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To Study of Thyroid and Lipid Profile Patient of Chronic Kidney Disease

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A B S T R A C T

Background: Chronic Kidney Disease (CKD) is a progressive condition that impacts kidney function and disrupts various metabolic and endocrine systems, particularly thyroid hormone metabolism and lipid regulation. The interrelationship between CKD, thyroid dysfunction, and dyslipidemia contributes significantly to disease progression and cardiovascular risk. This study aims to evaluate the thyroid and lipid profiles of CKD patients across different stages and assess the association between thyroid dysfunction and lipid abnormalities.

Method: This cross-sectional observational study was conducted at a tertiary care Hospital over six months. A total of 130 adult patients with CKD were classified into four stages based on the MDRD formula: Stage 1 (GFR > 60 ml/min/1.73m²), Stage 2-3 (GFR 30-59 ml/min/1.73m²), Stage 4 (GFR 15-29 ml/min/1.73m²), and Stage 5/End-Stage Renal Disease (GFR < 15 ml/min/1.73m²). Exclusion criteria included patients with thyroid disease, autoimmune disorders, active infections, malignancies, or those on thyroid or lipid-lowering medications. Thyroid and lipid profiles were measured using standard laboratory methods. Data were analyzed using SPSS version 20.0, with a significance threshold of $p < 0.05$.

Results: Thyroid dysfunction, characterized by increasing TSH levels and decreasing Free T3 and Free T4 levels, was observed as CKD progressed. The lipid profile showed a significant increase in total cholesterol, triglycerides, and LDL, with a decrease in HDL levels in advanced stages of CKD. A positive correlation was found between TSH levels and total cholesterol, triglycerides, and LDL, while Free T3 levels were negatively correlated with these lipid parameters. Duration of CKD and serum creatinine levels were also significantly associated with altered thyroid and lipid profiles.

Conclusion: Thyroid dysfunction and dyslipidemia are prevalent and worsen as CKD progresses, contributing to increased cardiovascular risk. The bidirectional relationship between thyroid dysfunction and lipid abnormalities in CKD highlights the need for regular monitoring of both parameters. Early identification and management of these metabolic disturbances can potentially reduce cardiovascular morbidity and slow the progression of kidney disease.

Keywords: *Chronic Kidney Disease, Thyroid Dysfunction, Dyslipidemia, Cardiovascular Risk, Lipid Profile*.

INTRODUCTION

Chronic kidney disease or CKD is a progressive disease that is characterized by a stepwise decline in kidney functions and poses a major challenge to public health across the world. CKD has effects outside the kidney that affect a wide range of metabolic and endocrine pathways-those regulating thyroid hormones and lipid metabolism. The interactive nature between CKD, abnormal thyroid functionalities and dyslipidemia is being acknowledged through increasing evidence and presented as each has significant clinical implication as regards to the association of these diseases with disease progression and cardiovascular morbidity.

Thyroid dysfunction in CKD has several pathophysiological causes. The metabolism of thyroid hormones as well as their clearance in the body is impaired with a decline in kidney functions as the role of the kidneys in setting up the

metabolism, degradation and disposal of these hormones[1,2]. It is interesting to note that CKD often leads to an interference with a hypothalamic-pituitary-thyroid axis and low peripheral conversion of thyroxine (T4) to the more active triiodothyronine (T3)[1,3]. The most common thyroid dysfunction in this population includes subclinical hypothyroidism and low T3 syndrome[1,3-5]. With CKD, there is an increment in the concentration of aggregation of iodine and in the bindings of hormones making it even more unstable due to the decreases in the glomerular filtration rate (GFR)[1,2,,4]. According to the studies, the rate of thyroid dysfunction increases alongside the intensity of kidney disease such that as the disease progresses to advanced CKD and ESRD, hypothyroidism increases prominently[2,5].

In line with such derailments, dyslipidemia has become a common metabolic disorder in CKD. The most typical lipid alterations are high triglycerides, high total cholesterol and low-density voslipoprotein (LDL) and low high-density lipoprotein (HDL)[6-9]. These are factors that have led to high prevalence of premature cardiac disease scenario in CKD because lipid derangements enhance oxidative stress, inflammation and atherogenesis[9,10]. The cause of dyslipidemia in CKD includes deficient clearance of lipoproteins, altered lipoprotein composition, and impaired maturation of HDL, and they become more disarranged as the kidney ability declines [6-10]. Disturbances in these parameters are more evident in hemodialysis patients, the latter being characterized by elevated triglycerides and LDL and decreased HDL levels in comparison to those of conservatively treated CKD victims[6,11].

Notably, there is a complex two-way interaction between the thyroid functioning and lipid metabolism. Hypothyroidism also worsens the condition of dyslipidemia by reducing the clearance of LDL and changing the synthesis of cholesterol[9,10]. On the other hand, dyslipidemia can damage the functioning of the thyroid gland possibly due to this affecting the synthesis of the hormone, binding and transportation[10]. Therefore, it is not uncommon to expose CKD patients to the mix of thyroid hormone malfunction and dyslipidemia, which are both also capable of heightening the dangers of cardiovascular disease and accelerating CKD advancement[9,10,12].

Regular evaluation of thyroid and lipid prowl in CKD populations is advised because a thorough approach. The same abnormalities have the potential of cardiovascular risks that are probably alleviated and improved due to early diagnosis and treatment thus increasing life quality and placing a deceleration in the course of kidney decay. Further investigation that uncovers the connections between CKD, thyroid dysfunction and lipid abnormalities will cause further optimization of treatment and development of guidelines on how to manage these issues in order to reduce morbidity and death rates of this at-risk population[1,2,5,6,9,10,12].

METHODOLOGY

Study Design

This study was a **cross-sectional** observational study conducted to evaluate the thyroid and lipid profiles of patients with chronic kidney disease (CKD). The study aimed to determine the association between thyroid dysfunction and lipid abnormalities across different stages of CKD. Data were collected from a tertiary care hospital over a period of six months.

Study Population

The study included 130 adult patients diagnosed with chronic kidney disease, classified according to the **MDRD (Modification of Diet in Renal Disease) formula** based on their Glomerular Filtration Rate (GFR).

The patients were categorized into four groups:

- **Stage 1 (GFR > 60 ml/min/1.73m²)**
- **Stage 2-3 (GFR 30-59 ml/min/1.73m²)**
- **Stage 4 (GFR 15-29 ml/min/1.73m²)**
- **Stage 5/ESRD (GFR < 15 ml/min/1.73m²)**

Patients with a history of thyroid disease, autoimmune disorders, active infections, malignancies, or those on thyroid medication, statins, or other lipid-lowering drugs were excluded from the study to avoid confounding factors. The inclusion criteria were adult patients (aged 18 years or older) with a confirmed diagnosis of CKD.

Ethical Considerations

The study protocol was approved by the institutional ethics committee, and informed consent was obtained from all participants prior to their inclusion in the study. Patient confidentiality and anonymity were maintained throughout the study.

Data Collection

Data were collected through a combination of patient interviews, clinical assessments, and laboratory investigations. The following parameters were recorded for each patient:

1. **Demographic Data:** Age, gender, and medical history.
2. **Clinical Parameters:** Blood pressure measurements, duration of CKD, and serum creatinine levels were recorded for each patient.
3. **Thyroid Profile:**
   - **TSH (Thyroid-Stimulating Hormone)**: Measured in µIU/mL.
   - **Free T3 (Triiodothyronine)**: Measured in pmol/L.
   - **Free T4 (Thyroxine)**: Measured in pmol/L.
   - **Total T3 (Triiodothyronine)**: Measured in nmol/L.

These thyroid parameters were assessed using standard immunoassay techniques in the hospital's laboratory.

4. **Lipid Profile:**
   - **Total Cholesterol**: Measured in mg/dL.
   - **Triglycerides**: Measured in mg/dL.
   - **LDL (Low-Density Lipoprotein)**: Measured in mg/dL.
   - **HDL (High-Density Lipoprotein)**: Measured in mg/dL.

Lipid levels were determined using enzymatic colorimetric methods.

5. **Renal Function:** GFR was estimated using the MDRD formula, and patients were classified into the corresponding CKD stages.

Statistical Analysis

All data were entered into a computerized database for statistical analysis. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Mean ± standard deviation (SD) was calculated for continuous variables, and frequencies and percentages were used for categorical variables.

RESULTS

Table 1: Classification of Chronic Kidney Disease Based on MDRD Formula (GFR)

GFR (ml/min/1.73m²)	Number of Patients	Percentage (%)
> 60 (Normal/Stage 1)	45	34.6%
30-59 (Stage 2-3)	50	38.5%
15-29 (Stage 4)	20	15.4%
< 15 (Stage 5/ESRD)	15	11.5%
Total	**130**	**100%**

The table presents the distribution of patients based on their Glomerular Filtration Rate (GFR) levels, which is used to assess kidney function. Out of 130 patients, 45 (34.6%) had a GFR greater than 60, indicating normal kidney function or Stage 1. The largest group, 50 patients (38.5%), had GFRs between 30-59, corresponding to Stage 2-3 kidney disease. A total of 20 patients (15.4%) were in Stage 4 with GFRs between 15-29, and 15 patients (11.5%) were in Stage 5/End-Stage Renal Disease (ESRD) with GFRs less than 15.

Table 2: Thyroid Profile in Chronic Kidney Disease Patients

Thyroid Parameter	Stage 1 (GFR > 60)	Stage 2-3 (GFR 30-59)	Stage 4 (GFR 15-29)	Stage 5/ESRD (GFR < 15)
TSH (µIU/mL)	2.3 ± 0.8	3.5 ± 1.1	4.7 ± 1.3	5.2 ± 1.4
Free T3 (pmol/L)	3.5 ± 1.0	3.1 ± 0.8	2.5 ± 0.9	2.0 ± 0.6

Free T4 (pmol/L)	18.2 ± 3.5	17.5 ± 4.0	16.2 ± 4.5	15.0 ± 3.0
Total T3 (nmol/L)	1.6 ± 0.5	1.4 ± 0.4	1.2 ± 0.5	1.0 ± 0.3

The thyroid-stimulating hormone (TSH) levels significantly increase with the progression of chronic kidney disease (CKD). Patients in later stages of CKD (Stage 4 and Stage 5) show higher TSH levels, while Free T3 and Free T4 levels decrease, indicating hypothyroidism, which is commonly observed in patients with CKD.

Table 3: Lipid Profile in Chronic Kidney Disease Patients

Lipid Parameter	Stage 1 (GFR > 60)	Stage 2-3 (GFR 30-59)	Stage 4 (GFR 15-29)	Stage 5/ESRD (GFR < 15)
Total Cholesterol (mg/dL)	190 ± 25	210 ± 30	230 ± 35	245 ± 40
Triglycerides (mg/dL)	145 ± 35	160 ± 40	190 ± 45	210 ± 50
LDL (mg/dL)	110 ± 22	120 ± 25	135 ± 30	140 ± 33
HDL (mg/dL)	50 ± 8	45 ± 10	40 ± 9	35 ± 7

As CKD progresses, total cholesterol, triglycerides, and LDL levels increase significantly, while HDL levels decrease. This pattern reflects the dyslipidemia commonly observed in CKD patients, which increases the risk of cardiovascular diseases. The severity of lipid abnormalities worsens with reduced kidney function.

Table 4: Correlation Between Thyroid Profile and Lipid Profile

Thyroid Parameter	Total Cholesterol (mg/dL)	Triglycerides (mg/dL)	LDL (mg/dL)	HDL (mg/dL)
TSH (µIU/mL)	0.35 (p = 0.02)	0.38 (p = 0.01)	0.42 (p = 0.03)	-0.30 (p = 0.04)
Free T3 (pmol/L)	-0.40 (p = 0.05)	-0.36 (p = 0.04)	-0.45 (p = 0.02)	0.32 (p = 0.03)
Free T4 (pmol/L)	-0.28 (p = 0.10)	-0.26 (p = 0.08)	-0.31 (p = 0.05)	0.23 (p = 0.09)

There is a significant positive correlation between TSH levels and total cholesterol, triglycerides, and LDL levels, suggesting that hypothyroidism may exacerbate dyslipidemia in CKD patients. Conversely, Free T3 levels have a negative correlation with these lipid parameters, further reinforcing the impact of thyroid dysfunction on lipid metabolism in CKD.

Table 5: Clinical Parameters and Association with Thyroid and Lipid Profile in CKD Patients

Clinical Parameter	Mean ± SD	Correlation with TSH (p-value)	Correlation with Lipid Parameters (p-value)
Age (years)	58 ± 12	0.03	0.04
Duration of CKD (years)	5.5 ± 3.0	0.01	0.02
Blood Pressure (mmHg)	145/90 ± 12/8	0.05	0.01
Serum Creatinine (mg/dL)	4.5 ± 1.2	0.02	0.03

The duration of CKD and serum creatinine levels are significantly associated with higher TSH levels and altered lipid profiles. This highlights the relationship between kidney function, thyroid dysfunction, and lipid disturbances. Blood pressure also appears to influence both thyroid and lipid parameters in CKD patients.

DISCUSSION

The current study highlights major changes in thyroid activity and lipid levels at various CKD stages, which are in line with the available literature. Your results of a progressive TSH or decreased Free T3 and Free T4 in the advanced CKD (Stages 4 and 5) are consistent with other literature publications stating the high incidence of hypothyroidism and low T3 syndrome in advanced kidney disease. The same studies by Mohamedali et al. (2014)[13] coupled with Kashif et al. (2023)[14] also found that thyroid dysfunction is coupled with a progressive reduction in the glomerular filtration rate (GFR), which denoted deteriorating hormonal imbalances at the later stages of CKD.

The acquired lipid patterns, which are the increased level of total cholesterol, triglycerides, and LDL cholesterol with a decreased one of HDL, can be compared to the results of Saini et al. (2022)[15] and Zoccali et al. (2011), [16] who reported the presence of dyslipidemic states. These researchers emphasized that the abnormalities of lipids worsen with the decline of kidney functions, which aggravates the cardiovascular risk of CKD patients dramatically.

Notably, correlations between thyroid hormones and lipid parameters have been demonstrated by YOUR study and there are previous reports focusing on the mutual relationship between thyroid dysfunction and dyslipidemia, that is bidirectional in CKD. The second finding of TSH positively correlating with total cholesterol, triglycerides, LDL and negative relation with Free T3 with further implication on exacerbating hypothyroidism in lipid derangements and thus posing a cardiovascular risk are identical to those of investigations by Ruchitha et al. (2018) [17]and the 2015 cross-sectional study of the Indian Journal of Endocrinology and Metabolism, reflecting the adverse impact of hypothyroidism on lipid imbalances and consequential card.

Previous studies also noted clinical parameters like the duration of CKD, the level of serum creatinine, and blood pressure which further regulated other thyroid and lipid imbalances. Similar trends were observed in Trivedi et al. (2021)[18] who highlighted the gradual progress of metabolic disturbances further indicating the presence of renal deterioration and associated hypertension as an aggravating factor.

A combination of these convergent results adds strength to the argument of early and frequent testing of thyroid as well as lipid profiles in CKD patients as it is suggested in various nephrological guidelines. The evidence provided by your results can be further supported to state that integrative management to solve the issue of thyroid dysfunction, dyslipidemia, can help reduce cardiovascular morbidity and possibly arrest CKD progression. Nonetheless, as in previous research, the studies are valued to be bigger and longitudinal in nature to investigate the substantial clinical advantages of these kinds of interventions.

CONCLUSION

Our research sheds light on how there is a strong correlation between lipid abnormalities and thyroid dysfunction in chronic kidney disease (CKD) patients. Currently, CKD leads to the elevation of TSH, a decline in Free T3 and Free T4 levels, meaning that a hypothyroid state has been established, and in severe conditions, further exacerbated. Meanwhile, lipid profiles become worse, and there is a rise in total cholesterol, triglycerides, and LDL and a fall in HDL. An increase in TSH is as well positively correlated with lipid parameters, indicating that hypothyroidism could worsen dyslipidemia in CKD, whereas the free T3 had a negative correlation. These metabolic perturbations are also affected by clinical variables, such as the length of CKD development, creatinine serum, and blood pressure. These results support the idea that thyroid status and lipid profile should be closely monitored and treated in CKD patients to reduce cardiovascular complications.

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