VOLUME-9, ISSUE-4, APRIL -2020 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper



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EVALUATION OF SERUM CALCIUM, MAGNESIUM AND PHOSPHOROUS LEVELS IN SUBJECTS WITH HYPERTHYROIDISM

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ABSTRACT Introduction: Thyroid hormones are essential for normal growth and maturation of skeleton, growth and maintenance of kidney function and plays an important role in maintenance of water and electrolyte homeostasis. On the other hand, kidney is involved in the metabolism and elimination of thyroid hormones. Thyroid hormone determines the mineral pool in the blood by influencing mobilization of minerals like calciumand phosphorous into the blood and by influencing their clearance through urinary excretion due to its effect on glomerular filtration rate (GFR) or renal plasma flow (RPF). Objectives of the study: To estimate TSH, T3, T4 levels in subjects with hyperthyroidism and healthy controls and to estimate and compare the serum levels of calcium, phosphorous and magnesium in subjects with hyperthyroidism and healthy controls. Materials and Methods: We included cases (hyperthyroidism) and healthy controls in the age group of 18-60 years both males and females were included in the study. After taking informed consents, about 3 ml of venous blood was drawn using a disposable syringe under aseptic conditions in a sterile bulb from selected subjects. The serum was used for the analysis of calcium, magnesium and phosphorous by the spectrophotometric method on semi autoanalyzer using commercially available kits. Results: A total of 80 subjects were enrolled in the study, 40 cases of hyperthyroidism and 40 healthy controls. Out of 40, controls 7 were males, 33 were females and out of 40 cases 8 were males and 32 were females. There was highly significant decrease in TSH and magnesium, increase in T3, T4, Calcium, phosphorous levels in subjects with hyperthyroidism compared to healthy controls. There was no statistically significant correlation existed between TSH and serum calcium, phosphorous and magnesium levels in subjects with hyperthyroidism.Conclusion: Our study indicates the profound influence of thyroid hormone on mineral metabolism and changes in these minerals may eventually lead to complications like decreased bone mineral density and secondary osteoporosis. Therefore, it is necessary to evaluate the serum levels of these minerals in all patients with thyroid disorders.

KEYWORDS : calcium, phosphorous, magnesium, hyperthyroidism and thyroid hormones

INTRODUCTION:

Thyroid disorders are most common endocrine disorders affecting Indian population, with the incidence of 42 million. The thyroid gland produces two related hormones, Thyroxin (T4) and triiodothyronine (T3). Acting through thyroid hormone receptors and , these hormones plays a critical role in cell differentiation during development and helps to maintain thermogenic and metabolic homeostasis (Fauci AS et al, 2008). Thyroid hormones are essential for normal growth and maturation of skeleton, growth and maintenance of kidney function and plays an important role in maintenance of water and electrolyte homeostasis. On the other hand, kidney is involved in the metabolism and elimination of thyroid hormones.¹⁴

Hyperthyroidism refers to the sustained overproduction of thyroid hormones. In the past several studies have been conducted on the prevalence of hyperthyroidism. In an epidemiological community survey conducted at cochin showed the prevalence of subclinical and overt hyperthyroid is 1.6% and 1.3% respectively.5 In a hospital-based study of women from Pondicherry, subclinical and overt hyperthyroidism were present in 0.6% and 1.2% of subjects.⁶

Calcium, phosphate, and magnesium are multivalent cations that are important for many biologic and cellular functions. The kidneys play a central role in the homeostasis of these ions. Gastrointestinal absorption is balanced by renal excretion. When body stores of these ions decline significantly, gastrointestinal absorption, bone resorption, and renal tubular reabsorption increase to normalize their levels. Renal regulation of these ions occurs through glomerular filtration and tubular reabsorption and/or secretion and is therefore an important determinant of plasma ion concentration.Thyroid hormone determines the mineral pool in the blood by influencing mobilization of minerals like calciumand phosphorous into the blood and by influencing their clearance through urinary excretion due to its effect on glomerular filtration rate (GFR) or renal plasma flow (RPF).

Magnesium is the second most abundant intracellular cation in the body after potassium (Moe MS, 2008). Most of the total body magnesium (67%) are found in bones and soft tissues. Previous studies done on serum calcium, phosphorous and magnesiumlevels in thyroid disorders have shown conflicting results. Even though thyroid disorders are most common and prevalent conditions in India, studies focusing on blood levels of minerals are sparse 7-9. Hence, we have taken up this study to estimate levels of serum calcium, phosphorous and magnesium levels in subjects with hyperthyroidism.

OBJECTIVES OF THE STUDY:

The objectives of our study include,

- 1) To estimate TSH, T3, T4 levels in subjects with hyperthyroidism and healthy controls
- 2) To estimate and compare the serum levels of calcium, phosphorous and magnesium in subjects with hyperthyroidism and healthy controls

MATERIALS AND METHODS:

Source of data and Study design: A case-control study was conducted at CM Medical College and Research, Bhilai, Durgfrom July 2018-December 2018 Inclusion Criteria: We included cases (hyperthyroidism) and healthy controls in the age group of 18- 60 years both males and females were included in the study. They were divided into 2 groups: 1) Group 1: included 40 newly diagnosed and untreated cases of hyperthyroidism. The diagnosis was based on increased serum T3and T4levels associated with decreased TSH levels. All patients suffering from thyroid disorders were diagnosed and confirmed by the physician based on T3(Normal: 0.7- 2.0 ng/mL), T4 (Normal: 4.5- 11.0 µg/dL) and TSH (Normal: 0.4- 4.2 µIU/mL) levels of the patients. 2) Group 2 included 40 healthy controls in the similar age group having

normal thyroid profile. Exclusion Criteria: Paediatric age group (<18 yrs), elderly age group (>60 yrs), renal disorders, hepatic disorders, bone disorders, diabetes, hypertension or any other systemic illness that may affect the mineral status, patients on mineral supplementation, drugs for treatment of thyroid disorders or any other medications that might affect serum mineral concentration.

Sample collection and biochemical analysis: After taking informed consents, about 3 ml of venous blood was drawn using a disposable syringe under aseptic conditions in a sterile bulb from selected subjects. Blood was allowed to clot and serum was separated after 30-45 min by Remicentrifuge machine at 3000 rpm. The serum was used for the analysis of calcium, magnesium and phosphorous by the spectrophotometric method on semi autoanalyzer using commercially available kits. T3, T4 and TSH was estimated by chemiluminiscence immunoassay. Statistical Analysis: The data was expressed in terms of mean and standard deviation. The comparison among the groups was done using one way analysis of variance (ANOVA) and post hoc.

RESULTS

A total of 80 subjects were enrolled in the study, 40 cases of hyperthyroidism and 40 healthy controls. Out of 40, controls 7 were males, 33 were females and out of 40 cases 8 were males and 32 were females. The mean age and SD in controls was 39.0812.07 years and in cases 36.3511.09 years. There was highly significant decrease in TSH and magnesium, increase in T3, T4, Calcium, phosphorous levels in subjects with hyperthyroidism compared to healthy controls (Table 2). There was no statistically significant correlation existed between TSH and serum calcium, phosphorous and magnesium levels in subjects with hyperthyroidism (table 3).

Table 1: Shows Age and Gender wise distribution of the cases and controls

	Controls	Cases
Gender (M/F)	7/33	8/32
Age Groups (years)	39.0812.07	36.3511.09

Table 2: Comparision of serum levels of calcium, phosphorous and magnesium levels between group 1 and group 2

	Group 1 (cases)	Group 2	p value
	n = 40	(controls) $n = 40$	
T3 (ng/mL)	3.641.98	1.020.42	HS
T4 (g/mL)	15.12.89	9.232.42	HS
TSH (IU/mL)	0.140.28	3.020.98	HS
Calcium (mg/dL)	13.891.89	8.970.93	HS
Phosphorous (mg/dL)	5.890.32	3.560.61	HS
Magnesium (mg/dL)	1.190.32	2.080.32	HS

P<0.05 significant (S)

P<0.001 highly significant (HS)

Table 3: Correlation between TSH and calcium, phosphorous and magnesium levels

	r value	p value
TSH and calcium	-0.08	0.56
TSH and phosphorous	0.26	0.18
TSH and magnesium	0.13	0.56

DISCUSSION:

In our study, we found that there was increased levels of calcium and phosphorous levels in subjects with hyperthyroidism and decreased levels of serum magnesium levels in hyperthyroidism subjects as compared to healthy controls. We found that the peak incidence of cases was seen the age group of 25-37 years, females were more affected in comparison to males. Previous studies done on serum calcium, phosphorous and magnesium levels in thyroid disorders have shown variable results. Most of the studies have shown hypercalcemia in hyperthyroidism which is consistent with the present study. The bone metabolism is thought to be regulated by thyroid hormone as well.

It has been reported that hyperthyroidism is associated with mild to moderate hypercalcemia in approximately 20% of total patients.The serum calcium levels are often increased by a mild to moderate range and it rarely exceeds 3.0 mmol/L in hyperthyroidism associated hypercalcemia.Hypercalcemia was defined as a calcium level exceeding 3.5 mmol/L and patient often has symptoms including multiple kidney stones, constipation, and muscle weakness. Severe hypercalcemia or hypercalcemic crisis (serum calcium above 3.5 mmol/L) is considered rare. 10-14Thyroid hormones exert its effect on osteoblasts via nuclear receptors to stimulate osteoclastic bone resorption. Patients with hyperthyroidism have a significantly decreased bone mineral density (BMD). Thus, hyperthyroidism is one of the major causes of secondary osteoporosis. Some studies reported hyperphosphatemia in hyperthyroidism and vice versa which is consistent with the present study. The changes are due to suppressed parathyroid hormone (PTH) levels as well as direct effects of thyroid hormones on tissue phosphorous metabolism and renal phosphorous handling. Thyroid hormones stimulate bone resorption directly thereby increasing serum calciumand phosphorouslevels and suppressing PTH.7,8 Studies regarding serum magnesium in thyroid disorders are also conflicting. Some studies reported hypermagnesaemia in hypothyroidism and vice versa which is consistent with the present study. Thyroid hormone has direct effect on the tubule, which if chronically absent, results in renal retention of magnesium. Hyperthyroidism can increase renal excretion of magnesium, thus leading to hypomagnesemia. Increased thyroid activity causes more magnesium to be consumed by the tissue, thus favouring hypomagnesemia. In hyperthyroidism, there is hypermagnesaemia because of low clearance of magnesium from renal tubules.^{7,1}

CONCLUSION:

Our study indicates the profound influence of thyroid hormone on mineral metabolism and changes in these minerals may eventually lead to complications like decreased bone mineral density and secondary osteoporosis. Therefore, it is necessary to evaluate the serum levels of these minerals in all patients with thyroid disorders.

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VOLUME-9, ISSUE-4, APRIL -2020 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

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