

A Study of Serum Urea, Creatinine and Uric Acid Levels In Hypothyroid Patients

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ABSTRACT

BACKGROUND: Hypothyroidism is a progressive disorder that presents with diverse degrees of thyroid failure and metabolic consequences. The objective of this study was to determine the effects of thyroid dysfunction on serum values of Urea, Creatinine & Uric acid. **MATERIALS AND METHODS:** A cross-sectional study was done and included 100 individuals (50 hypothyroid cases and 50 normal controls). Serum TSH levels were estimated by Chemiluminescent microparticle immunoassay (CMIA) method to assess the hypothyroid cases. Serum Urea, Creatinine & Uric acid were estimated by colorimetric method on fully automated chemistry analyser. **RESULT:** Serum Urea, Creatinine & Uric acid levels were significantly elevated in hypothyroid group as compared to euthyroid controls. **CONCLUSION:** Hypothyroid state is associated with hemodynamic changes like reduction in renal plasma flow and glomerular filtration rate, which causes increase in the levels of serum urea, creatinine and uric acid. Purine metabolism is also affected by disturbance in thyroid hormones, leading to alteration in the uric acid levels, leading to hyperuricemia and gout. Hence these parameters should be regularly monitored in hypothyroid patients.

Keywords: hypothyroid, serum TSH, urea, creatinine, uric acid

INTRODUCTION

The thyroid gland produces two related hormones, thyroxine (T₄) and triiodothyronine (T₃). These thyroid hormones act through α and β receptors and play a critical role in cell differentiation during development and to maintain thermogenic and metabolic homeostasis in the adult¹. Thyroid hormones secreted by the thyroid gland are regulated by the anterior pituitary hormone -thyroid stimulating hormone (TSH), which is under the control of the hypothalamic thyrotropin-releasing hormone (TRH)². Thyroxine (T₄) is produced primarily by the thyroid gland and is converted to the more biologically active form triiodothyronine (T₃). The kidney is implicated in the production of T₃ through local deiodination of T₄ by the isoform D1 of the enzyme T₄-5'-deiodinase².

These thyroid hormones (T₄ and T₃) regulate the rate of metabolism, affect growth, and modulate energy utilization by increasing the basal metabolic rate and increasing oxygen consumption, and facilitating heat production³. Long standing hypothyroidism can cause significant changes in renal function such as a decrease in sodium reabsorption in the proximal tubule, impairment in the concentrating and diluting capacities of the distal tubules, a decrease in the urinary urate excretion and a decrease in the renal blood flow and glomerular filtration rate (GFR)^{4,5}. In hypothyroidism, physiological effects include changes in water and electrolyte metabolism, alterations of renal hemodynamics, lowered renal blood flow, renal plasma flow, glomerular filtration rate (GFR), and single nephron GFR. The deficiency of thyroid hormones (TH) reduces the cardiac output leading to generalized hypodynamic state of the circulatory system⁶. GFR values in hypothyroid patients are on an average one-third lower than the values in euthyroid individuals⁵. The cause of the decreased renal plasma flow and GFR

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observed is believed to be principally due to the generalized hypodynamic state of the circulatory system in hypothyroidism⁷.

MATERIALS AND METHODS

Study setting and study type: The study was a Cross sectional study conducted at Civil Hospital, Ahmedabad during October-2015 to December-2015.

Sample size: The study sample included 50 hypothyroid cases and 50 euthyroid persons. Case group had a mean age of 41.94 ± 21.9 years; of which, 20% were men and 80% were women. The control group had mean age of 44.74 ± 5.66 years; of which, 26% were men and 74% were women.

Diagnostic test and criteria: Venous blood samples were collected in fasting state and samples were tested for the parameters. Diagnostic criteria for hypothyroidism was based on TSH level (Normal: 0.4- 4µIU/ ml). The test methodology for Serum TSH level was by Chemiluminescent Microparticle Immunoassay (CMIA) method (Reference range: 0.4-4µIU/ml). Serum Urea was estimated by GLDH (glutamate dehydrogenase) method (Reference range:13-45mg/dl), Serum Creatinine by Jaffe’s method (Reference range:0.6-1.4mg/dl) and Serum Uric acid by Uricase-Trinder Method. (Reference range: 3-7mg/dl) in fully auto chemistry analyser.

Exclusion criteria: Pregnancy, age group (<18 yrs or > 60 yrs), known cases of renal disorders, hepatic disorders, bone disorders, diabetes, hypertension or any other systemic illness that may affect the renal function were not included in the study.

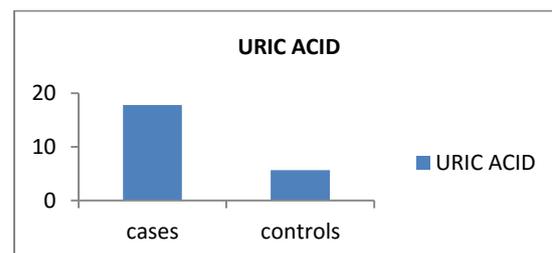
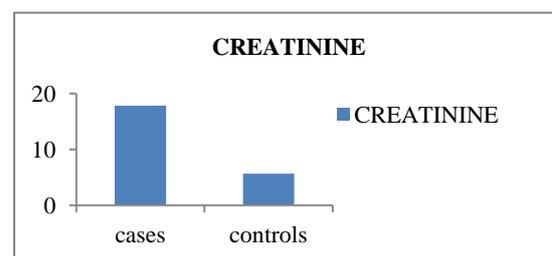
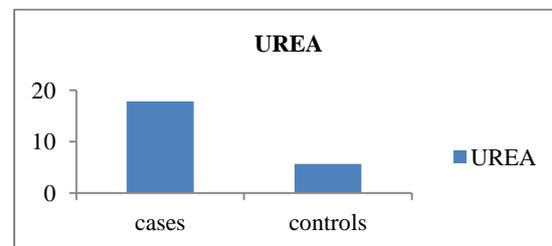
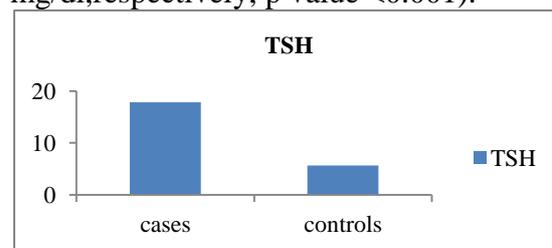
Statistical Analysis: Data was entered under Microsoft Excel 2007 and epi info 7. Demographic data analysis was performed and unpaired t-test was used to show the significance of serum TSH, urea, creatinine and uric acid levels between cases and controls. The entire data were analyzed using the software Graphpad. A p-value of <0.001 was considered to be statistically highly significant.

RESULTS

Table 1: Comparison of S.TSH, Urea, Creatinine, Uric acid in cases & controls

Variable	Cases (Mean± SD) n=50	Controls (Mean ± SD) n=50	P value	Degree of freedom
S.TSH (µIU/ ml)	11.78 ± 0.09	±2.09 ± 2.19	< 0.001	98
S.Urea (mg/dl)	44.59 ± 20.15	±31.65 ± 12.60	< 0.001	98
S.Creatinine (mg/dl)	1.61 ± 1.37	0.974 ± 0.14	< 0.001	98
S.Uric acid (mg/dl)	17.83 ± 0.14	±5.66 ± 3.65	< 0.001	98

The table shows that serum Urea level is higher in hypothyroid cases as compared to euthyroid controls (44.59 ± 20.15 mg/dl, 31.65 ± 12.60 mg/dl, respectively; p value <0.001). Serum Uric acid level is significantly higher in cases as compared to controls (17.83 ± 0.14 mg/dl, 5.66 ± 3.65 mg/dl, respectively; p value <0.001). Serum Creatinine level is also significantly higher in cases as compared to controls (1.61 ± 1.37 mg/dl, 0.974 ± 0.14 mg/dl, respectively; p value <0.001).



The graphs show significant difference in each parameter in cases & controls.

DISCUSSION

Our study shows that primary hypothyroidism may alter renal functions. There is significant increase in the serum levels of all parameters tested in this study- urea, creatinine and uric acid in hypothyroid patients as compared to euthyroid controls. The difference in serum Urea level was significant with p value <0.001. Our study correlated well with studies done by Vaneet Kaur et al.⁸ and Vandana Saini et al.⁹ which also showed that mean S.Urea level was significantly higher in comparison to euthyroid controls. However studies by Qahtan A.Rashead et al.¹⁰ showed that there was no significant difference between normal & abnormal values of urea in hypothyroid patients and euthyroid controls. Our study also showed a significant difference in serum creatinine levels in cases, p value <0.001. Studies by Kreisman and Hennessey et al.⁷, Khan AH et al.¹¹ and Vaneet Kaur et al.⁸ also point toward mean S.Creatinine level being significantly higher in hypothyroid cases. The serum Creatinine concentration increases in hypothyroid patients due to reduction of glomerular filtration rate because of hemodynamic changes in severe hypothyroidism¹². Serum Creatinine level may also be increased due to hypothyroid myopathy¹¹. Hypothyroidism must be considered in patients presenting with acute renal failure and elevated muscle enzymes. The renal impairment could be due to reduced cardiac output and increased systemic and renal vasoconstriction leading to reduced renal blood and plasma flow and decreased GFR. A highly significant difference in values of uric acid, p value <0.001 was seen. Studies by Giordano et al.¹³ showed 33.3% prevalence of hyperuricemia in patients with hypothyroidism. Similar studies were conducted by Erickson et al.¹⁴ and Dariyerli et al.¹⁵ and found hyperuricemia in patients with hypothyroidism. There is high prevalence of hyperuricemia and gout in hypothyroidism. In hypothyroidism the

hyperuricemia is secondary to a decreased renal plasma flow and impaired glomerular filtration⁸.

CONCLUSION

Mean serum urea, creatinine & uric acid levels were found significantly higher in hypothyroid patients compared to controls which shows that hypothyroidism is associated with deteriorating renal function. The understanding of this association can prevent unnecessary investigations, treatment cost and worry in patients presenting with either increased urea, creatinine or gout with undetermined thyroid status. Moreover, hypothyroid-induced renal dysfunction may lead to adverse clinical consequences, especially among patients on medications cleared by the kidneys. The thyroid function should, therefore, be regularly monitored for evaluation of patients presenting with deranged renal function and vice versa. A multisystem approach should be taken to evaluate and treat patients with hypothyroidism.

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