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Evaluation of serum calcium phosphorus and magnesium levels in patients with hypothyroidism

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Abstract

Introduction: Hypothyroidism is a most common endocrine disorder and its prevalence in India is 10-11%. The thyroid hormones take part in regulation of carbohydrate, fat, protein and mineral metabolism and also help in maintenance of the basal metabolic rate, modulate vitamin metabolism and assist in regulation of long bone growth and control of various metabolisim. In view of possible alteration of serum calcium, phosphorus and magnesium levels in patients of hypothyroidism that lead to an increased risk of secondary osteoporosis and bone fractures. However, there is lack of data regarding this disturbance of mineral metabolisim hence we aimed to evaluate the serum calcium, phosphorus and magnesium with TSH levels in cases of hypothyroidism.

Methodology: This is a Hospital based case control study .Sample size was calculated 80 cases of newly diagnosed of hypothyroidism of age group of 18-60 years from OPD and IPD and 80 peoples of same age and sex as control group were included in our study**.**

Result: In our study there was a significant decrease in serum calcium levels in hypothyroid patients (8.16±0.88 mg/dL) when compared with the euthyroid subjects (8.66±0.85 mg/dL) ($p<0.004$). We found inverse relation found between TSH and serum calcium ($r=-0.23$, $p=0.004$).There was not a statistically significant difference in mean Serum Phosphorus ($p=0.69$) and Serum magnesium ($p=0.1$). In hypothyroid patients compairing with euthyroid subjects.

Conclusion: present study concludes that in hypothyroid patients the serum calcium levels was significantly decrease but serum phosphorus and serum magnesium levels were not significantly deranged when compared to euthyroid control subject. Regular monitoring or evaluation mineral status provides a great advantage in assessing the progression bone complications in

hypothyroid patients so if necessary preventive measures can be initiated early.

Keywords: Hypothyroidism, calcium, phosphorus and magnesium.

Introduction

The thyroid hormones take part in regulation of carbohydrate, fat, protein and mineral metabolism. They take part in maintenance of the basal metabolic rate, modulate vitamin metabolism and assist in regulation of long bone growth and control of various metabolism. In endocrine hypothyroidism is a most common disorder which causes reduced metabolic processes.[1]

In hypothyroidism level of thyroid hormones is decreased. In subclinical hypothyroidism, serum thyroid-stimulating hormones (TSH) level is high but with levels of free thyroxine (FT4) is normal. The prevalence of hypothyroidism in India is approx 10-11% compared with only 2% in the UK and 4.6 % in the USA and more common in women than in men and increase with age .[2]. The reason behind this is in past was assume that iodine deficiency was a common cause of hypothyrodisim in India but disease is still present even after adequate encourage supplement of iodised salt. There are two major factors responsible for it is one is poverty and inability of user to assess the quality of salt they purchase and second is iodine supplementation itself can also induce or enhance autoantibodies. Thyroid-stimulating hormones is a ligand hormone between the thyroid gland and hypothalamic-pituitary axis .[3]

There is a important relation between thyroid hormones and minerals metabolism, although their changes may be slight, but disturbances of these minerals like calcium, phosphorus and magnesium give rise to some abnormalities like metabolic syndrome, cardiovascular diseases hypertension and secondary osteoporosis. Literature reports diverse data on role of these cations in metabolic pathways directly or indirectly regulated by thyroid hormone but the exact mechanism is not well understood.[4] Thyroid hormones bring to bear its effects on osteoblasts via nuclear receptors and stimulate osteoclastic bone resorption and increase bone turnover. Ionized calcium and phosphorus metabolism are often deranged in thyroid disease. A negative calcium balance may ultimately result in hyperthyroid osteopenia.[5]

In hypothyroid patients hypocalcemia has been a remarkable derenged mineral finding as per the literature. Thyroid hormones also control calcium in the blood by out flux it from the cells. In hypothyroidism thyroxine level is less which lead to release of calcium from the cells is decreased. In hypothyroidism Calcitonin production is increased which enhance tubular clearance of calcium and also increase tubular absorption of phosphorus.[6]

In view of possible alteration of serum calcium, phosphorus and magnesium levels in patients of hypothyroidism there be an increased risk of secondary osteoporosis and bone fractures.

However, there is lack of data in this geographic area regarding this disturbance of mineral metabolism hence we aimed to evaluate the serum calcium, phosphorus and magnesium with TSH levels in cases of hypothyroidism.

Material and Methods

This is a Hospital based observational study conducted in the Department of General Medicine, SMS Medical College and attached group of hospitals, Jaipur. Sample size was calculated 80 cases of newly diagnosed of hypothyroidism of age group of 18-60 years from OPD and IPD and 80 peoples of same age and sex as control group were included in our study**.** Patients suffering from renal diseases, hepatic diseases, pituitary adenomas, bone diseases, diabetes mellitus, alcoholism, and other serious medical conditions which affect mineral metabolism and

Patients on anti thyroid drugs, mineral supplementation or any drugs that would affect mineral metabolism were excluded.

Observation and Results

In the present study we included 80 cases and 80 control patients. We found that mean age for case group was 41.15 years and for control group it was 38.98 years. The majority 81.25% patients in case group and 68.7% patients in control group were female while 18.7% patients in case group and 31.2% patients in control group were male.

Table 1: Comparison of TSH, FT3 and FT4 in case and control subjects.

Parameter	Case Group		Control Group		P-Value
	Mean	SD	Mean	SD	
TSH(0.35-5.5 pg/ml)	10.5	9.56	2.8	0.79	<0.0001
FT3(2.3-4.2 pg/ml)	2.27	0.73	3.2	0.38	<0.0001
FT4(0.89-1.76ng/dl)	1.19	0.66	1.27	0.18	0.29

Table 2: Comparison of serum Calcium, Phosphorus and Magnesium in case and control subject.

Parameter	Case Group		Control Group		P-Value
	Mean	SD	Mean	SD	
Serum Calcium(8.5-10.2 mg/dl)	8.16	0.88	8.66	0.85	0.0003
Serum Phosphorus(4-7 mg/dl)	4.3	1.22	4.37	1.02	0.69
Serum Magnesium (1.7-2.2 mg/dl)	1.7	0.31	1.74	0.24	0.78

Table 3: Pearson Correlation between TSH and serum calcium, serum phosphorus and serum magnesium among hypothyroid patients.

Pearson Correlation	Serum Calcium		Serum Phosphorus		Serum Magnesium	
	r-value	p-value	r-value	p-value	r-value	p-value
TSH	-0.23	0.004	-0.13	0.1	-0.008	0.92

Table 4: Pearson Correlation between FT3 and serum calcium, serum phosphorus and serum magnesium among hypothyroid patients.

Pearson Correlation	Serum Calcium		Serum Phosphorus		Serum Magnesium	
	r-value	p-value	r-value	p-value	r-value	p-value
FT3	0.028	0.725	0.092	0.247	-0.087	0.273

Table 5: Pearson Correlation between FT4 and serum calcium, serum phosphorus and serum magnesium among hypothyroid patients.

Pearson Correlation	Serum Calcium		Serum Phosphorus		Serum Magnesium	
	r-value	p-value	r-value	p-value	r-value	p-value
FT4	-0.114	0.151	0.008	0.92	0.056	0.48

Discussion

Thyroid hormones play impotent role in regulation of the body hemodynamics, metabolism and thermoregulation. It has an influence on renal hemodynamics, glomerular filtration and electrolyte handling. Thyroid disorders play an important role in causing secondary osteoporosis.[7]. In hypothyroidism there is a impaired turnover due to reduced mobilization of calcium into the bone that give rise to decrease blood calcium level. The present study was done to assess the levels of serum calcium, serum phosphorus and serum magnesium among hypothyroid patients.

In present study we found that mean TSH, FT3 and FT4 for case group was 10.5 pg/ml, 2.27 pg/ml and 1.19 ng/dl respectively while for control group TSH was 2.8 pg/ml, FT3 was 3.2 pg/ml and FT4 was 1.27 ng/dl.

In our study there was a significant decrease ($p<0.004$) in serum calcium levels in hypothyroid patients (8.16±0.88 mg/dL) when compared with the euthyroid group (8.66±0.85 mg/dL). Thyroid hormone is essential

for normal growth and maturation of the skeleton. It exerts its effects on osteoblasts via nuclear receptors and stimulates osteoclastic bone resorption and increase bone turnover. It regulates calcium in the blood by out flux of calcium from the cells. In hypothyroidism also increased production of Calcitonin can promote tubular clearance of calcium. So reduced level of thyroid hormone cause decrease level of calcium which leads to secondary osteoporosis. Our results correlate with A study Jat R K et al[8] found that mean serum calcium levels in patients of subclinical hypothyroidism, hypothyroidism, and in controls was 8.75 ± 0.40 mg/dL, 8.37 ± 0.52 mg/dL and 9.67 ± 0.97 mg/dL respectively. Our results also correlate with a study conducted by Kavitha MM et al9, Arvind Bharti et al10 - 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.

In our study we found inverse relation between TSH and serum phosphorus (r value- 0.13, p=0.1) parameter i.e as TSH increases serum phosphorus will decreases and vice versa. But there was not a statistically significant difference in mean S. Phosphorus (p<0.69) in hypothyroid patients and euthyroid subjects. For case group mean S. Phosphorus was (4.3± 1.22) mg/dl and for control group mean S. Phosphorus was (4.37±1.02 mg/dl). Dhungana A et al11 found that a significant positive correlation between TSH and a serum phosphorus level was observed in this study (r-value 0.593, p<0.001). They found serum phosphorous levels were markedly increased in cases of hypothyroidism when compared to healthy euthyroid controls at 4.08±0.40 and 3.19±0.43 respectively, likewise, the level of phosphorous was also increased in subclinical hypothyroidism when compared with control as 3.73±0.30 and 3.19±0.43 respectively (p value<0.001).It could be due to increased production of Calcitonin which favours the tubular excretion of calcium and promotes the tubular reabsorption of phosphate from the kidney leading to hypocalcemia and hyperphosphatemia due to compensatory effect of Calcitonin and PTH. Serum T3 which is the active form of thyroid hormone is required for the stimulation of phosphorus reabsorption from renal tubules mediated through Na/P co-transporters, therefore hyperphosphataemia is due to T3 mediated action on kidneys tubules. They also propose thyroid hormones as long term regulators for phosphate metabolism.. A another study which is conducted by Schwarz C et al and Gohel MG et al12 Whereas, a contradict finding was reported by where serum phosphorus level was decreased in hypothyroidism.

In present study we also found inverse relation found between TSH and serum Magnesium (- 0.008,p=0.92) parameter i.e as TSH increases serum Magnesium will decreases and vice versa. But there was not a statistically significant difference in mean Serum Magnesium in hypothyroid patients (1.7± 0.31) mg/dl and euthyroid subjects (1.74±0.24)mg/dl (p<0.1). A study conducted by Athokpham D et al13 found that mean concentration of serum Mg in cases and controls were 1.41±0.29 mg/dL, (p<0.001) and 2.39±0.29 mg/dL respectively, where highly significant decreased levels were observed when compared with controls. In hypothyroidism there is hypomagnesemia is could be explained by increased urinary excretion of magnesium.14. An another study conduct by Dhungana A et al found that The serum, magnesium was significantly increased in the hypothyroid case when compared with control as follows 1.91±0.15 and 1.73±0.10 (p=0.001) respectively53

Conclusion

Our study concludes that in hypothyroid patients the serum calcium levels was significantly decrease but serum phosphorus and serum magnesium levels were not significantly deranged when compared to euthyroid control subject. We found strong inverse relation between TSH and serum calcium in hypothyroid patients. Regular monitoring or evaluation mineral status provides a great advantage in assessing the progression bone complications and other clinical manifestations in thyroid dysfunction and also may be helpful for the better management of the disease and to prevent further complications associated with it. If necessary, preventive measures like supplementation of minerals or hormone replacement therapy can be initiated early in those who are at risk for rapid bone loss and to prevent osteoporotic fracture.

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