

A study of serum magnesium level in hypothyroid cases in a tertiary care hospital, Perambalur

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DOI: <https://doi.org/10.17511/ijmrr.2019.i03.08>


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Magnesium is an incredibly vital mineral found in the human body. Magnesium clearly affects the entire body and naturally will interact with thyroid functions, both directly and indirectly.

Objectives: To assess the levels of serum magnesium in patients with hypothyroidism and its correlation with TSH levels. **Methodology:** An observational study consists of 174 cases of hypothyroidism were selected. All patients with hypothyroidism, newly diagnosed with age above 18 years were included, all patients with malignancy, multiple endocrine disorder, CKD and patients supplemented with minerals were excluded in the study. Thyroid function and serum magnesium levels were done and analyzed in these patients. **Results:** In our study mean serum magnesium level in hypothyroid cases was 2.18 ± 0.02 mg/dl. Our study done with a follow up of thyroid function and serum magnesium level in hypothyroidism after supplementation with thyroid hormone and diet supplementation for magnesium showed a significant improvement which reciprocate the incidence of hypo magnesium in hypothyroidism and which is inversely proportionate to TSH levels which was not statistically significant. **Conclusion:** The alteration of serum magnesium level in hypothyroidism was not established in our study statistically.

Keywords: Serum magnesium, Hypothyroidism, Thyroid function test

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I. Vijayapriya, Assistant Professor, Department of Biochemistry, Government Head Quarters Hospital, Perambalur, Tamilnadu, India. Email: drvijayapriya@gmail.com	Vijayapriya I, Saravanan S. A study of serum magnesium level in hypothyroid cases in a tertiary care hospital, Perambalur. Int J Med Res Rev. 2019;7(3):195-199. Available From https://ijmrr.medresearch.in/index.php/ijmrr/article/view/1058	

Manuscript Received
2019-05-10

Review Round 1
2019-05-20

Review Round 2
2019-05-24

Review Round 3

Accepted
2019-05-28

Conflict of Interest
No

Funding
Nil

Ethical Approval
Yes

Plagiarism X-checker
4%

Note



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Introduction

Dysfunction and anatomic abnormalities of the thyroid are among the most common diseases of endocrine glands [1]. Hypothyroidism is one of the most common forms of thyroid dysfunction resulting from the deficiency of thyroid hormones or from their impaired activity [2]. Hypothyroidism is ten times more common in women than men and its prevalence increase with age [3]. Biochemically decrease in T3 and T4 concentration leads to hyper secretion of pituitary TSH and an amplified increase in serum TSH levels. This is a key laboratory finding in diagnosis of hypothyroidism [4].

Thyroid hormones perform a wide array of metabolic functions including regulation of lipids, carbohydrates, protein and electrolytes and mineral metabolism [5]. Mineral metabolisms like calcium, magnesium and phosphorous is frequently disturbed in thyroid dysfunctions. Thyroid hormones exert its effects on osteoblasts via nuclear receptors to stimulate osteoclastic bone resorption [6]. Thyroid hormones probably stimulate bone resorption directly, thereby increasing serum calcium and phosphorous concentrations and also suppressing serum parathyroid hormone and 1,25-dihydroxy vitaminD3 concentrations. The decrease in these bone-resorbing hormones limits further increase in serum calcium concentration but also results in enhanced intestinal calcium absorption. In adult hypothyroidism the opposite effects are seen [7].

Although the changes in analytes, including magnesium and calcium may be slight in thyroid disease, it is possible that these disturbances will be important for a patient in long term. Recently, it has been suggested that some of metabolic disorders, hypertension and cardiovascular disease are linked by common defects in metabolism of divalent cations such as calcium and magnesium. The exact mechanism underlying these relationships is not fully understood, potential mechanism is the basic role of these cations in metabolic pathways [8].

Indian patients are different from western patients from bone mineral homeostasis point of view. On one hand, thyroid disorders are most common prevalent conditions and on the other hand, Indian studies focusing on the blood levels of calcium & phosphorous in thyroid disorders are sparse [6]. The present study was undertaken to assess the alterations in the levels of serum magnesium total in patients with hypothyroidism.

We also investigated the correlation between TSH levels and the serum concentration of the above mineral.

Methodology

Type of study and setting: This study was a hospital based multicentric study conducted at Biochemistry department, Internal medicine department, DSMCH, and OP department of GH, Perambalur, between 2016 and 2019.

Sampling method: An observational study consists of 174 cases of hypothyroidism were selected.

Sample collection: Blood Sample Collection- A 3ml of venous blood was drawn from each volunteer using a disposable plain vacutainer system in fasting condition. Serum was separated within half an hour by centrifugation and stored at 2-8°C temperature till analysis was done. After written consent for enrollment in the study, a detailed history was taken from all the subjects along with a detailed clinical examination.

Analysis of Sample: Serum T3, T4 and TSH were measured by MAGLUMI 1000 Chemi Luminescent Immuno Assay. Serum magnesium total was estimated by Calmagite method on Erba 320 fully automated analyzer using commercially available kits. Inclusion criteria: All patients with hypothyroidism newly diagnosed with age above 18 years. Exclusion criteria: All patients with malignancy, multiple endocrine disorder, CKD and patients supplemented with minerals. Statistical method: Data are expressed as Mean±S.D. Correlation between parameter was studied by Pearson's correlation coefficient using Graph Pad statistical software.

Results

Table-1: Age and Sex wise Distribution.

Age	Sex		No of Patients	%
	Male	Female		
Below 20	-	05	05	2.87
21-30	10	47	57	32.75
31-40	11	47	58	33.33
41-50	08	25	33	18.96
51-60	07	07	14	8.04
>60	04	03	07	4.02
Total	40	134	174	100%

A total of 174 cases were studied.

Among the cases 40 (22.98%) were male and 134 (77.01%) were female. There were more females than males among cases. The maximum number of patients were in the age group between 21-40 years age (>65%).

Table-2: Baseline characteristics of cases.

Mean age		39.23±6.74
Mean BP	Systolic	103.2±2.37
	Diastolic	72.6±1.98
Mean PR		81.2±1.24
Mean HT		154±2.43
Mean Wt		52.45±1.98
Mean		
T3 (ng/ml)		0.4832±0.027
T4 (µg/dl)		4.9349±0.738
TSH (µIU/ml)		39.447±3.143
Mean magnesium (mg/dl)		2.18±0.02

In our present study the mean age was 39.23±6.74. In the present study the mean pulse rate was 81.2±1.24. The mean systolic and diastolic blood pressure was 103.2±2.37 and 72.6±1.98 mmHg. The mean height and weight were 154±2.43 cm and 52.45±1.98 kg respectively. In the present study the mean TSH was 39.447±3.143µIU/ml. The mean magnesium was 2.18±0.02 mg/dl.

Table-3: Serum Magnesium level in relationship with TSH.

S. No	TSH level	Mean Serum Magnesium level
1	<0.4	-
2	0.4-4.5	1.9±0.01 (1)
3	4.5-10	1.98±0.02(44)
4	>10	1.87±0.01(129)

In the present study the mean serum magnesium level was 1.87±0.01 mg/dl in patients with a TSH value of >10µIU/ml. The mean serum magnesium level was 1.98±0.02 mg/dl in patients with a TSH value of 4.5-10 µIU/ml.

Table-4: Serum Magnesium level in relationship with T3.

S. No	T3 level	Mean Serum Magnesium level
1	0.1-0.5	1.79±0.21 (94)
2	0.6-2.5	1.98±0.3 (80)
3	>2.5	-

In the present study the mean serum magnesium level was 1.79±0.21 mg/dl in patients with a T3 value of 0.1-0.5 ng/ml. The mean serum magnesium level was 1.98±0.03 mg/dl in patients with a T3 value of 0.6-2.5 ng/ml.

Table-5: Serum Magnesium level in relationship with T4

S. No	T4 level	Mean Serum Magnesium level
1	0.1-5.0	2.1±0.21 (95)
2	5.1-13.0	1.98±0.22 (78)
3	>13	1.8±0.12(1)

In the present study the mean serum magnesium level was 2.1±0.21 mg/dl in patients with a T4 value of 0.1-5.0 µg/dl. The mean serum magnesium level was 1.98±0.22 mg/dl in patients with a T4 value of 5.1-13.0 µg/dl.

Table-6: Mean levels in beginning and six month follow up study (n=36).

Investigation	Beginning of our study levels (n=36)	Six month follow up levels (n=36)	P value
Mean T3 (ng/ml)	0.632±0.02	0.78±0.027	p=0.043 (p<0.01)
Mean T4 (µg/dl)	4.9±0.2	6.132±0.2	p=0.008 (p<0.001)
Mean TSH (µIU/ml)	38.55±1.42	4.55±0.32	p=0.000732 (p<0.0001)
Mean magnesium level (mg/dl)	1.647±0.012	1.849±0.02	p=0.0651 (p<0.01)

In the present study the mean magnesium level was 1.647±0.012 and after a regular follow up and adequate replacement of thyroid hormone the follow up mean magnesium was 1.849±0.02 which was not statically significant.

Discussion

Magnesium is an incredibly vital mineral found in the human body. Sadly other minerals like calcium and iron tend to take the spotlight, leaving many adults oblivious to how important magnesium is. Magnesium plays an important role in a wide range of body functions. Over 300 different enzyme systems within the body rely on magnesium to function properly. Magnesium performs double-duty when it comes to this process.

Not only does magnesium stimulate the thyroid gland to produce more T4, but it simultaneously changes T4 into T3. This is a huge reason why magnesium is so vital. There is also a strong correlation between magnesium and the development of goiter. Important nutrient in preventing goiter is iodine, but magnesium is right there helping too. Magnesium helps you to make more T4 in the thyroid gland.

Without magnesium, many of the thyroid enzymes that make thyroid hormone simply could not function. Thyroid hormone is a central regulator of body hemodynamics, thermoregulation and metabolism.

Therefore, it has an influence on renal hemodynamics, glomerular filtration and electrolyte handling [9]. Thyroid hormone affects the glomerular filtration rate and blood flow and has a direct effect on Ca and Mg resorption [10]. Total magnesium levels in serum were found to be significantly lowered in hypothyroid patients. Thyroid hormone is essential for normal growth and maturation of the skeleton.

In hypothyroidism there is a depressed turnover due to impaired mobilization of calcium into the bone that leads to decrease blood calcium level. In hypothyroidism there is hypomagnesaemia because of urinary output and fractional excretion of magnesium through urine. Magnesium level is reduced due to influence on GFR and decreased clearance. In hypothyroidism there is an increased renal blood flow leading to high clearance of magnesium from the kidneys.

With the above evidence our study was focused on estimation of serum magnesium level in hypothyroidism. In our study the mean age was 39.23±6.74 years which was similar to a study done by Mukesh G Gohel et al (14) showed a mean age of 46.7±7.3 years. Our study showed mean serum magnesium 2.18±0.02 mg/dl, which was normal range in respect to reference in hypothyroidism. Other study ranges are

Study	Serum Magnesium(mg/dl)	Comment
In present study	2.18±0.02	Negative correlation
Mukesh G Gohel et al [12]	1.36±0.49 (hypothyroidism)	Positive correlation
Kavitha MM et al [13]	2.37±0.46(overt hypothyroidism)	Positive correlation
Mane AY et al [11]	2.21±0.29	Positive correlation
Arvind Bharti et al [14]	2.28±0.27	Positive correlation
Susanna et al [15]	1.88±0.15	Negative correlation

Lower serum magnesium level in hypothyroid patients is due to impaired magnesium homeostasis [11]. Our study done with a follow up of thyroid function and serum magnesium level in hypothyroidism after supplementation with thyroid

Hormone and diet supplementation for magnesium showed a significant improvement which reciprocate the incidence of hypo magnesium in hypothyroidism and which is inversely proportionate to TSH levels which was not statistically significant.

Conclusion

In our study done to estimate the serum magnesium level in hypothyroidism in south India did not reveal a statistical significant lower value of serum magnesium levels. The present study showed negative correlation with normal range of serum magnesium levels in patients with hypothyroidism. The present study signifies no need of supplementing magnesium of any sources. The ideal modality is to have an adequate maintenance of TSH with adequate dose of thyroid supplementation will not affect the magnesium levels.

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