e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(1); 1338-1341

Original Research Article

Evaluation of Thyroid Hormone Level and Lipid Profile in Chronic Kidney Disease Patients

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Received: 25-10-2023 / Revised: 23-11-2023 / Accepted: 26-12-2023
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Conflict of interest: Nil

Abstract:

Background: Low glomerular filtration rate and impaired kidney function are associated with chronic kidney disease (CKD). Indian research demonstrating the pathophysiological relationship between CKD and lipid profile has shown almost no lipid profile abnormalities in CKD to patho-physiologically noteworthy alterations in lipid profile in patients with CKD, such as elevated triglycerides and decreased high-density lipoprotein levels. This study aims to quantify thyroid hormone levels and investigate correlations between lipid profiles and thyroid hormone levels in patients with chronic renal disease.

Methods: In order to measure serum Total T3, T4, TSH, and serum lipid profile in undialyzed CKD patients and compare them with healthy controls, the current study was conducted on these patients. There were 130 participants in the study group. Of these, forty (Group 2) are in stage 3 of CKD, thirty (Group 3) are in stages 4 and 5 of CKD, and fifty (Group 1) were in age and sex-matched controls.

Results: Comparing CKD patients to the control group, serum total T3, T4, and HDL showed decreases, while TSH and other lipid profile indicators showed increases. As a result, dyslipidemia and thyroid dysfunction are linked to CKD.

Conclusion: This study demonstrates the strong correlation between the advancement of CKD and thyroid disease and dyslipidemia, as well as the prevalence of these conditions in CKD patients.

Keywords: CKD, GFR, Thyroid, Dyslipidemia.

Introduction

The term "chronic kidney disease" (CKD) describes a variety of pathophysiological mechanisms associated with reduced kidney function and a sustained decline in glomerular filtration rate (GFR). [1] Both the estimated GFR and the level of albumin in the urine are used to categorize different phases of chronic renal disease. [2]

Several clinical processes in chronic kidney disease (CKD) lead to the loss of renal excretory, synthetic, endocrine, and metabolic activities because of the accumulation of various nitrogenous substances. [1]

Indian research has demonstrated the pathophysiological relationship between CKD and lipid profile, from nearly no lipid profile abnormalities in CKD to pathophysiologically noteworthy differences in lipid profile in patients with CKD, such as elevated triglycerides and low levels of high-density lipoprotein [HDL]. Numerous studies have demonstrated that individuals with CKD have aberrant lipid profiles, including high levels of hypertriglyceridemia, higher total cholesterol, and low HDL. Thyroid dysfunction is frequently indicated by symptoms such as dry skin, cold sensitivity, low basal metabolic rate, lethargy, edema, and a sallow complexion in individuals with chronic kidney disease (CKD).[3–7] There have been several studies on thyroid function in uremic patients, with differing results. Hypothyroidism, hyperthyroidism, and euthyroidism have all been reported by different workers.[8] Iodine, a necessary ingredient in the synthesis of thyroid hormone, is eliminated from the bloodstream under healthy conditions by glomerular filtration. The 'Wolff Chaikoff effect' is a condition in which the production of thyroid hormone is decreased due to a build-up of iodine in the blood after a progressive decline in GFR in chronic kidney disease. Consequently, the quantities of free

triiodothyronine [T3] and serum total were below normal. Thyroxine [T4] concentrations both total and free, are categorized as low, normal, or high.

Serum TSH levels were found to be normal in the majority of CKD patients. Between 0% and 9% of patients with end-stage renal disease (ESRD) are predicted to have hypothyroidism.[1] Previous research has identified thyroid problems, including euthyroidism, hyperthyroidism, and hypothyroidism, in people with chronic kidney disease (CKD).[9]

Material and Methods

This study was conducted at Department of Biochemistry, Patna Medical College, Patna, Bihar from July 2022 to June 2023.

Simple random sampling of patients who presented to our hospital, spanning both sexes and age groups from 30 to 70 years, was used to choose the patients. Renal function tests and the clinical profile of the patients led to the diagnosis of CKD. Prior to the collection of a blood sample, the patients and controls provided their informed consent. Every patient has a moderate-to-severe CKD diagnosis. The MDRD formula was utilized to compute eGFR. In the current study, eGFR < 30 ml/min was classified as severe CKD (Stages 4 & 5) and eGFR between 30 and 60 ml/min was classified as moderate CKD (Stage 3). Patients with history of hyper or hypothyroidism, CKD patients who were or underwent previous dialysis, obesity, Nephrotic Syndrome, patients on estrogens, corticosteroids, anti-thyroid drugs, dietary supplements and pregnant woman etc were excluded in this study. All included 130 patients divided in into three groups: Group 1: CONTROLS - 50 age and sex matched normal individuals, Group 2: CASES – 40 patients with moderate CKD and Group 3: CASES - 30 patients with severe CKD.

A 3-milliliter sample of fasting venous blood was taken from every participant. After that, the blood samples were placed into sterile, clean centrifuge tubes and given time to coagulate. To extract the serum, each clotted sample was centrifuged at 3000 rpm for 3 minutes at room temperature. Using a micropipette, the serum was extracted from the mixture and put into appendroff tubes. The biochemical test was completed in a day after the sample was collected.

Using the Beckman Coulter Chemi luminescent immunoassay (CLIA), total T3, T4, and TSH were measured. T3: 0.7-2.0 ng/ml, T4: 4.5-12.5 ng/ml, and TSH: 0.4-4.0 μU/ml were the reference ranges. The ERBA Semiautoanalyzer was used to analyze the lipid profile, which includes total cholesterol, triglycerides, and HDL cholesterol. Using Friedewald's technique, serum triglycerides and LDL cholesterol were determined.

The acquired data were subjected to analysis using the Student's t-test, with a significance threshold of $p < 0.05$. Highly statistically significant was defined as $p < 0.001$, and extremely statistically significant as $p < 0.0001$. Every outcome was shown as Mean ± SD.

Results

The results obtained for various parameters are tabulated as follows –

Table 1: Renal and Thyroid profile in CKD patients vs Controls

Value (mg/dl)	Group 1 (n=50)	Group 2 (n=40)	Group 3 (n=30)	Group 2 + Group 3
Urea	29.56±5.43	56.21±3.89	88.70±13.12	70.01±18.55
Creatinine	0.81±0.24	1.72±0.13	5.87±1.42	3.49±2.25
Total T_3	1.45±0.36	1.25±0.52	1.02±0.42	1.15±0.49
Total T_4	8.17±1.67	7.58±0.82	7.29±0.58	7.45±0.74
Total TSH	2.28±0.99	2.36±0.76	2.45±0.83	2.40±0.79

From the above data (Table 2) it was observed that the thyroid profile parameters were elevated in both Group 2 & 3, compared to control subjects (Group 1).

Table 2: Lipid profile parameters in CKD patients vs Controls

Value (mg/dl)	Group 1 (n=50)	Group 2 (n=40)	Group 3 (n=30)	Group 2 + Group 3
Total-C	179.62±15.61	214.17±21.54	221.03±22.24	217.11±22.10
Triglycerides	141.07±10.86	188.87±19.81	200.60±29.82	193.90±25.27
HDL-C	38.40±3.66	34.52±3.19	33.23±4.68	34.40±3.90
VLDL-C	28.22±2.19	37.82±4.07	40.16±5.97	38.82±5.11
LDL-C	102.62±18.28	142.90±21.10	151.30±25.47	146.50±23.45

From the above data (Table 2) it was observed that the lipid profile parameters were elevated in both Group 2 & 3, compared to control subjects (Group 1).

Table 3:

	P value (Gr. 2/Gr.1)	P value (Gr. 3/Gr.1)	P value (Gr. 3/Gr.2)	P value (Gr. 2+3/Gr.1)
Total T_3	0.0342*	<0.0001***	0.0513$^{n.s}$	0.0004***
Total T_4	0.0439*	0.0068**	0.1034 $^{n.s}$	0.0018**
Total TSH	0.6746$^{n.s}$	0.4329$^{n.s}$	0.6389 $^{n.s}$	0.4622 $^{n.s}$
Total – C	<0.001**	<0.001**	0.197 $^{n.s}$	<0.001**
Triglycerides	<0.001**	<0.001**	0.052 $^{n.s}$	<0.001**
HDL-C	<0.001**	<0.001**	0.174 $^{n.s}$	<0.001**
VLDL-C	<0.001**	<0.001**	0.055 $^{n.s}$	<0.001**
LDL-C	<0.001**	<0.001**	0.136 $^{n.s}$	<0.001**

*** Statistically extremely significant, **very significant, *significant, $^{n.s}$ not significant

Discussion

Thyroid dysfunction and dyslipidemia were noted in CKD patients in the current investigation. Comparing the total T3 and T4 readings to the control group revealed a substantial decrease.

The primary source of T3, peripheral deiodination of T4, is impaired and can lead to a decrease in total T3 values [10]. In the current investigation, we did not find a statistically significant decrease in serum T3 in individuals with severe CKD relative to those with moderate CKD. Thyroid hormone Binding Globulin (TBG) is coupled to the majority of circulating T4. T4 ability to bind to proteins is inhibited by toxic uremic solutes such creatinine and urea.[11] Low T4 levels are seen because CKD is linked to elevated blood urea and creatinine concentrations. In our current investigation, there was no discernible drop in serum T4 in individuals with severe CKD compared to those with moderate CKD.

In contrast, our current study's data on serum TSH levels did not reveal a statistically significant increase in CKD patients relative to the control group. Its intact thyroid-pituitary axis [13] and inhibited responsiveness to thyroid releasing hormone (TRH)[12] may be the causes of this. In addition to the previously mentioned processes, thyroid dysfunction in individuals with chronic kidney disease (CKD) has also been linked to systemic inflammation [14,15] and metabolic acidosis [16].

Excess LDL cholesterol, hypertriglyceridemia, and hypercholesterolemia are caused by CKD's impact on lipoprotein metabolism [17]. In the current investigation, CKD patients had significantly higher levels of all lipid profile indicators (with the exception of HDL cholesterol) than the control group. Reduced catabolism is the main mechanism behind the rise in triglyceride content [18]. The downregulation of the apo C-II gene [19] and the presence of lipase inhibitors [20] have resulted in decreased lipoprotein lipase activity, which is the cause of the decreased catabolic rate. While apolipoprotein CII is an activator of lipoprotein lipase, apolipoprotein C-III is a strong inhibitor of the enzyme. Lipoprotein lipase inactivation in chronic kidney disease (CKD) may be caused by a drop in the apolipoprotein C-II/C-III ratio as a result of an unequal increase in plasma apolipoprotein C-III [21, 22]. Reduced catabolism of chylomicrons and intermediates, such as chylomicron remnants and VLDL remnants, is another effect of reduced activity of lipoprotein lipase and hepatic lipase, which raises the quantities of these substances [23].

Additionally, patients with chronic kidney disease (CKD) have lower levels of the primary HDL protein constituents, apolipoproteins AI and AII [24], lower activity of the enzyme LCAT (which is responsible for esterifying free cholesterol in HDL particles) [25,26], and higher activity of cholesteryl ester transfer protein (CETP)[27], which makes it easier for cholesterol esters to move from HDL to triglyceride-rich lipoproteins, lowering serum concentrations of HDL-cholesterol.

Conclusion

The results of this study offer important insights into the relationship between patients with chronic renal disease, aberrant lipid profiles, and thyroid issues. The advancement of renal disease and the risk of cardiovascular disease are both influenced by thyroid dysfunction and dyslipidemia. Therefore, we advise CKD patients to get their thyroid and lipid profile checked on a regular basis.

References

1. Levey AS, Coresh J, Balk E, Kausz AT, Levin A, Steffes MW, *et al.*. National Kidney Foundation practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Ann Intern Med. 2003 Jul 15; 139[2]: 137-47.
2. Helou R. Should we continue to use the Cockcroft-Gault formula? Nephron Clin Pract. 2010; 116[3]: c172-85; discussion c186.
3. Choudhary N. A study of lipid profile in chronic kidney disease in pre- dialysis patients. Int J Med Res Rev. 2019 Jun; 7[3]:150-6.
4. Khatiwada S, Kc R, Sah SK, Khan SA, Chaudhari RK, Baral N, Lamsal M. Thyroid Dysfunction and Associated Risk Factors

among Nepalese Diabetes Mellitus Patients. Int J Endocrinol. 2015; 2015: 570198.
5. Peters J, Roumeliotis S, Mertens PR, Liakopoulos V. Thyroid hormone status in patients with impaired kidney function. Int Urol Nephrol. 2021 Nov; 53[11]: 2349-2358.
6. Narasaki Y, Sohn P, Rhee CM. The Interplay between Thyroid Dysfunction and Kidney Disease. Semin Nephrol. 2021 Mar; 41[2]:133-143.
7. Praw SS, Way JSA, Weiss R. Evaluating Thyroid Function Tests in Patients with Kidney Disease. 1st ed. Switzerland: Springer International Publishing; c2019. Chapter 7, Endocrine Disorders in Kidney Disease; p. 85-96.
8. Mohammed Shamsuddin, Makandar Asmabi. Comparative Study of Thyroid Abnormalities with Severity of Chronic Renal Failure. J of Evolution of Med and Dent Sci. 2015;4[80]:14039-14047.
9. Spector DA, Davis PJ, Helderman JH, Bell B, Utiger RD. Thyroid function and metabolic state in chronic renal failure. Ann Intern Med. 1976 Dec; 85[6]:724-30.
10. Hoschestetler LA, Flanigan MJ, Lim VS. Abnormal endocrine tests in hemodialysis patient. J Am Soc Nephrol, 1994; 4(10):1754-1759.
11. Zoccali C, Tripepi G, Cutrupi S, Pizzini P, Mallamaci F. Low triiodothyronine: A new facet of inflammation in end-stage kidney disease. J Am Soc Nephrol 2005; 16:2789–2795.
12. Kaptein EM. Thyroid hormone metabolism and thyroid diseases in chronic renal failure. Endocrine Reviews: 1996; 17:45-63.
13. Ramirez G, O Neill W, Jubiz W, Bloomer HA. Thyroid dysfunction in uremia: evidence for thyroid and hypophysial abnormalities. Annals of Internal Medicine: 1976; 84:672-676.
14. Carrero JJ, Qureshi AR, Axelsson J, Yilmaz MI, Rehnmark S, Witt MR *et al*. Clinical and biochemical implications of low thyroid hormone levels (total and free forms) in euthyroid patients with chronic kidney disease. J Intern Med 2007; 262:690–701.
15. Wiederkehr MR, Kalogiros J, Krapf R. Correction of metabolic acidosis improves thyroid and growth hormone axes in hemodialysis patients. Nephrol Dial Transplant 2004; 19: 1190-1197. 28.
16. Yilmaz MI, Sonmez A, Karaman M, Ay SA, Saglam M, Yaman H. Low triiodothyronine alters flow mediated vasodilatation in advanced nondiabetic kidney disease. Am J Nephrol 2011; 33:25-32.
17. Tsimihodimos V, Mitrogianni Z, Elisaf M. Dyslipidemia associated with chronic kidney disease. Open Cardiovasc Med J. 2011;5:41–8.
18. Prinsen BH, de Sain-van der Velden MG, de Koning EJ, Koomans HA, Berger R, Rabelink TJ. Hypertriglyceridemia in patients with chronic renal failure: possible mechanisms. Kidney Int Suppl 2003; 84:S121-4.
19. Vaziri ND, Liang K. Down-regulation of tissue lipoprotein lipase expression in experimental chronic renal failure. Kidney Int 1996; 50:1928-35.
20. Cheung AK, Parker CJ, Ren K, Iverius PH. Increased lipase inhibition in uremia: identification of pre-beta-HDL as a major inhibitor in normal and uremic plasma. Kidney Int 1996; 49:1360-71.
21. Chan DT, Dogra GK, Irish AB. Chronic kidney disease delays VLDL apo B-100 particle catabolism: potential role of apo C-III. J Lipid Res 2009; 50:2524-31.
22. Bagdade J, Casaretto A, Albers J. Effects of chronic uremia, hemodialysis, and renal transplantation on plasma lipids and lipoproteins in man. J Lab Clin Med 1976; 87:38-48.
23. Weintraub M, Burstein A, Rassin T. Severe defect in clearing postprandial chylomicron remnants in dialysis patients. Kidney Int. 1992; 42:1247-1252.
24. Vaziri ND, Deng G, Liang K. Hepatic HDL receptor, SRB1 and Apo A-I expression in chronic renal failure. Nephrol Dial Transplant 1999; 14:1462-6.
25. Vaziri ND, Liang K, Parks JS. Down-regulation of hepatic lecithin: cholesterol acyltransferase gene expression in chronic renal failure. Kidney Int 2001; 59:2192-6.
26. Guarnieri GF, Moracchiello M, Campanacci L. Lecithincholesterol acyltransferase (LCAT) activity in chronic uremia. Kidney Int Suppl 1978; S26-S30.
27. Kimura H, Miyazaki R, Imura T. Hepatic lipase mutation may reduce vascular disease prevalence in hemodialysis patients with high CETP levels. Kidney Int 2003; 64:1829-37.