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Original Research Article

A Cross-Sectional Study of Thyroid Dysfunction in Chronic Kidney Disease Patients Attending DSP Main Hospital, Durgapur

Dr. Ashish Chatterjee[1*], Dr. Akash Kumar Rai[2], Dr. Sukhdev Shankar Patil[3]
[1*]Professor & HOD, Department of General Medicine, Shri Ramkrishna Institute of Medical Sciences & Sanaka Hospital (SRIMS), Durgapur, West Bengal, India.
[2]Senior Resident, Department of General Medicine, All India Institute of Medical Sciences (AIIMS), Patna, Bihar, India.
[3]Additional CMO, Department of General Medicine, DSP Hospital, Durgapur, West Bengal, India.
Corresponding Author: Dr. Ashish Chatterjee
Professor & HOD, Department of General Medicine, Shri Ramkrishna Institute of Medical Sciences & Sanaka Hospital (SRIMS), Durgapur, West Bengal, India.
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ABSTRACT

Background: Numerous metabolic and endocrine disorders are linked to CKD (Chronic Kidney Disease), a chronic illness marked by permanent loss of renal function. Thyroid hormone metabolism, breakdown, and excretion are all significantly influenced by the kidneys. Therefore, aberrant thyroid hormone levels may result from impaired renal function. Thyroid dysfunction, particularly hypothyroidism and low T3 syndrome, is frequently observed in CKD patients and may worsen disease progression and clinical outcomes. The goal of the current investigation was to evaluate thyroid function abnormalities in individuals with CKD and ascertain the correlation between thyroid dysfunction and the severity of CKD.

Methods: This hospital-based cross-sectional study was conducted in the Department of Medicine at DSP Main Hospital, Durgapur. A total of 90 patients with CKD stage III and above, aged above 18 years, were included over a period of two years using purposive consecutive sampling. Patients with known thyroid disorders, pregnancy, or those taking drugs affecting thyroid function were excluded. Blood samples were analysed for T3, T4, and TSH levels using ECLIA (Electrochemiluminescence Immunoassay). Renal function was measured using serum creatinine and eGFR (estimated Glomerular Filtration Rate) computed using the Cockcroft-Gault algorithm. SPSS software version 21 was used for the statistical analysis, and $p < 0.05$ was deemed significant.

Results: The mean age of the study population was 61.31 ± 14.4 years, with males constituting 53.3% of the subjects. Most patients were in CKD stage III (66.7%), followed by stage IV (22.2%) and stage V (11.1%). Thyroid dysfunction was observed in 35.6% of CKD patients. Among these, low T3 syndrome (16.7%) was the most common abnormality, followed by subclinical hypothyroidism (15.6%) and overt hypothyroidism (3.3%). The prevalence of thyroid dysfunction increased with CKD severity, affecting 25% of stage III, 50% of stage IV, and 70% of stage V patients. A significant negative correlation was found between TSH and eGFR, while T3 and T4 showed a positive correlation with eGFR.

Conclusion: Thyroid dysfunction is common among CKD patients and its prevalence increases with disease severity. Low T3 syndrome and subclinical hypothyroidism are the most frequent abnormalities. Routine assessment of thyroid function in CKD patients may aid in early detection and better management of endocrine complications associated with renal disease.

Keywords: Chronic Kidney Disease, Thyroid Dysfunction, Low T3 Syndrome, Subclinical Hypothyroidism, EGFR, Thyroid Hormones.

INTRODUCTION

"Bones can break, muscles can atrophy, glands can loaf, and even the brain can go to sleep without immediate danger to survival. But should kidneys fail, neither bone, muscle, gland, nor could brain carry on."[1] This statement highlights the critical role of the kidneys in maintaining life. Proper kidney function is essential for maintaining body homeostasis through filtration of blood, regulation of body fluids, and excretion of metabolic waste products. [2]

The hallmark of CKD is a steady decline in GFR (Glomerular Filtration Rate) to less than 60 ml/min for three months or more, frequently accompanied by nephron structural

destruction. ESRD (End-Stage Renal Disease) is usually the result of the disease's progressive progression. Numerous problems, such as hypertension, anaemia, renal bone disease, neuropathy, nutritional impairment, a lower quality of life, and a shorter life expectancy, are linked to CKD. [3]

A silent epidemic of the twenty-first century, CKD has become a significant public health concern. Studies suggest that approximately 16% of the adult population is affected worldwide. In India alone, more than one lakh individuals are diagnosed with CKD each year, many of whom require long-term dialysis or kidney transplantation. [4,5] Cardiovascular disease continues to be the primary cause of death for people with ESRD and recipients of kidney transplants, and it is extremely common among CKD patients.[6–8]

Thyroid hormone metabolism, breakdown, and excretion are all significantly influenced by the kidneys. As a result, anomalies in thyroid hormone levels and changes in the hypothalamic-pituitary-thyroid axis might result from disruptions in renal function. [9,10] Among thyroid hormones, triiodothyronine (T3) is the most metabolically active form and its levels are typically lowered in ESRD patients due to decreased peripheral conversion of thyroxine (T4) to T3.[11,12] Impaired protein binding and other metabolic alterations linked to chronic disease may also lead to decreased T3 levels.[13]

Additionally, impaired renal excretion of iodide in CKD results in increased plasma iodide levels, which can inhibit thyroid hormone synthesis through the Wolff–Chaikoff effect.[14,15] Therefore, thyroid function is impacted by chronic renal failure through a variety of processes, such as altered hormone metabolism, decreased circulating hormone levels, and increased iodine build-up in thyroid tissue.[16,17]

Aims and Objectives

The study aimed to assess thyroid function in patients with CKD attending DSP Main Hospital. The study also seeks to evaluate the nature and frequency of thyroid dysfunction among CKD patients and to compare thyroid functional status with the severity of chronic kidney disease, thereby determining the relationship between thyroid hormone abnormalities and the progression of renal impairment.

MATERIALS AND METHODS

Study Design

This study was conducted in the Department of Medicine at DSP Main Hospital, Durgapur. Patients with stage III or higher CKD who visited the hospital during the study period made up the study population. A cross-sectional study design was adopted to evaluate thyroid function among these patients. The study was carried out over a period of two years.

Inclusion and Exclusion Criteria

The study included patients of any gender who were diagnosed with stage III or higher CKD while in the hospital and were older than eighteen. Based on GFR, CKD staging was categorised as follows: Stage 4 (GFR 15–29 ml/min), Stage 5 (GFR<15 ml/min), Stage 3A (GFR 45–59 ml/min), and Stage 3B (GFR 30–44 ml/min). The study excluded pregnant women, those with a history of thyroid abnormalities, and those using drugs known to interfere with thyroid function.

Sample Size Calculation

The sample size was calculated using following formulae: $n = (Za/2)\ 2 * (PQ) / E^2$

N = Sample size

Za/2 – Z value at 5% error (1.96)

P = Prevalence of thyroid disorders in CKD cases (35%) [Alshammari Fetal][18]

E = Allowable error (taken as 10%)

$$N= \frac{(1.96)^2 * (0.35*0.75)}{(0.10)^2}$$

n = 90(approx.)

Sample type = Purposive consecutive.

90 patients satisfying inclusion and exclusion criterion were included.

Data Collection Procedure

A comprehensive clinical history was acquired from all recruited patients with CKD stage III and above. In addition to other laboratory tests like complete blood counts, blood glucose, blood urea, serum creatinine, serum calcium, phosphorus, liver function tests, serum proteins, serum electrolytes, and complete urine analysis, blood samples were taken following an overnight fast in order to estimate thyroid hormones such as TSH (Thyroid Stimulating Hormone), triiodothyronine (T3), and thyroxine (T4). Kidney size and corticomedullary differentiation were assessed by abdominal

USG (Ultrasonography). KDIGO (Kidney Disease Improving Global Outcomes) recommendations were used to define CKD staging, [9] and the Cockcroft–Gault formula was used to calculate GFR. Thyroid hormone levels were measured using electrochemiluminescence Immunoassay. Thyroid dysfunction was diagnosed based on laboratory reference ranges (T3: 1.3–3.1 nmol/ml, T4: 66–181 nmol/ml, TSH: 0.25–5.0 µIU/ml). Conditions identified included subclinical hypothyroidism, overt hypothyroidism, low T3 syndrome, low T4 syndrome, subclinical hyperthyroidism, and overt hyperthyroidism depending on deviations in T3, T4, and TSH levels.

Statistical Analysis

While nominal and categorical variables were displayed as percentages, quantitative data were given as mean ± standard deviation (SD). Quantitative data having a normal distribution were examined using the Student's t-test, while non-parametric data were examined using the Mann-Whitney test. The chi-square test was used to analyse categorical variables. The correlation between quantitative variables was ascertained using Pearson's correlation coefficient. Statistical significance was defined as a p-value of less than 0.05. SPSS software version 21 was used for all statistical analyses.

RESULTS

Table 1: Distribution of Study Subjects Based on Age

Age Parameter	Value
Mean Age (in years)	61.31 ± SD
Age > 60 years	59%
Age ≤ 60 years	41%

Overview

Table 1 observes the age distribution of the study population. The mean age of CKD patients included in the study was **61.31 years**, and the majority of patients (**59%**) belonged to the elderly age group (>60 years), indicating that CKD was more common in older individuals.

Table 2: Distribution of Subjects Based on Gender

Gender	Number (%)
Male	48 (53.3%)
Female	42 (46.7%)
Total	90 (100%)

Table 2 illustrates the gender distribution of the study population. Among the 90 CKD patients**,** 53.3% were malesand 46.7% were females, showing a slightly higher prevalence of CKD among males.

Table 3: Distribution of Subjects Based on Co-Morbidities

Co-Morbid Condition	Number (%)
Hypertension	41 (45.6%)
Diabetes Mellitus	18 (20%)
Ischemic Heart Disease	25 (27.8%)

Table 3 demonstrates the prevalence of co-morbid conditions among CKD patients. Hypertension (45.6%) was the most common co-morbidity, followed by ischemic heart disease (27.8%) and diabetes mellitus (20%)**,** highlighting the strong association between cardiovascular risk factors and CKD

Table 4: Distribution of Subjects Based on CKD Stage

CKD Stage	Number (%)
Stage III	60 (66.7%)
Stage IV	20 (22.2%)
Stage V	10 (11.1%)
Total	90 (100%)

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Table 4 illustrates the distribution of CKD stages in the study population. The majority of patients **(**66.7%**)** were in Stage III CKD, while 22.2% and 11.1% belonged to Stage IV and Stage V, respectively.

Table 5: Prevalence of Thyroid Dysfunction in CKD Patients

Thyroid Status	Number (%)
Thyroid Dysfunction Present	32 (35.6%)
Thyroid Dysfunction Absent	58 (64.4%)
Total	90 (100%)

Table 5 observes the prevalence of thyroid dysfunction among CKD patients. Thyroid abnormalities were detected in 35.6% of patients, indicating that thyroid dysfunction is relatively common among individuals with chronic kidney disease.

Table 6: Distribution Based on Type of Thyroid Dysfunction

Type of Thyroid Dysfunction	Number (%)
Low T3 Syndrome	15 (16.7%)
Subclinical Hypothyroidism	14 (15.6%)
Overt Hypothyroidism	3 (3.3%)
Total	32 (35.6%)

Table 6 illustrates the types of thyroid dysfunction observed among CKD patients. Low T3 syndrome (16.7%) was the most common abnormality, followed by subclinical hypothyroidism (15.6%)**,** whileovert hypothyroidism (3.3%) was relatively less frequent.

Table 7: Association of CKD Stage with Thyroid Dysfunction

CKD Stage	Thyroid Dysfunction (%)
Stage III	25%
Stage IV	50%
Stage V	70%

Table 7 demonstrates the relationship between CKD severity and thyroid dysfunction. The prevalence of thyroid dysfunction increased progressively with advancing CKD stage, affecting 25% of Stage III**,** 50% of Stage IV**,** and70% of Stage V patients, suggesting a significant association between worsening renal function and thyroid abnormalities ($p < 0.05$).

DISCUSSION

It has long been known that thyroid and renal function interact. Renal physiology and development are negatively impacted by thyroid dysfunction, while thyroid function can be negatively impacted by kidney disease. Due to common etiological reasons, thyroid and renal illnesses may coexist, and treating one condition may have an impact on the other. The goal of the current hospital-based study was to assess thyroid function in patients with CKD and establish a relationship between thyroid dysfunction and the severity of CKD.

Demographic Profile

Of the 90 subjects enrolled in this study, 53.3% were males and 46.7% were females. This distribution is consistent with findings from Singh S et al.,[19] who reported 57.28% males and 42.71% females among 103 CKD patients, and Cotoi L et al.,[20] who observed 52.6% males and 47.4% females in a series of 123 CKD patients. The National Kidney Foundation K/DOQI analysis of 18 studies further corroborates this male predominance, noting that male sex was associated with higher risk of CRF (Chronic Renal Failure) and faster progression to ESRD in the majority of reviewed studies. [21] Regarding age distribution, the present study found that CKD was significantly more prevalent in patients above 30 years, with the majority (59%) aged over 60 years and a mean age of 61.31 years. This aligns with Cotoi L et al., [20] who reported a mean age of 62.2 ± 11.01 years with most cases above 65 years, and is consistent with the National Kidney Foundation K/DOQI findings reported by Fivush et al. [22]

Co-Morbidities

Hypertension was the most common co-morbidity (45.6%), followed by IHD (Ischaemic Heart Disease) (27.8%) and diabetes mellitus (20%). This pattern mirrors findings by Dash and Agarwal at AIIMS[23] and Lysaght et al. in American populations.[24] The high burden of hypertensive nephropathy is further supported by Xue et al., where nearly 50% of the study population had hypertensive nephropathy,[25] and parallels data from other developing countries such as Egypt and Bolivia.[26,27]

Thyroid Dysfunction

The prevalence of subclinical primary hypothyroidism in the general population is believed to be between 4 and 10%.[28–30] and 7–26% among senior citizens.[31,32] Previous research has shown that patients with ESRD are more likely to have goitre and thyroid hormone abnormalities.[33] Notably, low plasma free triiodothyronine (T3) with normal TSH-a feature of low T3 syndrome-has been found to be an independent predictor of cardiovascular and all-cause death in long-term dialysis patients. This finding may be related to underlying chronic inflammation.[33] The exact pathophysiological connection between advanced CKD and primary thyroid dysfunction is still unclear, despite the fact that several contributory pathways have been suggested, such as altered iodine metabolism, decreased peripheral hormone sensitivity, and autoimmune thyroiditis.In the present study, thyroid dysfunction was identified in approximately one-third (35.6%) of CKD patients. Low T3 syndrome was the most frequent abnormality (16.7%), followed by subclinical hypothyroidism (15.6%), with overt hypothyroidism in a smaller proportion (3.3%). These findings are broadly consistent with prior literature, though the precise prevalence estimates vary. Hossain MM et al., [34] reported primary hypothyroidism in 11%, low T3 syndrome in 45%, and subclinical hypothyroidism in 5% of CKD patients. Gupta UN et al., [35] observed thyroid dysfunction in 53% of 100 CKD patients, with subclinical and clinical hypothyroidism in 33% and 20%, respectively. Singh S et al., [19] found low free T3 in 33.98% and low free T4 in 18.44% (with normal TSH) among 103 CKD patients. Seema Gupta et al.[36] in a study of 154 CKD subjects, observed low T3 syndrome in 30%, low T4 syndrome in 24%, and subclinical hypothyroidism in 7%, with 39% remaining euthyroid. Alshammari F et al., [18] reported hypothyroidism (including subclinical) in 34.9% of 255 CKD patients.

Association of Severity of CKD and Thyroid Dysfunction

The present investigation indicated a steady increase in the prevalence of thyroid dysfunction with advancing CKD stage: 25% in stage III, 50% in stage IV, and 70% in stage V, with a statistically significant difference ($p < 0.05$). eGFR and TSH levels showed a strong negative connection, suggesting that patients trend toward a hypothyroid condition (elevated TSH) as renal function declines. Correspondingly, a positive correlation was found between eGFR and both T3 and T4 levels.

These observations are supported by several prior studies. Hossain MM et al., [34] noted a progressive decline in thyroid functional status with decreasing eGFR. Gupta UN et al., [35] similarly found that the proportion of patients with hypothyroidism rose with increasing renal failure severity, concluding that there is a significant association between CKD progression and thyroid dysfunction. Gupta et al., [36] demonstrated a positive linear correlation between GFR and total T3 and T4 levels, and a negative linear correlation between GFR and Alshammari F et al., [18] found that T3 and T4 were higher in non-dialysis patients, while TSH was higher in dialysis patients, reinforcing the conclusion that hypothyroidism prevalence increases as GFR declines.

CONCLUSION

Nearly one-third of the study population had CKD, which was associated with a high prevalence of thyroid dysfunction. Among the various thyroid abnormalities identified**,** low T3 syndrome and subclinical hypothyroidism were the most commonly observed conditions. The study also demonstrated a significant positive correlation between TSH levels and CKD severity**,** while serum T3 and T4 levels showedan inverse correlation with the progression of CKD. These findings indicate that thyroid function tends to deteriorate as the severity of chronic kidney disease increases.

Based on the results of this study, it is recommended that all patients with CKD should undergo routine evaluation of thyroid function, as they are at a higher risk of developing thyroid dysfunction. Furthermore, thyroid hormone parameters may serve as

useful indicators for assessing the severity and progression of CKD, thereby aiding in the early detection and better management of associated endocrine abnormalities.

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