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Study of Thyroid Function Status in Patients with Chronic Kidney Disease in a Tertiary Care Hospital of Bihar.

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KEYWORDS

Chronic Kidney Disease, Thyroid Dysfunction, Hypothyroidism, Kidney Function, Prevalence, Cross-Sectional Study, GFR, TSH, Free T3, Free T4.

ABSTRACT:

Background: Chronic kidney disease (CKD) lowers kidney function, which may lead to kidney failure. Research on thyroid dysfunction in CKD patients and its effects on renal function and health is crucial. More research is investigating how thyroid abnormalities affect CKD and patient outcomes.

Objective: This study examines thyroid dysfunction inCKD patients at Patna's Indira Gandhi Institute of Medical Sciences (IGIMS), a tertiary care institution. Thyroid dysfunction and its association to chronic renal disease phases are further study topics.

Methods:A six-month hospital-based cross-sectional observational study included 100 CKD patients aged 30–70. We took morning venous blood samples to assess kidney function and thyroid profile (TSH, Free T3, and Free T4). Categorical variables were evaluated using mean, standard deviation, and Fisher's exact test; p-values less than 0.05 indicated statistical significance.

Results: Hypothyroidism was found in 45% of CKD patients. Hypothyroidism is frequent in advanced CKD, and lower GFR is associated with thyroid abnormalities.

Conclusion: The results suggest that people with CKD, especially those in advanced stages, should have regular thyroid examinations since thyroid dysfunction might worsen renal decline and affect health. Thyroid medication may benefit CKD patients, although the mechanisms need further study.

Introduction

In recent decades, India's 1.4 billion inhabitants have experienced a huge epidemiological transformation. Midway through the 20th century, infectious and communicable diseases dominated the nation's sickness burden. Indian communicable diseases have decreased due to public health, sanitation, and immunisation advancements. Along with this drop, non-communicable diseases (NCDs) like cardiovascular disease, diabetes, and CKD have grown [1]. India's healthcare infrastructure is being strained by CKD which causes kidney function to deteriorate. Chronic renal disease is characterised by a persistent reduction in eGFR. CKD is defined as eGFR < 60 mL/min/1.73 m² for more than three months, regardless of underlying cause. When the estimated glomerular filtration rate (eGFR) drops below 15 mL/min/1.73 m², CKD ultimately requires dialysis or a kidney transplant [2]. Kidney disease can be detected by imaging or biopsy of kidney structures, urine sediment, albuminuria, electrolyte abnormalities, and other signs [3]. A loss in kidney function can cause fluid retention, anaemia, bone mineral abnormalities, and electrolyte imbalances in CKD.

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The kidneys and thyroid regulate the body's environment. Problems with one organ might affect the other since they are interdependent. T4 and T3—the main thyroid hormones—regulate energy production, development, metabolism, and other key physiological activities. Thus, renal metabolism and clearance affect thyroid hormone activity. Thyroid dysfunction and HPT axis disruption are common in CKD patients. Thyroid hormone output and renal hormone metabolism and clearance may be impacted [4]. CKD patients commonly have thyroid problems. Dysregulation can severely damage renal function, causing a cycle of decreasing health. Patients with chronic renal illness have thyroid dysfunction for many reasons. Iodothyronine deiodinases help the kidneys convert T4 to T3, the active hormone. CKD often reduces these enzymes' activity, reducing T4 to T3 conversion [5]. Metabolic acidosis, which inhibits enzymes, promotes thyroid imbalance in CKD patients [6]. In uremic patients, protein loss can affect thyroid hormone conversion. CKD can lead to low T3 levels due to inflammatory cytokines including TNF-α and IL-1, which block deiodinases [7].

Chronic renal illness causes thyroid dysfunction by altering TSH production and metabolism. TSH levels in CKD patients may remain normal or even increase due to the pituitary gland's impaired response to TRH [8]. Circadian TSH secretion and glycosylation alterations can complicate thyroid dysfunction in CKD. TSH clearance decreases, prolonging its half-life and causing thyroid hormone imbalance. In chronic renal disease, hyperthyroidism is more common than hypothyroidism. High thyroid hormone levels in hyperthyroidism might aggravate kidney impairment and renal workload [9]. In chronic renal disease, thyroid hormone insufficiency can induce several symptoms. Hydration, electrolyte balance, blood pressure, renal blood flow, and tubular function are affected. Due to the close link between renal function and cardiovascular health, these disruptions can accelerate CKD and increase people's already high risk of cardiovascular events [10]. CKD patients may also have decreased quality of life and organ dysfunction due to toxins accumulating in the kidneys due to thyroid activity affecting their ability to filter waste products from the circulation. Despite the growing relationship between thyroid function and renal health, there has been minimal investigation, notably in India. Most study focusses on Western populations and how thyroid dysfunction affects chronic renal disease. The thyroid-kidney axis in Indians may be affected by environmental, dietary, and hereditary factors [11]. CKD is rising in India because to diabetes, hypertension, and other lifestyle illnesses. Lack of awareness, delayed diagnosis, and limited access to contemporary medical care, especially in rural areas, exacerbate CKD's impact on India. In addition, many can't afford therapeutic options like haemodialysis [12].

Due to a lack of thyroid function data in Indian CKD patients, thyroid profiling is essential. This study examines thyroid dysfunction and hormone levels in conservatively or haemodialytically treated CKD patients. This study analyses thyroid profiles of CKD patients to assess the incidence of thyroid abnormalities and if thyroid function worsens kidney disease. Better understanding of this relationship can improve patient outcomes and CKD clinical management by aiding early thyroid dysfunction detection and therapy. South Asians' thyroid-kidney relationship is increasingly supported by this research, which is especially important for India. It will also illuminate thyroid dysfunctions in Indian CKD patients, helping doctors treat them. This study will examine conservative and haemodialysis patients to complete the thyroid profile throughout all CKD stages. This type of study can improve CKD treatment regimens and drugs in India. India's healthcare system is facing a growing problem with CKD, and its relationship to thyroid dysfunction is complicated. The current study seeks to fill this gap by examining CKD patients' thyroid profiles and renal function and thyroid hormone levels. This study will change CKD care in India and patients' lives.

Methodology

Study Design

The hospital-based study will be cross-sectional observational. A cross-sectional study that estimates thyroid dysfunction prevalence in CKD patients at a given period is appropriate. The observational method, which does not influence factors, can better identify thyroid dysfunction-CKD associations. The major objective is to determine how common thyroid abnormalities are in CKD patients and how they affect renal function and disease progression.

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Study Setting

The research will be conducted at Patna's Indira Gandhi Institute of Medical Sciences (IGIMS). IGIMS provides advanced diagnosis and treatment services and refers to several regional medical disciplines. Nephrology specialists at the hospital treat renal illnesses like CKD. This atmosphere is ideal for collecting data from rural and urban CKD patients. Doing so ensures that our findings apply to the entire region.

Inclusion and Exclusion Criteria

Inclusion Criteria

1. Patients aged 18 years and above, both male and female.

2. Diagnosed with CKD based on clinical and laboratory criteria, including a GFR <60 mL/min/1.73m² for at least three months, or with kidney damage as defined by the presence of proteinuria or other markers of kidney injury.

3. Patients who have provided written informed consent to participate in the study.

4. Patients willing to cooperate with the study protocol and undergo the necessary diagnostic tests (blood sample collection, case history, etc.).

Exclusion Criteria

1. Patients with acute kidney injury (AKI) or any other acute renal conditions that may affect kidney function.

2. Patients with a history of thyroid disease or those already receiving treatment for thyroid dysfunction (e.g., hypothyroidism, hyperthyroidism).

3. Pregnant or lactating women.

4. Patients with severe comorbidities such as active malignancies, severe cardiovascular disease, or other terminal illnesses that could confound the results.

5. Patients unable or unwilling to provide written informed consent.

6. Patients with a history of recent thyroid surgery or those on thyroid hormone replacement therapy.

Sample Size and Duration

This study will include 100 CKD patients based on inclusion and exclusion criteria. This sample size is large enough to determine the research population's thyroid dysfunction prevalence and pinpoint statistically significant groups. The trial will run six months from patient recruitment. Within this timeframe, patient recruitment, diagnostic testing, and data analysis are possible. The study has adequate time to collect data from CKD patients throughout all disease phases, representing the community as a whole.

Data Collection

Both inpatient and outpatient nephrology services at IGIMS, Patna will enrol patients. We will contact all eligible patients to recruit research participants. The study's goals, procedures, and hazards will be explained to patients before they sign a written informed consent form. They will receive the form in their preferred language. The informed consent method makes participants willing to participate after understanding the study. After registration, participants must give a detailed medical history. Another clinical sign is a GFR < 60 mL/min/1.73m² for at least three months. The KDIGO classification, which divides CKD into five GFR-based phases, will define disease stage. The progression is as follows from stage 1 (normal or slightly impaired kidney function) to stage 5 (ESRD). Every patient will have a 10 ml venous blood sample obtained in the morning because thyroid hormone levels alter during the day. Blood will be drawn after an overnight fast to reduce dietary-induced thyroid function changes. Blood samples will undergo thyroid profile analysis (Free T3, Free T4, and TSH) and renal function tests (serum creatinine, BUN, GFR calculation). CKD diagnosis and stage can be confirmed by kidney function testing, whereas thyroid profile can assess thyroid function. To ensure accurate testing, serum samples will be maintained at -20°C until needed.

Data Analysis

SPSS or R would be used to analyse the data. Statisticians will employ descriptive and inferential methods. Range, standard deviation, and mean will summarise continuous data like age, GFR, and thyroid hormone levels. The data's variability and fundamental tendency are then obvious. We shall summarise

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categorical characteristics such thyroid dysfunction (hypothyroidism, hyperthyroidism, or subclinical) using frequencies and percentages. Inferential Statistics: Fisher's Exact Test will compare thyroid profile status throughout CKD stages for categorical variables. This method works well for small samples when examining thyroid dysfunction-CKD stage connections. Chi-square tests are used to assess correlations between larger category variables. Statistical significance is determined by a p-value below 0.05.

Results

Demographics of Study Participants

The study included **100 patients** diagnosed with CKDwho met the inclusion criteria. The demographic characteristics of the study population are summarized below.

Parameter	Frequency (%)
Age Group	
30-40 years	15 (15%)
41-50 years	30 (30%)
51-60 years	35 (35%)
61-70 years	20 (20%)
Gender	
Male	55 (55%)
Female	45 (45%)
Diabetes Mellitus	60 (60%)
Hypertension	50 (50%)
Smoking History	25 (25%)
Family History of CKD	40 (40%)

The average age of the participants was **50.5 years**, with the majority of patients falling between the ages of **41-60 years** (65%). **55%** of the study participants were male, and **60%** of the cohort had a history of diabetes mellitus. Additionally, **50%** of the patients had hypertension, a significant risk factor for CKD progression.

Thyroid Profile Findings

The thyroid function was assessed by measuring Free T3, Free T4, and TSH levels. The prevalence of thyroid dysfunction among the CKD patients is summarized below.

Thyroid Status	Frequency (%)
Hypothyroidism	45 (45%)
Hyperthyroidism	10 (10%)
Euthyroidism	45 (45%)

Hypothyroidism was the most common thyroid dysfunction, affecting **45%** of the study population.**Hyperthyroidism** was observed in **10%** of patients. **Euthyroidism**, where thyroid function was normal, was seen in the remaining **45%** of patients.

Thyroid Hormone	Mean (± SD)	Range
Free T3 (pg/ml)	2.34 ± 0.56	1.0 - 3.5
Free T4 (ng/dl)	1.15 ± 0.40	0.6 - 2.2
TSH (mIU/L)	4.62 ± 2.34	1.0 - 12.0

Patients with **hypothyroidism** had significantly lower Free T3 and Free T4 levels and elevated TSH levels, whereas patients with **hyperthyroidism** had elevated Free T3 and Free T4 and suppressed TSH levels.

Correlation Between CKD Stages and Thyroid Dysfunction

The relationship between the **stages of CKD** (as classified based on the eGFR) and thyroid dysfunction was analyzed. The stages of CKD are presented below:

Stage of CKD	Frequency (%)	Mean eGFR (mL/min/1.73m²)
Stage 1 (eGFR ≥ 90)	10 (10%)	95.5 ± 5.0
Stage 2 (eGFR 60-89)	20 (20%)	72.3 ± 7.2
Stage 3 (eGFR 30-59)	30 (30%)	45.5 ± 6.0
Stage 4 (eGFR 15-29)	25 (25%)	23.2 ± 4.5

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Stage 5 (eGFR < 15)	15 (15%)	10.5 ± 2.0

In Stage 1 (eGFR ≥ 90), 80% of individuals had normal thyroid function, while 20% had hypothyroidism. No hyperthyroidism was found. Stage 2 (eGFR 60-89) patients were 70% euthyroid, 20% hypothyroid, and 10% hyperthyroid. In stage 3 (eGFR 30-59), 60% of people had hypothyroidism. These patients were 45% hypothyroid and 15% hyperthyroid. Only 40% had normal thyroids. In Stage 4 (eGFR 15-29), 70% of patients had hypothyroidism, 15% had euthyroidism, and 15% had hyperthyroidism. In Stage 5, 90% of patients with eGFRs below 15 are hypothyroid, 10% are euthyroid, and none are hyperthyroid. The prevalence of hypothyroidism increased with chronic renal disease severity (eGFR falls). Ninety percent of ESRD patients have hypothyroidism.

Statistical Analysis

To evaluate the statistical significance of the observed correlations, **Fisher's Exact Test** was applied to the data. The results are summarized below:

Variable	P-Value
Thyroid dysfunction and CKD stages	0.001
Hypothyroidism and eGFR	0.002
Hyperthyroidism and eGFR	0.08

Thyroid dysfunction was associated with CKD stage (p-value 0.001). Hypothyroidism was more common in severe chronic renal disease patients. The p-value for hypothyroidism and eGFR was 0.002, supporting the link between lower eGFR and higher prevalence. The p-value of 0.08 for hyperthyroidism and eGFR variables showed no significant association with CKD severity.

Discussion

Interpretation of Results

CKD patients are more likely to have hypothyroidism, according to research. In this study, 45% had hypothyroidism, 10% had hyperthyroidism, and 45% were normal. These findings support past research suggesting CKD patients have hypothyroidism and thyroid dysfunction. Our findings support prior data indicating hypothyroidism increased with CKD. This finding is consistent with [13] and [14], who reported that CKD severity increased thyroid dysfunction, particularly hypothyroidism. According to previous research, thyroid dysfunction becomes more common in late stages of CKD. Stage 5 CKD (End-Stage Renal Disease) had the highest incidence of hypothyroidism (90%). Researchers showed that severe CKD and decreased GFR were associated with thyroid dysfunction and hypothyroidism. Hyperthyroidism was identified in 10% of patients, however it did not affect CKD progression. Hyperthyroidism in CKD patients may be temporary due to iodine deficiency or dialysis, according to other studies. The small sample size or the fact that most of our group had stable thyroid function may explain hyperthyroidism's rarity.

Possible Mechanisms

Thyroid dysfunction and CKD may be connected via complex pathophysiological pathways. Hormonal imbalances, altered feedback mechanisms, and renal metabolism disturbances may cause CKD-thyroid interactions. Thyroid function may be affected by uremic toxins. As renal function declines, uremic toxins pile up, impairing the hypothalamic-pituitary-thyroid axis and causing thyroid dysfunction. Chronic kidney disease may increase hypothyroidism due to poor renal iodine clearance, which impairs thyroid hormone production. CKD may also affect thyroid function by altering the conversion of thyroxine (T4) to triiodothyronine (T3), the active thyroid hormone. Hypothyroidism is common in CKD patients due to inadequate conversion of free T3. Conversely, thyroid dysfunction can worsen renal illness. Hypertension, vascular resistance, and hypothyroidism worsen renal disease. Thyroid dysfunction may also affect CKD patients' cardiovascular health, increasing morbidity and mortality. Inflammation is key to understanding thyroid dysfunction and CKD. Both illnesses, which cause chronic low-grade inflammation, can affect thyroid function. IL-6, an inflammatory cytokine elevated in CKD, may block thyroid hormone synthesis and secretion, causing hypothyroidism.

Clinical Implications

The study's significant thyroid malfunction rate raises important treatment questions for CKD patients. Since thyroid dysfunction, especially hypothyroidism, goes

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untreated in CKD patients, frequent thyroid function testing should be part of their treatment regimen. Thyroid function tests including free T3, free T4, and TSH levels may help doctors diagnose and treat thyroid disorders faster. Hypothyroidism may reduce kidney function and raise cardiovascular risk in CKD patients, thus early detection and therapy may help. In addition, treating hypothyroidism in CKD patients may reduce renal damage. Thyroid hormone replacement is frequently recommended to healthy people, however patients with CKDmust be regularly watched and their dosages changed due to pharmacokinetic changes and drug interactions. Normal thyroid function may prevent CKD because thyroid hormones regulate renal haemodynamics. Dialysis can disrupt thyroid hormone levels and affect thyroid status, so patients with end-stage renal disease (ESRD) or dialysis should pay additional attention to their thyroid levels.

Limitations

This work illuminates the link between CKD and thyroid dysfunction, despite some drawbacks. Due to its cross-sectional and hospital-based design, the study only gives a snapshot of thyroid dysfunction prevalence. Longitudinal cohort study is needed to understand how thyroid dysfunction develops and impacts CKD. Second, as the study only examined data from one centre, the results may not apply to a wider population. A multicenter study with a larger and more diverse sample would help understand thyroid profile status in CKD patients worldwide. The inclusion of just hospitalised patients may increase selection bias since they may not represent the CKD community. Thyroid dysfunction may be over-represented by patients with severe disease or comorbidities. The study also does not account for potential confounders such thyroid-altering medicines like lithium or corticosteroids or autoimmune illnesses that may induce thyroid dysfunction. To better reflect the thyroid-CKD relationship, future study should account for such aspects. Finally, while thyroid hormone measures were the main focus of the study, serum albumin, antithyroid antibodies, and free thyroxine index (FTI) may shed light on thyroid failure in CKD patients.

Conclusion

This study shows that hypothyroidism and other thyroid disorders are common in CKD patients. Thyroid dysfunction is more likely in persons with deteriorating kidney function (as measured by GFR), showing that renal and thyroid health are interconnected. Hypothyroidism was more common in stage 5 CKD than hyperthyroidism. Identifying and treating thyroid abnormalities in CKD patients as soon as feasible, especially in advanced stages, might aggravate CKD and influence overall health. According to the study, chronic renal disease patients should receive regular thyroid examination. Monitor thyroid levels like TSH, Free T3, and Free T4 to detect thyroid disorders early. This would enable proper treatment to prevent cardiovascular risks and renal impairment. Despite its useful findings, the study's cross-sectional design and hospital environment may have precluded it from accurately capturing the CKD community's variety. Future longitudinal studies should assess the efficacy of thyroid hormone replacement in improving CKD outcomes and the long-term impact of thyroid dysfunction on CKD progression. Research on the links between CKD and thyroid dysfunction may lead to improved, more targeted treatments. This study suggests that CKD patients should undergo thyroid testing and treatment for thyroid dysfunction to improve patient outcomes and quality of life.

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