

## EVALUATION OF RENAL FUNCTIONS IN SUDANESE PATIENTS WITH THYROID DISORDERS

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### ABSTRACT:

**Background:** Thyroid dysfunction causes significant changes in kidney function. Both hypothyroidism and hyperthyroidism affect renal blood flow and glomerular filtration rate (GFR). Aim: to evaluate serum creatinine, urea, and creatinine clearance concentrations in patients with thyroid dysfunctions. Materials and Methods: the study involved a control group of apparently healthy (euthyroid) (N = 90) matched for age with a test group of patients with thyroid dysfunctions (N = 96). The age range of both groups was 25-63 years. Serum creatinine, urea, and creatinine clearance concentrations were measured according to the standards. Appropriate statistical tests were used to assess significant difference in the means of the studied concentrations between patients and the control group. Results: The hypothyroid patients showed significantly higher serum creatinine (M±SD = 1.04±0.15 mg/dl), level compared with euthyroid (M±SD = 0.97±0.17, P = 0.033), and reduced creatinine clearance (M±SD = 93±13.6 ml/min, and 101±10.9 ml/min, respectively, P = 0.004). In hyperthyroid patients, serum creatinine concentrations were not differed (M±SD = 0.98±0.19 mg/dl) compared with the euthyroid group (M±SD = 0.97±0.17mg/dl, P = 0.16). Creatinine clearance was significantly higher in hyperthyroid compared with euthyroid (M±SD = 125±15 ml/min, and 101±10 ml/min, respectively, P = 0.006).

Blood urea concentrations were not significantly different in the studied groups

**Conclusion:** the study added further evidences for the possible changes that can occurs in renal functions in patients with thyroid disorders, especially GFR.

### INTRODUCTION

Thyroid hormones (TH) are essential for an adequate growth and development of the kidney. The

kidney is not only an organ for metabolism and elimination of TH, but also a target organ of some of the iodothyronines' actions<sup>(1)</sup>.

Thyroid hormones affect renal function by both pre-renal and direct renal effects. Pre-renal effects are mediated by the influence of thyroid hormones on the cardiovascular system and the renal blood flow (RBF). The direct renal effects are mediated by the effect of thyroid hormones on glomerular filtration rate (GFR), tubular secretory and re-absorptive processes, as well as the hormonal influences on renal tubular physiology. Thyroid hormones affect renal clearance of water load by their effects on the GFR<sup>(2;3)</sup>.

Hyperthyroidism results in increased RBF and GFR<sup>(4)</sup>. The effect of thyroid hormones on RBF and GFR occurs at multiple levels. Among the pre-renal factors, thyroid hormones increase the cardiac output by positive chronotropic and inotropic effects as well as a reduction in systemic vascular resistance<sup>(5;6)</sup>. This indirectly contributes to an increase in RBF. There is an increased endothelial production of nitric oxide (NO) in the renal cortex and medulla by induction of nitric oxide synthase (NOS)<sup>(7)</sup>, directly by the thyroid hormones and indirectly by high arterial pressure related endothelial shear stress<sup>(8)</sup>. This is accompanied by a reduction in renal vasoconstrictor endothelin. Thus, an increased intrarenal vasodilatation and decreased vasoconstriction ensues, contributing to a net increase in RBF. The GFR increases by about 18-25% among hyperthyroid patients. This improvement in GFR is not solely due to an increased RBF<sup>(4)</sup>.

The effects of hypothyroidism on the kidney are usually opposite to the effects of hyperthyroidism. The RBF is reduced in hypothyroidism by decreased cardiac output (negative chronotropic and inotropic effects)<sup>(9;10)</sup>, increased peripheral vascular resistance, intrarenal vasoconstriction, reduced renal response to vasodilators<sup>(11)</sup>. The GFR is reversibly reduced (by about 40%) in more than 55% of adults with hypothyroidism<sup>(12)</sup>.

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**MATERIALS AND METHODS**

**Study population**

Study was conducted in Khartoum state-Sudan on people who suffer from thyroid problems (hyperthyroidism and hypothyroidism) of various ages and gender with the exclusion of people who suffer from kidney problems.

**Blood samples collection and processing**

Following informed concept, 193 heparinized blood samples were drawn from patients who were referred for thyroid evaluation by thyroid function test. Another 90 heparinized blood samples from healthy volunteers as normal control. Out of 193 patients 96 were observed with thyroid problem, 63 patients with hyperthyroidism and 33 patients with hypothyroidism.

The blood samples were analyzed at Omdurman Military Hospital for thyroid function test using fully automated immune analyzer (Elecsys 2010, Germany).

Urea and creatinine at Ahmed Gasim Hospital using fully automated chemistry analyzer (Mindray BS-200, China), and creatinine clearance was calculated by using Cockcroft Gault equation<sup>(13,14)</sup>.

**RESULTS**

The age of participants ranged between 19 and 69 years-old with mean age of 41 years. The M±SD of TSH in hyperthyroidism group was (0.023±0.01mIU/ml), and of T3= (4.1±1.2ng/ml), and of T4 = (14.5±3.1µg/dl), in hypothyroidism TSH =(M±SD=33.89±7.5mIU/ml),, T3 (M±SD=1.29±1.0ng/ml), and T4 (M±SD= 6.2±2.4µg/dl), the results of thyroid function test was shown in table 1.

**Table (1) Thyroid function test in studied groups**

Parameters	Euthyroid (n=90) (Mean± SD)	Hypothyroid (n=32) (Mean±SD)	Hyperthyroid (n=64) (Mean±SD)
T3 (ng/ml)	1.0±0.8	1.29±1.0	4.1±1.2
T4 (µg/dl)	8.2±2.5	6.2±2.4	14.5±3.1
TSH (mIU/ml)	1.5±1.0	33.89±7.5	0.023±0.01

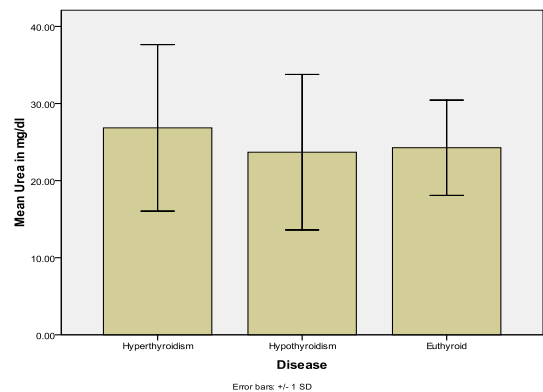
Urea concentrations were higher in hyperthyroid patients (M±SD = 26.8±10.7 mg/dl) compared with the euthyroid group (M±SD = 24.2±6.1 mg/dl), but this

elevation did not achieve statistical significant (P = 0.06).

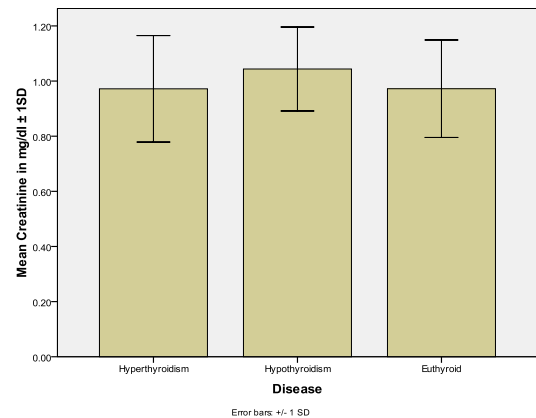
Creatinine concentrations were similar in hyperthyroid patients (M±SD = 0.98±0.19 mg/dl) compared with the euthyroid group (M±SD = 0.97±0.17 mg/dl, P = 0.16).

The mean of creatinine clearance was significantly higher in hyperthyroid compared with euthyroid (M±SD = 125±15 ml/min, and 101±10 ml/min, respectively, P = 0.006).

The blood urea concentrations in patients with hypothyroidism is not differed compared with control

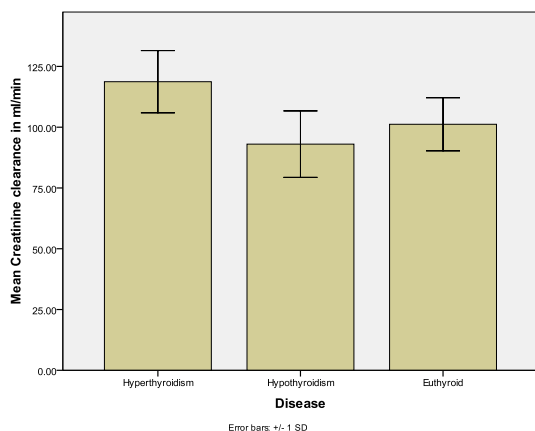


**Figure 1, Urea concentration in studied group**



**Figure 2, Creatinine concentration in studied group**

(M±SD 23.6±10 and 24.2±6.0, respectively, P = 0.7) both creatinine and creatinine clearance showed significant difference (M±SD = 1.04±0.15 mg/dl and 93±13.6 ml/min, respectively), compared to euthyroid group (M±SD = 0.97±0.17 mg/dl and 101±10.9 ml/min, P = 0.033 and 0.004 respectively), as shown in figures 1, 2, and 3.



**Figure 3, Creatinine clearance in studied group**

## DISCUSSION

Our patients demonstrate a remarkable effect of thyroid function on glomerular filtration rate. The creatinine clearance of the patient with hyperthyroidism was increased, while the creatinine clearance of the hypothyroid patient was decreased, this finding is in agreement with Claus T et al., (2005) findings<sup>(15)</sup>.

The serum creatinine data presented here confirm previous studies showing increased values in hypothyroidism<sup>(16;17)</sup>.

Jayagopal et al. studied the effects of the hyperthyroid and hypothyroid state on changes in serum creatinine in 17 patients with hypothyroidism and 19 patients with hyperthyroidism<sup>(18)</sup>. All patients were newly diagnosed. The hypothyroid patients had a mean serum creatinine of 1.02mg/dl while the hyperthyroid patients had a mean serum creatinine of 0.67mg/dl.

It had been confirmed that the rise in creatinine levels in hypothyroid patients did not relate to abnormalities in other renal functions or creatine kinase levels, which is markedly elevated in such patients, suggesting that neither hypothyroid myopathy nor intrinsic renal disease contributed to the changes seen in creatinine levels<sup>(19)</sup>. Previous studies reported that the elevated creatinine values of hypothyroidism are indeed fully reversible on full replacement of thyroxine<sup>(16)</sup>.

The consistency of the elevation in creatinine levels in our study and others, argues against the previously held notion of a net unchanged creatinine value due to a balance between the decrease in renal clearance and a decrease in creatinine generation<sup>(16)</sup>.

## CONCLUSION

This study confirms that the hypothyroid state is associated with a consistent elevation in the serum creatinine level and reduced creatinine clearance, presumably due to a decrease in the GFR, and hyperthyroid state associated with increase in creatinine clearance compared with euthyroid control group.

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