Serum Calcium and Magnesium Levels in Patients with Hypothyroidism

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Micronutrient such as serum calcium and magnesium deficiency are associated with hypothyroidism. This study is aimed to observe serum calcium and magnesium in patients with hypothyroidism. This cross sectional study was carried out in the Department of Biochemistry, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka from July 2014 to June 2015. About 50 subjects were selected from the out-patient department of different tertiary hospitals. The age range of the patients was 20 to 50 years. Among them 25 were normal healthy subjects(control) & 25 patients of hypo- thyroidism(experimental) were included in this study. Thyroid function tests were performed by the chemiluminescence method and serum calcium and magnesium were measured by Bichromatic end point technique. For statistical analysis independent sample "t" test was performed by computer based software SPSS- 17.0 version for windows. Serum calcium level was highly significantly decreased (P<0.0001) and Serum magnesium level was highly significantly increased (P<0.0001) in patients with hypothyroidism. This study may conclude that micronutrient deficiency may be one of the risk factor of the hypothyroidism. Therefore, early detection and supplementation to treat this deficiency may reduce the incidence of hypothyroidism.

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Key words: Calcium, magnesium, free T_3, free T_4, TSH, hypothyroidism

Introduction

The maintenance of optimal health requires an adequate supply of carbohydrate, protein, lipid, macronutrients, micronutrients and trace elements.[1] Many trace elements play an essential role in our biological processes through their actions as activators or inhibitors of enzymatic reactions, by competing with other elements and proteins for binding sites, by influencing the permeability of cell membranes, or through other mechanisms. Trace elements are known to influence hormone secretion and activity and binding to target tissue. Conversely, hormones influence trace element metabolism in excretion and transport of them.[2] Hence, trace elements assay might be used as diagnostic or prognostic aid in patients with different hormonal disturbances along with other biochemical parameters.

Thyroid hormones regulate the rate of metabolic processes and development of body. But deficiency of thyroid hormones causes many metabolic processes to slow down.[3]

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Hypothyroidism is characterized by a generalized reduction in metabolic function that most often manifests as a slowing of physical and mental activity. Hypothyroidism presents with a wide range of clinical features, including fatigue, forgetfulness, depression, hair loss, dry skin, puffy eyes, deepening of the voice, persistent dry throat, infertility and menstrual irregularities, weight gain, elevated cholesterol and a slowed heartbeat.[4] Disturbance of calcium and phosphorous homeostasis were frequently observed with thyroid dysfunction.[5]

Thyroid hormones are central regulator of body haemodynamics, thermoregulation, metabolism and also influence renal glomerular filtration, the renin angiotensin aldosterone mechanism and renal electrolyte handling.[6] Thyroid hormones are essential for normal growth and maturation of skeletal system.[7]

Thyroid disorders are one of the most common endocrine disorder. Bone remodeling is affected by the direct or indirect effect of the thyroid hormones on the bone cells.[8] The bone is affected by the interaction of the thyroid stimulating hormone (TSH) with the TSH receptors that are expressed on the precursors of osteoblasts and osteoclasts.[9] In the early life, a deficiency of the thyroid hormone can lead to a delay in the bone development. An impaired mobilization of calcium into the bone can cause a depressed turnover in hypothyroidism, and this can often lead to a decrease in the blood calcium level.[10] The plasma contains calcium that occurs in three physiochemical states: Ionized calcium, which is also termed as free calcium constitutes, approximately 50%, about 40% plasma calcium is bound to the plasma proteins and the rest 10% is complexed with small anions. All plasma or serum calcium is ionized, regardless of its association with proteins or small anions. Because the free or ionized calcium is biologically active and tightly regulated, it is the best indicator for calcium status. Despite the measurement of free calcium being clinically more useful, it has not replaced the measurement of total calcium.[11]

Low serum magnesium is associated with cardiovascular events and metabolic syndrome.[12] Although, the exact mechanism underlying these relationships is not fully understood, potential mechanism is the basic role of these cations in metabolic pathways.[13]

The changes in magnesium and calcium may be slight in thyroid disease. It is possible that these disturbances will affect a patient in the long term.[14] Recently, it has been suggested that some of metabolic disorders, hypertension and some cardiovascular diseases are linked by common defects in metabolism of divalent cations such as calcium and magnesium.[15] The positive relationship between serum calcium and metabolic syndrome, cardiovascular diseases, or myocardial infarction has been reported.[16]

Method

The present cross-sectional analytical study was carried out in the department of Biochemistry, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka from July 2014 to June 2015. A total subjects of 50 were taken in this study. Study subjects were divided into two groups. There were 25 normal healthy control subjects in group A and 25 hypothyroid patients in group B. After selection of subjects, the purpose of the study was explained to each subjects. When they felt free to agree for participation, then informed written consent was taken from the subjects. Detailed family history and medical history were taken. Tests were carried out as early as possible. All data were recorded

systematically in a preformed history sheet and all statistical analysis was done by computer using the software SPSS 17.0 version for windows. Serum calcium and serum magnesium levels were determined by Bichromatic end point technique. Data were expressed as mean ± SD. For statistical analysis independent sample "t" test were performed. The significance was noted at p<=0.05.

Results

The age range of the patients was from 20 to 50 years with a mean of 35.24 ± 6.79 years. Mean serum TSH level was higher in hypothyroid patients (45.72 ± 23.69) than in control subjects (1.65 ± 0.903) which was statistically significant (p<0.001). Mean serum FT_4 level was lower in hypothyroid patients (4.44 ± 3.45) than in control subjects (17.52 ± 2.51) which was statistically significant (p<0.001). Mean serum FT_3 level was also lower in hypothyroid patients (2.90 ± 1.68) than in control subjects (4.85 ± 1.04) which was statistically significant (p<0.001). Both serum calcium and serum magnesium levels were significantly decreased (P<0.0001) in hypothyroid patients in group B (experimental).

Table I: Showing serum TSH level in two groups

Group	Serum TSH level Mean ± SD mIU/L.	'P' value
A (control) n= 25	1.65 ± 0.903	< 0.001[HS]
B (case) n= 25	45.72 ± 23.69	

Normal Range of serum TSH Level 0.4 – 4 mIU/L.[17]

Table II: Showing serum FT_4 level in two groups

Group	Serum FT_4 level Mean ± SD pmol/L.	'P' value
A (control) n= 25	17.52 ± 2.51	< 0.001[HS]
B (case) n= 25	4.44 ± 0.291 (9 – 10.2)	

n= Number of subjects.
SD= Standard deviation.
t= Unpaired 't' test.
[HS]= Highly significant.
L= Lowest value.
H= Highest value.
# Normal Range of serum FT_4 Level 9-25 pmol/L.[17]

Table III: showing serum FT_3 level in two groups

Group	Serum FT_3 level Mean ± SD pmol/L.	'P' value
A (control) n= 25	4.85 ± 1.04	< 0.001[HS]
B (case) n= 25	2.90 ± 1.68	

n= Number of subjects.
SD= Standard deviation.
t= Unpaired 't' test.
[HS]= Highly significant.
L= Lowest value.
H= Highest value.
# Normal Range of serum FT_3 Level 3.5-7.8 pmol/L.[17]

The mean ± SD serum calcium levels were 10.158 ± 0.363 mg/dl in group A and 9.404 ± 0.291mg/dl in group B as shown in in Table IV.

Table IV: The mean ± SD serum calcium levels

Group	Serum calcium level Mean ± SD mg/dl Range (L - H) ng/ml	't' value	'P' value
A (control) n= 25	10.158 ± 0.363 (9.2 – 10.8)	7.9337	< 0.0001[HS]
B (case) n= 25	9.404 ± 0.291 (9 – 10.2)		

n= Number of subjects.
SD= Standard deviation.
t= Unpaired 't' test.
[HS]= Highly significant.
L= Lowest value.
H= Highest value.
#= Normal range of serum calcium level 9-11.mg/dl.[18]

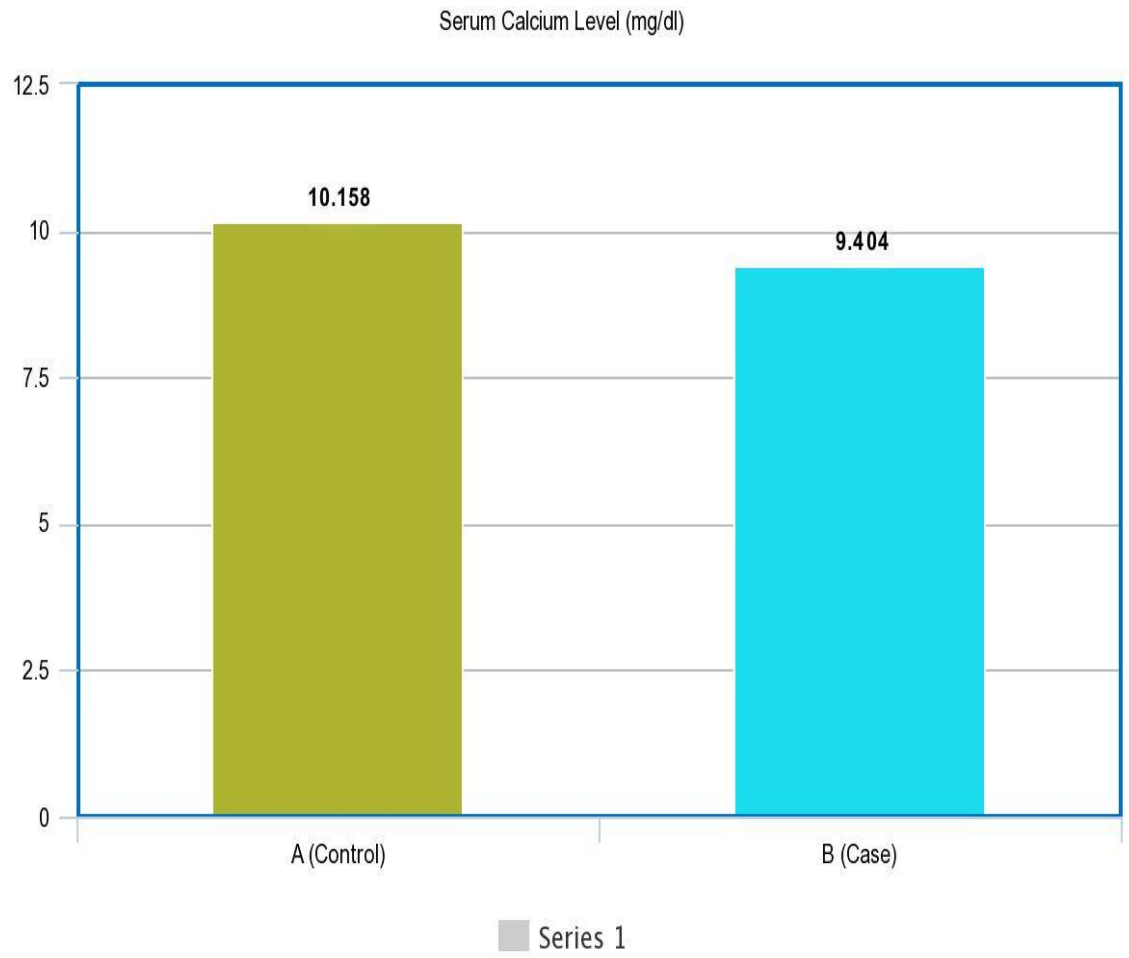

Fig-1. Bar diagram showing serum calcium level in hypothyroid patient

The mean ± SD serum magnesium levels were 1.9116 ± 0.0560 mg/dl in group A and 2.0720 ± 0.1768 mg/dl group B as shown in Table V.

Table V: mean ± SD serum magnesium levels

Group	Serum magnesium level Mean ± SD mg/dl. Range (L - H) mg/dl.	't' value	'P' value
A (control) n= 25	1.9116 ± 0.0560 (1.8 – 1.99)	4.3243	< 0.0001 HS
B (case) n= 25	2.0720 ± 0.1768 (1.8-2.4)		

n= Number of subjects., SD= Standard Deviation. t= Unpaired 't' test. HS= Highly significant.
L= Lowest value.H= Highest value.
#= Normal range of serum magnesium level 1.8 - 2.4mg/dl.[19]

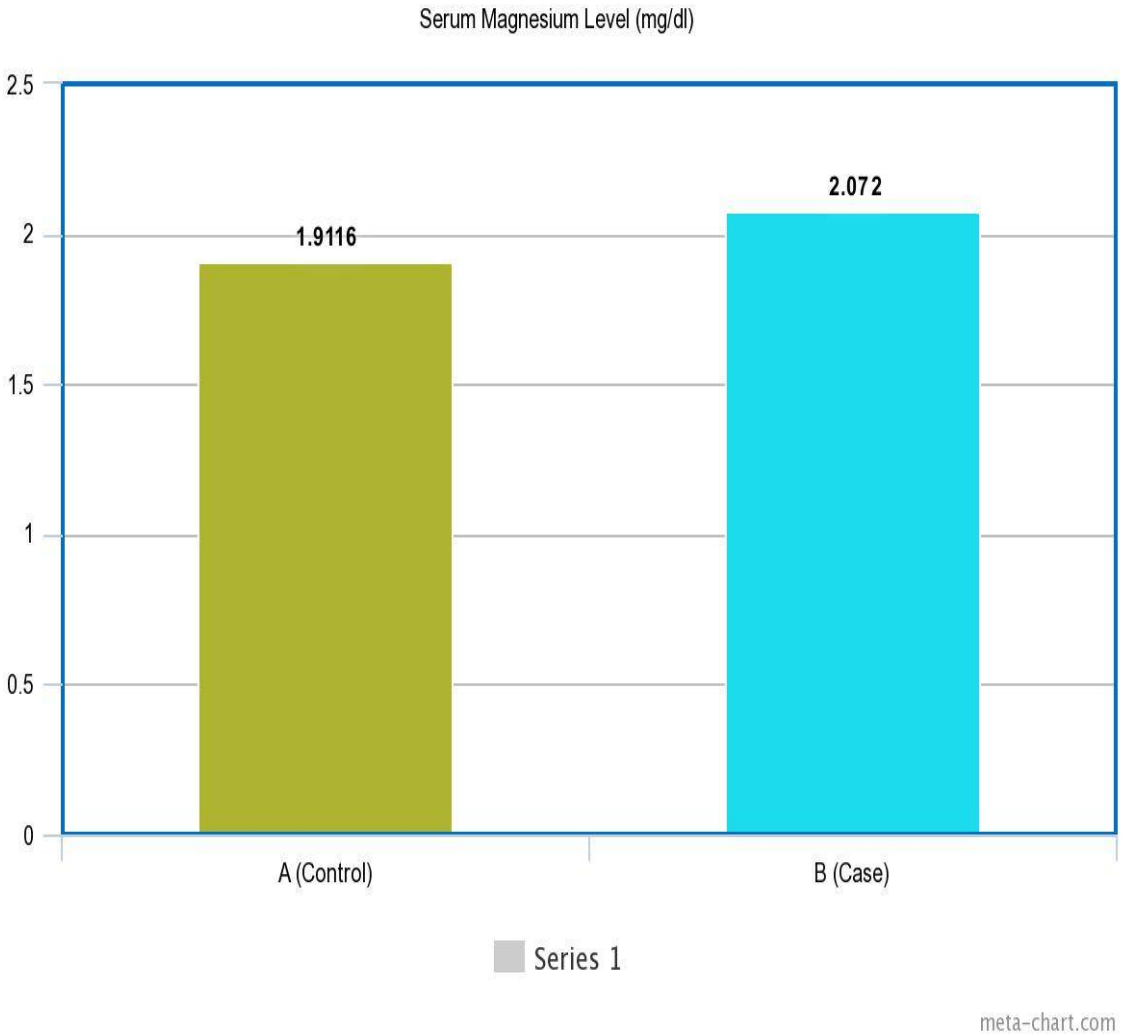

Fig 2. Bar diagram showing serum magnesium level in hypothyroid patient

Discussion

In this study, both serum calcium and serum magnesium level were highly significantly decreased (P<0.0001) in hypothyroid patients (in group B). The present result demonstrated a significant decrease of serum calcium in the experimental group than the control group. This finding is similar to the studies reported by Sridevi D et al[5] and Resnick et al.[13] Thyroxine normally regulates blood calcium levels by releasing calcium extra cellular. In hypothyroidism, less thyroxine in the bloodstream and thus less thyroxine entry into the cells leading to decreased extra cellular calcium release. Again low serum magnesium is associated with cardiovascular events and metabolic syndrome. Although, the exact mechanism underlying these relationships is not fully understood, potential mechanism is the basic role of these cations in metabolic pathways.

There is an association between the serum calcium and magnesium levels and thyroid functions, which may be relevant in marked cases of hypo or hyperthyroidism. Hence, it is better to estimate the levels of serum calcium and magnesium in all thyroid disorders. However, this will have to be correlated with the duration and severity of thyroid disorders. Similar conclusions has been reached by Abbas

M et al,[16] Roopa et al,[6] Sidhu GK et al[7] and Mendez et al.[10]

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