

Assessment of Serum Electrolytes & Uric Acid Level in Hypothyroid Patients in Western Uttar Pradesh.

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Abstract: Introduction: Thyroid hormone is a central regulator of body functions. Disorders of thyroid function are considered to be a cause of electrolyte alterations. Only few data on the association between thyroid function and electrolyte disorders exist. Aim of the study was to find out the association between serum sodium, potassium and uric acid level with fT3, fT4 & TSH in hypothyroid patients. **Materials & Methods:** Total 70 newly diagnosed hypothyroid patients were included in the study. Sera were collected from them and serum sodium, potassium, uric acid, fT3, fT4 & TSH level were estimated in the study group. **Result:** Patients with hypothyroidism showed significant decrease in serum sodium level and significant increase in serum potassium and uric acid level ($p < 0.05$). When correlated with TSH level, the correlation was negative for sodium whereas positive for the potassium and uric acid. Correlation with fT3 and fT4 level was positive with sodium and negative with potassium and uric acid level. **Conclusion:** The present study indicates the profound influence of thyroid hormones on serum uric acid and electrolytes. We suggest that hypothyroid patients should be regularly monitored for serum electrolytes and uric acid level. Monitoring of these parameters in hypothyroidism will be of great help in the management of the patients.

Key words: Hypothyroid, TSH, fT3, fT4

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I. Introduction

Among various endocrine problems, thyroid disorders are the most common worldwide. It has been reported that in India alone, about 42 million people suffer from thyroid disorders.^[1] Worldwide, iodine deficiency is the most common cause of hypothyroidism.^[2]

Primary hypothyroidism is a frequent syndrome, whose prevalence is 0.5–2.0% among women and around 0.2% among men. According to several authors, recently the number of patients with autoimmune diseases with hypothyroidism have increased by 2.1%.^[3] Hypothyroidism is state of thyroid hormone deficiency or their impaired functions with compensatory thyroid enlargement.^[4] Impaired production of thyroid hormones primarily due to thyroid abnormality or iodine deficiency; sometimes may be secondary to pituitary or hypothalamic disorders. Hypothyroidism is associated with weight gain, cold intolerance, constipation. Thyroid hormones have important biological effects such as regulation of body hemodynamic, thermoregulation, and various metabolisms. It influences almost all metabolisms in the body including carbohydrate, proteins, lipids, and maintenance of water and electrolyte homeostasis, which are well-established.^[5,6]

The interactions between thyroid gland and renal functions are known for years.^[7,8] Thyroid dysfunction can affect renal physiology and development, and on the other hand, kidney disorders can confluence thyroid function.^[9]

In many standard textbooks and reviews different electrolyte disorders were associated with thyroid dysfunction. In severe hypothyroidism and myxedema hyponatremia was described to be a consequence of enhanced renal water retention mediated by vasopressin.^[10] On the other hand, hypokalemia, hypomagnesaemia and hypocalcemia were mentioned in patients with thyrotoxicosis.^[11–13] Hypothyroidism may also be associated with kidney derangement resulting in altered uric acid level. Hyperuricemia can result from increased production or decreased excretion of uric acid or from a combination of two processes.^[14]

Therefore the present study was undertaken to show the relationship between serum electrolyte and uric acid level with thyroid hormones (fT3, fT4 and TSH) levels in patients with Hypothyroidism attending tertiary care centre (RMCH & RC, Hapur.)

II. Materials And Methods

This study was a hospital based cross sectional study conducted in the department of Biochemistry at RMCH &RC, Hapur from January 2016 to June 2018 comprising of 70 newly diagnosed and untreated cases of hypothyroidism. Institutional Ethical clearance was taken. The objectives of the study were explained to all eligible subjects. Informed consent of all subjects included in the study was obtained for involvement in study groups and for venipuncture.

2.1.1 Inclusion criteria

The diagnosis was based on decreased serum T3 and T4 level associated with increased TSH level. All patients suffering from hypothyroidism were diagnosed and confirmed by the physician based on free T3 (Normal: 2.4-4.2 pg/ml), free T4 (Normal: 0.7-1.4 ng/dl) and TSH (Normal: 0.34-4.25 μ IU/ml) level of the patients.^[15]

2.1.2 Exclusion criteria

Patients with history of chronic liver diseases, chronic kidney diseases, bone diseases, chronic alcoholism, diabetes mellitus, severe hypertension, malignancies, gout and patients who were under medications that can cause electrolytic changes were excluded from this study.

A 3ml of venous blood is drawn from each volunteer using a disposable plain vacutainer system in fasting condition. Serum is separated within half an hour by centrifugation and stored at 2-8°C temperature till analysis is done. Thyroid hormones assay test was done by Fluorometric enzyme immunoassay (FEIA) method on TOSHO AIA-360 Immunoanalyzer machine. Electrolyte levels (Na^+ , & K^+) were measured by ion selective electrode method on ROCHE 9180 electrolyte analyzer. Uric acid was estimated by Uricase -Enzymatic method on TRANSASIA EM 200 Auto analyzer machine.

The collected data were statistically analyzed by using SPSS statistics (Statistical Package for Social Sciences) software version 20.0. Correlations were done using Pearson's Correlation for numerical parametric data. P value < 0.05 was considered statistically significant.

III. Result

Clinical data was studied to find out the age and sex distribution of hypothyroidism in the selected population. It was observed that a majority of the patients (83%) were females and (17%) of the patients were males ($p < 0.0001$) (fig.1).

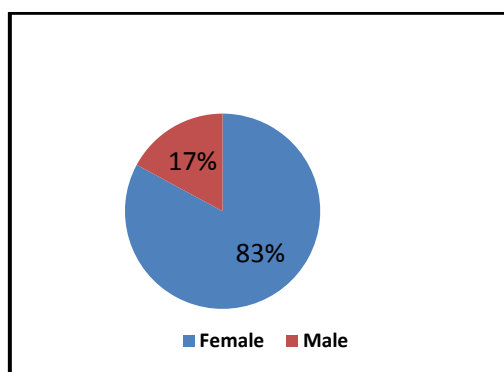


Fig. 1. Gender wise distribution of patients (n=70)

Among 70 patients, 17.1% (n=12) fall in age-group 20-39 years category, 51.4% (n=36) in 40-59 years category, 27.1% (n=19) in 60-79 years category and 4.2% (n=3) in ≥ 80 years category.

We also observed that highest number (51.4%) of patients belonged to the age group of 40-59 yrs. (Table.1).

Table 1. Distribution of patients according to different age-groups

Age-group (years)	Frequency	Percentage (%)
20-39	12	17.1
40-59	36	51.4
60-79	19	27.1
80 and above	3	4.2

Table2. Biochemical parameters of the patients

Parameters	Mean values
fT3 (pg/ml)	1.60 ± 0.73
fT4 (ng/dl)	0.61 ± 0.56
TSH (μIU/ml)	10.5 ± 13.43
Na ⁺ (mEq/l)	135.53 ± 5.37
K ⁺ (mEq/l)	5.63 ± 0.77
Uric acid (mg/dl)	7.82 ± 1.42

TSH = thyroid stimulating hormone; fT3 = free triiodothyronine; fT4 = free thyroxine; Na⁺ =Sodium; K⁺ = Potassium.

Table 2. shows the mean values of thyroid function parameters and electrolytes and uric acid level of study subjects. fT3, fT4 and TSH levels were 1.60 ± 0.73 pg/ml, 0.61± 0.56 ng/dl and 10.5 ± 13.43μIU/mL respectively. Serum electrolytes (Na⁺and K⁺) levels were found to be 135.53 ± 5.37mEq/l and 5.63 ± 0.77mEq/l respectively. Mean serum uric acid levels in cases was 7.82±1.42 mg/dl.

Table 3. Correlation coefficient values of thyroid hormones and TSH with Sodium,Potassium& Uric acid.

Parameters	Coefficient of correlation (r)	p value
fT3 vs. Na ⁺	0.388**	0.000
fT3 vs. K ⁺	-0.599**	0.000
fT4 vs. Na ⁺	0.315**	0.002
fT4 vs. K ⁺	-0.547**	0.000
TSH vs. Na ⁺	-0.324**	0.001
TSH vs. K ⁺	0.3574**	0.000
TSH vs. Uric Acid	0.476**	0.001

Note: - Values with superscript are significant (**p<0.001) i.e., correlation is significant at 0.001 level.

In the present study fT3(r= 0.388) and fT4(r=0.315) levels are positively correlated with serum sodium level, whereas serum potassium level is negatively correlated fT3(r= -0.599)and fT4(-0.547),and these are statistically significant.A negative correlation between TSH and serum sodium level and positive correlation between TSH and potassium was found which are statistically significant.We also found a significant positive correlation between TSH and serum uric acid (0.476).

IV. Discussion

This study was conducted to assess therelationship between hypothyroidism and serum electrolyte level among the patients attendingRMCH&RC. This study revealed more than three fourth (83%) of the hypothyroid patients weremale. Majority (51.4%) of them fall in agegroup40 to 59 years. This indicates that hypothyroidism is more common in middle-aged females. This finding is supported by earlier statistics which suggested much higher prevalence of hypothyroidism in women compared to men.

In the present study patients with hypothyroidism showed slight decrease in serum sodium and significant increase in serum potassium which agree withIglesias *etal*2009.^[16] An impaired urinary dilution capacity due to non-osmotic release ofanti-diuretic hormone, as well as increased urine sodium loss was the major mechanism forhypothyroid induced hyponatremia.^[17]

In the present study, we found statistically significant positive correlation between Na⁺concentration in relation to fT3 and fT4 while there was statistically significant negative correlation between Na⁺ and TSH. In contrast to Na⁺, the correlation for K⁺ was just reverse.

These findings in our study aresuggestive of the involvement of thyroid hormones in maintenance of electrolyte balance.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 pump in most of the tissues. In hypothyroidism, because of low potassium level, 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.^[18]

Our study showed the possible interrelationship between purine nucleotide metabolism and thyroid endocrine disorders. Significant increase in uric acid level was found in the patients with hypothyroidism. We found a significant positive correlation between serum TSH and uric acid level. Giordano et al. conducted a study among 28 patients with primary hypothyroidism and showed 33.3% prevalence of hyperuricemia in patients withhypothyroidism.^[19] Similar studies were conducted by Erickson et al.,^[20]Dariyerliet al.,^[21] and Yokogoshi and Saito^[22] and found hyperuricemia in patients with hypothyroidism.

The findings of this study confirm that the possible inter-relationship between purine nucleotide metabolism and thyroid disorders. Many biochemical pathways in the body can be affected by disturbance of thyroid hormones level, uric acid is one of these biochemical pathways. The hypo dynamic state of the circulatory system in hypothyroidism that causes the elevation of uric acid level as in this study^[23].

V. Conclusion

Thyroid dysfunction disturbance alters serum electrolyte and uric acid level, especially the hypothyroidism disorder. Whereas thyroid disorders therapy shifts the disturbance to normal level. This suggests that hypothyroid patients should be regularly checked for serum electrolytes and uric acid level. Early detection and treatment can prevent the further complications related to the disorder and will be helpful during the management of thyroid patients.

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