Variations in Hematological Indices in Patients with Thyroid Dysfunction

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ABSTRACT

Introduction: Thyroid hormones influence the haematological indices under physiological conditions. The exact cause of anemia in thyroid dysfunction is not clearly understood. The aim of this study was to investigate the changes in the haematological parameters in hypothyroidism, subclinical hypothyroidism and hyperthyroidism and the mechanisms underlying it.

Material and methods: The study was performed on 69 cases of clinical hypothyroidism, 15 cases of clinical hyperthyroidism, 6 cases of subclinical hypothyroidism and 99 healthy individuals selected as the control group. Patients were grouped as hypothyroid and hyperthyroid based on the TSH measurements (0.3-5.5µIU/mL) by Chemiluminescence method. Based on TSH levels (<0.3µIU/mL), patients were categorized as hyperthyroidism and TSH levels (>5.5µIU/mL) as hypothyroidism. Hemoglobin and complete blood count which includes PCV, MCV, MCH, MCHC, RDW were estimated. The results were analysed by SPSS software.

Results: Analysis of the data obtained showed statistically significant difference ($p<0.05$) in Hb, PCV, RDW between thyroid cases and controls. The difference was not significant ($p>0.05$) for MCV, MCH and MCHC.

Conclusion: Thyroid hormones have to be evaluated in cases of refractory anemia not responding to iron supplementation.

Keywords: Anemia; Hypothyroidism; Hyperthyroidism; RBC Indices

INTRODUCTION

Thyroid hormones are essential for normal growth, tissue differentiation and metabolism. The thyroid gland produces hormones namely triiodothyronine (T3), tetraiodothyronine or thyroxine (T4). Diseases affecting the thyroid gland are seen particularly in women affecting 3% to 5% of the general population. Thyroid hormones stimulate the basal metabolic rate. They enhance the synthesis of proteins. Thyroid hormones promote the intestinal absorption of glucose, increases glycogenolysis and gluconeogenesis with an effect of increasing the glucose levels in the blood leading to hyperglycemia. They counter act the actions of insulin. Thyroxine produces lipolysis and increases the turnover of lipids.[1]

They regulate hematopoiesis in the bone marrow. They are involved in the production of haemoglobin in adults and maturation of haemoglobin in the fetus.[2] Disorders in the thyroid hormone synthesis are accompanied by the abnormalities in the red blood cells. They increase erythropoiesis by causing the proliferation of erythroid progenitor cells. They increase the secretion of erythropoietin (EPO) by regulating the erythropoietin gene expression and secretion of erythropoietin by the kidneys. L-triiodothyronine stimulates the erythroid burst formation by normal human bone marrow cells.They enhance the growth of erythroid colonies (BFU-E, CFU-E) and increases 2,3 BPG levels leading to delivery of oxygen to the tissues.

Disorders affecting the thyroid gland namely hypothyroidism causes hypoplasia of erythroid cells in the marrow or proliferation of immature erythroid progenitor cells whereas hyperthyroidism leads to hyperplasia. In general thyroid disorders can lead to different effects on blood cell lineages.[3,4,5]

Hypothyroidism leads to decreased erythropoietin levels in the plasma. Hypothyroidism causes macrocytic hypochromic anemia by decreasing the oxygen metabolism. Microcytic anemia also occurs due to iron deficiency or loss of blood and macrocytic anemia due to malabsorption of Vitamin B12 and folate.[6]

On the other hand, anemia is not a frequent finding of hyperthyroidism which can manifest as erythrocytosis. Anemia in hyperthyroidism can be due to altered iron metabolism, oxidative stress and hemolysis due to increased osmotic fragility. The association of grave's disease and anemia was discovered by charcot in 1881.[7,8] There is limited data available on the association of subclinical hypothyroidism and anemia. Incidence of anemia in the subclinical hypothyroidism and euthyroidism are the same.[9] Hypothyroidism can result in reduced erythrocyte mass whereas hyperthyroidism leads to increased erythrocyte mass.

In autoimmune thyroid disorders, anemia can be due to comorbid conditions like pernicious anemia, atrophic gastritis, celiac disease and autoimmune haemolytic syndrome.[10] Iron deficiency anemia leads to reduced thyroid peroxidase activity which is involved in the synthesis of

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thyroid hormone.[11] Changes in the haematological parameters such as Hemoglobin (Hb), Packed cell volume (PCV), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin concentration (MCHC), Red cell distribution width (RDW) has been observed in thyroid disorders. Immunological mechanisms has been found to decrease the lifespan of red blood cells.[12]

Hence evaluation of haematological indices in cases of thyroid dysfunction is mandatory for the management of patients with refractory anemia.

MATERIAL AND METHODS

This cross sectional study was conducted on 69 cases of hypothyroidism, 15 cases of hyperthyroidism and 6 cases of subclinical hypothyroidism. 99 Age and sex matched control group comprising of healthy individuals without any thyroid dysfunction or disorders that may alter the haematological indices were selected. All the patients referred to laboratory after applying the inclusion and exclusion criteria in the year 2018 were enrolled in the study. Informed consent was obtained from all the study participants. Institutional ethical committee approval was obtained.

Two blood samples were collected from all the study participants. Whole blood EDTA sample was collected for determining complete blood count which includes Hb, PCV, MCV, MCHC, RDW which were analysed on cell counter. Serum samples were collected for the estimation of T3, T4, TSH by chemiluminescence method.

STATISTICAL ANALYSIS

Statistical analysis was performed by SPSS software. Results were reported as Mean ± Standard deviation for quantitative variables. Statistical Independent T test was used to evaluate the significance of differences between two groups. P value <0.05 was considered as a statistically significant change.

RESULTS

In the 69 patients with hypothyroidism, mean age was 37.4 years and in hyperthyroid 35.6 years, in subclinical hypothyroid 44.5 years and controls 42.9 years (Table 1).Comparison of RBC indices between control and hypothyroid showed statistically significant difference in

Cases/Controls	Number	Age (mean)	Max (Year)	Min (Year)	Male (%)	Female (%)	TSH µIU/ml (mean)	T3 ng/ml (mean)	T4 µg/dL (mean)
Hypothyroidism	69	38.5	78	12	15	85	4.93	1.10	1.13
Subclinical hypothyroidism	6	46.2	55	30	0	100	5.63	0.98	6.2
Hyperthyroidism	15	35.6	70	18	27	73	0.12	1.68	11.93
Control	99	42.9	66	18	29	71	2.7	0.9	6.8

Table-1: Descriptive analysis of cases with hypothyroidism, subclinical hypothyroidism, hyperthyroidism and healthy controls

Index		Number of patients	Mean	Standard deviation	pValue
Hb (g/dL)	Hypothyroidism	69	11.5	1.36	0.000
	Subclinical hypothyroidism	6	11.3	1.23	0.017
	Hyperthyroidism	15	12.4	1.32	0.210
	Control	99	12.9	1.17	
PCV (%)	Hypothyroidism	69	35.6	3.61	0.000
	Subclinical hypothyroidism	6	35.5	3.5	0.005
	Hyperthyroidism	15	37.6	3.2	0.210
	Control	99		2.7	
MCV(fl)	Hypothyroidism	69	86.2	9.23	0.760
	Subclinical hypothyroidism	6	83.3	7.89	0.247
	Hyperthyroidism	15	81.3	8.63	0.004
	Control	99	86.6	7.8	
MCH (pg)	Hypothyroidism	69	28.5	2.9	0.811
	Subclinical hypothyroidism	6	28.2	2.2	0.712
	Hyperthyroidism	15	26.9	2.7	0.019
	Control	99	28.6	2.4	
MCHC(g/dl)	Hypothyroidism	69	33.1	1.4	0.729
	Subclinical hypothyroidism	6	33.9	1.6	0.011
	Hyperthyroidism	15	33.0	1.7	0.881
	Control	99	32.9	1.3	
RDW%	Hypothyroidism	69	13.2	1.23	0.001
	Subclinical hypothyroidism	6	12.8	1.4	0.521
	Hyperthyroidism	15	13.2	1.36	0.111
	Control	99	12.5	1.27	

Table-2: Comparison of Hb and red blood cell indices between hypothyroidism, subclinical hypothyroidism, hyperthyroidism and healthy controls

Hb, PCV and RDW. Comparison of RBC indices between control and hyperthyroid showed statistically significant difference in MCV and MCH.Comparison between control and sub clinical hypothyroid showed statistically significant difference in Hb, PCV, MCHC (Table 2).

DISCUSSION

Thyroid gland is an important endocrine gland in our body which is required for normal growth, development, regulates carbohydrate metabolism, protein synthesis, lipid metabolism. It also regulates hematopoiesis in our body.

Disorders affecting the thyroid gland such as hypothyroidism, subclinical hypothyroidism, hyperthyroidism leads to anemia of varied severity and types. Hypothyroidism is known to cause thrombocytopenia, leukopenia, pancytopenia and also affect blood indices like PCV, MCV, MCHC, RDW and Hb.

This study was done to evaluate the effects of thyroid dysfunction on red blood cell indices. According to the results obtained, there was statistically significant difference between hypothyroid cases and controls ($p<0.05$) with respect to Hb, PCV and RDW. There was no statistically significant difference in MCV, MCHC. In hyperthyroid cases, statistically significant difference was observed in MCV and MCHC. In subclinical hypothyroid cases, statistically significant difference was observed in Hb, PCV and MCHC.

In a study done by Dorgalaleh et al., there was statistically significant difference between hypothyroid and hyperthyroid cases in Hb, PCV, MCV, MCHC but not RDW.[13] In a study done by Geetha J and Srikrishna R in 2012, there was statistically significant difference in RDW and MCV but not in other indices.[14]

Kawa MP et al in 2010 stated that RBC, Hb, PCV were increased in cases of hyperthyroidism while RBC, Hb was decreased and PCV increased. MCV was increased in both groups whereas MCH, MCHC was decreased.[4]

Carmen S.P Lima et al reported their findings in four cases of grave's disease with pancytopenia. They concluded that thyroid evaluation is needed to rule out the causes of pancytopenia.[15]

In accordance to the results obtained in this study, it is necessary to investigate the RBC indices in thyroid dysfunction to know the cause of anemia in cases refractory to treatment. Similar studies have to be carried out with more number of sample size.

CONCLUSION

Thyroid dysfunctions influence the red blood cell indices and Hb as well. Investigating all the RBC indices in cases of thyroid disorders helps in the management of anemia associated with thyroid disorders which are refractory to treatment with iron supplementation.

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