T3, T4, TSH, Zn and copper metabolism in hyperthyroidism and hypothyroidism

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We measured serum triiodothyronine (T3), serum thyroxine {14), serum thyroid-stimulated hormone (TSH), zinc (Zn) and copper (Cu) levels in 34 patients with hyperthyroidism, 28 patients with hypothyroidism and 32 healthy subjects. These values were significantly higher than normal in hyperthyroidism and lower than normal in hypothyroidism. There was correlation between serum T_3 levels and serum Zn and Cu concentrations in hyperthyroidism. However, there was no correlation among the all other parameters. [Turk J Med Res 1994; 12(3): 122-126]

Key Words: Hyperthyroidism, Hypothyroidism, Copper, Zinc

Trace elements have been shown to influence hormones at several levels, including hormone secretion and activity, and binding to the target tissue. For the synthesis and metabolism of thyroid hormones, numerous spesific enzyme and transport processes have to work in concert (1-3). There is now some evidence to suggest that zinc may likewise be involved in thyroid homeostasis (3,4). In addition, hormones have been shown to influence trace metal metabolism at several levels, including excretion and transport of trace metals (1-3). Deficiency of zinc, copper, manganese and selenium has been observed to affect the endocrine system (2,4).

This study was designed to investigate the alteration of plasma zinc and copper in hyperthroidism and hypothyroidism which are the functional diseases of the thyroid gland.

MATERIALS AND METHODS

We measured serum total T3, total T4, TSH, Zn and Cu levels in 34 patients with hyperthyroidism, 28 patients with hypothhyroidism and 32 healthy subjects. We classified the patients with hyperthyroidism Group 1, the patients with hypothyroidism as Group 2 and healthy subjects as Group 3. We investigated if there was a significant difference or a correlation in serum Zn and Cu levels between the patient groups and healthy subjects.

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We detected serum total T3 (Total T3, cat. no: TKT3 5, DPC, USA), total T4 (Total T4, cat.no: TKT4 5, DPC, USA) and TSH (TSH, cat.no: TKTSH 5, DPC, USA) by radioimmunoassay method, serum Zn and Cu levels (Perkin - Elmer AAS, USA) by atomic absorption spectrophotometry method in all subjects after obtaining venous blood samples.

Student's t-test and linear regression analysis were used for stastically evaluation.

RESULTS

Thirty four patients with hyperthyroidism (22 females, 12 males) (Group 1); 28 patients with hypothyroidizsm (12 females, 16 males) (Group 2) and 32 healthy subjects (19 females, 13 males) (Group 3) took part in this study. Twenty five (73,6 %) of the patients with hyperhyroidism had Basedow-Graves' disease and 9 (26,4%) had toxic nodular goiter. All of the patients with hypothyroidism had primary hypotty oidism. The reason of hypothyroidism was thyroidectomy in 19 (65,5 %) and subacute thyroiditis in 9 (34,5 %) of the patients.

The results and comparisons of the data between hyperthyroidism, hypothyroidism and control groups were demonstrated in Tables 1 to 3.

There was positive correlation only between plasma T3 and Cu levels ($p<0,001$), and between plasma T3 and Zn levels ($p<0,01$). But there was no correlation among the other parameters.

Tablo 1. Comparison of the data of hyperthyroidism group with that of control group.

		Hyperthyroidism group	Control group	t	P
Number of patients	(n)	34	32	1.03	>0.05
Mean age	(year)	39±12	38±11	1.88	>0.05
Total T3	(ng/mL)	267.6±43.C	130.5±24.0	16.09	<0.001
Total T4	(M9/mL)	12.4+.2.2	8.7±1.5	2.31	<0.05
TSH	(mlU/mL)	0.18±0.17	1.4±1.0	.5.70	<0.001
Zn	(mg/dL)	90.0±6.7	90.2±7.2	1.85	>0.05
Cu	(mg/dL)	164.0±30.0	98.1±10.9	2.31	<0.05

Tablo 2. Comparison of the data of hypothyroidism group with that of control group.

		Hypothyroidism group	Control group	t	p
Number of patients	(n)	28	32	1.98	>0.05
Mean age	(year)	37±11	38+11	1.30	>0.05
Total T3	(ng/mL)	61.6±5.1	130.5+24.0	-14.51	O.001
Total T4	(M9/mL)	4.6±0.9	8.7±1.5	-3.37	<0.001
TSH	(mlU/mL)	4.6±0.6	1.4±1.0	-9.26	<0.001
Zn	(mg/dL)	69.8+8.9	90.2±7.2	9.97	<0.001
Cu	(mg/dL)	89.6±8.1	98.1+10.9	2.37	<0.01

Tablo 3. Comparison of the data of hyperthyroidism group with that of hypothyroidism group.

		Hyperthyroidism group	Hypothyroidism group	t	P
Number of patients	(n)	34	28	1.98	>0.05
Mean age	(year)	39±12	37+11	1.13	>0.05
Total T3	(ng/mL)	267.6±43.3	61.6±5.1	10.67	<0.001
Total T4	(ng/mL)	12.4±.2.2	4.6±0.9	5.86	<0.01
TSH	(mlU/mL)	0.18±0.17	4.6±0.6	12.33	<0.001
Zn	(mg/dL)	90.0+6.7	69.8+8.9	4.02	<0.05
Cu	(mg/dL)	164.0+30.0	89.6±8.1	6.04	<0.05

DISCUSSION

There have been a few studies on plasma and erythrocyte Zn concentration and urinary Zn excretion in patients with thyroid disorder (2). High plasma Zn levels have been reported in hyperthyroidism and plasma Zn concentrations have been noted to correlate well with T3 and T4 levels (5-7). We detected increased plasma levels of Zn in the patients with hyperthyroidism and a positively correlation between plasma Zn and T3 levels. Changes in body metabolic rate have been shown to be reflected in altered Zn metabolism (2). Thyroxine administration to rats significantly enhanced the rate of Zn-turnover and altered its distribution in various organs. Zn turnover and utilization were significantly arrested in hypothyroid rats (8). However, it was suggested that thyroxine inhibits the synthesis of carbonic anhydrase C which results in decreased levels of carbonic anhydrase B and content of erythrocyte Zn in hyperthyroidism (9,10). However, normal plasma Zn concentrations in patients with hyperthyroidism have been reported (11-13).

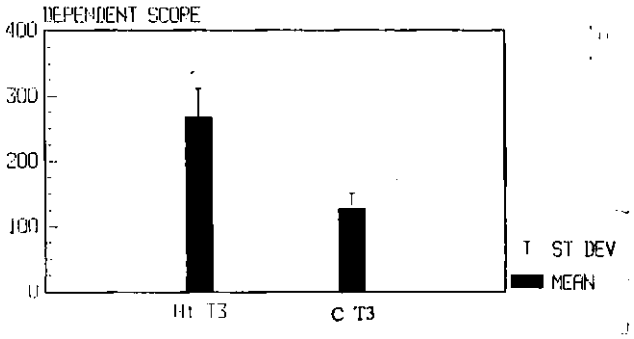

Figure 1. Plasma T3 levels in the hyperthyroidism and control groups.

In this study, we measured plasma Zn and Cu levels in patients with hyperthyroidism and hypothyroidism. We did not investigate eryhrocyte Zn concentration and urinary Zn excetion. There was significant difference in plasma Zn levels between

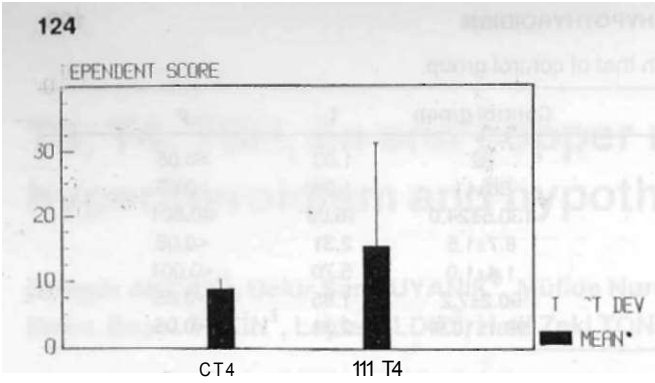

Figure 2. Plasma T4 levels in the hyperthyroidism and control groups.

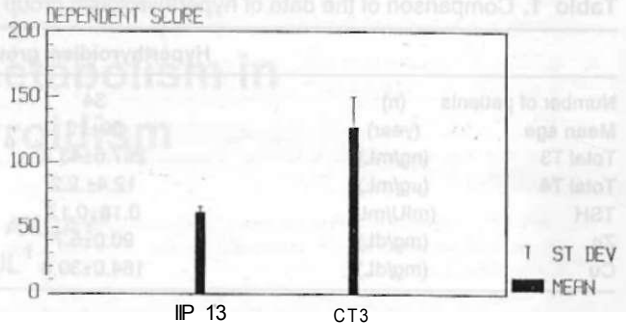

Figure 6. Plasma T3 levels in the hypothyroidism and control groups.

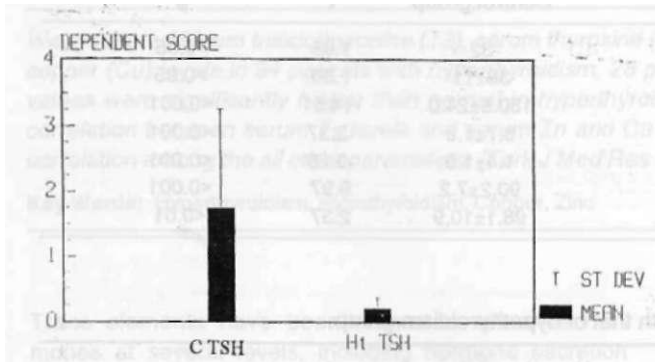

Figure 3. Plasma TSH levels in the hyperthyroidism and control groups.

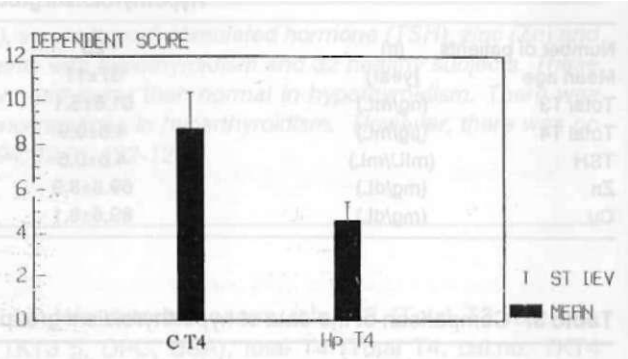

Figure 7. Plasma T4 levels in the hypothyroidism and control groups.

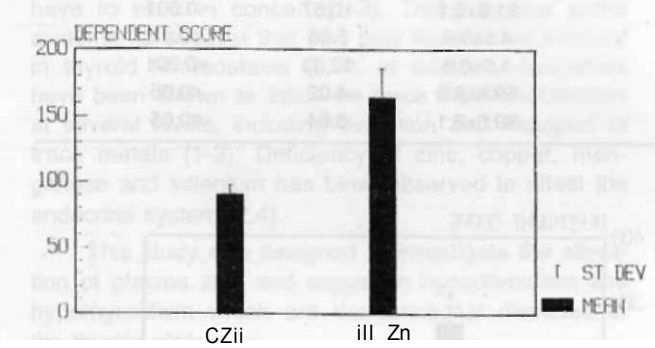

Figure 4. Plasma Zn levels in lhe hyperthyroidism and control groups.

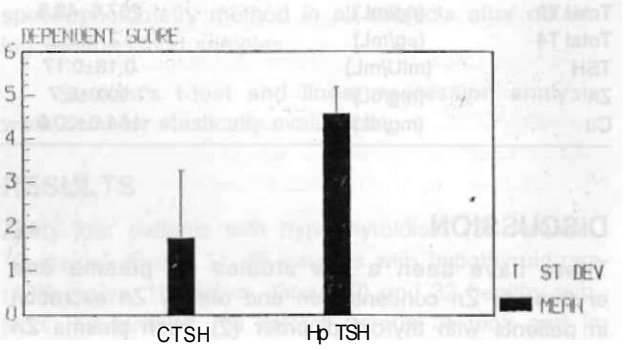

Figure 8. Plasma TSH levels in the hypothyroidism and control groups.

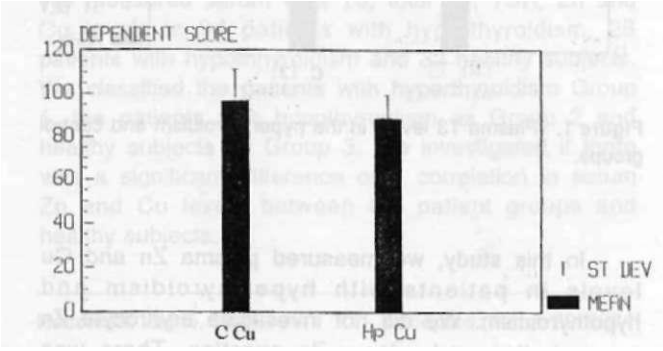

Figure 5. Plasma Cu levels in the hyperthyroidism and control groups.

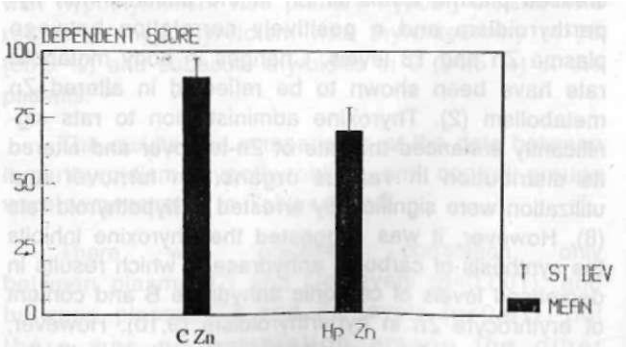

Figure 9. Plasma Zn levels in the hypothyroidism and control groups.

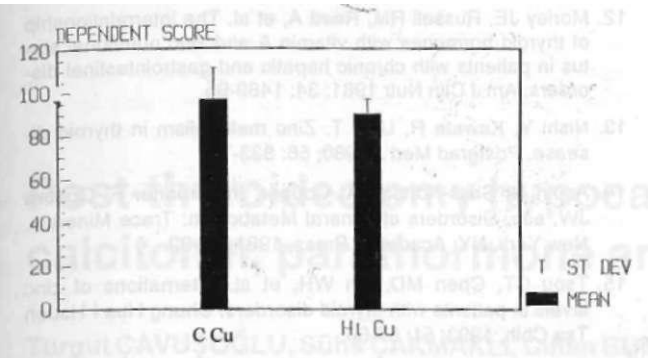

Figure 10. Plasma Cu levels in the hypothyroidism and control groups.

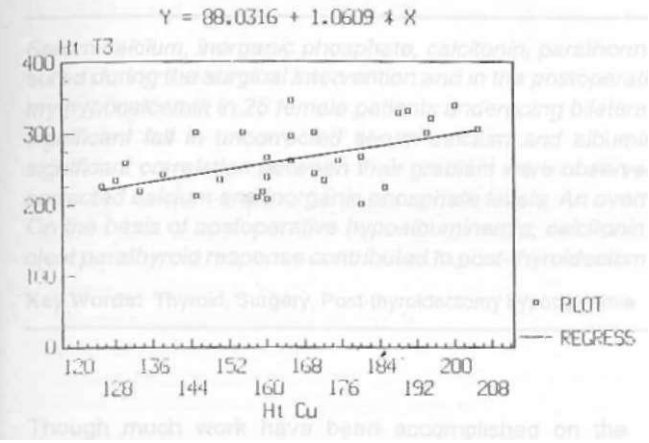

Figure 11. Positive correlation between plasma T3 and Cu levels in hyperthyroidism

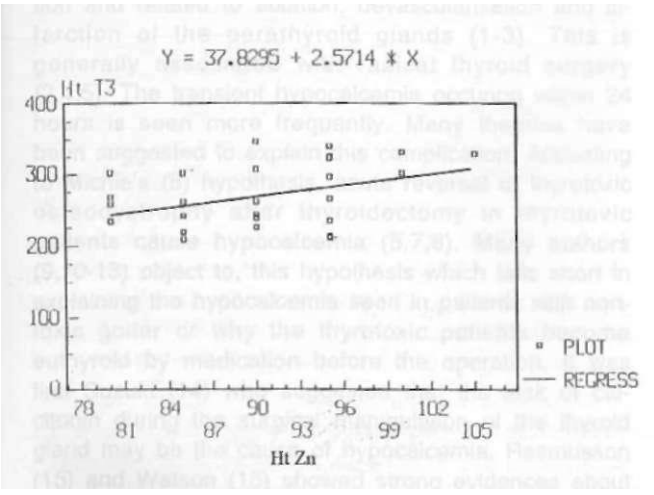

Figure 12. Positive correlation between plasma T3 and Zn levels in hyperthyroidism

the patients with hyperthyroidism and healthy subjects.

Plasma Zn levels were lower then normal in the patients with hypothyroidism in our study. In that patient group, there was no correlation between plasma T3, T4, TSH and Zn levels.

It has been reported that plasma ceruloplasmin levels, concentrations of plasma and erythrocyte Cu increase in patients with hyperthyroidism (2,14,15). Thyroid hormones enhance the synthesis of lysozymal enzymes in muscle and are necessary for the catabolic response to a variety of stimuli in this tissue and increase the concentration of free amino acids in plasma (1).

Plasma Cu levels were higher than normal in patients with hyperthyroidism and lower than normal in patients with hypothyroidism in our study. We did not investigate plasma ceruloplasmin levels and erythrocyte Cu concentrations. We found a positive correlation between plasma T3 and Cu levels only in the patients with hyperthyroidism.

Hipertiroidizm ve hipotiroidizmde T3, T4, TSH, Zn **ve bakır metabolizması**

34 hipertiroidli, 28 hipotiroidli ve 32 sağlıklı kişide serum triiodotironin (T3), serum tiroksin (T4), serum tirold stimüle edici hormon (TSH), Çinko (Zn) ve bakır (Cu) düzeyleri ölçüldü. Bu değerler anlamlı bir şekilde hipertiroidizmde normalden daha düşüktü, bununla birlikte diğer bütün parametreler arasında ilişki bulunamadı. [Turk J Med Res 1994; 12(3): 122-126]

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