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### Original Article

## Alteration in levels of Serum calcium, phosphorous and magnesium in patients of Hypothyroidism

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#### ARTICLE INFO

#### ABSTRACT

##### Keywords:

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Thyroid dysfunction constitutes the most common endocrine abnormality in the world second only to diabetes mellitus. Thyroid hormones play a central role in homeostasis of calcium and phosphorous levels in the body. Only few studies have been to find alterations of serum calcium, phosphorous and magnesium levels in subclinical hypothyroidism (SCH) and overt hypothyroidism (OH). Hence present study was aimed to find the changes in serum calcium, phosphorous and magnesium levels in SCH and OH and also correlate these parameters with serum TSH. Methodology: The study participants were selected from patients who have undergone thyroid profile evaluation. 50 subclinical hypothyroid patients, 50 overt hypothyroidism patients and 50 euthyroid patients were taken as control. Blood sample was collected from all these subjects and estimation of serum TSH, FT3, FT4, calcium, phosphorous and magnesium was done. Results: Our study shows the mean serum calcium levels were significantly ( $p < 0.001$ ) lower serum phosphorous and magnesium levels were significantly increased ( $p < 0.01$ ) in SCH and OH when compared to euthyroid. We also found there was statistically significant negative correlation between TSH and serum calcium positive correlation between TSH and serum phosphorous levels among both SCH and OH.

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### 1. Introduction

Thyroid hormones are essential for normal growth and maturation of skeletal system. Thyroid dysfunction is frequently associated with disturbances of calcium and phosphorous homeostasis. Thyroid disorders are important cause of secondary osteoporosis. Subclinical hypothyroidism (SCH) is defined as an elevated serum thyroid stimulating hormone (TSH) level associated with normal serum level of thyroxine (T4) and triiodothyronine (T3). Overt hypothyroidism (OH) is the elevated TSH and decrease serum T3 and T4 levels. SCH is much more common than OH, so early diagnosis and treatment may prevent onset of OH. Serum calcium, phosphorous levels can be fairly used as an index of bone resorption [1]. In hypothyroidism there is a depressed turnover due to impaired mobilization of calcium into the bone this leads to decrease in blood calcium level. In hypothyroidism increased production of calcitonin can promote

tubular reabsorption of phosphate and tubular excretion of calcium [2]. FT3 elevates the renal phosphate reabsorption and elevates serum phosphorus levels in rats. Animal studies propose thyroid hormones as long term regulators for phosphate metabolism [3].

Few studies show normal serum calcium and phosphorous levels [4-5] while others show decreased levels in hypothyroidism [6-7]. Even though the changes in the calcium and magnesium may be slight in thyroid disorders, these disturbances will be important for patient in the long run [8]. Few studies show that some of metabolic disorders, hypertension and cardiovascular disease are related to defects in metabolism of divalent cations such as calcium and magnesium [9-10].

Review of the articles show conflicting results. Hardly few studies are done to find the effect of thyroid hormones on these divalent cations in SCH. Hence the present study was undertaken to find the alteration of serum calcium, phosphorous and magnesium levels in subclinical hypothyroidism and overt hypothyroidism. We also compared serum levels of calcium, phosphorous and magnesium with euthyroids and the correlation was done between TSH and serum calcium, phosphorous and magnesium.

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## Material & Methods

The study was conducted in the department of Biochemistry in tertiary care centre, north Karnataka, India from January to June 2014. Study participants were selected from patients who underwent thyroid profile evaluation. Among them 150 participants of the age group between 20 to 60 years were selected. Fifty SCH and fifty OH subjects were chosen for the study. Fifty controls with normal thyroid profile i.e euthyroid were selected. The normal reference range of thyroid profile according to the kits (Maglumi, SNIBE) are TSH 0.5-4.5 unit mL/mL, FT3: 1.21 – 4.18 pg/mL and FT4: 8.9 – 17.2 pg/mL. SCH was established in terms of increased TSH and normal FT3 and FT4 levels whereas OH increased TSH and decreased FT3 and FT4 levels. Patients with history of hepatic disease, renal disease, bone disease, diabetes mellitus, alcoholism, those who were on supplementation with calcium and other mineral supplementation were excluded from the study.

The study was approved by the ethical committee of the institution. Informed consent was taken from all the participants. Under aseptic precaution 3mL of venous blood was drawn from the anterior cubital fossa from all the participants. Serum was separated by centrifugation and used for biochemical estimation. All the biochemical parameters were assessed on the same day. Serum TSH, FT3 and FT4 were measured by chemiluminescence immunoassay by using MAGLUMI-1000, SNIBE. Serum calcium by Arsenazo III method, phosphorous by ammonium molybdate method (Erba Kits) and magnesium by xylidyl blue method (Raichem kit) estimated on semiautoanalyser.

Statistical results are expressed as mean  $\pm$  SD. Analysis of variance (ANOVA) test was applied for comparison of three groups and 'F' value is noted. Pearson's correlation test was applied.  $p < 0.05$  was considered as statistical significant. Statistical analysis was done using Statistical Package Social System (SPSS) version 11.

## Results:

Table-1 shows male to female ratio, the mean age and thyroid profile of the different groups. It shows that no significant difference ( $p=0.6$ ) between the mean age among the euthyroid and cases. There is significant difference ( $p < 0.0001$ ) between means of TSH, FT3 and FT4 levels in SCH and OH when compared to euthyroids.

Comparison between serum levels of calcium, phosphorous and magnesium are shown in table-2. Our study shows the mean serum calcium levels were significantly ( $p < 0.001$ ) lower in SCH and OH when compared to euthyroids. Similarly serum phosphorous and magnesium levels were significantly increased ( $p < 0.01$ ) in SCH and OH when compared to euthyroid.

Table-3 shows the correlation between TSH values with serum calcium, phosphorous and magnesium levels among overt hypothyroidism and subclinical hypothyroidism. In our study analysis shows a statistically significant negative correlation between TSH and serum calcium among both OH and SCH. At the

same time statistically significant positive correlation between TSH and serum phosphorous levels in both the groups. Whereas TSH with serum magnesium shows statistically significant positive correlation with only overt hypothyroidism.

**Table-1: Comparison of Thyroid profile of Euthyroid, Subclinical and Overt Hypothyroidism**

Parameters	Euthyroid	Subclinical Hypothyroidism	Overt Hypothyroidism	ANOVA F	p-value
Male : Female	8:42	8:42	9:41	-	-
Age in years	34.26 $\pm$ 14.35	35.04 $\pm$ 13.35	34.67 $\pm$ 18.4	9.36	0.6
TSH mL/mL	2.6 $\pm$ 1.35	12.26 $\pm$ 8.15	49.78 $\pm$ 38.5	57.64	0.0001
FT3 pg/mL	2.5 $\pm$ 0.65	3.47 $\pm$ 1.3	1.15 $\pm$ 0.82	17.36	0.0001
FT4 pg/mL	11.53 $\pm$ 1.9	10.37 $\pm$ 2.12	4.13 $\pm$ 2.32	158.48	0.0001

$p < 0.05$  is Significant

**Table-2: Comparison of serum Calcium, Phosphorous and Magnesium levels in Euthyroid, Subclinical and Overt Hypothyroidism**

Parameters	Euthyroid	Subclinical Hypothyroidism	Overt Hypothyroidism	ANOVA F	p-value
Calcium mg/dL	9.31 $\pm$ 0.25	8.96 $\pm$ 0.78	8.52 $\pm$ 0.67	18.89	0.0001
Phosphorous mg/dL	3.6 $\pm$ 0.19	4.1 $\pm$ 0.46	4.42 $\pm$ 0.81	25.36	0.0001
Magnesium mg/dL	2.1 $\pm$ 0.28	2.1 $\pm$ 0.66	2.37 $\pm$ 0.46	4.52	0.01

$p < 0.05$  is Significant

**Table-3: Pearson correlation coefficient between TSH and Calcium, Phosphorous and Magnesium in Overt and Subclinical Hypothyroidism**

Groups	Correlation	r value	p value
Overt hypothyroidism	TSH vs Ca	- 0.574	0.001
	TSH vs PO4	0.38	0.01
	TSH vs Mg	0.432	0.003
Subclinical Hypothyroidism	TSH vs Ca	- 0.342	0.02
	TSH vs PO4	0.297	0.05
	TSH vs Mg	0.274	0.06

Correlation is significant at the  $p < 0.05$  level

### Discussion:

Thyroid hormones act as central regulators of body haemodynamics, thermoregulation and metabolism. Our study reveals a significant decrease ( $p < 0.0001$ ) in serum calcium levels in SCH and OH  $8.96 \pm 0.78$  and  $8.52 \pm 0.67$  compared to euthyroids  $9.31 \pm 0.25$ . This agrees with study done by Shivallela, who concluded that there was significant decrease in serum calcium levels in hypothyroid patients compared to controls [6]. Animal study done by Kumar and Prasad concludes that renal calcium excretion was increased in rats with high TSH levels [11]. Our findings are also in accordance with Roopa and Soans which states that thyroxine normally regulates blood calcium level by releasing calcium from cells, by decreasing T4 level in blood, less T4 enters the cells and less calcium is released [12].

The significant negative correlation of TSH with serum calcium levels in our study correlates with other clinical and animal studies [13-14].

In our study, phosphorous levels significantly increased ( $p < 0.0001$ ) in SCH and OH compared to euthyroids which is in accordance with many studies [13-16], who reported higher prevalence of hyperphosphatemia in the group with high TSH levels and positive correlation between TSH and serum phosphorous levels. Our findings are in contrast to Gammage [17] who reported decreased serum phosphorous levels in hypothyroidism.

Present study demonstrates that significantly elevated ( $p < 0.0001$ ) levels of serum magnesium in SCH and OH compared to euthyroids which is in agreement with Jaskin K, Schwarz and Frizel (18-19). Frizel in his study states that both plasma magnesium and ionized magnesium were increased in hypothyroidism. Our study show significant positive correlation ( $p < 0.003$ ) with only overt hypothyroidism and there is no correlation was observed ( $p = 0.06$ ) with SCH. But few studies show decreased levels of serum magnesium levels in hypothyroidism compared to controls and show negative correlation with thyroid hormones (20-21).

### Conclusion:

This study concludes that serum calcium levels were decreased in SCH and OH compared to euthyroids with negative correlation between serum TSH levels and serum calcium. Whereas serum phosphorous and magnesium levels were increased in SCH and OH and there is positive correlation between TSH and serum phosphorous. This suggests that hypothyroid patients to be regularly checked for serum calcium, phosphorous and magnesium levels. Early detection and treatment can prevent the further bone complications.

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