NTIS is associated with increased ICU stay, delayed recovery, and higher healthcare burden [10].

In the Indian context, the coexistence of thyroid disorders and cardiovascular diseases is increasingly recognized due to the rising burden of non-communicable diseases. Studies conducted in Indian populations have shown a higher prevalence of subclinical hypothyroidism and low T3 syndrome in ACS patients, likely influenced by nutritional factors, iodine intake variability, and delayed healthcare access [1,2]. The present study adds to the limited data from eastern India, particularly Bihar, where such region-specific studies are scarce.

The findings of this study have important clinical implications. First, thyroid function testing is a simple, cost-effective, and widely available investigation that can be incorporated into routine evaluation of ACS patients. Second, early identification of thyroid hormone abnormalities may help in risk stratification and prognostication, especially in resource-limited settings. Third, these findings raise the possibility that therapeutic modulation of thyroid hormone levels could improve cardiac outcomes, although further interventional studies are required to establish this.

However, certain limitations of the present study must be acknowledged. The sample size was relatively small and derived from a single tertiary care center, which may limit generalizability. The study evaluated only short-term in-hospital outcomes and did not include long-term follow-up. Additionally, serial thyroid hormone measurements were not performed, which could have provided better insight into dynamic hormonal changes during recovery.

Despite these limitations, the present study provides important evidence supporting the prognostic significance of thyroid hormone alterations in ACS. The strong association between low T3 levels and adverse outcomes suggests that thyroid hormone profile can serve as a valuable biomarker in the clinical management of ACS patients.

CONCLUSION

Thyroid hormone abnormalities, particularly low T3 syndrome, are common in acute coronary syndrome and strongly associated with increased mortality, complications, and prolonged hospitalization. Routine thyroid profile assessment may serve as a simple prognostic tool for early risk stratification and improved clinical management in ACS patients.

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