

EFFECTIVENESS OF THE LEVEL OF SERUM CALCIUM IN HYPO- AND HYPERTHYROIDISM PATIENTS AT TERTIARY CARE HOSPITAL, KANPURSATISH KUMAR YADAV[✉]*, SATYAPRAKASH SINGH, RAJMANGAL CHAUDHARY

Department of Biochemistry, Government Medical College, Azamgarh, Uttar Pradesh, India.

*Corresponding author: Satish KR Yadav; Email: sunityadav60@gmail.com

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ABSTRACT

Objectives: Hypothyroidism and hyperthyroidism are two primary pathological conditions that involve thyroid glands. Thyroid dysfunction amends calcium metabolism thereby necessitating regular monitoring of calcium levels.

The aim of the study is to find the prevalence of the level of serum calcium in hypo- and hyperthyroidism patients at tertiary care hospital Kanpur.

Methods: The Department of Biochemistry carried out this research at RMCH and RC, Kanpur, for 1 year between February 2019 and January 2020. In our study, we have taken 150 patients and classified them into three groups. Each group belonging to 50 subjects in total 100 subjects were suffering from thyroid. The left 50 subjects were normal and used as control for making a better understanding of hyper- and hypothyroidism. After study there thyroid profile and calcium level from the standard method. 5 mL of fasting venous blood sample was collected from each patient. In the present study, following analyses were conducted, thyroid function test (T3, T4, and thyroid-stimulating hormone [TSH]) and serum calcium.

Result: Out of 150 samples, in the present investigation, we find that the mean age group was 20–30-year-old patients included. Which number was higher in the group 1st (hyperthyroidism.) and 2nd group patients belonging 20–30 years but our value also indicated the same number in the age group 41–50-year hypothyroidism, whereas in the control group, we took that maximum age group was 20–30 years old, while investigated hyperthyroid patients, we observed mean value of T3=1.23±0.67, T4=8.15±2.43, TSH=0.16±0.13, and calcium 11.94±0.53. During the investigation of hypothyroidism patients, we find the following values of T3=0.87±0.27, T4=7.53±2.05, TSH=50.93±55.77, and Ca=7.53±0.75.

Conclusion: In our study, we found that serum calcium is affected by the thyroid hormones. Whenever there are any thyroid hormone disturbances, alterations in the levels of serum calcium should be looked for to prevent any abnormalities from occurring.

Keywords: Hypothyroidism, Hyperthyroidism, Serum calcium.

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INTRODUCTION

Thyroid diseases are different from other diseases in terms of their ease of diagnosis, accessibility of medical treatment, and the relative visibility that even a small swelling of the thyroid offers to the treating physician. Thyroid diseases are, arguably, among the most common endocrine disorders worldwide. India too is no exception [1]. Among the 42 million people suffering from thyroid diseases in India, hypothyroidism is the most common [2]. Dysfunction and anatomic abnormalities of the thyroid are among the most common diseases of the endocrine gland. Hypothyroidism is one of the most common forms of thyroid dysfunction resulting from the deficiency of thyroid hormones or their impaired activity [3].

Hypothyroidism and hyperthyroidism are two primary pathological conditions that involve thyroid glands [4]. Hypothyroidism is the most prevalent non-curable endocrine disorder that leads to mental and physical slowing. Actually, it is the subnormal activity of the thyroid gland in which the gland is unable to produce enough thyroid hormones [5]. The mean annual incidence rate of hypothyroidism is up to 4/1000 women, 1/1000 men, and 1 in 4000 inborn. The prevalence of overt hypothyroidism increases with age [6]. Thyroidism includes disorders with various etiologies characterized by inflammation of the thyroid gland. Iodine deficiency is the most common cause of hypothyroidism worldwide [7]. Moreover, the autoimmune disease Hashimoto's thyroiditis is the most common cause in the developed world [8]. Other causes include congenital abnormalities, diseases causing transient inflammation, surgical removal or radio ablation

of the thyroid, the drugs amiodarone and lithium, amyloidosis, and sarcoidosis [9]. Clinically hypothyroidism can lead to a variety of clinical situations including electrolytes, minerals and lipid disturbances, congestive heart failure, and coma. It may also present with a variety of signs and symptoms involving major systems of the body such as endocrine, cardiovascular, central nervous system, musculoskeletal, hematological, reproductive, gastrointestinal, and dermatological [15].

Thyroid dysfunction amends calcium metabolism thereby necessitating regular monitoring of calcium levels [16]. Even though the changes in the calcium may be slight in thyroid disorders, these disturbances will be important for patients in the long run [17]. In hypothyroidism, there is a depressed turnover due to impaired mobilization of calcium into the bone leads to a decrease in the blood calcium level. In hypothyroidism, increased production of thyroid calcitonin can promote the tubular reabsorption of also favor the tubular excretion of calcium [18]. On serum calcium levels in thyroid disorders have conflicting results. Some studies have reported normal levels [19] while others have reported decreased serum calcium and levels in hypothyroidism [20]. There are three main treatment options: Radioiodine therapy, medications, and thyroid surgery. The resulting hypothyroidism is treated with synthetic thyroid hormone [28]. Medications such as beta-blockers may control the symptoms, and anti-thyroid medications such as methimazole may temporarily help people while other treatments are having effects [22,29]. In hyperthyroidism, there is poor mobilization of calcium that leads to increases in the blood calcium level, in hypothyroidism increased

production of thyroid calcitonin [30], and in hyperthyroidism decreased production of thyroid calcitonin [31].

Hence, the objectives of the current study were to evaluate the frequencies of serum calcium levels in subjects with and without hypothyroidism and hyperthyroidism to investigate their correlations with thyroid-stimulating hormone (TSH) levels to illuminate the pathophysiological consequences of hypothyroidism on the body.

METHODS

Study setting

This study will be conducted within the Department of Biochemistry, Rama Medical College Hospital and Research Center, Kanpur.

Study design

Comparative study.

Type of study

Observational study.

Period of study

12 months.

Statistical test

All the parameters of three groups (Groups I, II, and III) were analyzed for mean and standard deviation. The results were expressed as mean±standard deviation. Data were analyzed by the Statistical Package for the Social Science, statistical software version 21.0. Comparison among the three groups was done using a t-test. Pearson's correlation coefficient was used to find the correlation between TSH and serum concentration of calcium.

Study period

This study will be conducted from February 2019 to January 2020.

Size of sample

One hundred and fifty clinical samples were collected.

They were divided into three groups:

- Group I included 50 newly diagnosed and untreated cases of hyperthyroidism. The diagnosis was based on decreased serum TSH levels associated with increased serum T4 and T3 levels.
- Group II included 50 newly diagnosed and untreated cases of hypothyroidism. The diagnosis was based on increased serum TSH levels associated with decreased serum T4 and T3 levels.
- Group III included 50 healthy controls in a similar group having normal thyroid profiles.

Inclusion criteria

- Subjects between 21 and 70 years age group were considered
- Both males and females were included

- Known hypothyroid and hyperthyroid patients on analysis of thyroid hormones were considered Group I (high serum TSH and low serum T4 and T3) and Group II (low serum TSH and high serum T4 and T3) cases
- Group III included 50 healthy controls in a similar age group having normal thyroid profiles.

Exclusion criteria

The following patients were excluded from the study.

- Youngsters <21 years and elders >70 years
- Patients having a history of coronary heart disease and acute illness
- Pregnant women
- Patients having disorders that affect lipid, calcium, and magnesium metabolism (e.g., diabetes mellitus, renal failure, nephritic syndrome, pancreatitis, hepatic diseases, pituitary adenomas, bone diseases, alcoholism, etc.)
- Patients on thyroid hormone therapy
- Patients taking calcium and magnesium supplements or any lipid-lowering drug.

Ethical consideration

Ethical clearance will be accessed from the Institutional Ethical Committee.

Study tool

A pre-tested questionnaire based on semi-constructed pro forma was used as a study tool to collect the data including a basic profile of participants, i.e., age, sex, B.P, and intake of thyroid drugs, etc.

Consent

A verbal or written consent was obtained from the participants before the sample collection.

Specimen collection

5 mL of fasting venous blood sample was collected from each participant in a plain vacutainer under all aseptic conditions after explaining the procedure to the subject.

Specimen processing

The blood sample was allowed to clot at room temperature for 15 min and serum was obtained by centrifugation at 3500 rpm (rotation per minute) for 10 min in the biochemistry laboratory and stored at -20°C until assayed.

Investigations

In the present study, following analyses were conducted:

Thyroid function test

- TSH - Estimation of serum TSH was done on Tosoh AIA-360 auto analyzer by Sandwich Fluorescence Enzyme Immunoassay method [64]. The reference range of TSH: (0.34–4.25 μ IU/mL) [65]

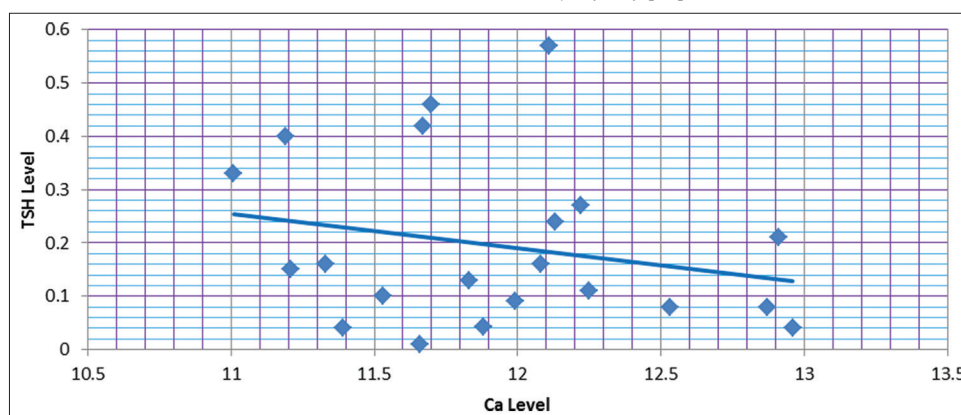


Fig. 1: Bar chart shows mean difference value of T3, T4, TSH, and Ca between hypothyroidism and normal patient

- Tetraiodothyronine or thyroxine (T4) – Estimation of serum T4 was done on Tosoh AIA-360 auto analyzer by Competitive Fluorescence Enzyme Immunoassay method [66]. The reference range of T4: (5.4-11.7 µg/dL) [65]
- Triiodothyronine (T3) – Estimation of serum T3 was done on Tosoh AIA-360 auto analyzer by Competitive Fluorescence Enzyme Immunoassay method [67]. The reference range of T3: (0.34-4.25 µIU/mL) [65]

Minerals assay-serum calcium

- Serum calcium was estimated on Erba CHEM-5 plus semi-auto analyzer by OCPC (Ortho-Cresolphthalein Complexone) method [68]. The reference range of serum calcium: (8.5-10.5 mg/dL).

RESULTS

In our study, we have taken 150 patients and classified them into three groups. Each group belonged to 50 subjects in total 100 subjects were suffering from thyroid. The left 50 subjects were normal and used as a control for making a better understanding of hyper and hypothyroidism. After study there thyroid profile and calcium levels from the standard method.

In our present investigation, we find that the mean age group was 20-30-year patients included. Which number was higher in the group 1st (hyperthyroidism.) and 2nd group patients belonging 20-30 years but our value also indicated the same number in age group 41-50 hypothyroidism. Whereas in the control group, we take that maximum age group was 20-30 years old.

While investigating hyperthyroid patients, we observed mean values of T3=1.23±0.67, T4=8.15±2.43, TSH=0.16±0.13, calcium 11.94±0.53,

Table 1: The gender and age distribution of the total subjects (cases-Group I and II and healthy individuals-Group III) included in the study

Group-I		Group-II		Group-III		
Age group	n	%	n	%	n	%
20-30	20	40.0	15	30.0	21	42.0
31-40	16	32.0	10	20.0	13	26.0
41-50	6	12.0	15	30.0	7	14.0
51-60	4	8.0	5	10.0	4	8.0
61-70	4	8.0	5	10.0	5	10.0
Total	50	100.0	50	100.0	50	100.0
Gender						
Male	13	26.0	19	38.0	13	26.0
Female	37	74.0	31	62.0	37	74.0
Total	50	100.0	50	100.0	50	100.0
Grand Total	n=150					

Table 2: Comparison of thyroid profile and calcium level between controls and hyperthyroidism patients

S.No	Parameter	Controls (Mean±SD)	Hyperthyroidism (Mean±SD)	p-value	t-test
1	T3	1.39±0.67	1.23±0.67	<0.224	1.22
2	T4	8.69±2.88	8.15±2.43	<0.318	1.00
3	TSH	2.32±1.22	0.16±0.13	<0.0001	12.38
4	Calcium	9.48±0.70	11.94±0.53	<0.0001	19.64

T3: Triiodothyronine, T4: Thyroxine, TSH: Thyroid-stimulating hormone, P<0.05, considered statistically significant. P<0.001, considered highly significant

Table 3: Comparison of study variables in controls and patients with hypothyroidism

S.No	Parameter	Controls (Mean±SD)	Hypothyroidism (Mean±SD)	p-value	t-test
1	T3	1.39±0.67	0.87±0.27	<0.0001	5.09
2	T4	8.69±2.88	7.53±2.05	<0.0228	2.31
3	TSH	2.32±1.22	50.93±55.77	<0.0001	6.16
4	Calcium	9.48±0.70	7.53±0.75	<0.0001	13.30

T3: Triiodothyronine, T4: Thyroxine, TSH: Thyroid stimulating hormone, P<0.05, considered statistically significant. P<0.001, considered highly significant

and their control, "p" value and t-test, respectively, given in Table 2. Table 2 also shows the mean difference and this value is compared to the control value also.

During the investigation of hypothyroidism patients, we find the following values of T3=0.87±0.27, T4=7.53±2.05, TSH=50.93±55.77, and Ca=7.53±0.75, given in Table 3. Respectively value of the control group was also given in Table 2 while comparing the control and case group of each value, we calculated the "p" value and t-test value given in Table 3.

DISCUSSION

Hypothyroidism T3

In the present study, we studied 150 subjects, 50 belonged to normal (control), and the rest 100 belonged to hyper and hypothyroidism. In patients belonging to hypothyroidism, we found that the T3 value was 0.87±0.27. Our study was similar with Modi and Sahi [24], in his observation, he found T3 value was 0.4±0.02. It was also resemblance with Mendez *et al.* [25] whose investigating value was 0.97±0.37 which was very close to our investigation. However, the study conflicted with Sridevi *et al.* [26] and Dubey *et al.* [27] whose finding was T3=1.09±0.35 and 1.39±0.22, respectively, which was high value from our investigation.

Hypothyroidism T4

In our investigation, the observed mean value of T4 was 7.53±2.05 which was near to Modi and Sahi [24] report for T4 value was 2.7±0.59. Another study by Dubey *et al.* [27] whose finding value was 1.98±0.46. Respectively, it was similar with Sridevi *et al.* [26] and their study value was 2.549±1.25 which was almost similar with us. Mendez *et al.* [25] investigation report for T4 5.53±2.9 which was near our value. However, I was dissimilar with Bharti *et al.* [28] whose investigation report tells that the mean T4 value was 85.99±13.09 which is very high compared to our case study.

Hypothyroidism TSH

In the present investigation observed, mean value of TSH was 50.93±55.77 which was similar with Mendez *et al.* investigation report suggested that TSH value was 31.51±36.3. Another observation conflicted with Modi and Sahi [24] whose investigation value of TSH was 6.1±1.6. This value was very low compared to our study. Lalithamma *et al.* [29] whose value was 7.80±2.64, which was very low compared to our study by Dubey *et al.* [27] whose study report suggested that the TSH value was 11.03±3.04 which was still very low compared to our study 13.87±9.78.

Hyperthyroidism T3

In our present observation on hyperthyroidism 50 our finding values for T3. In the present study, we observed 150 subjects, 50 belonged to normal (control), and the rest 100 belonged to hyper

and hypothyroidism. In patients belonging to hyperthyroidism, we found that the T3 value was 0.87 ± 0.27 . Our study was similar with Mendez *et al.* [25] and the investigation report T3 was 1.69 ± 0.7 . The study was also consistent with Shivallela *et al.* [30] finding and the T4 value was 2.7 ± 0.13 . However, conflicts with Modi and Sahi [24] whose observational value of T3 in hyperthyroidism was 3.1 ± 0.15 . It was also mismatched with the study of Bharti *et al.* [28]; his investigation report was 4.15 ± 2 of T3.

Hyperthyroidism in T4

The study was inconsistent with Modi and Sahi [24]; their report value was 15.3 ± 1.1 . Furthermore, conflicted with Mendez *et al.* [25] and the value was 14.07 ± 3.4 also conflicted with Shivallela *et al.* [30] whose investigation value was 13.9 ± 0.08 . However, while comparing Bharti *et al.* [28] study, they find an absolute very high value of T4 114.17 ± 24.14 .

Hyperthyroidism in TSH

In our present investigation finding, the TSH value in hyperthyroidism was 0.16 ± 0.13 ; it was similar with Mendez *et al.* [25] and their finding for TSH was 0.45 ± 2.3 . Furthermore, with Modi and Sahi [24] finding, 0.19 ± 0.13 was very near to our study. Modi and Sahi [24] investigation is also similar with our finding of 0.09 ± 0.03 . Furthermore, Bharti *et al.* [28] finding was 0.16 ± 0.09 which was very similar with us. Shivallela *et al.* [30] finding was also similar with us which was 0.03 ± 0.56 due to the lack of literature; we do not find any study report having any conflict with our finding.

Serum calcium level in hyperthyroidism

In investigation, we found Ca 11.94 ± 0.53 in hyperthyroidism patients. Our investigation is also similar with Mendez *et al.* [25] whose finding was 9.12 ± 1.79 . Furthermore, similar with Modi and Sahi [24] whose value was 12.7 ± 0.89 . Shivallela *et al.* [30] investigation finding was 10.02 ± 0.87 and these values were similar with our study. The study was not conflicted with Shivallela *et al.* [30] whose finding was 10.02 ± 0.87 . Elgassim *et al.* [31] whose value was 11.67 ± 1.42 and it was similar with our finding. Suneel *et al.* [32] found 12.46 ± 0.38 which was similar with us.

Bharti *et al.* [28] finding was 8.78 ± 0.47 which conflicted with our value.

Serum calcium level in hypothyroidism

Our finding value of calcium in hypothyroidism patients was 7.53 ± 0.75 which was similar with Mendez *et al.* finding that was 8.69 ± 2.0 . Furthermore, similar with Modi and Sahi [24] whose work report suggested that the value was 6.9 ± 0.93 . The finding of Bharti *et al.* [28] value was 8.78 ± 0.47 and this value was near to our finding. However, during studying of Shivallela *et al.* [30], the mean finding value was 10.02 ± 0.87 . Suneel *et al.* study also conflicted that with our study, his finding was 12.46 ± 2.38 which was very high compared to our study.

CONCLUSIONS

In our study, we found that serum calcium is affected by thyroid hormones. Whenever there are any thyroid hormone disturbances, alterations in the levels of serum calcium should be looked for to prevent any abnormalities from occurring. This study suggests that hypothyroid and hyperthyroid patients should be regularly checked for serum calcium. Early detection and treatment can prevent further complications related to the disorder and will be helpful during the management of thyroid patients. This study concludes that there is an association between serum calcium levels and thyroid function, which may be relevant in marked cases of hypo- or hyperthyroidism. Hence, it is better to estimate the levels of serum calcium in all thyroid disorders. However, this will have to be correlated with the duration and severity of thyroid disorders. Further studies are required, where direct estimation of ionic calcium by ion.

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