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MINERAL STATUS IN THYROID DISORDERS (HYPO & HYPER)

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ABSTRACT: Thyroid hormones influences the metabolism of all the substrates including minerals. A patient with thyroid dysfunction may also manifests the symptoms that are consequents upon the altered minerals levels. The study shows that, low levels of Ca^{+} in hypothyroid cases, increased bone turnover in hyper thyroidism increases the Ca^{++} level decreased bone turnover. In hypothyroidism low tubular re absorption of Po_4^{-} by affecting GFR, high clearance of Po_4^{-}. In hyperthyroidism increased tubular re absorption of Po_4^{-} affecting GFR, low clearance of Po_4-. In hypothyroidism rapid blood flow will be leading to rapid clearance of Mg^{2+} & Zn^{+} from kidney. So over tubular excretion of Mg^{2+} & Zn^{+} will be low levels in plasma. In hyperthyroidism decreased blood flow will be leading to low clearance of Mg^{2+} & Zn^{+} from kidney. So low tubular excretion of Mg^{2+} & Zn^{+} will be high levels in plasma

Materials & Methods

The study was conducted over a period of six months. In this study 30 subjects hypo & 30 hyperthyroidism with euthyroidism were selected. Both males and females were included. Blood sample were collected for estimation of TSH, FT3,FT4, serum Ca, serum Po_4^{-}, serum Mg^{2+} & serum Zn^{+}.

Results : In hypothyroid patients the serum levels of minerals Ca^{+}, Zn^{+} , Mg^{2+} ($p<0.001$) were significantly decreased and PO_4 ($p<0.001$) levels were significantly increased compared to controls. In hyperthyroid patients the serum levels of minerals Ca^{+}, Zn^{+} , Mg^{2+} ($p<0.001$) were significantly increased and PO_4 ($p<0.001$) levels were significantly decreased compared to controls.

Conclusion : Mineral status is observed in all the patients Ca^{+} levels are low because high bone turnover prominent phosphorus levels positive influences on paratharmone and calcitonine, Zn^{+} & Mg^{2+} levels reflects the influences on GFR and decreased clearance of these minerals.

Key words: Thyroid stimulating hormone Zinc , Calcium, Megnisum , Glomuruli Filtration Rate.

INTRODUCTION

Thyroid gland produces T_3 & T_4, these hormones play a critical role in cell differentiation during development and help to maintain thermogenic , mineral, metabolic homeostasis in the adult.

Hypothyroidsm: subnormal activity of thyroid gland that leads mental and physical slowing because of decrease is the basal metabolic rate.[4] Hyperthyroidsm: excess activity of thyroid gland that leads mental and physical slowing because of increases the basal metabolic rate

The mean annual incidence rate of hypothyroidism is up to 4 per 1000 women, 1 per 1000 men, 1 in 4000 inborns. The prevalence of overt hypothyroidism increase with age[6].

Thyroid hormone is essential for normal growth and maturation of the skeleton[1, 20] .

Deficiency of thyroid hormone in early life leads to both delay in the development of bone and stippled appearance of epiphysial centers of ossification, this result possible dwarfism. In hypothyroidism there is a depressed turnover due to impaired mobilization of calcium into the bone than leads to decrease the blood calcium level[7]. In hyperthyroidism there is poor mobilization of calcium than leads to increases the blood calcium level.

In hypothyriodism increased production of thyroid calcitonine[7]. Can promotes the tubular re absorption of phosphate and also favors the tubular excretion of calcium[2]. In hyperthyriodism decreased production of thyroid calcitonine[7]. Can promotes the tubular excretion of phosphate and also favors the tubular absorption of calcium[2].

Adults contain about 20 gr of Mg^{++} 70% of which is found in bones[14].

In hypothyroidism there is hypomegnesemia because of urinary output and fractional excretion of magnesium through urine [4,11]. In hyper thyroidism there is hyper megnesemia because of lower clearance of magnesium from renal tubules.

Zinc is a intracellular element it can influences the development and normal growth of tissues. Zinc too is needed to prevent hypothyroidism. Zinc is involved the process that converts inactive hormone T4 into active hormone T3 and decreases the metabolic rate. In hypothyroidism the tubular excretion of zinc leads to low levels of plasma zinc[17,18].
In hyperthyroidism the tubular excretion of zinc is low.
The treatment modalities can also be framed while treating a hypo & hyperthyroidism patients keeping in view of the altered mineral metabolism.
The present study was conducted to find out the status of minerals Ca^{++}, Zn^{++} , Mg^{2+} and PO_4 in hypo & hyperthyroidism

MATERIALS AND METHODS

The study was conducted over a period of 6 months in Narayana Medical College & Hospital. In this study we have included 60 diagnosed 30 hypo & 30 hyper thyroidism people as subjects & 25 numbers of healthy people having normal thyroid levels as controls.

Serum TSH[34 - 37], FT3[21-24], FT4[24 -25] were estimated by ELISA.

Serum Ca^{++} level was estimated by OCPC method (O-cresolphthalein Complexone Method)[38,39].

Serum PO_4 level was estimated by Ammonium hepto molibdate method (Mod,Gomorri's Method) [40,41].

Serum Mg^{2+} level was estimated by GEDTA method (Glycoletherdiamine – N,N,N',N'-tetra acitic acid)[42].

Serum Zn^{++} level was estimated by Nitro-PAPS method (Phosphor adenosyl phosphor sulfate method).[43,44]

RESULTS

The values obtained on analyzing specimens collected from patients and control groups are tabulated.

The mean values and standard deviation also have been calculated for comparative study of patients and controls.

The values of patients and control groups are also graphically represented for comparison at a glance . The graphs were plotted using mean values of all the study parameters.

Table 1 shows mean, standard deviation and p values of all the study parameters in hypo thyroid people and control subjects.

Table 1 : comparative study of hypothyroid patients with controls

S.No	parameter	patients		controls		P'value
		Mean	S.D	mean	S.D	
1	FT3	2.01	1.00	2.61	0.73	0.001
2	FT4	0.7	0.50	1.21	0.42	0.001
3	TSH	23.10	13.61	2.25	1.25	0.001
4	Calcium	6.60	2.76	10.48	1.40	0.001
5	Phosphorus	7.7	3.05	3.59	0.99	0.001
6	Magnesium	1.85	0.87	2.27	0.98	0.001
7	Zinc	66.68	30.86	110.70	14.50	0.001

The p value was used to compare cases and control. p value < 0.001 was considered significant. Levels of Ca^{++}, Mg^{2+}, Zn^{++} , were significantly (<0.001) decreased and PO_4 levels were significantly (<0.001) increased.

The TSH levels (0.0001) also significantly increased in cases and FT_3, FT_4 levels (<0.008) significantly decreased compared to controls

Table 2 shows mean, standard deviation and p values of all the study parameters in hyper thyroid people and control subjects.

Table: II : comparative study of hyper thyroid patients with controls:

Sl.no	parameter	patients		controls		P'value
		Mean	S.D	mean	S.D	
1	FT3	5.43	5.42	2.61	0.73	0.001
2	FT4	2.24	1.95	1.21	0.42	0.001
3	TSH	0.22	1.25	2.25	1.25	0.001
4	Calcium	12.46	2.38	10.48	1.40	0.002
5	Phosphorus	2.53	1.03	3.59	0.99	0.001
6	Magnesium	3.85	1.46	2.79	0.98	0.001
7	Zinc	167.42	34.58	110.70	14.50	0.001

p value < 0.001 was considered significant. PO_4 levels were significantly (<0.001) decreased . Ca^{++}, Mg^{2+}, Zn^{++} , were significantly (<0.001) increased.

Compared to controls the TSH levels (0.0001) also significantly decreased in cases and FT_3, FT_4 levels (<0.008) significantly increased.

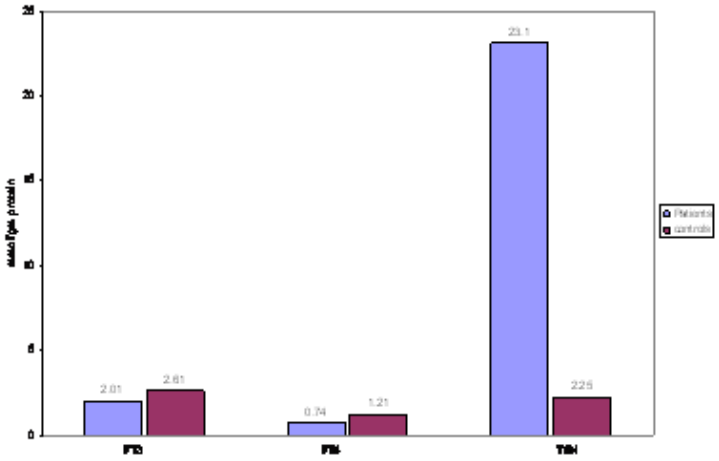

Figure – 1: Comparision of FT3, FT4 and TSH levels in hypothyroidism patients with controls.

Comparision of FT3,FT4 & TSH mean values between patients and controls.

The graph shows Significant elevation of TSH levels in subjects was observed compared to the controls . Decreased FT3 & FT4 in subjects. It indicates the hypothyroidism.

Evaluation of Ca^{++}, $P0_4^-$, Mg^{2+} & Zn^{++} mean values between patients and controls.

The graph shows Significant elevation of Po_4^- levels in subjects were observed compared to the controls . Decreased Ca^{++}, Mg^{2+} & Zn^{++} levels in hypothyroidism subjects compared to controls.

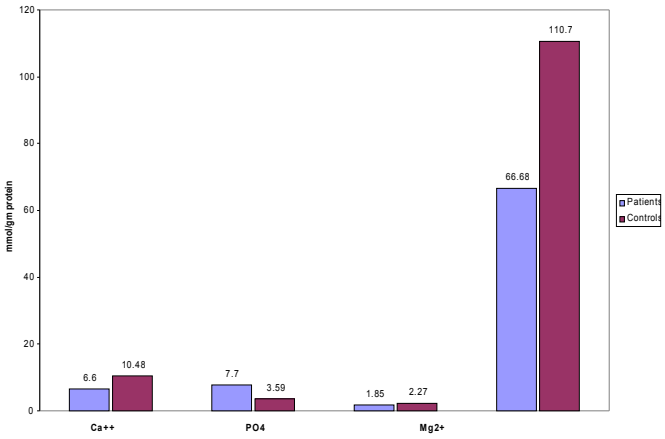

Figure – 2 : Comparision of Ca^{++}, PO_4^{-},Mg^{2+} and Zn^{++} levels in hypothyroidism patients with controls

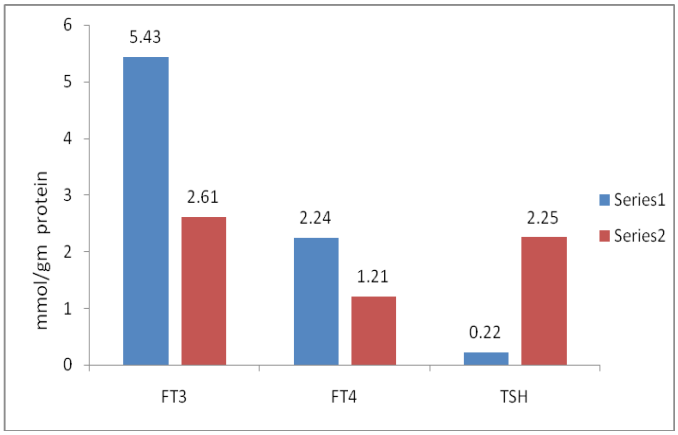

Figure – 3 : Comparision of FT3,FT4 and TSH levels in hyperthyroidism patients with controls.

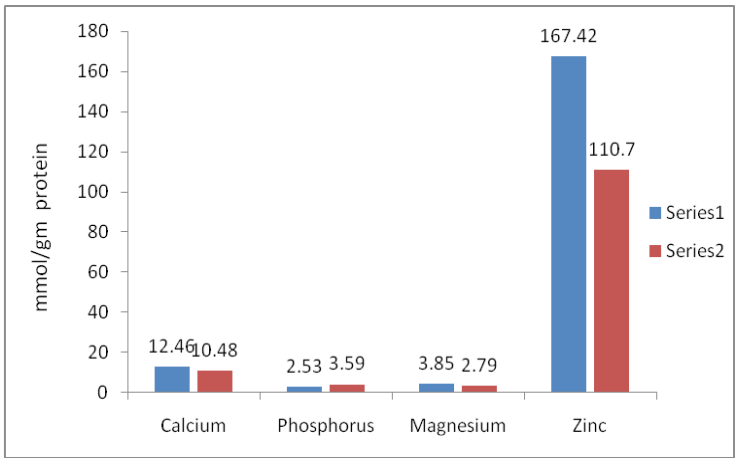

Figure- 4 : Comparision of Ca^{++}, PO_4^{-},Mg^{2+} and Zn^{++} levels in hyperthyroidism patients with controls

Correlation of FT3,FT4 & TSH mean values between patients and controls.

The graph shows Significant decreases of TSH levels in subjects were observed compared to the controls . Increases FT3 & FT4 in subjects. It indicates the hyperthyroidism.

Evaluation of Ca^{++}, $P0_4^-$, Mg^{2+} & Zn^{++} mean values between patients and controls.

The graph shows Significant decreases of Po_4^- levels in subjects were observed compared to the controls. Increased Ca^{++}, Mg^{2+} & Zn^{++} levels in hyperthyroidism subjects compared to controls.

DISCUSSION

The present study was conducted to find out the status of minerals (ca^+ ,mg^{2+},p and zn) in thyroid disorders.

Present study suggests hypo calcemia seen in hypothyroidism.

Previous studies also revealed that hypo calcemia is seen in hypothyroidism this is mainly due to the low levels of PTH and low levels of calcitriol.

In hypothyroidism, calcitonin regulates the over tubular re absorption of PO4 from kidney , which it is conditioned the PO4 levels are raised due to compensatory effect of calcitonin and parathrmone which favour tubular excretion (by inhibiting tubular re absorption), low levels of calcium found quite often.

Present study suggests hyper calcemia seen in hyperthyroidism.

Previous studies also revealed that hyper calcemia is seen in hyperthyroidism this is mainly due to the high levels of PTH and high levels of calcitriol.

In hyperthyroidism, calcitonin regulates the over tubular excretion of PO4 from kidney , which it is conditioned the PO4 levels are raised due to compensatory effect of calcitonin and paratharmone which favour tubular reabsorption (by inhibiting tubular re absorption), high levels of calcium found quite often.

In hypothyroidism there is a increased renal blood flow leading to high clearance of magnesium from the kidneys. So, low levels of magnesium will be causing hypo magnesemia.

In hyperthyroidism there is a decreased renal blood flow leading to low clearance of magnesium from the kidneys. So, high levels of magnesium will be causing hyper magnesemia.

Abnormal zinc metabolism occurs commonly in thyroid disease. In hypo thyroidisim there is a high renal blood flow and increased clearance of zinc is observed, leading low levels of zinc causing low zinc values.

In hyper thyroidisim there is a low renal blood flow and decreased clearance of zinc is observed, leading high levels of zinc causing higher zinc values.

Based on the findings of the study it is inferred that mineral metabolism is intimately associated with thyroid hormone.

Thyroid hormone determines the mineral pool in the blood by influencing mobilization of minerals like calcium and phosphorus, in to the blood and also by influencing their clearance through urinary excretion due to its effect on GFR or renal plasma flow. Low levels of calcium in hypothyroid cases reflects poor metabolism of calcium. This was evident in 76% of the total number of hypothyroid cases. High levels of calcium in hyperthyroid cases reflects prominent metabolism of calcium. This was evident in 65% of the total number of hyperthyroid cases.

Low levels of magnesium and zinc reflect influence of thyroid hormone on GFR and there by clearance of these minerals by filtration. Accordingly low levels were observed in hypothyroid cases.

High levels of magnesium and zinc reflect influence of thyroid hormone on GFR and there by clearance of these minerals by filtration. Accordingly high levels were observed in hyperthyroid cases.

All above finding with regard to mineral metabolism indicate the profound influence of thyroid hormone by affecting either mobilization or clearance from the blood or in to the blood.

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