



## Assessment of Serum Electrolytes in Hypothyroid Patients Attending Chitwan Medical College Teaching Hospital

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### Authors' contributions

*This work was carried out in collaboration between two authors. Author LBS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author ST helped in standardization and statistical analysis and helped in preparing first draft of manuscript. Both authors read and approved the final manuscript.*

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### ABSTRACT

**Aims:** The aim of present study was to find out the serum concentration of two important electrolytes Sodium and Potassium in hypothyroid patients and establish its relationship with thyroid function parameters.

**Study Design:** Hospital based retrospective cross-sectional study.

**Place and Duration of Study:** Department of Biochemistry, Chitwan Medical College Teaching Hospital, Bharatpur-10, Chitwan, Nepal. January to July 2016.

**Methodology:** 102 hypothyroid cases were chosen based upon their past history of hypothyroidism and thyroid function tests (TFTs) result. Retrospective analysis was done by screening the electronic database of the patients.

**Results:** It was found that the majority of the hypothyroid patients were females falling under age-group of 40-59 years ( $p < 0.05$ ). Mean values of free T3 (fT3), free T4 (fT4) and TSH levels were

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1.75 ± 0.86 pg/ml, 0.64 ± 0.45 ng/dl and 9.1 ± 11.43 µIU/mL respectively. Serum electrolytes (Na<sup>+</sup> and K<sup>+</sup>) levels were found to be 132.53 ± 5.48 and 5.43 ± 0.849 mEq/L respectively. A statistically significant positive correlation was observed between Na<sup>+</sup> concentration in relation to fT3 and fT4 while there was statistically significant negative correlation between Na<sup>+</sup> and TSH. In contrast to Na<sup>+</sup>, the correlation for K<sup>+</sup> was just reverse. There was significant negative correlation between K<sup>+</sup> concentration in relation to fT3 and fT4 and significant positive correlation between K<sup>+</sup> and TSH.  
**Conclusions:** This study suggests that hypothyroidism is strongly linked with the derangement of electrolyte concentration in blood. Regular monitoring of electrolyte concentration will be of great benefit to prevent further complications associated with hypothyroidism.

*Keywords: Hypothyroidism; thyroid hormones; hyponatremia; hyperkalemia.*

## 1. INTRODUCTION

Thyroid hormones perform a wide array of metabolic functions including regulation of lipid, carbohydrate, protein, electrolyte and mineral metabolisms [1]. Hypothyroidism is a clinical entity resulting from the deficiency or impaired activity of thyroid hormones [2].

Hypothyroidism is associated with dyslipidemia resulting in hypercholesterolemia, elevated low-density lipoprotein (LDL), and hypertriglyceridemia [3]. Hypothyroid patients are at increased risks to develop cardiovascular diseases due to this deranged lipid profile, endothelial dysfunction, metabolic, hormonal, and hemodynamic changes and coagulation disturbances [4]. While the effect of thyroid hormones on lipid metabolism is well known, the effect on electrolytes and minerals has not been well established and also the underlying mechanisms are not well understood [5].

Many literatures have reported changes in the serum electrolytes concentration and shown their association with thyroid dysfunction. Thyroid hormones regulate the activity of sodium potassium pumps in most of the tissues. Sodium and potassium are important components of the enzyme Na<sup>+</sup>-K<sup>+</sup>ATPase, which is an enzyme on the cell membrane that helps in the transport of water and nutrients across the cell membrane [6]. Most guidelines consider hypothyroidism to be a cause for hyponatremia [7-9]. Proposed mechanisms for hypothyroidism induced hyponatremia include increase in vasopressin (ADH) release [10-13] and reduced renal glomerular filtration rate (GFR) [8,14]. On the other hand, hypokalaemia, hypomagnesaemia and hypercalcaemia were mentioned in patients with thyrotoxicosis [15].

Therefore the present study was undertaken to show the relation between serum electrolyte

levels and thyroid hormones (fT3, fT4 and TSH) in patients with Hypothyroidism attending tertiary care centre (Chitwan Medical College Teaching Hospital).

## 2. MATERIALS AND METHODS

### 2.1 Study Design and Subjects

This study was a hospital based cross sectional study conducted in the department of Biochemistry at Chitwan Medical College Teaching Hospital (CMCTH), Bharatpur, Nepal from January 2016 to July 2016. A total of 102 patients suffering from hypothyroidism were enrolled in this study.

#### 2.1.1 Inclusion criteria

Based on previous thyroid history and TFT results, patients were classified as Hypothyroid using following definitions: serum fT4 < 0.89 ng/dL and TSH > 5.50 µIU/mL.

#### 2.1.2 Exclusion criteria

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

### 2.2 Collection of Data

In this cross-sectional study, we screened the electronic database of the patients suffering from hypothyroidism who had undergone thyroid function test (TFTs) by electrochemiluminescence immunoassay (eCLIA) method in Biochemistry lab of CMCTH. Of all 102 hypothyroid patients identified in the first step, we gathered

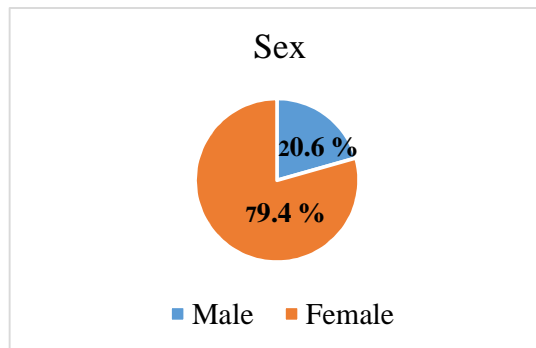
information on age and sex. Biochemical data regarding serum levels of thyroid stimulating hormone (TSH), free tri-iodothyronine (fT3) and free thyroxine (fT4) were obtained. Data on serum sodium and potassium estimated by ion selective electrode (ISE) method were also collected.

### 2.3 Statistical Analysis

The collected data were statistically analysed using IBM 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.

### 3. RESULTS

Fig. 1 shows the gender wise distribution of patients. Among 102 hypothyroid patients, 79.4% were female and remaining 20.6% were male. This showed that majority of patients were female compared to male ( $p < 0.0001$ ).



**Fig. 1. Genderwise distribution of patients (n=102)**

Table 1 shows the distribution of patients according to different age groups. Among 102 patients, 17.6% (n=18) fall in age-group 20-39 years category, 50.0% (n=51) in 40-59 years category, 31.3% (n=32) in 60-79 years category and 0.9% (n=1) in  $\geq 80$  years category. This showed that the mean age of the patients was  $45.55 \pm 16.63$  years and majority (50.0%) of them belonged to 40-59 years age-group category. This variation in the distribution of hypothyroidism according to different age-groups was statistically significant ( $p < 0.05$ ).

Table 2 shows the mean values of thyroid function parameters and electrolytes of study

subjects. fT3, fT4 and TSH levels were  $1.75 \pm 0.86$  pg/ml,  $0.64 \pm 0.45$  ng/dl and  $9.1 \pm 11.43$   $\mu$ IU/mL respectively. Serum electrolytes (Na+ and K+) levels were found to be  $132.53 \pm 5.48$  and  $5.43 \pm 0.849$  mEq/l respectively.

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

Age-group (years)	Frequency	Percentage (%)
20-39	18	17.6
40-59	51	50.0
60-79	32	31.3
80 and above	1	0.9

**Table 2. Biochemical parameters of patients**

TFTs parameters	Mean values
fT3	$1.75 \pm 0.86$
fT4	$0.64 \pm 0.45$
TSH	$9.1 \pm 11.43$
Na+	$132.53 \pm 5.48$
K+	$5.43 \pm 0.84$

*TSH = thyroid stimulating hormone; fT3 = free triiodothyronine; fT4 = free thyroxine; Na+ = sodium; K+ = potassium*

**Table 3. Correlation coefficient values of thyroid hormones and TSH with Sodium and potassium**

Thyroid hormones	Coefficient of correlation (r)	p value
fT3 vs. Na+	0.390**	0.000
fT3 vs. K+	-0.609**	0.000
fT4 vs. Na+	0.301**	0.002
fT4 vs. K+	-0.560**	0.000
TSH vs. Na+	-0.317**	0.001
TSH vs. K+	0.364**	0.000

*Note: - Values with superscript are significant (\*\* $p < 0.01$ ) i.e., correlation is significant at 0.01 level*

### 4. DISCUSSION

This study was conducted to assess the relationship between hypothyroidism and serum electrolyte level among the patients attending CMCTH. This study revealed more than three-fourth (79.4%) of the hypothyroid patients were female. Majority (50.0%) of them fall in age-group 40 to 59 years. This indicates that hypothyroidism is more common in middle-aged females. This finding is supported by earlier statistics which suggested much more higher prevalence of hypothyroidism in women compared to men.

In the present study we found significant decrease in serum sodium levels. This finding is in accordance with Schwarz et al. [15] and Roopa et al. [16] who stated hyponatremia is a common finding in patients with hypothyroidism. In contrast to hyponatremia, serum potassium levels were significantly raised in this study. This finding is supported by Abedelmula M et al. [17] and Bharti et al. [18] who stated there was significant increase in serum potassium levels in hypothyroid group compared to controls. Horie et al. [19] also reported hyperkalemia in a small percentage of hypothyroid patients after thyroid hormone withdrawal. But this finding in our study is contradictory to Schwarz et al. [15] and Roopa et al. [16].

In the present study, we found statistically significant positive correlation between  $\text{Na}^+$  concentration in relation to  $\text{fT}_3$  and  $\text{fT}_4$  while there was statistically significant negative correlation between  $\text{Na}^+$  and TSH. In contrast to  $\text{Na}^+$ , the correlation for  $\text{K}^+$  was just reverse. There was significant negative correlation between  $\text{K}^+$  concentration in relation to  $\text{fT}_3$  and  $\text{fT}_4$  and significant positive correlation between  $\text{K}^+$  and TSH. These findings in our study are suggestive of the involvement of thyroid hormones in maintenance of electrolyte balance.

Hypothyroidism has a direct effect on the status of electrolyte metabolism within the kidney. The activity of  $\text{Na}^+/\text{K}^+$  ATPase pump is decreased leading to the reduction of  $\text{Na}^+$  reabsorption. Hyponatremia is one of the commonest electrolyte derangement in hypothyroid patients because hypothyroidism is associated with decreased GFR, decreased renal plasma flow and decreased sodium reabsorption. Other possible mechanism of hypothyroidism induced hyponatremia is an inappropriate ADH secretion syndrome (SIADH)-like disorder [20,21]. It is a well established fact that hyponatremia is associated with hypothyroidism, but it is not known if hypo- or hyperkalemia is associated with hypothyroidism. Hyperkalemia observed in this study might be implicated to changes in the renal hemodynamics and deficient ADH secretion resulting in decreased Potassium excretion which occurs in hypothyroid patients.

## 5. CONCLUSION

This study revealed decreased Sodium level and increased Potassium level in patients with hypothyroidism. Since hypothyroidism is strongly linked with electrolytic imbalances, such patients

require regular check-up for their electrolyte profile along with TFTs. Early detection and treatment by supplementation can prevent the further damage associated with these electrolytic changes.

## 6. LIMITATIONS OF THE STUDY

This is a hospital based retrospective cross-sectional study with limited sample size. Prospective studies with long term follow up in patients with newly diagnosed hypothyroidism could help to determine whether the electrolyte disorder really resolves itself after starting hormone substitution.

## CONSENT

Informed consent was obtained from all the patients. The harmless nature and advantage of the research was also explained to them.

## ETHICAL APPROVAL

The study was approved by the institutional ethical committee.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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