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Assessment of Serum Electrolyte in Hypothyroid Patients Attending Chitwan Medical College

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ABSTRACT

INTRODUCTION: Hypothyroidism is a clinical condition resulting from inadequate synthesis of the thyroid hormones. Thyroid hormone has an influence on renal hemodynamics, glomerular filtration, as well as the renin angiotensin aldosterone system and renal electrolyte handling. The aim of present study was to find out the serum concentration of electrolytes sodium and potassium in hypothyroid patients attending a tertiary care hospital. **MATERIALS AND METHODS:** A hospital-based descriptive cross-sectional study was conducted from 24th July 2019 to November 30th 2019 at Chitwan Medical College Teaching Hospital. A venous blood sample was collected and T3, T4 and TSH levels were measured by using chemiluminescence technology. Sodium and potassium levels in blood were investigated by ion selective electrode (ISE) method. Data were analyzed using IBM SPSS 21 software. **RESULTS:** In our study parameters (T3, T4 & TSH and Na+) were significant (P<0.05) in hypothyroidism subjects (group II) as compared to control subjects (group I) except for electrolyte potassium which was non-significant at P<0.05. T3 and T4 were found significantly decreased whereas TSH was found elevated in subjects of hypothyroidism (group II) as compared to controls. The level of potassium was within the normal range but it was found not significant as compared to healthy controls. **CONCLUSIONS:** The study concluded that there was increase in TSH with decrease in T3 and T4 in hypothyroid subjects but the electrolyte sodium was found to be statistically significant.

Keywords: Hypothyroidism, Potassium, Sodium

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INTRODUCTION

Hypothyroidism is a disease of thyroid gland that characterized with low level of thyroxin hormone (T3 and T4) in addition to high level of thyroid stimulating hormone (TSH). It is an endocrine disorder that can cause a variety of clinical situations like congestive heart failure, electrolyte disorders, and coma. Electrolytes play a vital role in several body progressions, such as directing fluid levels, acid-base equilibrium (pH), nerve passage, blood coagulation and muscle tightening [1]. Hypothyroidism is ten times more common in women than men and its prevalence increases with age [2].The prevalence of hypothyroidism was found to be 29.6% followed by subclinical hypothyroidism (28.3%) in Nepal [3]. Sodium and potassium are important components of the enzyme Na+-K+ ATPase, which is an enzyme present on the cell membrane that helps in the transport of water and nutrients across the cell membrane [4].Thyroid hormones regulate the activity of sodium potassium pumps in most of the tissues [5]. The mortality rate was increased in patients with electrolyte disorders, mainly hypo and hypernatremia are associated with thyroid disorders [6]. This study is undertaken to measure the level of electrolytes which will aid the clinician in providing better clinical management for hypothyroid patients due to electrolyte imbalance issues. Thus, this study was conducted to assess the changes in serum electrolyte levels (sodium and potassium) in patients with hypothyroidism.

MATERIALS AND METHODS

Study design and setting

The study was a cross sectional study carried out in Department of Biochemistry in collaboration with department of Medicine, Chitwan Medical College, Nepal which is a tertiary Hospital. The hypothyroidism patients attending Department of Medicine in Chitwan Medical College were included in this research work by their consent. Laboratory

approved data was collected from 24th July 2019 to November 30th 2019 from the hospital laboratory of Chitwan Medical College, CMC.

Participants and procedure

Patient of all age group and both gender were included on the basis of previous thyroid history and TFT results. A total number of 300 subjects were taken for the research out of which number of healthy controls taken are 100 whereas hypothyroid subjects involved in the research were 200. Patients were classified as hypothyroid using following definitions: serum fT4 < 0.89 ng/dL and TSH > 5.50 µIU/mL. Patients with history of Chronic alcoholism, Chronic liver disease, diabetes mellitus , severe hypertension and bone disease along with patient who were under medication that can cause electrolytic changes were excluded on this study.

10ml of blood sample was drawn from anticubital vein following overnight fasting. The blood sample was collected in plain, fluoride and EDTA vacutainers. The blood sample was centrifuged for 10 min. at 3000 rpm at room temp. The serum was stored at 4oC for biochemical investigations. The standard screening procedures such as thyroid profile (T3, T4 & TSH) and Na+,K+ etc. were the parameters taken into account for the research work. The ADVIA Centaur T3, T4 and TSH assay were done which is competitive immunoassay using direct chemiluminescent technology for T3, T4 and TSH investigation [7].

Sodium, potassium (Na+/K+) were investigated using direct-sensing ion selective electrodes (ISE), methods which develop an electrical potential proportional to the activity of each specific ion in the sample. We defined electrolyte disorders according to the reference ranges as Hyponatraemia < 135 mmol/L, hypernatraemia >145 mmol/L, Hypokalaemia <3.5 mmol/L and hyperkalaemia >4.7 mmol/L.

Statistical analysis and data management

Data were analyzed using IBM SPSS 21 software. Descriptive statistics in the form of minimum, maximum, mean standard deviation and standard error of mean were used for continuous variables. Independent t-test was used to test the difference of paramenters between group I and group II. Statistical significance was set at p <0.05.

Ethical considerations

The ethical committee of CMC (CMC-IRC 076/077-042) has approved this research work. Informed consent was taken from all the patients.

RESULTS

Table 1 shows the comparative changes of thyroid profile and electrolyte in control group and hypothyroidism subjects. All study parameters were significant (p<0.05) in group II hypothyroidism subjects as compared to control subjects (group I) except for electrolyte potassium which was non-significant at p<0.05.

Table 2 shows the comparative changes of thyroid profile and electrolyte in control group and hypothyroidism male subjects. All study parameters were significant (p<0.05) in group I hypothyroidism male subjects as compared to control male subjects except for electrolyte sodium and potassium which was non-significant at p<0.05.

Table 3 shows the comparative changes of thyroid profile and electrolyte in control group and hypothyroidism among female subjects.

Table 1| Changes of hypothyroidism profile in control (group1) and hypothyroidism subjects (group 2)

Group I	N=100	**T_3**	**T_4**	**TSH**	**Na^+**	**K^+**
	Minimum	2.30	0.89	0.67	136	3.30
	Maximum	3.82	1.71	5.82	143	5.20
	Mean	2.85	1.06	2.80	139.72	4.22
	S.D.	0.39	0.20	1.48	1.81	0.50
	S.E.M.	0.078	0.04	0.29	0.36	0.10
Group II	N= 200					
	Minimum	0.22	0.10	0.36	105.0	2.74
	Maximum	2.29	0.89	159.10	159.70	6.30
	Mean	1.78*	0.59*	55.03**	135.30**	4.21NS
	S.D.	0.50	0.22	54.95	7.46	0.67
	S.E.M.	0.04	0.01	4.91	0.66	0.06

*Significant at (p<0.05), ** Significant at (p<0.001) & NS: Non Significant

Table 2|Changes in group 1 (Control) and group 2 (Hypothyroidism) male subjects

Group I	N=50	T_3	T_4	TSH	Na^+	K^+
	Minimum	2.47	0.93	0.67	136.0	3.70
	maximum	3.82	1.60	4.51	141.0	4.40
	Mean	3.06	1.08	2.25	138.70	4.01
	S.D.	0.42	0.20	1.40	1.70	0.28
	S.E.M.	0.13	0.06	0.44	0.53	0.09
Group II	N=100					
	Minimum	0.58	0.12	0.36	105.0	2.75
	maximum	2.29	0.89	150.0	144.0	6.30
	Mean	1.72**	0.60**	54.44*	134.54NS	4.42NS
	S.D.	0.49	0.20	55.12	8.02	0.75
	S.E.M.	0.07	0.03	7.95	1.15	0.10

*Significant at (p<0.05), ** Significant at (p<0.001) & NS :Non Significant

All study parameters were significant ($p<0.05$) in group 1 hypothyroidism female subjects as compared to control female subjects except for electrolyte sodium and potassium which was non-significant ($p<0.05$).

DISCUSSION

Hypothyroidism is the most common form of thyroid dysfunction. Thyroid hormone act as central regulator of various body functions and has influence on metabolism, renal hemodynamics, glomerular filtration and electrolyte handling. In our study parameters (T3,T4,TSH and Na+) were significant ($P<0.05$) in group II hypothyroidism subjects as compared to control subjects (group 1) except for electrolyte potassium which was non-significant at $P<0.05$. T3 and T4 was found significantly decreased whereas TSH was found elevated in subjects of hypothyroidism (group II). The level of sodium was within the normal range but it was found significantly decreased as compared to healthy controls. Yen PM 2001 et.al. [8], JaskinKaur et al. [9] and Ganga Deepkaur Sidhu et al. [10] stated that underactivity of the thyroid gland leads to inadequate production of thyroid hormones and a slowing of metabolism which were in consistent with our results.

In our study the sodium was found significantly increased but it was with in the normal range in both control and hypothyroid patients. Hanna FW et al. [11] and Schmitt R et al.2003 [12] stated that The Na+/potassium (K+) adenosine triphosphates (ATPase) enzyme exchange process is the metabolic pacemaker of thyroid hormone-responsive tissues, leading to an increase in Na+ pump activity. Na+/K+/ATPase activity is higher in euthyroid states. Reduced Na+/K+/ ATPase enzymatic activity and impaired Na+/H+ exchange activity of the proximal tubular borders and other specific segments, as part of a decline in cell metabolism in hypothyroid conditions, can contribute to the diminished proximal tubular capacity for Na reabsorption in hypothyroidism which is in consistent with Ahmed S. Abuzaidet [13] and Kavita MM et al. [14] leading to hyponatremia in hypothyroid subjects.

Hierholzer Ket al. [15] stated that hypernatremia in hypothyroidism is the accumulation of interstitial mucopolysaccharides resulting in mutual solute and fluid retention, diminishing effective tissue perfusion and local lymphatic drainage, particularly in myxedema. In hypothyroidism, hypernatremia seems to be associated only with the severest cases of myxedema as impaired cardiac function causes baroreceptor-mediated vasopressin secretion and total body water retention. Furthermore, thyroid hormones regulate the activity of sodium potassium pumps in most of the tissues. In hypothyroidism because of low potassium levels and deficiency of thyroid hormones sodium-potassium ATPase is affected, resulting in accumulation of water in the interstitial space causing edema causing hyponatremia which was in accordance to Ismail Beigi F et al. [16].

In our study the potassium was found insignificant and it was with in the normal range in both control and hypothyroid patients. But Ganga deepkaur sidhu et al. [10] suggested that in hypothyroidism because of low potassium levels and deficiency of thyroid hormones sodium-potassium ATPase is affected, resulting in accumulation of water in the interstitial space causing edema. Furthermore, thyroid hormones regulate the activity of sodium potassium pumps in most of the tissues. In hypothyroidism because of low potassium levels and deficiency of thyroid hormones sodium-potassium ATPase is affected, resulting in accumulation of water in the interstitial space causing edema causing hyponatraemia. But Abedelmula M, et al. [17], concludes that significant increase in serum potassium levels in hypothyroid group compared to controls which was contradictory.

Table 3|Changes in group 1 (Control) and group 2 (Hypothyroidism) female subjects

		T_3	T_4	TSH	Na^+	K^+
Group I	N=50					
	Minimum	2.30	0.89	0.93	138.0	3.30
	maximum	3.43	1.71	5.82	143.0	5.20
	Mean	2.70	1.05	3.17	140.40	4.37
	S.D.	0.30	0.20	1.46	1.59	0.57
	S.E.M.	0.79	0.53	0.37	0.41	0.14
Group II	N=100					
	Minimum	0.22	0.10	0.89	109.0	2.74
	maximum	2.29	0.89	159.1	159.70	6.10
	Mean	1.81**	0.58**	55.40*	135.77^{NS}	4.09^{NS}
	S.D.	0.50	0.23	55.21	7.11	0.59
	S.E.M.	0.57	0.26	6.29	0.81	0.67

*Significant at ($p<0.05$), ** Significant at ($p<0.001$) & NS: Non Significant

CONCLUSIONS

The study concluded that the thyroid hormones (T3 and T4) was decreased and TSH was increased in hypothyroid subjects whereas the electrolytes sodium and potassium were within the normal range. However, sodium was found significant in hypothyroid as compared to control groups.

ADDITIONAL INFORMATION AND DECLARATIONS

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Data Availability: Data will be available upon request to corresponding authors after valid reason.

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