ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 12, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

STUDY OF RENAL FUNCTION TESTS IN THYROID DISORDER PATIENTS

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Received: 05 October 2024, Revised and Accepted: 20 November 2024

ABSTRACT

Objective: To analyse serum creatine, urea, fT3, fT4 and TSH among thyroid disorder patients.

Method: 75 thyroid disorder patients were included in the study. Serum creatinine and blood urea were determined by the colorimeteric method using an autoanalyzer c311. Thyroid Profile-fT3, fT4, and TSH were estimated by chemiluminescence immunoassay. Serum creatinine and blood urea were found to be raised among hypothyroidisms.

Results: The mean fT3=2.09, mean fT4= 0.88 and mean TSH=17.82μIU/ml, mean urea=72.32 mg/dl and mean creatinine=2.4 mg/dl. The highest creatinine value was 12 mg/dl and highest urea value among the hypothyroidism patient was found to be 180.4 mg/dl.

Conclusion: Assessment of hypothyroidism and its effect on kidney will be helpful in early diagnosis and management of the patients.

Keywords: Creatinine, Urea, Glomerular filtration rate, Hypothyroidism, Hyperthyroidism.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i12.52950. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Thyroid hormones affect the growth and differentiation of cells and modulate important functions in virtually all cells, tissues, and organs. As per available statistics, approximately 200 million people across the world have a thyroid disorder. People of all ages can get thyroid disease, but women are 5–8 times more likely to have thyroid disorders than men [1].

Thyroid hormones including thyroxine (T4) and triiodothyronine (T3) induce considerable functional effects in organ systems including the heart, brain, kidney, and muscles [2]. The kidney is the main body organ involved in metabolic waste excretion, maintenance of fluid, and acid-base balance. The hormones from the thyroid gland influence the functions of the kidney, both during embryonic development and in the mature condition. It can be directly affected by glomerular function, tubular secretory and absorptive capacities, electrolyte, and water homeostasis, or in part is mediated by thyroid hormone-induced cardiovascular changes [3].

The kidneys also play an important role in the clearance of iodine, TSH, and thyrotropin-releasing hormone. Any dysfunction in the thyroid can affect the production of thyroid hormones (T3 and T4) which can be linked to various renal pathologies and are responsible for alterations in clinically important serum creatinine, urea, glomerular filtration rate (GFR), ACR (albumin creatinine ratio), etc. [4].

Pathophysiological changes in hypothyroidism are seen to be opposite to those that occur during hyperthyroid status. It could be due to the generalized hypodynamic state of the circulatory system.

Hypothyroidism is associated with a reduction in GFR and an increase in serum creatinine in more than half of the adults. Such changes are evident even in subclinical hypothyroidism cases. There is also prominent hyponatremia [5].

Effects of hypothyroidism and hyperthyroidism on kidney function are the result of direct renal effects, as well as systemic hemodynamic, metabolic, and cardiovascular effects. Fortunately, most of the renal manifestations of thyroid disorders are reversible with treatment [6].

Numbers of studies are available on hypothyroidism but very few are available on hyperthyroidism. Hence, the aim of the present study is to see the effect of thyroid disorders (hypothyroidism and hyperthyroidism) on the renal profile. The study will help to increase clinical knowledge and enable clinicians to provide better management for their patients who have thyroid dysfunction. The observation of this study may help to take necessary steps in patients with thyroid dysfunction to prevent premature development of renal disorders and can also make the clinicians to think about thyroid dysfunction in patients with unexplained abnormal renal function.

Aim of study

- To measure serum creatinine, blood urea, fT3, fT4, and TSH
- To correlate renal function parameters with fT3, f T4, and TSH.

METHODS

Study design

Case-control study.

Study period

The present study was conducted from March 2024 to July 2024.

Sample size

A total number of 150 subjects were enrolled among them 75 were healthy controls and 75 were thyroid disorder patients.

Selection of patients

The study was conducted over a period of 5 months at Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan.

The study population was selected from the patients referred to the laboratory of the Department of Biochemistry for routine tests and thyroid profiles. Apparently, healthy individuals of both male and

female gender, without any previously known disease condition or drug history in the age group of 20–60 years were included.

Inclusion criteria

The following criteria were included in the study:

- Participants consented to take part in the study
- Patient of age group (20–60) years
- Confirmed cases of hypothyroidism and hyperthyroidism.

Exclusion criteria

The following criteria were excluded from the study:

- Participants not consenting to enroll in the study
- Patients with renal disorders that can alter renal function parameters such as nephritis, chronic kidney disease, nephritis, etc.
- Patients with diabetes, cardiovascular disorder, chronic diseases such as TB, any autoimmune disorders, malignancies
- Pregnant females
- Any systemic illness that could alter renal or thyroid profile.

After having proper consent, using semi-structured questionnaires the particulars of participants, including height, weight, family history, etc., were taken along with blood and urine samples for the study. The values of the parameters under study, namely, thyroid hormonal status (serum TSH and free T3 T4), serum creatinine, and blood urea values were collected and recorded. Estimated GFR was calculated by a four-variable.

Investigations pertaining to study

- Renal function tests: Blood urea, serum creatinine.
- Blood urea and serum creatinine estimation: Kit-based method using auto-analyzer
- Thyroid profile: fT3, f T4, TSH estimated by chemiluminescence immune assay
- Funding strategy: (a letter to be attached either for Intramural or Extramural).

Ethical consideration

Written consent was taken from all participants and ethical permission was taken from the college Ethical Committee.

Statistical analysis

Microsoft Excel worksheets were used and data were analyzed using SPSS version 20.00. The data were analyzed for normal distribution using Shapiro–Wilk's test. If the data follow normal distribution, parametric tests such as the Student's t-test and ANOVA will be used for comparative analysis.

If the data are not normally distributed, non-parametric tests such as the Mann–Whitney test and Kruskal–Wali's test were used for comparative analysis.

The correlation coefficient was determined using Pearson's correlation coefficient.

RESULTS

The average age of the patient was 39.42 years. Mean fT3=2.09, mean fT4=0.88, mean TSH=17.82μIU/ml, mean urea=72.32 mg/dl, and mean creatinine=2.4 mg/dl. The highest fT3 value was found to be 4.74 and the lowest was 0.72 shown in Tables 1 and 2. The highest fT4 was 7.74 and the lowest was 0.23. Similarly, the highest TSH value noted was 100. The highest creatinine value was 12 mg/dl and the highest urea value among the hypothyroidism patients was found to be 180.4 mg/dl.

Renal function parameters (urea and creatinine) significantly correlated with thyroid function parameters. Serum creatinine and urea are positively related to serum TSH and the relation is statistically significant (Tables 1 and 2) whereas these parameters are significantly and negatively related to fT3 and fT4 (Tables 1 and 2).

Table 1: Thyroid profile and blood urea of patient

Thyroid profile	Results	Urea	R-value	p-value
TSH	17.82	72.32	0.527	0.0009
fT4	0.88		−0.174	0.0286
fT3	2.09		−0.538	0.001

p<.05

Table 2: Thyroid profile and serum creatinine of patient

Thyroid profile	Results	Creatinine	R-value	p-value
TSH	17.82	2.4	0.5298	0.0001
fT4	0.88		−0.3529	0.03929
fT3	2.09		−0.5904	0.0001

p<0.05

DISCUSSION

A study done in 2011, showed significantly elevated creatinine levels in hypothyroid patients [7]. Further other studies conducted in 2015 showed significantly elevated plasma creatinine levels in the hypothyroid group (p=0.000) [8]. Blood urea level was significantly elevated in hypothyroidism (p=0.005) in the study of 2015. This was in close agreement with the study performed in 2012 (p=0.000) [9].

The GFR can be reduced up to 40% in hypothyroid humans just as predicted in experiments on animal models. This declining trend of GFR is corrected as soon as the hormone replacement for hypothyroidism is started. This can only be possible if the changes in renal function do not cause permanent histological damage [10]. Previous studies evaluating the correlation between renal parameters and thyroid functions revealed that in the hypothyroid group, plasma creatinine had a significant positive correlation with TSH and a significant negative with both T4 and T3 levels (p=0.000 in each), which meant that creatinine increased as TSH increased and T4 and T3 decreased. These results were consistent with a study done in 2015 in Pakistan in which TSH had a significant positive correlation with creatinine and T3 and a significant negative correlation with T4 (p=0.000 for each) [11,12]. A study conducted in 2012 also documented a significant positive correlation of TSH with creatinine [9].

A study done in 2022 showed that fT3 and fT4 levels were negatively correlated with serum creatinine levels and positively correlated with eGFR. In contrast, TSH was negatively correlated with eGFR [13].

A correlational study conducted in thyroid patients showed that eGFR significantly and negatively correlated with TSH whereas it significantly and positively correlated with T4 and T3 in hypothyroid patients. Increased plasma creatinine, blood urea, and decreased eGFR in hypothyroid subjects are believed to be related to the generalized hypodynamic circulatory system [8]. Available literature shows that changes in creatinine, urea, and eGFR in hypothyroidism are strongly related to TSH, T4, and T3. Thus, it is evident that renal function is noticeably altered in hypothyroidism. The association of various types of glomerulopathies with thyroid hyperfunction and hypofunction has been reported.

CONCLUSION

Effects of hypothyroidism and hyperthyroidism on kidney function are the result of direct renal effects, as well as systemic hemodynamic, metabolic, and cardiovascular effects. Fortunately, most of the renal manifestations of thyroid disorders are reversible with treatment. Hypothyroidism is associated with a reduction in GFR and an increase in serum creatinine and urea. Such changes are evident even in subclinical hypothyroidism cases. This study also showed similar findings as previous studies. Therefore, this will help in treatment and among subclinical hypothyroidism.

ACKNOWLEDGMENTS

The authors wish to thank all the patients who were enrolled in this study.

FUNDING

None.

DECLARATION OF CONFLICTING INTERESTS

The authors declare that they have no competing interests, and all authors have confirmed the accuracy of this statement.

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