

Renal Dysfunction in Hypothyroid Patients Estimation of Blood Urea, Serum Creatinine, T3, T4 and TSH

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ABSTRACT

Introduction: Thyroid gland produces two principal hormones - Thyroxine (T4) and triiodothyronine (T3). They act on thyroid α and β receptors for performing various functions. To maintain the growth and metabolism of renal system, they play an indispensable role. Decrease or fall in the activity of renal system is accompanied by compensatory alteration in the level, synthesis and metabolism of thyroid hormones. It is well established fact that renal system is affected by hypothyroid states of the body. Hence; we evaluated the effect of hypothyroidism on the renal functions of the body.

Material and methods: The present study included assessment of 80 patients who reported to the department with the chief problem of hypothyroidism. 80 healthy controls were also evaluated for comparing with the study group. With the help of a disposable syringe, approximately 4 ml of venous blood was withdrawn from the patients under sterile and aseptic conditions. Clotting of the blood was allowed to occur followed by separation of the serum of the patients by a centrifugation machine at three thousand revolutions per minute. Following methods were used for the assessment of creatinine and blood urea levels; Modified Jaffe's method for estimation of serum creatinine and Modified Trinder peroxide method for the estimation of blood urea. All the results were analyzed by SPSS software.

Results: Mean age of the patients in the control group and in the hypothyroid group was 39.5 and 36.8 years respectively. Non-significant results were obtained while comparing the demographic details of the patients in the two study groups. Mean level of T3 in the control group and in the hypothyroid group was 1.15 and 0.82 ng/ml respectively. Mean level of T4 in the control group and hypothyroid group were 8.91 and 4.75 $\mu\text{g/dl}$ respectively. However; while comparing the mean levels of T3, T4 and TSH in between the two study groups, significant difference was obtained.

Conclusion: Thyroid hormones have a profuse effect on the renal system.

Keywords: Hormones, Renal, Thyroid

INTRODUCTION

Thyroxine (T4) and triiodothyronine (T3) are the two linked hormones produced and secreted by the thyroid glands. Primarily, they perform all their functions by acting through various receptors (α and β) of thyroid hormones. During the development processes, these hormones mainly act and play a crucial role in the cellular differentiation and maintenance of metabolic homeostasis in the adults.¹ These hormones are also indispensable for the renal system's growth and for maintaining the homeostasis of fluid and electrolytes levels. Metabolism and elimination of thyroid hormones is one the function which the renal system involves. Decrease or fall in the activity of renal system is accompanied by compensatory alteration in the level, synthesis and metabolism of thyroid hormones. On

the other hand, medical treatment followed for the treatment of renal and thyroid dysfunction adversely affects the thyroid and renal system respectively.² The clinical condition arising due to deficiency of thyroid hormones or fall in the thyroid hormones below the physiologic reference range is known as hypothyroidism. It further results in generalized fall in the metabolic processes of the body.^{3,4} It is well established fact that renal system is affected by hypothyroid states of the body. Hence; we evaluated the effect of hypothyroidism on the renal functions of the body.

MATERIAL AND METHODS

The present was carried out in the department of endocrinology and clinical biochemistry in Osmania General Hospital, Hyderabad and included assessment of all the patients who reported to the department with the chief problem of hypothyroidism from July 2013 to June 2015. A total of 80 cases were evaluated in the present study which was diagnosed with suffering from hypothyroidism. 80 healthy controls were also evaluated for comparing with the study group. Ethical approval was taken from the institutional ethical committee and written consent was obtained after explaining in written the entire research protocol to the subjects. Mean age of the patients in the study group was 20 to 50 years. The patients of the control group were taken with approximately comparable demographic details. Diagnosis of hypothyroidism was based on the detection of following characteristics;

Decrease in physiologic serum levels of T3 and T4 in association with the increase in mean TSH levels

Physiologic levels of the above mentioned hormones which were taken as standard for attaining the diagnosis of hypothyroidism were as follows:

- T3 levels: 0.7 to 2.0 ng/ml
- T4 levels: 4.5-11.0 $\mu\text{g/dl}$
- TSH (Thyroid stimulating hormone) levels: 0.4- 4.2 $\mu\text{IU/ml}$

All the patients with the history of any other systemic illness, any known drug allergy, pregnant females, and patients less than 18 years of age, with history of any kidney, liver or bone disorders were excluded from the present study. Patients of both the groups were prepared for sample collection in the morning

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Parameter		Control group	Hypothyroid group	p-value
Mean age (years)		39.5	36.8	0.52
Sex	Males (percentage)	25	33.3	0.42
	Females (percentage)	75	66.7	

Table-1: P-value for demographic details of the patients

Parameter	Control group	Hypothyroid group	p-value
Mean T3 (ng/ml)	1.15	0.82	0.01*
Mean T4 (µg/dl)	8.91	4.75	0.01*
Mean TSH (µIU/ml)	2.42	27.81	0.01*
Mean Creatinine (mg/dl)	0.92	1.71	0.84
Mean blood urea (mg/dl)	5.80	6.81	0.61

*: Significant

Table-2: p-value for the comparison of various endocrinal and biochemical parameters in between the two study groups

time. With the help of a disposable syringe, approximately 4 ml of venous blood was withdrawn from the patients under sterile and aseptic conditions. Clotting of the blood was allowed to occur followed by separation of the serum of the patients by a centrifugation machine at three thousand revolutions per minute. Following methods were used for the assessment of creatinine and blood urea levels;⁵⁻⁷

- Modified Jaffe’s method for estimation of serum creatinine
- Diacetyl monoxime method for the estimation of Blood Urea.

STATISTICAL ANALYSIS

All the results were analyzed by SPSS software. Chi-square test was used for the assessment of level of significance.

RESULTS

Figure 1 shows the demographic details of the patients in the two study groups. Mean age of the patients in the control group and in the hypothyroid group was 39.5 and 36.8 years respectively. In control group, 25 percent of the study population were males while in the hypothyroid group, 33.3 percent of the study population were males. Non-significant results were obtained while comparing the demographic details of the patients in the two study groups (Table 1). Figure 2 highlights the levels of T3, T4, TSH, Creatinine and blood urea. in the patients of the two study groups. Mean level of T3 in the control group and in the hypothyroid group was 1.15 and 0.82 ng/ml respectively. Mean level of T4 in the control group and hypothyroid group were 8.91 and 4.75 µg/dl respectively. However; while comparing the mean levels of T3, T4 and TSH in between the two study groups, significant difference was obtained.

DISCUSSION

T3 and T4 hormones are produced by one of the largest gland in the human body i.e. the thyroid gland. Hypothalamus and pituitary gland regulates the production of T4 and T3 hormones by the thyroid gland. A progressive pathologic condition characterized by various degrees of thyroid failure and adverse alteration of the body’s metabolic function is the hypothyroidism. Assessment of TSH levels is used for the assessment of early dysfunction in the metabolic activity of thyroid gland.^{8,9} Harmful effect of physiologic interaction occurring in between the thyroid hormones and blood urea.

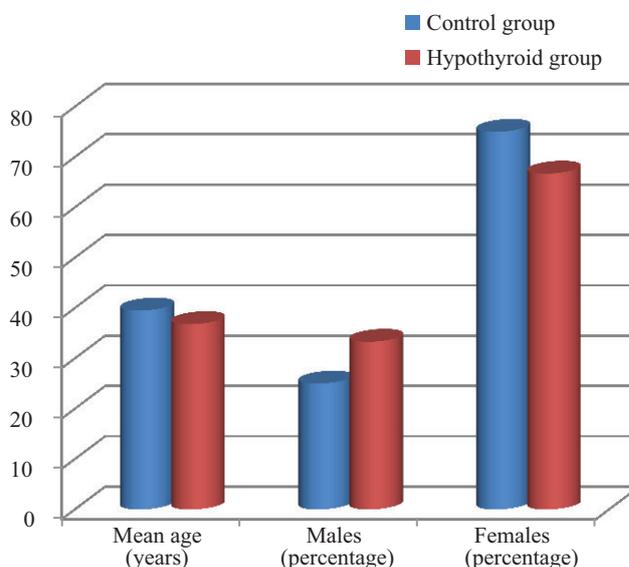


Figure-1: Demographic details of the patients

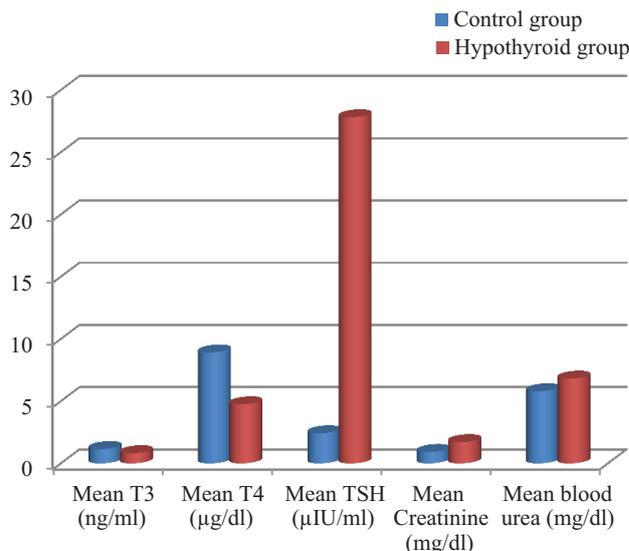


Figure-2: Levels of T3, T4, TSH, Creatinine and uric acid in the patients of the two study groups

synthesis and some degree of hypothyroidism is seen on various tissues and this condition is referred to as euthyroid. However; fall in these hormones levels lead to alteration in the levels of renal biochemical parameters.¹⁰ Hence; we evaluated the effect of hypothyroidism on the renal functions of the body. In the present study, we observed that a significant alteration in the levels of TSH, T3 and T4 occurs in individuals with hypothyroidism in comparison with the control individuals. However, the alterations in the serum blood urea. levels and serum creatinine levels were non-significant (Table 2). An increase in the serum creatinine levels have been seen in hypothyroid patients in most of the previous studies.^{11,12} Zhou et al evaluated the impact of various grades of hypothyroidism in pregnant women with severe pre-eclampsia (S-PE) on the

functioning of renal system. 46 patients that were suffering from subclinical hypothyroidism (SCH) were evaluated in the present study. From the results, they concluded that certain effect of hypothyroidism state on the renal system do exists in patients with pre-eclampsia.¹³ Zhou et al analyzed the changes occurring in the thyroid level of the women with pre-eclampsia patients and assessed the relationship of thyroid hormone levels and pre-eclampsia. They assessed 171 patients with pre-eclampsia and divided them into two broad groups. One group comprised of 114 patients with early onset pre-eclampsia (EP) while the other group comprised of 57 patients with late onset pre-eclampsia (LP). 171 healthy subjects with comparable age and other demographic details were taken as healthy control. Estimation of T3, T4 and TSH levels was done with solid-phase chemiluminescent enzyme immunoassay method. They observed that mean values of TSH and T3 in patients of PE group was 3.4 mU/L and 12.0 Pmol/L respectively. From the results, they concluded that in patients with thyroid dysfunction, it is common to have complication in pre-eclampsia. Therefore; estimation of physiologic levels of thyroid gland in pregnancies is essential as a precautionary measure.¹⁴ Jia et al assessed the relationship between blood urea and creatinine in patients suffering from hypothyroidism. They physically examined over 2000 patients and measured their serum TSH, T3 and T4 levels by electrochemiluminescence. They also evaluated their blood urea levels by Diacetyl monoxime method. They observed that out of all the patients, 38 belonged to the group containing hypothyroidism affected patients while 355 patients belonged to the group with subclinical hypothyroid state. Significantly higher levels of TSH were observed in patients affected by hypothyroidism in comparison with the control group and patients with subclinical hypothyroid state. However, significant differences were observed while comparing the mean T3 and T4 levels in patients of the three study groups. In hypothyroidism affected patients, significantly higher levels of serum creatinine levels and blood urea levels were observed in comparison with the patients of the other study groups. From the results, they concluded that elevation of serum creatinine may occur in patients associated with reduced levels of thyroid hormones.¹⁵ Hekimsoy et al prospectively analyzed the serum creatine kinase (CK) levels in patients with clinical and subclinical condition of hypothyroidism. They observed that in 57 percent of the patients with overt hypothyroidism, CK elevation was observed. From the results, they concluded that hypothyroidism do affects the skeletal muscles more profoundly in comparison with the cases of overt hypothyroidism.¹⁶ Lyu et al evaluated the effect of serum blood urea. on the physiologic functioning of kidneys in patients with abnormal glucose metabolism. They evaluated a total of 1495 patients and estimated their serum nitrogen levels, creatinine levels, triglycerides levels, cholesterol levels and blood urea. levels and concluded that hypothyroidism is associated with renal dysfunction.¹⁷ Sharkia et al evaluated and compared the levels of TSH in patients with Prader-Willi syndrome (PWS) and concluded that in youths with PWS, levothyroxine treatment should not be frequently followed.¹⁸

CONCLUSION

From the above results, the authors conclude that thyroid hormones have a profuse effect on the renal system. However,

future studies are advocated for the better exploration of these areas of endocrine medicine.

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