



IMPACT OF SUBCLINICAL HYPOTHYROIDISM ON HEMATOLOGICAL PARAMETERS LIKE HEMOGLOBIN AND RED BLOOD CELLS.

Biochemistry

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ABSTRACT

Background: Thyroid hormones perform cardinal role in every steps of erythropoiesis. These hormones motivates the growth of colonies like erythroid burst forming units (BFU-e) and colony forming units (CFU-e) and Repletion of the Hypoxia Inducible Factor 1 is escalated by these hormones of the thyroid gland. They enhance erythropoiesis and they do so by increasing the rate of proliferation of erythroid progenitors (immature) and they also increase erythropoietin secretion by inducing gene expression of erythropoietin. The compactness of erythrocyte 2, 3-Diphospho glycerate also steps up by hormones of the thyroid gland and as the result of which the rate of oxygen delivery increases to every tissues of body. Thus, if there is reduction in the levels of the thyroid hormones, erythropoiesis is affected, leading to changes in RBC count and hemoglobin.

Material and Method: This is a cross sectional study conducted in department of biochemistry which includes 50 newly diagnosed, untreated hypothyroid subjects and 50 healthy euthyroid subjects. The period of this study is from December 2016 to September 2017. The hematological parameters like hemoglobin, RBC count and TSH levels were analyzed by appropriate biochemical tests and statistical software.

Result: It was found in our study that subjects having hypothyroidism had mean Hb level 9.40 gm/dl and mean RBC count as 3.5 millions/cu mm, compared to normal control group having mean Hb 12.41 gm/dl and 4.49 millions/cu mm respectively. Statistically significant difference was obtained between both these study groups with p value <0.001.

Conclusion: Subjects with hypothyroidism have lower levels of hemoglobin and RBC count compared to normal subjects. This is because, hypothyroidism is associated with decreased erythropoiesis, leading to anemia and should be managed to prevent it.

KEYWORDS

Hypothyroidism, Red blood cells, Hemoglobin

Introduction

Thyroid hormones are indispensable for the metabolic balance of every tissues, they are important for proper physiological functions. They are also involved in normal development of body. The most common endocrine disease is thyroid gland disease.¹The commonest functional disorder of the thyroid gland is hypothyroidism and it is due to deficiency of thyroid hormones in our body. The clinical manifestations of it are extremely variable. The manifestations depend on age at onset, severity and duration of thyroid hormone deficiency.²Metabolic abnormalities like anemia, hyperlipidemia, reversible increase in creatinine, dilutional hyponatremia etc. are associated with hypothyroidism.³The rate of prevalence of anemia has been found 20-60% in hypothyroidism. Hemoglobin synthesis in adults and maturation of hemoglobin in fetus require thyroid hormones and they affect hematopoietic process also. Anemia has been shown to occur by slowing down the oxygen process in tissues.¹In Anemia either there is a decrease in number of red blood cells or decrease in the quantity of hemoglobin require normally in the blood. Anemia can be due to several reasons like there may be reduction of the half life time of red cells,⁴ or patients may have abnormality of the formation of the red cells.⁵

Thyroid gland has important effect on erythropoiesis. The thyroid hormones induce secretion of erythropoietin and they enhance erythropoiesis by means of proliferating erythroid progenitors.^{6,7} Thyroid hormones perform cardinal role in every steps of erythropoiesis. These hormones motivates the growth of colonies like erythroid burst forming units (BFU-e) and colony forming units (CFU-e) and Repletion of the Hypoxia Inducible Factor 1 is escalated by these hormones of the thyroid gland. They enhance erythropoiesis and they do so by increasing the rate of proliferation of erythroid progenitors (immature) and they also increase erythropoietin secretion by inducing gene expression of erythropoietin. The compactness of erythrocyte 2, 3-Diphospho glycerate also steps up by hormones of the thyroid gland and as the result of which the rate of oxygen delivery increases to every tissues of body.⁸Hence, if there is reduction in the levels of the thyroid hormones; erythropoiesis is affected, leading to changes in RBC count and hemoglobin. So the study aims to analyze the effects of hypothyroidism on parameters like red cells and hemoglobin.

Material and Method

This cross sectional-hospital based study was conducted at the clinical

biochemistry and hematology research laboratory of Sheth Vadilal Sarabhai General Hospital and Sheth Chinai Maternity Hospital and Smt. N.H.L. Municipal medical college, Ellisbridge, Ahmedabad. The study was approved by the ethical committee of the institute and informed consents were obtained from patients. The study was conducted during the period from December 2016 to September 2017. Detailed history of patients was taken to rule out other causes of low hemoglobin.

Exclusion criteria

Patients with known cases of following conditions were excluded from study.

Diabetes mellitus, cerebrovascular diseases, pregnancy, asthma, known psychological illnesses, chronic renal failure, patients on previous thyroxin therapy. Also patients having other causes of reduced hemoglobin level like dietary deficiencies, low iron level etc. were not included in the study.

Inclusion criteria

Hypothyroid patients and normal patients

Sample collection

This is a cross sectional study conducted in department of biochemistry which includes 50 newly diagnosed, untreated hypothyroid subjects and 50 healthy euthyroid subjects. Two vacuainers were used for collection of blood samples – plain vacuainers for thyroid profile, EDTA (K3 EDTA anticoagulated) vacuainers for complete blood count also called CBC. All the samples were collected with aseptic blood collection techniques by use of sterile gloves and through disinfection of venipuncture site with 70% ethyl alcohol. All the samples were collected in sitting position. Samples were centrifuged within one hour at 1500 rpm for 15 minutes. These would be processed to obtain serum for thyroid profile. Estimation of TSH was carried out on fully automated ARCHITECT ABBOTT i-1000. Estimation of complete blood count was carried out on CELL DYN RUBY ABBOTT five part auto analyzer.

During the course of the study there was no change in equipment, reagent, Calibration standard and controls. Before starting the analysis the instruments were calibrated using calibrators and the controls and they were checked at different concentrations of the analytes. The hematological parameters like hemoglobin, RBC count and TSH

levels were analyzed by appropriate biochemical tests and statistical software.

Thyroid hormone profile:

Blood samples were taken in plain vacutainers containing clot activator and samples were centrifuged for separating serum. Serum was taken in aliquot prior to analysis. All hemolysed and lipemic samples were eliminated during procedures. The samples were analyzed in instrument along with controls. Thyroid function test (TFT) was executed by Chemiluminescence Immunoassay method also known as CLIA Method using fully automated analyzer ABBOTT ARCHITECT i-1000.

Measurement of Hematological parameters:

Assessments of hematological parameters were done from samples collected in EDTA vials. These samples were also run in batch and controls were run with each batch. Whole blood was properly mixed prior to process. The estimation of hematological parameter was carried out on ABBOTT CELL DYN RUBY five part auto analyzer.

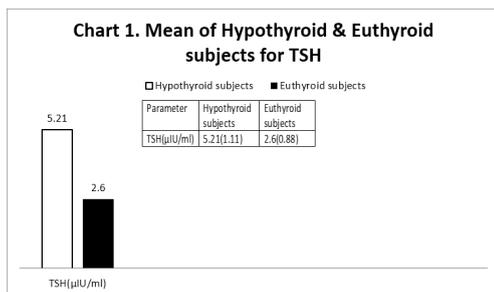
Statistical technique:

Microsoft Excel[®] and IBM, SPSS 20, SPSS Inc., 233 South Wacker Drive, 11th Floor, Chicago, IL 60606-6412, USA for Windows[®] were used for data storage and analysis.

The quantitative data were expressed as mean ± standard deviation and statistical test Student's t-test was used to determine statistical difference between variables.

Results

In our study we have enrolled 50 newly diagnosed, untreated hypothyroid subjects and 50 healthy euthyroid subjects that have normal thyroid profile and hematological parameters during investigations.

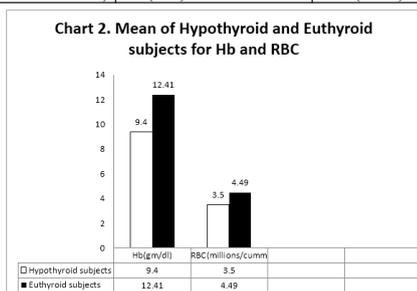


It was found in our study that patients having hypothyroidism had mean TSH level 5.21µIU/ml compared to euthyroid subjects having mean TSH level 2.6 µIU/ml.(Chart 1) Statistically significant difference was obtained between both these study groups with p value <0.001.

It was also found in our study that subjects having hypothyroidism had mean Hb level 9.40 gm/dl and mean RBC count as 3.5 millions/cu mm, compared to normal group having mean Hb 12.41 gm/dl and 4.49 millions/cu mm respectively.(Table 1,Chart 2) Statistically significant difference was obtained between both these study groups with p value <0.001.

Table 1. Showing Mean(SD) of Hb and RBC in hypothyroid and Euthyroid subjects

	Mean(SD)	
Parameter	Hypothyroid subjects	Euthyroid subjects
Hb(gm/dl)	9.40(1.95)	12.41(1.41)
RBC(millions/cumm)	3.5(0.9)	4.49(0.85)



Discussion

Thyroid gland is an endocrine gland in body. Thyroid gland produces three most important hormones in our body Triiodothyronine(T3) , tetraiodothyronine(T4) also called thyroxine and calcitonin. T3 and T4 hormones are iodinated tyrosine derivative and are required for many important functions like gene expression, tissue differentiation, general development, cellular metabolism and reproductive functions.

Through inducing the secretion of erythropoietin, the thyroid gland has critical effect on the process of erythropoiesis. The thyroid hormones are expected to raise the proliferation rate of erythroid progenitors.⁸ The most common thyroid dysfunction, hypothyroidism affects the blood cells like red cells and causes anemia with different severity.

Hypothyroidism can lead to wide variety of anemic disorders. Thyroid hormones are extremely important in synthesis of hemoglobin in adults and also in maturation of hemoglobin in fetus. They affect hematopoietic process also and in hypothyroidism the slowing of oxygen process would be one cause of anemia.⁹⁻¹¹ Reduced erythrocyte mass has been found in patients having hypothyroidism due to reduction of plasma volume.¹² It is due to their important effect on erythropoiesis. They induce the erythropoietin gene expression in order to increase its secretion in body. In hypothyroidism, this picture is affected and there will be decreased secretion of erythropoietin. Erythroid cells are depleted in hypothyroidism. Plasma erythropoietin levels are reduced and also shows reduced proliferative activity. These changes in erythropoiesis in the hypothyroidism appear to be a part of physiological adjustment to the reduced oxygen requirement of the tissues in body due to diminished basal metabolic rate.¹³

The growth of erythroid colonies are directly or indirectly being stimulated by hormones of thyroid gland through erythropoietin.¹⁴ Normocytic anemia is frequently seen in patients of hypothyroidism. In absence of thyroid hormones, there is reduction in distribution of oxygen to different tissues. Lack of stimulation of erythroid colony development by thyroid hormones, diminution of erythropoietin level leads to normocytic anemia.¹⁵ Hematocrit, mean corpuscular hemoglobin, white blood cells count, mean corpuscular volume, platelet counts are other hematological parameters which might change in dysfunction of the thyroid gland.^{16,17}

Thyroid hormones have a significant influence on erythropoiesis. So various forms of anemia like normocytic, hypochromic-microcytic or macrocytic have been associated with declines in thyroid function of body.¹⁸

Thyroid hormones enhance the repletion of Hypoxia Inducible Factor1 and motivate the growth of erythroid colonies. They intensify the compactness of erythrocytes which enhances the rate of the delivery of oxygen to most of the tissues of the body. In patients of hypothyroidism these functions are depressed and they affect proper functioning of erythrocytes. So this study was aimed to evaluate the effects of hypothyroidism on parameters like red cells and hemoglobin.

In this cross sectional study, we obtained data after evaluating 50 hypothyroid patients with 50 euthyroid subjects. According to our obtained data, there was difference between two groups. The mean Hb level was 9.40 gm/dl which was low as compared to control. The P value was <0.001 which was statistically significant. We also found the mean RBC count was 3.5 millions/cu mm which was also low. P value of which was <0.001 which was also significant. Comparison of hypothyroid patients with euthyroid subjects revealed significant difference in Hemoglobin and Red blood cell count.

Kawa MP, Grymůła K, Paczkowska E et al in 2010 described in their study that they detected significantly decreased levels of RBCs in hypothyroid patients and similarly low Hb concentrations were recorded, which clinically indicates anemia. In the same notion, we determined that these patients presented a hypochromic state of RBCs.¹⁹

Omar S, HadjTaeib Sand et al done study including 177 hypothyroid patients which reports that thyroid disorders are many times associated with erythrocyte abnormalities including normocytic anemia in hypothyroidism.²⁰

Our suggestion for those people with thyroid disease is that they should undergo routine screening of hematological, biochemical and hormonal profile assay. We also suggest simultaneous proper management of this metabolic disease. It is recommended to conduct

further studies with large number of cases to amend the existing problems.

Conclusion

Subjects with hypothyroidism have lower levels of hemoglobin and RBC count compared to normal subjects. This is because, hypothyroidism is associated with decreased erythropoiesis, leading to anemia and should be managed to prevent it.

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