



ORIGINAL RESEARCH PAPER

Biochemistry

ASSESSMENT OF SERUM MINERALS IN PATIENTS WITH THYROID DISORDERS

KEY WORDS:

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ABSTRACT

Introduction: Normal thyroid function plays an important role in regulation of cellular activity, and influences basal metabolic rate and general body metabolism. Thus, thyroid dysfunction is often associated with disturbed mineral metabolism.

Materials and methods: This study included 70 patients with subclinical hypothyroidism, 70 patients with overt hypothyroidism, and 70 age- and sex-matched healthy controls. Thyroid profile (estimation of free triiodothyronine [FT3], free thyroxine [FT4], TSH) was done. In both cases and controls serum calcium and serum phosphorus levels were estimated.

Results: Serum calcium in patients with subclinical hypothyroidism and hypothyroid patients were lower than the controls. Serum phosphorus levels in patients of subclinical hypothyroidism and hypothyroid patients were higher than the controls. The values were found to be statistically significant ($p < 0.001$).

Conclusions: In subclinical hypothyroidism serum calcium and serum phosphorus levels are significantly altered. Regular follow-up and estimating serum levels of these minerals in subclinical hypothyroidism patients should be done so it is beneficial to give mineral supplementations to prevent bone complications during the treatment of the disease.

INTRODUCTION

Normal thyroid function plays an important role in regulation of cellular activity, and influences basal metabolic rate and general body metabolism. Thus, thyroid dysfunction is often associated with and disturbed mineral metabolism.

On the other hand, thyroid hormones are known to stimulate the bone turnover. Thyrotoxicosis was reported to be associated with decreased bone mineral density, increased risk of osteoporotic fractures, and disturbed serum calcium and phosphate levels. This study was planned to investigate the changes in the levels of serum calcium, phosphate, and magnesium associated with thyroid disorders.

Hypothyroidism is one of the most common endocrine disorders worldwide [2]. The prevalence of hypothyroid is 10-11% in India. Hypothyroidism is caused by decreased levels of thyroid hormones and it is among the most common endocrine disorders. Subnormal activity of the thyroid gland in hypothyroidism leads to mental and physical slowing because of a decrease in the basal metabolic rate.

Subclinical hypothyroidism, defined as an elevated serum thyroid-stimulating hormones (TSH) level with normal levels of free thyroxine (FT4) affects up to 10% of the adult population. Subclinical (without obvious symptoms) hypothyroidism (low thyroid function) describes a situation in which thyroid function is only mildly low, so that the blood level of thyroxine remains within the normal range but the blood level of TSH is elevated. Subclinical hypothyroidism, which is defined as elevated thyroid-stimulating hormone (TSH) levels with free thyroxine concentrations within the reference range, is a common disorder that increases with age and affects up to 18% of the elderly, with a higher prevalence in women compared to men.

TSH can exert a direct effect on bone metabolism independently of the peripheral thyroid hormone (thyroxine [T4] and triiodothyronine [T3]) levels. The role of thyroid hormones in phosphorus and calcium balance in the body by direct action on bone turnover have variously been reported

in the literature. Phosphorus and ionized calcium metabolism are frequently altered in thyroid disease. A negative calcium balance may ultimately result in hyperthyroid osteopenia. Calcium and phosphorus are important parts of the metabolic pathways regulated by the thyroid hormones.

This study aims to assess serum calcium and serum phosphorus levels in newly diagnosed hypothyroidism, subclinical hypothyroidism, and euthyroid individuals and establish a comparison.

MATERIAL & METHODS:

A hospital-based observational study was conducted in the Department of Medicine, JLN medical college, Ajmer in January 2021 to December 2021. Total 210 subjects included in this study were divided into three groups - euthyroid, subclinical hypothyroid, and hypothyroid.

Seventy subjects included in each group were selected according to the inclusion and exclusion criteria and serum calcium, phosphorus levels were measured. Subjects aged 18-70 years were included in this study.

Patients with a history of pre-existing hepatic disease, renal disease, bone diseases, and other major medical conditions, patients with a history of alcohol abuse, diabetes mellitus, pediatric age group and persons on mineral supplementation or any medications that might affect serum calcium, magnesium, and phosphorus concentration were excluded from this study.

In statistical methods, the p-value is obtained by applying a one-way analysis of variance (ANOVA).

RESULTS-

Mean FT3, FT4, and TSH in patients of subclinical hypothyroidism was 2.75 ± 0.44 pg/mL, 1.21 ± 0.34 ng/dL, and 9.35 ± 4.10 μ IU/mL, respectively. In patients with hypothyroidism it was 1.45 ± 0.41 pg/mL, 0.45 ± 0.14 ng/dL, and 24.30 ± 20.5 μ IU/mL, respectively, And in controls it was 3.1 ± 0.51 pg/mL, 1.24 ± 0.47 ng/dL, and 2.02 ± 1.10 μ IU/mL,

respectively. Difference in FT3, FT4, and TSH was statistically significant ($p < 0.001$) in all three groups. Serum calcium and phosphorus levels in patients of subclinical hypothyroidism was 8.72 ± 0.38 mg/dL and 3.95 ± 0.60 mg/dL, respectively. In patients with hypothyroidism they were 8.32 ± 0.52 mg/dL and 4.20 ± 0.85 mg/dL, respectively, and in controls it was 9.8 ± 0.95 mg/dL and 3.80 ± 0.71 mg/dL, respectively. Difference between these groups was statistically significant ($p < 0.05$) (Table 1) (Figure 1)

Table 1- Comparison of T3, T4, TSH, Serum Calcium, and Phosphorous of Controls and Cases.

Parameters	Control	Subclinical Hypothyroidism	Hypothyroidism	p-value*
FT3(pg/mL)	3.1 ± 0.51	2.75 ± 0.44	1.45 ± 0.41	<0.001
FT4(mg/dL)	1.24 ± 0.47	1.21 ± 0.34	0.45 ± 0.14	<0.001
TSH(μ IU/mL)	2.02 ± 1.10	9.35 ± 4.10	24.30 ± 20.5	<0.001
S. Calcium (mg/dl)	9.8 ± 0.95	8.72 ± 0.38	8.32 ± 0.52	<0.001
Phosphorus (mg/dl)	3.80 ± 0.71	3.95 ± 0.60	4.20 ± 0.85	<0.001

DISCUSSION

The mean age in our study in patients with subclinical hypothyroidism was 41 ± 14.33 years, in patients with hypothyroidism was 43.07 ± 10.75 years, and in controls was 36.30 ± 13.19 . It shows age-matched cases and controls ($p = 0.165$).

In this study, we found mean serum calcium levels in patients of subclinical hypothyroidism, hypothyroidism, and in controls was 8.72 ± 0.38 mg/dL, 8.32 ± 0.52 mg/dL and 9.8 ± 0.95 mg/dL respectively. These results show significantly ($p < 0.001$) low values of serum calcium in patients of subclinical hypothyroidism and overt hypothyroidism in comparison to euthyroid patients.

Our results correlate with a study conducted by Kavitha MM et al. they found the mean serum calcium levels were significantly ($p < 0.001$) low in subclinical hypothyroidism patients and overt hypothyroidism patients in comparison to euthyroid patients. According to Zahra N et al study, the Level of calcium and phosphorus were determined in patients with hypothyroidism. Long-term hyperthyroidism resulted in net negative calcium ion (Ca^{2+}) balance in response to increased skeletal turnover. It is noteworthy here that a long-term hyperthyroid state is also associated with malabsorption of Ca^{2+} and increased bone resorption. On the other hand, hyperthyroidism is known to increase renal blood flow, glomerular filtration rate (GFR) and reabsorption of inorganic phosphate (Pi), Ca^{2+} , and sodium ion (Na^+).

The mean serum phosphorus level in patients of subclinical hypothyroidism, hypothyroidism, and in controls was 3.95 ± 0.60 mg/dL, 4.20 ± 0.85 mg/dL, and 3.80 ± 0.71 mg/dL, respectively. These results show significantly ($p < 0.001$) high values of serum phosphorus levels in patients of subclinical hypothyroidism and overt hypothyroidism in comparison to euthyroid patients. Our results correlate with the study conducted by Kavitha MM et al and Arvind Bharti et al who also found the mean serum phosphorus levels were significantly ($p < 0.001$) high in subclinical hypothyroidism patients and overt hypothyroidism patients in comparison to euthyroid patients. The mechanisms of thyroid hormone-induced bone resorption include cyclic adenosine monophosphate (cAMP)-mediated, increased sensitivity of beta-adrenergic receptors to catecholamines, increased sensitivity of bone cells to parathyroid hormone (PTH), osteoclast activator factor, and interleukin-1 (IL-1)-mediated increased bone resorption. Previous studies revealed that hypocalcemia is seen in hypothyroidism this is mainly due to the low levels of PTH and low levels of calcitriol.

CONCLUSION-

Hypothyroidism caused impaired renal function, glucose intolerance, hyperlipidemia, and reduction in serum phosphate. Hyperthyroidism caused a reduction in serum lipids, magnesium, and potassium. Thyroxine therapy normalized the deranged lipids and minerals, but not glucose. Results indicate that thyroid function tests should be considered when diagnosing those metabolic disorders.

To conclude, the present study gives us an idea that the derangement in level serum calcium and phosphorus is associated with skeletal deformities so it needs to be studied further. Also, such disturbances need to be monitored at least once or twice per year and treated appropriately to avoid the ill effects resulting from the changes in their serum levels.

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