



**ASSESSMENT OF SERUM ELECTROLYTE AND LIPID PROFILE IN HYPOTHYROIDISM PATIENTS
IN KASHMIR VALLEY INDIA**

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ABSTRACT

Hypothyroidism is a frequent, potentially serious clinical entity resulting from deficiency of Thyroid hormones or due to their impaired activity which may affect electrolyte levels as well as lipids in circulation. The objective of this study was to find out the effect of hypothyroidism on certain electrolytes and on lipids. During our study among all the Thyroid patients the highest number (76.86%) of patients belonged to the female gender and majority of patients were between the age group 31-40 years. When the cases and controls were compared, there was a significant variation in some biological values between the two groups. All the lipids measured (namely total cholesterol, triglycerides, LDL and HDL) were found to be significantly elevated in hypothyroid patients when compared to the controls ($p < 0.001$). The levels of sodium were significantly decreased in cases when compared to controls ($p < 0.001$). However, serum potassium levels in hypothyroid patients were found to be less than that of controls but the difference was not significant. The serum TSH values of patients were studied in relation to the values of serum lipids, sodium and potassium. On analyzing the values, a significant positive correlation between the serum levels of TSH and lipids was noticed, while a significant negative correlation was found between serum TSH and electrolyte levels. From this study, we were able to conclude that higher the TSH levels, higher will be the level of lipids in blood while there was a decrease in the values of electrolytes (Sodium and Potassium).

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INTRODUCTION

Thyroid gland is a butterfly-shaped crucial link organ in the endocrine system and sits at the front of neck below the Adam's apple. It produces two related hormones, thyroxine (T4) & triiodothyroxine (T3), which play a critical role in cell differentiation during development, help to maintain thermogenic & metabolic homeostasis. Hypothyroidism is deficiency of thyroid activity and is a common endocrine disorder resulting from deficiency of thyroid hormone or, more rarely, from their impaired activity at tissue level (1). There are many disorders that result in hypothyroidism, these disorders may directly or indirectly involve the thyroid gland. Because thyroid hormone affects growth, development, and many cellular processes, inadequate thyroid hormone has widespread consequences for the body systems like circulatory, electrolyte, muscular systems. In its clinically overt form, hypothyroidism is a relatively common condition, with an approximate prevalence of 2% in adult women and 0.2% in

adult men increasing to 15% by age 75 years (2, 3). Hypothyroidism is a common metabolic disorder in the general population. In India, 42 million people are suffering from thyroid diseases; hypothyroidism being the commonest thyroid disorder (4, 5). Thyroid hormones perform a wide array of metabolic functions including regulation of lipids, carbohydrates, protein and electrolytes and mineral metabolism (6, 5). The most common effect on lipid metabolism includes mobilization of triglycerides from the adipose tissue causing increased concentration of free fatty acids in plasma. In patients with overt hypothyroidism there is an increase in serum total cholesterol (TC), Low Density Lipoprotein cholesterol (LDL-C), & possibly triglyceride (TG) (5, 6). Thyroid hormone increases basal metabolic rate. Biochemically decrease in T3 and T4 concentration leads to hypersecretion of pituitary TSH and an amplified increase in serum TSH levels. This is a key laboratory finding, particularly in the early detection of thyroid failure (7). They are also believed to influence calcium metabolism (8, 5). Several studies have suggested that hypothyroidism could be a cause of hypokalemia (low level of potassium in the blood serum) and that hyponatremia (when the concentration of sodium in your blood is abnormally low) in hypothyroidism is due to a pure renal mechanism (9, 5). The effect of thyroid

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hormones on electrolytes and minerals has not been well established and the underlying mechanism is not well understood also. So, the present study was undertaken to determine the alterations in the levels of serum electrolytes and lipid profile in hypothyroidism patients in comparison with normal controls and the correlation between serum concentration of electrolytes, lipid and TSH was accessed.

MATERIALS & METHODS

Sample Collection: This study was carried out at the department of Biochemistry Government Medical College (GMC), Srinagar. 134 cases (male 31 and female 103) of clinically established hypothyroidism were chosen. Biochemically, hypothyroidism was established based on low T3, low T4 and high TSH values in serum. Total number of controls was 134 (Male 31 and female 103).

Inclusion criteria: Age group: 10 – 80years.

Exclusion criteria: -Pediatric age group (1-9 years), -Renal disorders. 2ml of venous blood samples were collected into vacutainer plain tubes from cases and controls after an overnight fast from the patients. The blood was allowed to clot, centrifuged at 5000rpm for 10 minutes within 25 min of sample collection. The serum was collected and immediately total cholesterol, triglycerides, LDL, HDL, sodium and potassium were measured on Architect C-4000 Abbott. The thyroid hormones were measured on Advia centaur XPT, Siemens (chemiluminescence Immunoassay method) fully automatic analyser and all results were tabulated.

Statistical analysis: The Statistical software namely SPSS were used for the analysis of the data. The results of cases and controls were compared by student’ test. A p value of <0.05 was considered significant.

RESULTS

Age wise distribution of Cases and Controls: Clinical data was studied to find out the age and sex distribution of hypothyroidism in the selected patients. It was observed that a highest number (34.32%) of patients belonged to the age group of 31- 40 yrs. (Table I).

Table 1 Age distribution

Age in years	Cases		Controls	
	No	%	No	%
10-20	10	7.46	10	7.46
21-30	33	24.62	33	24.62
31-40	46	34.32	46	34.32
41-50	22	16.41	22	16.41
51-60	15	11.19	15	11.19
61-70	6	4.47	6	4.47
71-80	2	1.49	2	1.49
Total	134	100	134	100
Mean ± SD	37.77±14.01		37.82±13.34	

Gender wise distribution of Cases and Controls: We also observed that majority of the patients (76.86%) were females and 23.13% of the patients were males (Table II).

Table 2 Gender distribution

Gender	Cases	No %	Controls	No %
Male	31	23.13	31	23.13
Female	103	76.86	103	76.86
Total	134	100	134	100

Comparison of thyroid profile in case and control group

The levels of T4 were significantly decreased in cases when compared to controls (p<0.001) and TSH were significantly increased in cases when compared to controls (p<0.001) (Table III). However, T3 levels in hypothyroid patients were found to be less than that of controls but the difference was not statistically significant. Figure-1 show graphical representations of T3, T4 and TSH levels respectively in hypothyroid cases in comparison with controls.

Table 3 Comparison of Thyroid profile in two groups

Lab variables	Cases	Controls	P value
T3 (Triiodothyronine) ng/ml	1.05±0.42	2.33±14.00	0.241
T4 (Thyroxine) µg/dl	6.50±2.0	14.90±2.01	<0.001
TSH (Thyroid-stimulating hormone) mIU/ml	25.59±24.3	2.79±1.19	<0.001

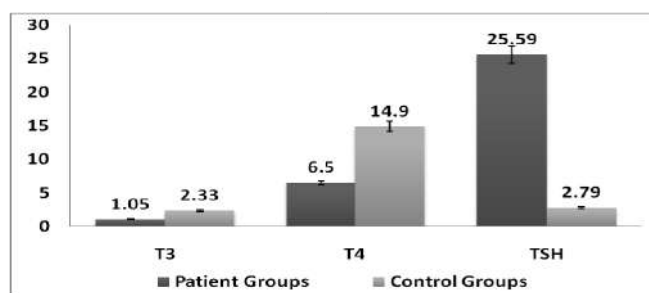


Fig 1 Comparison of thyroid profile in two groups

Comparison of electrolyte profile in case and control group

The levels of sodium were significantly decreased in cases when compared to controls (p<0.001) (Table IV). However, serum potassium levels in hypothyroid patients were found to be less than that of controls but the difference was not statistically significant. Figure-2 show graphical representations of serum sodium and phosphorus levels respectively in hypothyroid cases in comparison with controls.

Table 4 electrolyte profile in case and control group

Lab variables	Cases	Controls	P value
Na (mmol/l)	128.70±10.83	138.90±2.23	<0.001
K (mmol/l)	4.01±0.29	6.02±17.24	0.174

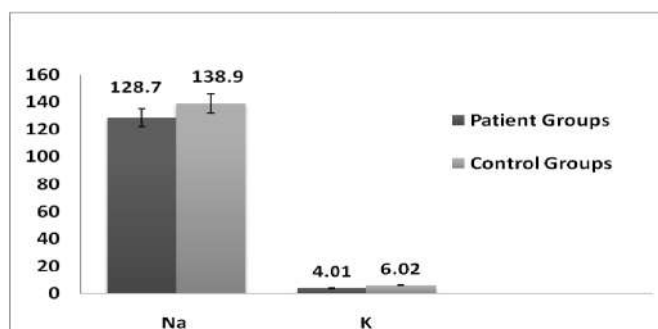


Fig 2 Comparison of electrolyte profile in case & control groups

Comparison of lipid profile in two groups: When the cases and controls were compared, there was a significant variation in the values between the two groups. All the lipids measured, namely total cholesterol, triglycerides, LDL and HDL were found to be significantly elevated in hypothyroid patients when compared to the controls (p<0.001)(Table V). Figure-3 show graphical representations of serum total cholesterol and triglycerides levels respectively in hypothyroid cases in comparison with controls.

Table 5 Comparison of lipid profile in two groups

Lab variables	Cases	Controls	P value
TC (mg/dl)	235.80±58.90	157.80±18.90	<0.001
TG (mg/dl)	179.20±28.96	96.73±27.01	<0.001
LDL (mg/dl)	156.75±28.76	90.05±16.81	<0.001
HDL (mg/dl)	43.42±4.90	31.13±3.90	<0.001

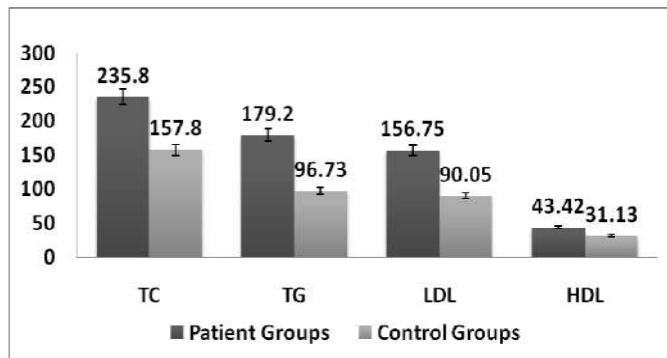


Fig 3 Comparison of lipid profile in two groups.

Correlation of TSH with other biochemical parameters (taken in the study): The serum TSH values of patients were studied in relation to the values of serum lipids, sodium and potassium. On analyzing the values, a statistically significant positive correlation between serum TSH and cholesterol, triglyceride, HDL and LDL levels was noticed ($p < 0.001$). At the same, a statistically significant negative correlation between serum TSH and sodium, potassium levels was observed (Table VI).

Table 6 Correlation of TSH with other lab parameters

Lab variables	Cases	
	r value	p value
Na vs TSH	-0.260	0.004
K vs TSH	-0.280	0.002
TC vs TSH	0.930	<0.001
TG vs TSH	0.850	<0.001
LDL vs TSH	0.849	<0.001
HDL vs TSH	0.875	<0.001

DISCUSSION

Hypothyroidism is one of the thyroid disorders where the body suffers from insufficient thyroid hormone production. Since thyroid hormones are involved in controlling various metabolisms, more importantly lipid metabolism and that of various electrolytes balance in the human body. In hypothyroidism condition the patients generally suffers from a slow metabolism resulting in dyslipidemias and electrolyte disturbances. During our study among all the hypothyroid patients the highest number (76.86%) of patients belonged to the female gender and majority of patients were between the age group 31-40 years which supports the various earlier research reports (10, 2, 3, 5).

In our study, the level of T4 was significantly decreased and TSH was significantly increased in cases when compared to controls. However, T3 levels in hypothyroid patients were found to be less than that of controls but the difference was not statistically significant. These results were supported by the findings of Targher, *et al.*, 2008 & Mane, *et al.*, 2011, as they showed in their results there was a significant increase in the TSH and there was decline in the T3 and T4 levels in hypothyroid patients, which can effect the body metabolism and disturbs the whole body system (11, 12). The levels of sodium were significantly decreased in cases when compared to controls. However, serum potassium levels in hypothyroid

patients were found to be less than that of controls but the difference was not statistically significant which was supported by the findings of Bhart, *et al.*, 2015 and Schwaraz, *et al.*, 2012. (13, 14). This imbalance in sodium and potassium electrolyte balance can lead to a variety of clinical situations, including congestive heart failure, electrolyte disturbances and coma (15, 16).

There was a significant variation within the values of hypothyroidism patients and controls, the lipids measured, namely total cholesterol, triglycerides, LDL and HDL were found to be significantly elevated in hypothyroid patients. These results are in accordance with the findings of Mittal 2010, Galisanu, *et al.*, 2004 and Asvold 2007, *et al.*, 2007, as they have also showed in their study that there was elevated level of cholesterol and LDL in hypothyroidism patients as compared to normal controls (17, 7, 18). Thyroid hormones have a significant role to play in metabolism of lipids. Any deficiency of thyroid hormones tends to cause hyperlipidemia, which is a known risk factor for development of atherosclerotic disease. These elevated levels in cholesterol and LDL may be due to the fact that expression of LDL receptor is modulated by thyroid hormones. We also observed the elevation of triglycerides in overt hypothyroidism which are in agreement with the the findings of Murgod 2010 and Mittal 2010, as it may be due to the fact that there is poor clearance of endogenous and exogenous triglycerides from circulation in hypothyroidism (17, 19). HDL level was found to be increased in hypothyroid cases when compared to controls, the elevated levels of HDL in hypothyroid cases is due to reduced activities of Cholesterol Ester Transfer protein (CETP) and hepatic lipase as per the 18, 20. The results of Altonsi *et al* 2004 also indicated a significantly elevated serum cholesterol and triglyceride levels in the hypothyroid patients, which supports our findings during this study (21).

There was a significant negative correlation between TSH levels and serum sodium levels in cases. Serum potassium levels were found to be decreased in hypothyroid patients when compared to controls, though it was statistically significant. But when potassium values were studied in relation to serum TSH values, a significant negative correlation was found ($p = -0.002$). Higher the value of TSH, lower was the level of serum potassium. Sodium and potassium are important components of the enzyme Na-K ATPase, which is an enzyme on the cell membrane 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 (22). In hypothyroidism, because of low potassium levels, and because of deficiency of thyroid hormones, this enzyme is affected, resulting in accumulation of water inside the cells and causing edema. This is said to be one of the mechanisms responsible for weight gain seen in hypothyroid patients.

CONCLUSION

It has been shown in our study that there were elevated atherogenic parameters in hypothyroid patients due to which they are at high risk for developing cardiovascular disorders. They also possess serum electrolyte disturbances such as low sodium and low potassium levels in blood. Hence monitoring of serum levels of these electrolytes and lipid parameters during the follow up of hypothyroid patients will be of great benefit and may act as prognostic marker. Also, electrolyte

disturbances need to be monitored and treated appropriately in conditions such as myxedema coma to avoid the ill effects resulting from the changes in the serum levels of these electrolytes.

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