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Biochemistry

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STUDY OF SERUM ELECTROLYTES IN HYPOTHYROID PATIENTS ATTENDING TERTIARY CARE HOSPITAL

Dr. P Divya Gayatri W/O R J Srikanth, Flat no B2, Swarna rivera apartments, Kakinada,E.G District, Andhra Pradesh, 533003

Dr G Rajeswari * Professor and HOD Department Of Biochemistry,Rangaraya Medical College Kakinada E.G District, Andhra Pradesh, 533003*Corresponding Author

ABSTRACT

Hypothyroidism is a clinical condition resulting from inadequate synthesis of the thyroid hormones. Estimation of Serum electrolytes is used to identify imbalance of electrolytes, fluid or pH in the body. The main aim of the study is to analyse and evaluate the serum electrolytes (Na+, K+) in hypothyroid patients and to compare with age and sex matched controls. A prospective study was conducted on 60 population, of which, 30 hypothyroid patients with decreased serumT3 ,T4 & increased serum TSH concentration done at Biochemistry Department ,GGH (a tertiary care hospital) Kakinada and compared with 30 healthy controls. Results of this study showed, significant decrease of serum Na+ and an increase in serum K+ in hypothyroid patients. Conclusion: This study suggests that hypothyroidism is strong linked with the electrolyte imbalance. Regular monitoring of electrolytes will be of great benefit to prevent complications associated with hypothyroidism.

INTRODUCTION:

Hypothyroidism is defined as the deficiency of thyroid activity, which results from decreased secretion of T3 and T4 irrespective of the cause1 . In worldwide, around, more than 200 million people have thyroid disease.2 The prevalence of thyroid dysfunction in adults in the general population ranges from 1 to 10%.3 According to various studies on disorders of the thyroid gland, it has been estimated, around 42 million people in India suffer from thyroid disorders.4 Hypothyroidism is a common form of disease of the thyroid gland. In India Hypothyroidism is highly prevalent . 1 in 10 people in India are having hypothyroidism. With an increase in age, the prevalence of the thyroid disease also increases and is more common in women. In India, the prevalence of Hypothyroidism varies from 0.9 to 17.5%.5,6

Thyroid hormones plays vital role in maintaining body's metabolism, BMR, thermoregulation and hemodynamic status. Thyroid hormones regulate the metabolism of carbohydrate, protein, Lipids, electrolytes and minerals. The effect and the underlying mechanism of action of thyroid hormones on electrolytes and mineral metabolism is not well known. Hyponatremia, clinical features include dehydration, drop in blood pressure, drowsiness, lethargy, confusion, abdominal cramps, oliguria, tremors and coma. Hypothyroidism is accompanied by remarkable alterations in the metabolism of water and electrolytes3-4. Sodium and potassium are important components of the enzyme sodium potassium ATPase which is a cell membrane enzyme that helps in the transport of water and nutrients across the cell membrane. Thyroid hormones regulate the activity of sodium potassium pumps in most of the tissues Prospective studies show that hypothyroidism is associated with hyponatraemia. Plasma potassium level above 5.5 mmol/L is known as hyperkalemia. Since the normal level of K+ is kept at a very narrow margin, even minor increase is life-threatening.

In hyperkalemia, there is increased membrane excitability, which leads to ventricular arrythmia and ventricular fibrillation. Hyperkalemia is characterized by flaccid paralysis, bradycardia and cardiac arrest. ECG shows elevated T wave, widening of QRS complex and lengthening of PR interval. Any disturbance in the electrolytes is life threatening. The present study aimed to assess the variations in the serum electrolytes(Na+, K+) in hypothyroid patients and to compare with euthyroid controls attending to the outpatient department in the tertiary care hospital, Government general hospital, Kakinada.

Materials and Methods:

The present study was conducted in Department of Biochemistry, Government General hospital, Kakinada. A total of 60 subjects, out of which 30 subjects were hypothyroid patients and 30 were healthy age and sex matched controls.

Inclusion Criteria:

Recently detected or poorly controlled hypothyroid patients.
Age eligible for the study ----20 years to 50 years.

Exclusion Criteria:

Patients with any other metabolic abnormalities, hypertensives, diabetes mellitus, Paediatric age group, Cushing's syndrome , renal and hepatic disorders were excluded from the study. Other conditions like pregnancy and lactation were also excluded. Subjects taking drugs affecting thyroid hormone levels, lipid profile levels were also excluded. Subjects taking Corticosteroids are excluded.

Control Group:

30 age and sex matched healthy controls were included.

Method Of Analysis:

An informed consent was taken from the patients and controls before collecting the sample. A 3ml of venous blood from fasting subjects was drawn from the ante cubital vein from both cases and controls. Serum is separated immediately. Serum samples were analysed for Electrolytes (Na+, K+) on Radiometer ABL 800 analyser by Ion selective electrode. Thyroid profile (T3, T4, TSH) was estimated on Beckmann Coulter Access 2 by chemiluminescence immunoassay method. Biochemical parameters Fasting Blood Sugar (FBS) by Hexokinase method, Serum Creatinine by Jaffes method and Blood Urea by Urease method are estimated on Beckmann Coulter AU 480.

Statistical analysis:

The observed values were compared with the control group for statistical analysis. All data were expressed as mean ± SD. Statistical analysis was done by student T-test. Differences with 'p' value less than 0.05 were considered to be statistically significant.

Normal Reference value:

Serum thyrotropin / Thyroid-stimulating hormone(TSH)-- 0.4- 4.2 µU/mL

Serum tri-iodothyronine(T3)-- 0.8-1.8 µg/L = 80-180 ng/dL
Serum thyroxine(T4)-- 46–120 µg/l = 4.6–12.0µg/dL
Fasting Blood sugar-- 70-110 mg/dL
Blood Urea-- 17-43 mg/dL
Serum Creatinine -- 0.6-1.3 mg/dL
Serum Sodium (Na+) -- 135-145 mEq/L
Serum Potassium(K+)-- 3.5 - 5 mEq/L

Results:

Table 1:
Levels of different biochemical parameters in Hypothyroid cases

and control group.

S.No	PARAMETER	CONTROLS(N=30) Mean ± SD	PATIENTS (N=30) Mean ± SD	P value	Significance
1	Fasting Blood sugar (mg/dl)	92.42 ± 15.37	119.13 ± 16.52	<0.0001	Significant
2	Blood Urea (mg/dl)	29.023 ± 2.33	28.75 ± 2.65	0.5947	Not significant
3	Serum Creatinine (mg/dl)	0.81 ± 0.14	0.81 ± 0.12	0.9751	Not Significant
4	Tri iodothyronine(T3)(µg/L)	1.24+0.31	0.93 + 0.34	<0.0001	Significant
5	Tetra iodothyronine(T4) (ng/dl)	10.74 + 1.41	8.28 +4.60	0.0005	Significant
6	TSH (µU/ml)	2.36 + 0.79	28.30+34.09	<0.0001	Significant
7	Na+(mEq/L)	139.38+7.39	130.88+2.03	0.0073	Significant
8	K+(mEq/L)	3.863+0.169	5.262+0.325	<0.0001	Significant

P value < 0.05 was considered statistically significant.

Table 1: shows a significantly higher TSH (P < 0.0001), Serum K+ (P < 0.0001) levels in Hypothyroid Patients than the control group. Hypothyroid patients had significantly lower Serum Na + (P Value 0.0073).

DISCUSSION:

Hypothyroidism means an underactive thyroid ("hypo" means "under" or "below normal"). In people with hypothyroidism, the thyroid does not make enough thyroid hormone to keep the body in normal functioning. The thyroid hormones act on almost every cell in the body. They act to increase the basal metabolic rate, help regulate long bone growth (synergy with growth hormone), affect protein synthesis, and neural maturation, and increase the body's sensitivity to catecholamines (such as adrenaline) by permissiveness. The thyroid hormones are necessary to proper growth and differentiation of all cells of the human body. These hormones also regulate carbohydrate, fat and protein metabolism, affecting how human cells use energetic compounds. They also stimulate vitamin metabolism. Numerous physiological and pathological stimuli influence thyroid hormone synthesis. Common causes of hypothyroidism are surgical removal of the thyroid, autoimmune disease, and radiation treatment. Low thyroid hormone levels cause the body's functions to slow down, leading to common symptoms like dry skin, loss of energy, exhaustion, and memory problems.

In our study shows a significantly higher TSH (28.30+34.09) (P < 0.0001), Serum K+(5.262+0.325) (P < 0.0001) levels in Hypothyroid Patients than the control group. Hypothyroid patients had significantly lower Serum Na +(139.38+7.39) (P value 0.0073) similar to the findings of the study Arvind Bharti et al7.

The enzyme Na+-K+ ATPase is present in almost every cell in the body. The main function of the enzyme is to transport of water and nutrients across the cell membrane8. Sodium and potassium pumps are regulated by thyroid hormones9.Research in the recent years , Focussed on the prognosis of the patients having electrolyte imbalance, mostly Hyponatraemia and Hypernatraemia showed an increased mortality10. In several literatures, it is shown that electrolytes disorders are commonly related with thyroid dysfunction. Hyponatraemia in hypothyroidism is described as the consequence of increased water retention mediated by ADH. In contrary, Hypokalaemia is seen in thyrotoxic patients 11.

In this present study, FBS (119.13 ± 16.52) is significantly elevated (p<0.0001) in hypothyroid patients when compared with controls FBS (92.42 ± 15.37). Similar results were observed by Maram Sushma et al12.

Hypothyroidism has been associated with insulin resistance,13,14,15 dyslipidemia 16,17 and obesity.18,19 Insulin resistance in the setting of hypothyroidism has been documented and is associated with decreased responsiveness of glucose uptake in muscle and adipose tissue to insulin, as well as decreased glycogen synthesis in skeletal muscle.13,14,15,20

Blood Urea (28.75 ± 2.65), S. Creatinine (0.81 ± 0.12) in hypothyroid patients is not statistically significant when compared with controls Blood Urea (29.023 ± 2.33), S. Creatinine (0.81 ± 0.14).

Conclusion:

The results of the above study shows Significant decrease of serum sodium and increase in serum potassium in hypothyroid patients. This suggests that hypothyroid patients should be regularly screened for imbalance in serum electrolytes. Early detection and necessary treatment prevents complications of electrolyte disturbances in patients.

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