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Study of Calcium, Magnesium and Phosphorus in Hypothyroidism Patients In Vidarbha Region

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ABSTRACT

Thyroid hormones, by their direct action on bone turnover, play a significant role in calcium and phosphorus homeostasis. Thyroid hormones have a vital role in calcium and phosphorus metabolism, which is frequently affected in thyroid disease. Increases in serum calcium and phosphorus levels should be monitored in thyroid illness. The goal of this research is to compare serum calcium and phosphorus levels in Sudanese hypothyroidism patients to those in seemingly healthy controls. A study of calcium, magnesium, and phosphorus in hypothyroidism patients was undertaken in the Vidharbha district. Between February 2019 and June 2020, a clinical-based case control study was performed. A research group of 100 hypothyroid patients from the Shalinitai Meghe Hospital in Nagpur was compared to a control group of 100 seemingly healthy people. Serum calcium, phosphorus, and magnesium levels were measured in blood samples obtained from the classes. In this sample, the results show that the test group had a significant decrease in mean serum calcium levels compared to the control group and a significant increase in mean serum phosphorus levels compared to the control group. Serum magnesium levels were considerably increased in comparison to controls, with mean values of the samples. In hypothyroid disorders, serum calcium and phosphorus levels are substantially altered. The levels of these minerals should be tested in hypothyroidism patients. Testing the levels of these minerals in SCH patients on a regular basis should be done. To avoid more bone complications, the primary cause should be treated and, if possible, mineral supplementation should be taken.

KEY WORDS: THYROID STIMULATING HORMONE, THYROXIN, TRI-IODOTHYRONINE, MINERALS AND SUBCLINICAL HYPOTHYROIDISM.

INTRODUCTION

The thyroid gland is involved in a variety of metabolic functions, including lipid, carbohydrate, protein, and mineral metabolism (Pearce EN et al., 2004). Thyroid hormones are necessary for the physiological growth and maturation of the skeletal system. Thyroid disease is widespread, and its incidence and prevalence are thought to rise with age. Hypothyroidism is one of the most common endocrine illnesses today, caused by a lack of thyroid hormones. The condition causes metabolic processes all across the body to slow down. The disease affects between 12% and 15% of the world's population. Women have a higher rate of infection than men (Fakhar UN et al., 2014).

Thyroid hormones are essential for the development and growth of the skeletal system. According to this research, TSH is a direct regulator of bone remodeling, highlighting the significance of the hypothalamo-pituitary thyroid axis' integrity (Eva Feigerlova et al.,). Thyroid disorder has a negative impact on mineral and bone homeostasis (Orluwenec. G et al., 2013). Thyroid hormones control several metabolic pathways, and divalent metal ions like calcium, phosphorus, and magnesium are required for metalloenzymes (Susanna TY et al., 2016).

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According to the literature, hypocalcemia is a common finding in hypothyroid patients. Thyroid hormones regulate calcium levels in the bloodstream by releasing calcium from cells. Since thyroxine levels are lower in hypothyroidism, calcium outflow from cells is reduced (Murgod R et al., 2012). In hypothyroidism, increased calcitonin output can help with calcium tubular clearance and phosphate tubular absorption (B. Suneel et al., 2011). In hypothyroidism, disturbances in magnesium metabolism have also been discovered in a few studies (Ford HC 1989 & Ranjit S 2020). According to the literature, serum magnesium levels are higher in hypothyroid disorders (Ranjit S 2020)). Despite the fact that increases in calcium and magnesium account for minor levels in thyroid disorders, these disruptions were critical in the long run for the patients (Ford HC 1989 & Ranjit S 2020).

Secondary osteoporosis is caused by a variety of factors, including thyroid disorders. Hypothyroidism causes reduced calcium levels due to poor calcium mobilization into the bone. Furthermore, calcitonin synthesis rises, facilitating phosphate reabsorption and calcium excretion from the tubules of the kidney. Mineral metabolism problems, such as calcium and magnesium deficiency, have been linked to major metabolic disorders including hypertension and cardiovascular disease. Mineral levels in hypothyroidism have been studied extensively, with mixed results. Mineral status in subclinical hypothyroidism has received very little research. As a result, the current study was conducted to establish the mineral status of hypothyroid patients in terms of calcium and phosphorus. Since the impact of hypothyroidism on these minerals is complicated, this research was conducted to determine their changes.

MATERIAL AND METHODS

The study used a case-control design. The research was carried out at Nagpur's Datta Meghe Medical College and SMHRC Hospital. The research was carried out between February and June 2020. A pilot group of 100 hypothyroid patients was chosen from the SMHRC Hospital Nagpur. The research group was linked to a control group of 100 volunteers who appeared to be in good health. After explaining the protocol to study participants, they gave their informed consent. The population enrolled 100 hypothyroidism cases identified within the previous year, as well as 100 healthy controls that were age and sex matched to the cases. If the patient's serum T3 and T4 levels are low to average, and their TSH levels are high, the patient is diagnosed with hypothyroidism.

Place of Study: The research was carried out in collaboration with SMHRC Hospital, Wardha, at the Department of Biochemistry, Datta Meghe Medical College and SMHRC Hospital, Deemed University, Nagpur.

Inclusion Criteria:

1. Participants had to be between the ages of 20 and 55.
2. Patients with a history of hypothyroidism who had their serum T3, T4, and TSH levels checked were considered cases.

Exclusion Criteria

1. Hepatic illness, renal illness, bone disease, diabetes, and a history of drunkenness
2. Patients who are taking mineral supplements or who are taking drugs that interfere with mineral metabolism.
3. Pregnant mothers, children under the age of 18, and other serious medical conditions

Blood Sample Collection: In a fasted and aseptic setting, venous blood was drawn using a simple disposable vacutainer device. The serum was isolated, and the results were analysed. Under aseptic circumstances, a sample of 4 mL venous blood was obtained. Thyroid hormones were calculated using a hormone analyser. A semi-automated analyzer was used to determine the quantities of calcium, phosphorus, and magnesium in the blood.

METHODOLOGY

1. Estimation of Serum T3, T4 and Thyroid Stimulating Hormone (TSH) was done by Monobind Acculite TSH kits using CLIA.
2. The Arsenazo 3 method is used to calculate serum calcium.
3. Ammonium molybdate technique for calculating serum phosphorus.
4. Calmagite technique for estimating serum magnesium.

Statistical Analysis: Student t test was used to compare the above biochemical parameters between cases and controls, and the results were expressed as Mean± Standard Deviation. Pearson's correlation coefficient was calculated using SPSS Package Version 20 statistical software to correlate the parameters among the cases. Statistically significant and highly significant were described as $p<0.05$ and $p<0.01$, respectively.

RESULTS

Table 1. Analysis of TotalT3, TotalT4, TSH, Serum Calcium, Phosphorous, Magnesium in Study and Control Groups.

Parameters	Study group N=100	Control group N=100
T3(ng/dl)	125.5±38.4	138.7±41.6
T4(µg/dl)	9.10±3.59	11.4±2.68
TSH (µ IU/ml)	22.98±29.18	3.41±1.82
Calcium(mg/dl)	10.8±0.78	11.4±0.97
Phosphorus(mg/dl)	5.65±0.75	4.98±0.99
Magnesium (mg/dl)	6.08±0.62	2.85±0.43

Table 1 shows that there is a significant difference between the means of calcium in the test group and the

control group, a significant difference between the means of phosphorus in the test group and the control group, a significant difference between the means of (TSH) in the test group and the control group, a significant difference between the means of (T3) in the test group and the control group, and a significant difference between the means of (T4) in the test group and the control group.
TSH levels were higher in the Study group than in the control group, while serum T3 and T4 levels were lower in the Study group than in the control group, despite being within the normal range, as shown in Table 1. Serum calcium levels in the study group are significantly lower than in the control group. Meanwhile, as indicated in Table 1, the Study community's serum phosphorus and magnesium levels grew dramatically.
In the cases, Thyroid Stimulating Hormone levels were linked to serum calcium, phosphorus, and magnesium levels. A strong negative association was discovered between serum TSH and calcium after examination. In addition to TSH, phosphorus and magnesium had no major association among the cases.

DISCUSSION

Thyroid hormones are involved in the regulation of body hemodynamics, thermoregulation, and metabolism. Renal hemodynamics, glomerular filtration, and electrolyte handling are all affected by them. 17 Hypothyroidism, the most common endocrine condition, may cause electrolyte and mineral imbalances, congestive heart failure, and coma, among other complications. Thyroid dysfunctions often disrupted calcium, magnesium, and phosphorous homeostasis. Thyroid hormones influence calcium and magnesium resorption directly by influencing the glomerular filtration rate and blood flow.

The aim of this research was to see how hypothyroidism affected serum calcium as well as other minerals including phosphorus and magnesium. Mineral disturbances in any form of thyroid dysfunction were likely, according to various case reports in the literature. The current investigation demonstrated a considerable rise in serum phosphorus levels in the Study population when compared to healthy controls, which is consistent with research by Frizel et al 1967 and Schwarz et al 2012. Similar investigations in hypothyroid individuals have been undertaken by many other scientists, including Jaskiran K et al 2014 and D. Sridevi et al 2016, who discovered that calcium levels are much lower while magnesium and phosphorous levels are higher in some situations. Similar findings were discovered by Suneel B et al 2011.demonstrating that increases in calcium and phosphorus levels are primarily attributable to the actions of PTH and calcitonin.

Other studies by Arvind Bharti et al. 2015 and Frizel et al. 196724,19 reported no significant connection between TSH and serum magnesium levels among cases, which is validated by the current study. In hypothyroid patients, total calcium levels in the blood were found to be substantially lower than in controls. Thyroxine controls blood calcium levels by releasing calcium into the extracellular space. Hypothyroidism causes a drop in extracellular calcium release so there is less thyroxine in the bloodstream and hence less thyroxine entry into the cells. Christoph Schwarza, et al 2012 identified a strong association between serum phosphorus and serum TSH, T3, and T4 in hypothyroid patients in their study. Abedelmula M, et al. 2013 found that hypothyroid patients had significantly higher serum magnesium levels than controls.Studies on different thyroid disorders were reported 27-30. Talwar et. al. reported on Serious Clinical Manifestations in thyroid disorders. Neema et. al. reflected on Gonadotropin Levels in Hypothyroid Women of Reproductive Age 32. Related studies by Gaidhane et. al. , Dixit et. al. and Kumar et. al. were reviewed.

CONCLUSION

In hypothyroidism, serum calcium levels were lower than in euthyroids, according to our findings. In hypothyroid people, there was a clear negative association between serum TSH levels and serum calcium. In hypothyroidism, the levels of magnesium and phosphorus in the blood were higher. Hypothyroid patients' serum calcium, phosphorus, and magnesium values should be checked on a regular basis, as early detection and correction will avoid further complications from mineral metabolism dysfunction. As a result, patients would benefit from monitoring these minerals over time and supplementing them if their blood levels are low, as this would help them avoid further bone issues. The study's drawback was its limited sample size, which could explain the lack of a meaningful association between serum phosphorus and magnesium and TSH among cases.

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