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Original Research Article

Evaluation of Serum Calcium and Serum Phosphorus in Hypothyroid Disease

Pooja[1], Gulab Kanwar[2], Santosh Kumari Sharma[3], Mukesh Gehlot[4]

[1]Ph.D. Scholar, Department of Biochemistry, Government Medical College, Kota, Rajasthan
[2]Senior Professor & Head, Department of Biochemistry, Government Medical College, Kota, Rajasthan
[3]Assistant Professor, Department of Biochemistry, Government Medical College, Kota, Rajasthan
[4] Junior Specialist, Department of General Medicine, Sawai Man Singh Medical College, Jaipur, Rajasthan

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Corresponding Author: Dr. Mukesh Gehlot
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Abstract:
Background: The thyroid gland synthesizes primarily two hormones, triiodothyronine (T3) and thyroxin (T4) which are vital to maintain numerous functions especially metabolic, mineral and thermogenic homeostasis in body. The disorders of thyroid function especially hypothyroidism is important it can cause of disturbance in Calcium & Phosphorus metabolism.
Objectives: This study was designed to estimate serum T3, serum T4, serum TSH, serum Calcium and serum Phosphorus in hypothyroid patients and control subjects.
Materials and Methods: After ethical committee approval, a case control study was conducted in the Department of Biochemistry in Govt. Medical College and associated group of Hospital, Kota (Raj.). A total of 144 subjects included in this study were divided into two groups – control and hypothyroid.
Result: The significant ($p < 0.001$) decreased mean value of serum Calcium and serum Phosphorus in hypothyroid patients when compared with control subjects.
Conclusion: In our study we found that serum Calcium and serum Phosphorus were altered in hypothyroid patients. Hence estimation of serum Calcium & Phosphorus may be supportive for better management to avert further problems from mineral metabolism dysfunction.
Keyword: Serum Calcium & Phosphorus, Hypothyroidism.

Introduction

Triiodothyronine (T3) and thyroxine (T4) are the two hormones that are produced and secreted by the thyroid gland and are referred to as thyroid hormones. This hormone is necessary for the skeleton's proper growth and development [1]. Thyroid hormones are essential for cell differentiation during development and to maintain mineral, metabolic, and thermogenic homeostasis in adult. Thyroid gland disorders are commonest among endocrine disorders. About 200 million people worldwide are suffering from various thyroid disorders, and more than half of them remain undiagnosed [2].

Hypothyroidism is a common endocrine condition results from either insufficient thyroid hormone or, less frequently, from the thyroid gland's delayed activity. Hypothyroidism has a mean yearly incidence rate of up to 4 per 1000 women, 1 per 1000 men, and 1 in 4000 newborns. With advancing age, overt hypothyroidism becomes more common [3]. Calcium and phosphorous are very important minerals in our body, which are regulated by various mechanisms in our body. Alteration in the homeostasis of these minerals will lead to hazardous effects in the body. The adverse effects of hypercalcemia are anorexia, confusion, psychosis, renal stones etc. The symptoms of hypocalcemia are muscle cramps, paresthesia, tetany, seizures etc [4] Other than the usual regulators of calcium and phosphorous like vitamin D, calcitonin and parathyroid hormones, it is said that thyroid hormones also play a role in the regulation of calcium and phosphorous in our body [4,5]. Thyroid hormones perform a wide array of metabolic functions including regulation of lipids, carbohydrates, protein and electrolytes and mineral metabolism [6].

Mineral metabolisms like calcium, magnesium and phosphorous is frequently disturbed in thyroid dysfunctions. Thyroid hormones exert its effects on osteoblasts via nuclear receptors to stimulate osteoclastic bone resorption [7]. Thyroid hormones probably stimulate bone resorption directly, thereby increasing serum calcium and phosphorous concentrations and also suppressing serum parathyroid hormone and 1,25-dihydroxyvitamin D3 concentrations. The decrease in these bone-resorbing hormones limits further increase in serum calcium concentration but also results in enhanced intestinal calcium absorption. In adult hypothyroidism the opposite effects are seen [8]. Hence, the present study was undertaken to evaluate the alteration in mineral status by estimating serum calcium and phosphorus in patients diagnosed with hypothyroidism.

Material & Methods

The present case-control study was conducted in the Department of Biochemistry in Govt. Medical College and associated group of Hospital, Kota (Raj.). A total of 144 subjects recruited from department of medicine with formal approval from the concerned department and the institution Ethics Committee.

Inclusion Criteria:

1. A total 144 subjects included in this study were divided into two groups – control and hypothyroid.
    - Group I: 72 healthy individuals were included as control group.
    - Group II: 72 hypothyroid patients were diagnosed by increased levels of TSH (> 10 µIU/ml) and decreased serum T3 and serum T4.
2. The subject's age 25-55 years were included in this study.
3. The subjects who were willing to give written consent for the project.

Exclusion Criteria:

1. Hemolyzed samples were excluded.
2. Patients suffering with hepatic disease, renal disease, bone disease, pituitary adenomas, diabetes mellitus.
3. Patients on mineral supplementation or any drugs that affect mineral metabolism.

Biochemical Investigations: Serum T_3, serum T_4 and serum TSH were estimated by Chemiluminescence Immunoassay method on Backman Coulter "Access-2''. Serum Calcium was estimated by Arsenazo III method and serum Phosphorus was estimated by UV Molybdate on ERBA EM-360 (Transasia Bio-Medicals Ltd., Mumbai, India).

Statistical Analysis: We conducted the data analysis using the statistical package for the social sciences [SPSS] version 20.0. Results were expressed as Mean ± SD. The statistical significance was calculated by using the student's t-test; $p < 0.05$ is considered significant and $p < 0.001$ is considered highly significant.

Collection and Analysis of Blood Sample: A 5ml venous blood sample was drawn from the anticubital vein of each subject by using standard aseptic techniques. Blood samples were collected in plain vials: Plain vial: In this vial, collected blood was allowed to clot. The serum was separated from the clotted specimen by centrifugation at 3000 rpm for 10 minutes and serum was used for the estimation of serum T3, serum T4, serum TSH, and serum calcium and serum phosphorus.

Results

Table 1: Age Distribution

Case	Age range (years)	Frequency no.	Percent %
Hypothyroid Patients N=72	25-35	18	25%
	36-45	24	33.3%
	46-55	30	41.7%

This table shows age distribution of hypothyroid patients. In the case of hypothyroid disorder maximum patients were present between the age group of 46 to 55 years that is followed by the age group of 36 to 45 years.

Table 2: Comparison of mean values of Thyroid Profile between control subjects (N=72) and hypothyroid patients (N=72)

S. No.	Variables	Control Subjects (N=72) (Mean±SD)	Hypothyroid Patients (N=72) (Mean±SD)	Significant
1	T3	1.41±0.24	0.43±0.19	<0.001
2	T4	9.42±1.22	3.13±0.68	<0.001
3	TSH	2.91±0.56	16.15±3.07	<0.001

Impaired t-test applied. P value < 0.05 was taken as statistically significant.

This table shows a significant ($p < 0.001$) decreased mean value of T3 and T4 and a significant ($p < 0.001$) high mean value of TSH in hypothyroid patients when compared with control subjects.

Table 3: Comparison of mean values of Calcium and Phosphorus between control subjects (N=72) and hypothyroid patients (N=72)

S. No.	Variables	Control Subjects (N=72) (Mean±SD)	Hypothyroid Patients (N=72) (Mean±SD)	Significant
1	Ca	10.01±0.34	8.99±0.95	<0.001
2	P	3.86±0.41	3.50±0.73	<0.001

Impaired t-test applied. P value < 0.05 was taken as statistically significant.

This table shows a significant ($p < 0.001$) decreased mean value of Calcium and Phosphorus in hypothyroid patients when compared with control subjects.

Discussion

As the most common endocrine disease, hypothyroidism can cause a variety of clinical problems such as electrolyte and mineral imbalances, congestive heart failure, and coma. Thyroid dysfunctions frequently disrupted calcium, magnesium, and phosphorous homeostasis, have a direct effect on calcium and magnesium resorption by influencing glomerular filtration rate and blood flow9.

In our study, we observed that the mean value of serum calcium was 10.01±0.34 mg/dl and 8.99±0.95 mg/dl in the healthy control subjects and hypothyroid cases. Serum calcium was significantly (<0.001) decreased in hypothyroid cases in comparison with control subjects. In our study, we observed that the mean value of serum phosphorus was 3.86±0.41 mg/dl and 3.50±0.73 mg/dl in the healthy control subjects and hypothyroid cases. Serum phosphorus was significantly (<0.001) decreased in hypothyroid cases as comparison with control subjects. Our results were similar to the study done by Modi et al., 2012 [10], Shivleela et al., 2012 [7] who were reported decreased serum calcium and serum phosphorus levels in hypothyroid patients as compared with control subjects.

According to Murgod et al., 2012 [11] serum calcium levels have been decreased in hypothyroid cases. Thyroid hormones control calcium in the blood by releasing calcium from the cells. Since the serum level of T4 is reduced in hypothyroid cases, the outflux of calcium from the cells is reduced. According to Suneel et al., 2011 [12] reduced concentrations of serum calcium in hypothyroid subjects reveal poor metabolism of calcium.

They also reveal decreased & in hypothyroid disorder mainly due to the influence of PTH and calcitonin. According to Mane et al., 2012 [13] had shown that the absence of thyroid hormones, (especially T3) or mostly low or unnoticeable levels of thyroid hormones in serum, suppress the stimulation of osteoclasts. These outcomes slowdown of bone turnover procedure. Afterward, the rate of bone loss is declined thus serum concentration of total calcium and ionic calcium is decreased in hypothyroid disorder.

Our findings were in contrast to Athokpham et al., 2020 [14] who reported increase serum levels of phosphorus in hypothyroid patients. Shivakumar et al., 2020 [15] who reported increase serum levels of calcium in hypothyroid patients in comparison with control subjects.

Conclusion

According to our finding levels of serum calcium and serum phosphorus were reduced in hypothyroid patients. These modifications may play a key role in measuring the problems of hypothyroid subjects. The impaired mineral metabolism may have an influential role in the progression of thyroid disorders & later progress of problems. Our study also revealed the impact of hypothyroidism on serum calcium and serum phosphorus, which may lead to several bone, renal & intestinal dysfunction. Hence estimation of serum calcium & phosphorus may be supportive for better management to avert further problems from mineral metabolism dysfunction.

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