Some Biochemical Changes in Goitrous Patients

*Al-Samerraie A. K

*M.B.ch.B.M.Sc.Ph.D
National Diabetes Center
Al-Mustansiriyah University

Abstract:

Hundred goitrous patients (forty-seven males and fifty-three females) with various thyroid diseases, in addition to twenty-five control subjects (seventeen females and eight males) were enrolled in this study. Depending on the thyroid function tests, with clinical signs and symptoms, the patients were divided into three main groups [Euthroid (33 patients), hypothyroid (30 patients) and hyperthyroid (37 patients]. The results of this study showed significant reduction of serum potassium, while serum calcium and sodium showed significant increment in hyperthyroid patients compared to control subjects ($p < 0.01$), (0.001) respectively. In addition to that, the data showed significant elevation of serum potassium, while serum calcium and sodium showed significant lowering in hyperthyroid patients in comparison to those control subjects ($p < 0.01$)($p < 0.001$), respectively.

Introduction:

Thyroid hormones do not appear a discrete target tissue, and almost all the tissues appear to require optimal amounts of thyroid hormones for their normal operation.

Thyroid hormones modulate large number of metabolic processes by regulating the production and activation of many enzymes, also the production and metabolism of most other hormones, beside the utilization of substrates, vitamins, and minerals.

JBMS 2006; Volume 6:50-55

Effect of Thyroid Hormones on Calcium Metabolism:

Calcium levels are significantly increased in hyperthyroid patients compared to euthyroid or hypothyroid patients.[1,2,3 & 4] This increment enhanced with osteobiastic and osteclastic activity and patients have frequently low bone mineral density and high bone turnover.[5&6] Iqbal *et al*, suggested that hyperthyroidism due to Grave's disease causes an increment of the level of bone metabolism markers such as osteocalin, alkaline phosphatase in addition to serum and urinary excretion.[7]

Effect of Thyroid Hormones on Potassium Metabolism:

It has been shown that in hyperthyroid patients, the concentration of serum potassium was higher after treatment with anti- hyperthyroid drugs than before treatment.[8&9] It is not uncommon for patients with Grave's disease to present to the emergency room with sever weakness and a markedly low serum potassium concentration.[10,11&12] Many authors have reported in hypothyroid patients, the level of thyroid hormones before treatment may correlate inversely with potassium level,[13] whereas the values of serum potassium decrease significantly upon treatment.[8]

Effect of Thyroid Hormones on Sodium Metabolism:

The prevalence and severity of hyponatremia in hypothyroid patients without comobrid, conditions have not been well documented.

Shall *et al*, demonstrate that thyroid hormone is a factor responsible for the maturational increase in both active and passive proximal straight tubule (PST) NaCI transport0. [16] While De-Riva *et al*, demonstrate that in untreated Grave's disease an alternation in phosphohpids pattern is present at cellular levels with an a concomitant de-arrangement in membrane permeability.[17]

Material and Methods:

Hundred goitrous with various thyroid diseases, which were attended to the National Diabetes Center, during the period from October 2003 till July 2005, in addition to twenty five control subjects were participated in this study. All patients and control subjects were sent for thyroid function tests [T3, T4, TSH, T3 uptake, (RIA)], serum Na^+ serum K^+, and serum Ca^{+2} in addition to thyroid scan as a part of assessment.

Results:

Thyroid Function Tests: The euthyroid patients group showed no significant variation with respect to serum T3, T3 uptake with control group, while T4, FTI exhibit significant low levels compared with control group ($p < 0.001$) (Tables 1, 2, 3,4). As expected, significant decrease of serum T3, T4, T3 uptake and FTI was found in hypothyroid patients compared with control group ($p < 0.001$) Tables 1,3,2,4).

In hyperthyroid patients, the level of T3, T3 uptake, T4 and FTI was significantly higher than control ($p < 0.001$) (Tables 1, 3, 2, 4). Regarding TSH level in euthyroid patients, no significant difference was observed compared with control, while significant elevation serum TSH level was showed for those patients with hypothyroid ($p < 0.001$) (Table-5), and significantly decrease serum TSH level was detected for those patients with hyperthyroid patients ($p < 0.001$) (Table 5).

Serum Calcium:

Our data, showed significant low serum calcium level in hypothyroid patients ($p< 0.001$), significant high serum calcium level in hyperthyroid ($p< 0.001$), and no significant difference were detected compared with control (Table 6).

Serum Potassium:

In comparison of the patients group with control group, significant low serum potassium was found in the hyperthyroid patients ($p< 0.001$) and significant higher found in hypothyroid ($p< 0.01$), while lacking such difference in euthyroid patients (Table 7).

Serum Sodium: Serum sodium level in hypothyroid patients was significantly lower than the control group ($p< 0.01$) and significantly higher in the hyperthyroid patients ($p< 0.01$), while no such difference in serum sodium level was found in euthyroid group compared to control subject (Table 8).

Table (1): Serum Ts level for thyroid patients and controls.

Groups	Control	Euthyroid	Hypothyroid	hyperthyroid
N	25	33	30	37
Mean(x) (ng/ml)	1.99	1.45	0.64	3.97
SD± (ng/ml)	0.47	0.31	0.15	0.64
P-value		N.S.	0.001	0.001

Table (2): T3 uptake for thyroid patients and controls

Groups	Control	Euthyroid	Hypothyroid	hyperthyroid
N.	25	33	30	37
Mean(x) (%)	31.2	29.4	18.5	45.7
SD± (%)	2.5	3.7	3.3	4.4
P-value		N.S.	< 0.001	< 0.001

Table (3): Serum T4 for thyroid patients and controls

Groups	Control	Euthyroid	Hypothyroid	hyperthyroid
N	25	33	30	37
Mean (x) (µg/100ml)	8.69	6.28	3.85	14.96
SD± (µg/100ml)	1.62	1.03	0.29	2.02
P-value		< 0.001	< 0.001	< 0.001

Table (4): FTI for thyroid patients and controls

Groups	Control	Euthyroid	Hypothyroid	hyperthyroid
N	25	33	30	37
Mean(x) (µg/100ml)	32.81	27.61	9.14	86.66
SD± (µg/100ml)	4.52	6.85	1.85	19.61
P-value		< 0.001	< 0.001	< 0.001

Table (5): Serum TSH for thyroid patients and controls

Groups	Control	Euthyroid	Hypothyroid	hyperthyroid
N	25	33	30	37
Mean(x) (mμ/L)	2.21	3.84	6.83	1.90
SD± (mμ/L)	1.22	6.99	1.14	1.73
P-value		N.S.	< 0.001	< 0.001

Table (6): Serum Ca^{+2} for thyroid patients and controls

Groups	Control	Euthyroid	Hypothyroid	hyperthyroid
N	25	33	30	37
Mean(x) (mg/l 00ml)	8.81	8.92	7.63	9.30
SD± (mg/100ml)	0.31	0.35	0.34	1.28
P-value		N.S.	< 0.001	< 0.001

Table (7): Serum K^{+} for thyroid patients and controls

Groups	Control	Euthyroid	Hypothyroid	hyperthyroid
N	25	33	30	37
Mean (x) (mmol/L)	4.32	4.75	4.84	3.34
SD± (mmol/L)	0.67	0.33	0.35	0.23
P-value		N.S.	<0.01	<0.01

Table (8): Serum Na^{+2} for thyroid patients and controls

Groups	Control	Euthyroid	Hypothyroid	hyperthyroid
N	25	33	30	37
Mean (x) (mmol/L)	143.08	140.52	137.33	154.08'
SD± (mmol/L)	6.33	3.55	2.58	5.05
P-value		N.S.	<0.01	<0.01

Discussion:

Serum Calcium:

Our data revealed high serum calcium in hyperthyroid patients compared to that of the control objects. This finding is in agreement with of previous reports.[1,3] Hyperthyroid patients have high bone turnover with negative calcium phosphorus balance, which often associated with mild osteopenia.[5] Early during mineral balance is converted to positive and sometimes hypocalcemia occurs.[7] In addition to that hypercalcemia was found to have thyrotoxicosis, if no underlying cause for die elevated serum calcium level was detected.[7] The excitating points pushes the physician to consider thyrotoxiasis in the differential diagnosis of unexplained hypercalcemia.

Serum Potassium:

Our results showed lower serum potassium in hyperthyroid patients compared to the results of the control group. These results coincide with that of other reports.[11,12] It is not uncommon for patients with hyperthyroidism presented with weakness, markedly low serum potassium level, and periodic paralysis.[11] The hypokalemia is, due to massive shift of K^{+} from the extra to the intracellular compartment.[10] The effect of thyroid hormone action is on the K^{+} permeability of proximal tubular cell membrane.[8] This latter effect could explained the increase is isotonic fluid re-absorption through an increase in the driving force for sodium.

Finally, hypothyroid patients have a decrease in glomerular filtration rate and renal plasma flow that are completely reverse by thyroxin administration.[13]
On other hand, hyperthyroid subjects exhibits a significant increase in both parameters.[12]

Serum Sodium:

Our results show serum sodium in hypothyroid patients compared to that of the control objects. These data are in agreement with that of previous reports.[14,15]
In hyperthyroid patients, the results show increase of sodium level in comparison to that of the normal subjects. Again, these results coincide with previous reports.[17]
Thyroid hormones cause an alternation in phospholipids pattern at cellular level with a concomitant de-arrangement in membrane permeability define as (22) Na influx and (45) Ca uptake.[17] Thus, thionamide therapy for hyperthyroidism replaces the normal membrane permeability, presumably as a consequence of restoring the normal phospholipids membrane composition. From this we conclude that thyroid hormones are able to induce a quick breakdown of a large number of membrane components, such as membrane phospholipids.

Conclusion:

1. Thyrotoxicosis could be the underlying cause for the unexplained hypercalcaemia.
2. It is not uncommon for patients with hyperthyroidism presented with hypokalaemia.
3. Hyponatremia is a common finding in hypothyroid patients which suggested that this group may be in high risk of C.V.A.
4. Changing in serum calcium, potassium and sodium levels are uncommon finding in euthyroid patients.

References:

1. Alikan Z, Singh A, Hyperthyroidism manifested as hypercalcemia. South-Med-J. 1996, 89(10): 997-8.
2. Lager J, Ruiz Jc, Guidbourdenche J, Bone mineral density and metabolism in children with congential hypothyroidsm after prolonged L. thyroxin therapy. Acta-Pediatr. 1977, 86 (7): 704-10.
3. Begic K, Wagner B, RAber W, Senu-n calcium in thyroid disease. Wein-Khn-Wochenschr. 2001, 113 (1-2): 65-8.
4. Lopez-M B, Wawkins F, Rigopoulou D, The risk factors and bone mineral density. Med. Clin. Bare. 1999, 112(3): 85-9.
5. Isaia G C , Roggia C, Gola D, Bone turnover in hyperthyroidism before and after thyroxine management. J. Endocrinol. Invest. 2001, 23(11):31-727.
6. Sabuncu T, Akosy N, Arikan E, Early changes in parameter of bone and mineral metabolism during therapy for hyper and hypothyroidism. Endocrol. Res. 2002, 27(1-2): 2003-13.
7. Iqbal A A, Burgess E M, Gullina D. L. Hypercalcemia, parathyroid hormone, and 1, 25 dihydroxyvitamin Da levels during management of thyrotoxicosis, Endocr. Prct. 2204, 9(6): 517-21.
8. Capasso G, de-Tommaso G, Pica A, Effect of thyroid hormones on heart and kidney functions. Miner-Electrolyte. Metab. 1999, 25(1-2): 56-64.
9. Lin C, Hehrmer R, Van Mayerback K, Hypokalaemia and paralysis. 2001، QJM.94 (3): 133-9.
10. Hansen P S, Bonnema S J, Hegedus L, Thyrotoxic periolic paralysis. Uges Kr.Lacger. 1991. 161 (31): 4411-2.
11. Didonna D D, Alessandro G, De-Michele A, Thyrotoxic periolic paralysis in a Caucasian man in treatment for Grave's disease. Panminerva-Med. 2001, 42(4): 293-4.
12. Klouche K, Bismuth J, Lechiche C, Thyrotoxic periolic paralysis. A cause of pseudo-paralysis hypokalemia that should not be ignored in Caucasians. Press. Med. 2003, 32(26): 1213-5.
13. Castillo V-A, Pisarev M-A, Leiia J-C, Commercial diet induced hypothyroidism due to high iodine. Vet. A. 2002, 23(4): 218-23.
14. Yonemura K, Euruga R, Oki Y, Imparied water excretion in a hyponatremia patient following thyroidectomy: causel role of glucocorticol deficiency. Miner-EIectroluyte-Metabohsm. 1998, 24(5): 341-7
15. Baajafer F S, Hammami M M, Mohamed G E, Prevalence and Severity of Hyponateremia and hypercreatininemia in short term uncomplicated hypothyroidism. J. Endocrinol. Invest. 1999, 22(1): 35-9.
16. Shah M, Quigky R, Baum M, Maturation of proximal straight tubule NaCl transport role of thyroid hormone. AM. J. Physiol. Renal. Physiol. 2000 :(4)278 ،F596-602.
17. De-Riva C, Virgili F, Frigata F, Increased Sodium influx and calcium uptake in erythrocyte in hyperthyroidism: role of abnormal membrane lipid levels. Metabolism. 1996, 45(6); 707-11.