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Thyroid Hormone Profile in Chronic Kidney Disease Patients Handled Conservatively or by Haemodialysis

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Abstract

Background: There is an interdependency between thyroid hormones and renal function. Chronic Kidney Disease (CKD) is a degradation of renal function that is irreversible.

Aimsand Objectives: To compare the thyroid hormone profiles of CKD patients receiving two distinct therapeutic approaches.

Materials and methods: Over the course of one year, 200 newly diagnosed or known patients withCKD were recruited for a cross-sectional study. Group 1 consisted of 100 CKD patients treated conservatively, whereas Group 2 consisted of 100 CKD patients on haemodialysis. Fasting Blood Glucose (FBG), Serum urea (S. Urea), Serum Creatinine (S. Creatinine), and a thyroid hormone profile were all measured. Estimated Glomerular Filtration Rate (eGFR) was calculated using the Cockcroft-Gault formula.

Results: The mean age of patients in Group 1 was 51.04 years and in Group 2 it was 53.20 years. S. Creatinine, S. Urea, and eGFR values changed significantly between the two treatment groups. In 36% of instances, a thyroid malfunction was present. Only FT4 differed significantly across the two groups ($p = 0.026$)**Conclusion:**Low levels of the thyroid hormones FT3, FT4, TT3, and TT4 were detected in all CKD cases. However, no significant differences in thyroid status were found between haemodialysis patients and non-dialysis patients.

Keywords: Chronic Kidney Disease, Conservative Management, Haemodialysis, Thyroid Hormones

Introduction

Importantly, kidneys perform other homeostatic tasks in addition to their excretory role. Therefore, it is more accurate to refer to kidneys as regulatory organs than excretory organs. The kidneys regulate osmolality and volume of body fluids, electrolyte balance, acid-base balance, hormone production and secretion, and the elimination of metabolic waste and foreign substances.

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The Kidney exemplifies, to the greatest extent, the phenomena of sensitivity, the capacity to respond to a variety of stimuli in a manner conducive to the survival of the organism, and a capacity for adaptation that nearly gives the impression that its components are endowed with intelligence.

Triiodothyronine (T3) and thyroxine (T4) are necessary for controlling metabolism, growth, and protein synthesis. In addition, these hormones can have an important impact on kidney disease. T4 is only produced by the thyroid gland. Moreover, the majority of T3 and reverse T3 (rT3) are generated by the peripheral enzymatic deiodination of T4 in the liver, kidney, skeletal muscle, heart, and brain. Kidneys are necessary for thyroid hormone metabolism, breakdown, and elimination. In patients with severe kidney illness, thyroid dysfunction takes on certain characteristics.[1]

A fascinating subject is how thyroid hormone levels influence the course of chronic renal disease. Various abnormalities in thyroid hormone levels and metabolism have been described in people with this condition.[2,3]

In recent years, a worldwide increase in chronic kidney disease (CKD) has placed a significant burden on the healthcare system in this region of the world. Concerns also surround thyroid dysfunction in CKD. Keeping in mind the lack of information in this area, the present study was done to examine thyroid dysfunction in patients with CKD. The thyroid dysfunction of CKD patients undergoing conservative treatment (CM) versus haemodialysis (HM) was evaluated to identify any differences**.**

Aims and Objectives

To evaluate the pattern of Thyroid profile, i.e., serum-free Triiodothyronine (FT3), free Thyroxine (FT4), total T3 (TT3), total T4 (TT4), and Thyroid stimulating hormone (TSH), in CKD patients treated with a conservative approach and haemodialysis.

Materials and Methods

Study design:

Cross-sectional research

Study settings:

A hospital-based study involving 200 males and females with newly diagnosed or known cases of CKD, regardless of disease duration, was conducted at a teaching hospital in Northern India. The purpose and protocol of the study were outlined, and all participants gave their written informed consent. Each patient received a thorough medical history and physical examination.

Study Participants: The study participants were selected as follows:

Inclusion Criteria:

1. Age restrictions between 20 and 80 years of age
2. More than or equal to 1.4 mg/dL of serum creatinine.
3. Estimated creatinine clearance below 60 ml/min (using Cockcroft-Gault formula)[4]

Exclusion criteria:

1. Diagnosed hypothyroidism and hyperthyroidism cases
2. Post renal transplant patients
3. People taking drugs capable of altering the Thyroid profile
4. Pregnant woman.
5. Individuals who rejected to participate in the study

Two groupings of cases were created.

Group 1 consists of 100 patients managed conservatively for CKD (CM)

100 haemodialysis cases comprise Group 2 (HM)

Laboratory Analysis:

Each patient donated 5 mL of venous blood for biochemical analysis.

1. Serum urea
2. Concentration of Creatinine in Serum
3. The clearance of creatinine and
4. Serum FT3, FT4, TT3, TT4, and TSH

Statistical analysis:

All study-generated data were entered into MS Excel 2019 version. SPSS 22.0 was used to conduct the statistical analysis. Using the unpaired Student's t-test, we compared the normally distributed study group data. The Mann-Whitney U and Wilcoxon W tests were used to examine non-normally distributed data. Less than 0.05 was considered statistically significant.

Results

The study comprised 200 cases of CKD, 129 of which were male and 71 of which were female. The ages of our volunteers ranged from 21 to 79 years old. The mean age of patients getting conservative therapy was 51.04 years, while those receiving haemodialysis were 53.20 years old on average. In Group 1, the ratio of males to females was 66 to 34, while in Group 2 it was 63 to 37. The data from the study are reported in Tables 1 to 3 below.

Table 1: Baseline biochemical parameters for Patients in Group 1 and Group 2

Parameter	Group 1 (N=100) Mean ±SD	Group 2 (N=100) Mean± SD	p-value
S.Creatinine(mg/dl)	2.79± 0.70	7.66± 3.25	0.000*
S.Urea (mg/dl)	85.86± 10.90	131.91± 25.97	0.000*
eGFR (ml/min)	26.75± 8.54	9.93± 3.23	0.000*

Table 2: Thyroid status in CKD cases

Thyroidstatus	Number of patients (percentage of total)
a) Euthyroid	128 (64%)
b) Euthyroidsicksyndrome	56 (28%)
c) Subclinicalhypothyroidism	16 (8%)
Total	200 (100 %)

Table 3: Comparison of Thyroid Profile of CKD Patients Based on Treatment Modality

Parameters	Group1 (N=100)		Group2 (N=100)		p-value
	Mean±SD	Rank	Mean±SD	Rank	
FT3 (pg/ml)	2.25±0.50	104.23	2.17±0.67	96.78	0.36
FT4(ng/dl)	1.10±0.18	91.4	1.05±0.15	109.61	0.02*
TT3(ng/ml)	0.94±0.28	96.84	0.93±0.23	104.16	0.37
TT4 (µg/dl)	6.99±2.07	102.07	6.98±1.67	98.94	0.70
TSH(µIU/ml)	2.19±1.35	97.08	2.62±2.24	103.92	0.40

*statisticallysignificant

Group 1 and Group 2 patients receiving conservative and hemodialysis therapies; mean/rank of various thyroid hormones. Group 1 had an FT3 concentration of 2.25 pg/ml, while Group 2 had a value of 2.17 pg/ml. In Group 1, the FT4 concentration was 1.10 ng/dl, but in Group 2, it was 1.05 ng/dl. Group 1 had a TT3 value of 0.94 ng/ml, while Group 2 had a concentration of 0.93 ng/ml. In Group 1, the concentration of TT4 was 6.99 µg/dl, while in Group 2 it was 6.98 µg/dl. In Group 1, TSH levels were 2.19 µIU/ml, whereas they were 2.62 µIU/ml in Group 2. Consequently, FT3, FT4, TT3, and TT4 were lower, although TSH was higher in the hemodialysis patient, indicating that haemodialysis affected the thyroid profile. In contrast, only FT4 demonstrated statistically significant variations between the two groups (p = 0.026).

Discussion

CKD is defined as abnormalities of kidney structure with signs of kidney damage or function and a GFR of less than 60 ml/min per 1.73 m^2 that have been present for at least three months and have health consequences. End-stage renal disease (ESRD) is the final stage of chronic renal disease (stage 5) characterized by a GFR of less than 15 ml/min/1.73 m^2. 5-10% of the global population is affected by CKD, making it a worldwide public health concern. Recent reports of a rise in the prevalence of chronic kidney disease (CKD) in developing Asian nations have been linked to a rise in concomitant diseases such as type 2 diabetes, hypertension, and cardiovascular disease (CVDs).[5] KDIGO's (2012) Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease includes the following treatment options: Renal Replacement Therapy, comprising peritoneal dialysis, hemodialysis, and kidney transplantation.Patients in the first stages of CKD or ESRD who prefer not to undergo RRT have the option of conservative therapy. Candidates seeking a kidney transplant must undergo dialysis until a suitable donor kidney is obtained.[6] Thyroid dysfunction is an additional symptom of CKD.

The average age of our study population was similar to that of Avasthi G et al.[7] According to these findings, elderly patients are more susceptible to CKD.Age is connected with a fivefold increase in the probability of passing away within 90 days of beginning dialysis.[8]

There were 129 male patients (64.5% of the study population) and 71 female patients (35.5%), giving a male-to-female ratio of 1.80:1. Compared to the study by Hossain M et al., the ratio of males to females was greater. [9] Among both trials, male participants outnumbered females, demonstrating that CKD is significantly more common in men.

In our investigation, the majority of CKD cases (64%), followed by euthyroid sick syndrome (28%) and subclinical hypothyroidism (8%), demonstrated euthyroidism. A Nepalese study of haemodialysis patients revealed a frequency of subclinical and clinical hypothyroidism of 26.6 percent. [10]

According to Lo JC, when GFR drops, the frequency of subclinical hypothyroidism continuously rises.[11]Quion Verde H et al. found a significant prevalence (5%) of hypothyroidism among persons with end-stage renal failure. [12]

No hypothyroidism or hyperthyroidism symptoms were detected in the participants of this investigation. On occasion, certain patients experienced overlapping physical symptoms of CKD and hypothyroidism, such as facial puffiness and pedal oedema. No patient was identified as having thyromegaly. Contrary to the findings of Silverberg DS et al. and Lim VS et al.[13,14], the absence of goitre in our investigation is consistent with that of Mehta HJ et al.[15]

Thyroid function in CKD is distinguished from primary hypothyroidism by low thyroid hormone levels and normal TSH levels. In primary hypothyroidism, elevated TSH levels accompany low thyroid hormone levels.

Comparing Group 1 and Group 2, low FT3 levels were seen in 19 instances of Group 1 and 37 cases of Group 2, indicating a progression of CKD stage. In three cases of Group 1 and four cases of Group 2, low FT4 was identified, and each case indicated progression with increasing CKD stage. Ten patients in Group 1 and seventeen cases in Group 2 were found to have low TT3 levels, and in both groups, the values dropped as the stage progressed. 8 instances of Group 1 and 12 cases of Group 2 were found to have low TT4 levels; the values for each case declined with the progression of the CKD stage.In contrast, seven instances in Group 1 displayed elevated TSH levels with varying average percentages of thyroid profile, compared to nine cases in Group 2; each case exhibited an increase in TSH levels as the disease progressed. The average values for additional issues were low in both study groups. Group 2 cases had lower FT3, FT4, TT3, and TT4 levels, whereas TSH levels were greater; however, only FT4 levels were statistically different (p=0.026).

Singh S reported low FT3 levels in 33.98% of CKD haemodialysis patients and low FT4 levels with normal TSH levels in 18.44% of cases.[16]

Similarly, Srivastava S et al. found significantly lower FT3 and free thyroxine FT4 (P <0.001 for each)

in undialyzed CKD patients, whereas TSH levels were unaltered in both patients and controls.[17]According to Zoccali et al., a decrease in FT3 in CKD patients is indicative of inflammation.[18]ESRD patients' increased TSH levels can be explained by the severity of their ailment. Joseph et al. show that when renal insufficiency develops, TSH levels rise.[19] The outcomes of this study demonstrate the importance of routine screening and treatment of thyroid dysfunction in CKD patients for improved clinical management and, subsequently, improved quality of life.

Recommendations:

1. Low FT3 levels have been demonstrated to be an independent predictor of mortality in haemodialysis patients; hence, its levels should be routinely evaluated as part of the haemodialysis panel in order to reduce morbidity and enhance the quality of life in CKD cases.

2. Low FT3 levels are associated with an increased risk of graft loss after transplantation; consequently, it is essential for nephrologists to monitor thyroid levels in patients prior to renal transplantation.

Conclusion

In cases of CKD, the thyroid hormones FT3, FT4, TT3, and TT4 were all at low levels despite a nearly normal TSH, and this condition worsens as CKD progresses. There was no significant difference in thyroid status between patients on dialysis and those not on dialysis.

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Ethical Clearance: Received

References

1. Kaptein EM, Quion-Verde H, Chooljian CJ, Tang WW, Friedman PE, Rodriquez HJ, Massry SG. The thyroid in end-stage renal disease. Medicine (Baltimore).1988 May;67(3):187-97.
2. Gupta A, Kuldeep K, Virmani SK, Arora M. Thyroid dysfunction in patients of chronic kidney disease. Int J Adv Med. 2017;4:1333-1337.
3. Thomas R, Kanso A, Sedor JR. Chronic kidney disease and its complications. Prim Care. 2008;35:329-344.
4. Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. Nephron. 1976; 16(1): 31-41.
5. Tsukamoto Y, Wang H, Becker G, Chen HC, Han DS, Harris D, Imai E, Jha V, Li PK, Lee EJ. Matsuo S, Tomino Y, Tungasanga K, Yamagata K, Hishida A. Report of the Asian Forum of Chronic Kidney Disease Initiative (AFCKDI) 2007. "Current status and perspective of CKD in Asia": diversity and specificity among Asian countries. Clin Exp Nephrol. 2009 Jun;13(3):249–56.
6. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Workgroup. KDIGO 2012 Clinical practice guidelines for the evaluation and management of chronic kidney disease. Kidney Inter Suppl. 2013;3:1-150.
7. Avasthi G, Malhotra S, Narang APS, Sengupta S. Study of thyroidfunctions in patients of chronic renal failure. Indian J Nephrol. 2001;11:165-69.
8. Soucie JM, McClellan WM. Early death in dialysis patients: risk factors and impact on incidence and mortality rates. J Am Soc Nephrol. 1996 Oct;7(10):2169-75.
9. HossainMM, Shah K, BegumN, Ahmed P, Islam AK, Chowdhury NI. Thyroid Functional Status in Chronic Kidney Disease. Bangladesh Jof Nucl Med 2015; 18(2):141–144.
10. Paudel K. Prevalence and Clinical Characteristics of hypothyroidism in a Population Undergoing Maintenance Haemodialysis. J Clin Diagn Res. 2014 Apr;8(4):MC01-MC04. Published online 2014 Apr 15.
11. Lo JC, Chertow GM, Go AS, Hsu CY. Increased prevalence of subclinical and clinical hypothyroidism in persons with chronic kidney disease. Kidney Int. 2005;67:1047–52.
12. Quionverde H, Kaptein EM, Rodriguez HJ, Massry S. Prevalence of thyroid -disease in chronic renal failure (CRF) and dialysis patients. In Kidney International 350 Main ST, Malden, MA 02148: Blackwell Science Inc.1984 Jan; 25(1): 190-190.
13. Silverberg DS, Ulan RA, Fawcett DM, Dossetor JB, Grace M,Bettcher K. Effects of chronic hemodialysis on thyroid function inchronicrenal failure.Can MedAssoc J.1973;109(4):282-86.
14. LimVS, ZavalaDC, FlaniganMJ, FreemanRM. Blunted peripheral tissue responsiveness to thyroidhormo neinuremic patients. KidneyInt 1987;31(3):808-14.

15. Mehta HJ, Joseph LJ, Desai KB, Mehta MN, Samuel AM, Almeida AF, Acharya VN. Total and free thyroid hormone levels in chronic renal failure. J Postgrad Med.1991 Apr;37(2): 79-83.
16. Singh S, Verma A, Aryal G, Thapa S, Khakurel S, Shrestha K. Thyroid hormone profile in patients with chronic kidney disease: a single centre study. J Nepal Health Res Counc. 2016 Sep;14(34):197-201.
17. Srivastava S, Rajput J, Shrivastava M, Chandra R, Gupta M, Sharma R. Correlation of Thyroid Hormone Profile with Biochemical Markers of Renal Function in Patients with Undialyzed Chronic Kidney Disease. Indian J Endocrinol Metab. 2018 May-June;22(3):316-320.
18. Zoccali C, Tripepi G, Cutrupi S, Pizzini P, Mallamaci F. Low triiodothyronine: a new facet of inflammation in end-stage renal disease. J Am Soc Nephrol. 2005 Sep;16(9):2789-95.
19. Joseph LJ, Desai KB, Mehta HJ, Mehta MN, Almeida AF, Acharya VN, Samuel AM. Measurement of serum thyrotropin levels using sensitive immunoradiometric assays in patients with chronic renal failure: alterations suggesting an intact pituitary thyroid axis. Thyroidology. 1993 Aug;5(2):35-9.