



ORIGINAL ARTICLE

Impact of thyroid dysfunction on red cell indices in a Sahiwal Teaching Hospital, Sahiwal.

Amna Arooj¹, Maryam Rafiq², Yasmeen Batool³, Qurat Ul Ain Tahir⁴, Fariha Muzammil⁵

Article Citation: Arooj A, Rafiq M, Batool Y, Qurat Ul Ain Tahir, Muzammil F. Impact of thyroid dysfunction on red cell indices in a Sahiwal Teaching Hospital, Sahiwal. Professional Med J 2022; 29(8):1157-1161. <https://doi.org/10.29309/TPMJ/2022.29.08.6961>

ABSTRACT... Objective: To see the impact of abnormal secretion of thyroid hormones on red cell indices in patients of thyroid disorders. **Study Design:** Descriptive Cross Sectional study. **Setting:** Department of Pathology, Sahiwal Teaching Hospital, Sahiwal. **Period:** September 2020 to March 2021. **Material & Methods:** Two hundred and thirty four (234) patients of thyroid disorders were enrolled in total, out of which 44 were hyperthyroid, 102 were euthyroid and 88 were hypothyroid. Patients of both genders with age limit of 20-60 years were included. Blood samples for CBC and serum TSH were analysed. SPSS 20 was used to analyse data. To analyze significance among various groups of thyroid dysfunction, we applied an independent t-test. **Results:** The comparison of hyperthyroid and euthyroid groups, showed a statistically significant difference in the RBC count ($p=0.043$) and hematocrit ($p=0.032$). Between hyperthyroid and hypothyroid groups a statistically significant difference was also noted in the mean hemoglobin ($p=0.036$) and hematocrit ($p=0.022$). Comparison of hypothyroid and euthyroid groups remained statistically non-significant for any of the hematological parameters. **Conclusion:** A fluctuation in hematological indices is seen due to interrelation between erythropoiesis and thyroid dysfunction, therefore in patients with thyroid disorders, monitoring of hematological parameters should be done.

Key words: Erythropoiesis, Euthyroid, Hematocrit, Hyperthyroid, Hypothyroid, Mean Corpuscular Volume, Red Cell Indices, Thyroid Stimulating Hormone.

INTRODUCTION

Thyroid Hormones secreted by thyroid gland, acts on most of the cells of the body and helps in regulation of metabolic rate and synthesis of various proteins. Anemia is often seen in patients of thyroid disorders as red blood cell production is modulated by thyroid hormones. Triiodothyronine (T₃) and tetraiodothyronine (T₄), are the hormones secreted by the follicular epithelial cells of the thyroid gland that modulate many functions of the body. The anterior Pituitary gland secretes Thyroid Stimulating Hormone (TSH), that regulates the secretion of T₃ and T₄ by thyroid gland. These hormones affects almost all the organ systems including growth and development mainly by the interaction of active form of T₃ i.e. free T₃ to specified parts of nuclear receptor (thyroid receptor alpha and thyroid receptor beta).^{1,2}

There is a positive correlation between thyroid dysfunction and hematological parameters³, as thyroid hormones plays a role in hematopoiesis in the bone marrow. The genes encoding proteins necessary for mature red blood cells are turned on during the differentiation of mature red blood cells from bone marrow stem cells. Induction of erythropoietin genetic appearance leads to increased production of immature erythroid precursors and enhanced secretion of erythropoietin (EPO). 2,3-Diphosphoglycerate is increased by thyroid hormones, which raises the oxygen capacity, thus enhancing its delivery to tissues.³ Among thyroid disorders, frequency of hypothyroidism is being 2-5% cases annually^{4,5}, making it the most prevalent thyroid disorder; Prevalence of anemia in hypothyroidism is 20-60%.⁶ In hypothyroidism, anemia can be normocytic normochromic or can be macrocytic

1. MBBS, FCPS (Hematology), Assistant Professor Pathology, Sahiwal Medical College, Sahiwal.
2. MBBS, FCPS (Chemical Pathology), Assistant Professor Chemical Pathology, Sahiwal Medical College, Sahiwal.
3. MBBS, FCPS (Hematology), Assistant Professor Pathology, Nishtar Medical University, Multan.
4. MBBS, FCPS (Histopathology), Assistant Professor Pathology, Sahiwal Medical College, Sahiwal.
5. MBBS, M.Phil (Biochemistry), Assistant Professor Biochemistry, Sahiwal Medical College, Sahiwal.

Correspondence Address:
Dr. Amna Arooj
Department of Pathology
Sahiwal Medical College, Sahiwal, Pakistan.
amnaarooj84@gmail.com

Article received on: 03/01/2022
Accepted for publication: 09/03/2022

and hypochromic that is moderate in severity.

There is also a possibility of hyperproliferation of immature erythroid progenitors. In hyperthyroidism, erythrocytosis is common instead of anemia.³ A decrease in other cell lines has been also seen in hypothyroidism, like low WBC count, neutropenia and thrombocytopenia. While in hyperthyroidism, WBC count is either increased, normal or slightly decreased. So, in hyperthyroidism, hyperplasia of all myeloid lineages is observed and in hypothyroidism, hypoplasia of all myeloid lineages is seen.⁷ Our aim of this study was to assess the effects of thyroid dysfunction on red cell indices in a patients of Sahiwal Teaching Hospital, Sahiwal. The rationale of our study is prompt management of hematological complications in patients of thyroid disorders.

MATERIAL & METHODS

This descriptive cross sectional study, conducted at the Sahiwal Teaching Hospital, Sahiwal, from September 2020 to March 2021. Permission granted from institutional ethical review committee (53/SLMC/SWL). We excluded the possible confounders of study like patients having liver diseases and alcoholism. Data was taken only patients with confirmed thyroid dysfunction. Our sample size was 234 patients in total. Initially we measured TSH level of patients by Beckman Coulter Access2 Immunoassay Analyzer by Chemiluminescence micro particle immunoassay technique.

Normal reference range for thyroid stimulating hormone (TSH) is 0.4 – 4.0 $\mu\text{IU/mL}$ in adults.⁸ Based on this reference range, Patients were divided into three groups; hypothyroid (TSH >4.0 $\mu\text{IU/mL}$), hyperthyroid (TSH <0.40 $\mu\text{IU/mL}$) and euthyroid (0.40-4.0 $\mu\text{IU/mL}$). Age range of subjects were from 20-60 years. CBC results for these patients was also analyzed by Swelab Alpha CBC analyser to assess the haematological parameters and comparison was made among different age groups and genders.

SPSS version 20 software was used for Statistical analysis. For measurable variables,

Mean \pm standard deviation (SD) were taken and for categorical variables, percentages and frequencies were taken. For substantial differences, Independent t-test was applied. P-value of <0.05 was considered as a significant value.

RESULTS

Samples of 234 patients were taken for this study that fall in the age group of 20-60 years. These patients were assorted in three groups as: hyperthyroid 19 % (n=44), euthyroid 44% (n= 102) and hypothyroid 38% (n= 88). The ratio of female was found to be high in contrast to male in all three groups. Table-I.

Comparing hyperthyroid and euthyroid group manifested a statistically significant difference in the red blood count (RBC) count ($p= 0.039$) and hematocrit ($p=0.028$) while no significant difference was seen in other hematological parameters including mean hemoglobin levels, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). Table-II.

A statistically significant difference was noted in the mean hemoglobin levels ($p=0.036$) and hematocrit ($p=0.022$) between hyperthyroid and hypothyroid groups but no significant difference was seen in RBC count, MCV, MCH and MCHC. Table-III.

None of the hematological parameters revealed statistical significance between hypothyroid and euthyroid groups. Table IV.

Hypothyroid individuals had the greatest haemoglobin levels compared to the euthyroid and hyperthyroid groups, as indicated in Figure-1. When comparing hyperthyroid and hypothyroid groups to each other and to the euthyroid group, hematocrit was the only variable that revealed a statistically significant difference. Figure-2 shows that the hypothyroid group had the greatest hematocrit relative to the hyperthyroid and euthyroid groups. Figure-3 shows that the euthyroid group had the greatest RBC count when

compared to the hypothyroid and hyperthyroid groups.

Thyroid Status	Number n	Gender		Age Mean+ SD (Years)	TSH Mean+ SD (mIU/ml)
		Male n (%)	Female n (%)		
Hyperthyroid	44	9 (20.4)	35(79.5)	36.92 + 9.9	0.11 +0.12
Euthyroid	102	23(22.5)	79(77.4)	38.21+10.9	1.75 + 0.89
Hypothyroid	88	18(20.4)	70(78.6)	39.86+ 8.8	20.89+25.7

Table-I. General characteristics of subject groups

Comparison between Hyperthyroid & Euthyroid						
Thyroid Status (n)	Hb (g/dl)	RBC (x 10 ¹² /L)	Hct (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Hyperthyroid (44)	11.68+1.97	3.89 + 0.59	34.8 + 5.9	82.1 + 8.0	25.9 + 2.8	31.7 + 1.1
Euthyroid (102)	11.81+1.95	3.81 + 0.51	35.2 + 5.8	83.1 + 8.9	27.1+ 2.4	32.0 + 1.2
p- value	0.061	0.039*	0.028*	0.791	0.816	0.693

Table-II. Comparison of hematological parameters between hyperthyroid & euthyroid group

Comparison Between Hyperthyroid & Hypothyroid						
Thyroid Status (n)	Hb (g/dl)	RBC (x 10 ¹² /L)	Hct (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Hyperthyroid (44)	11.68+1.97	3.89+ 0.59	34.8 + 5.9	82.1 + 8.0	25.9 + 2.8	31.7 + 1.1
Hypothyroid (88)	11.92+1.89	3.93+ 0.56	35.9 + 6.0	83.9 + 9.1	26.8 + 2.9	31.9 + 1.3
p- value	0.029*	0.19	0.041*	0.113	0.209	0.698

Table-III. Comparison of hematological parameters between hyperthyroid & hypothyroid group

Comparison Between Hypothyroid & Euthyroid						
Thyroid Status (n)	Hb (g/dl)	RBC (x 10 ¹² /L)	Hct (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Hypothyroid (88)	11.92+1.89	3.93+ 0.56	35.9 + 6.0	83.9 + 9.1	26.8 + 2.9	31.9 + 1.3
Euthyroid (102)	11.81+1.95	3.81+ 0.51	35.2 + 5.8	83.1 + 8.9	27.1 + 2.4	32.0 + 1.2
p- value	0.692	0.513	0.718	0.079	0.237	0.747

Table-IV. Comparison of hematological parameters between hypothyroid & euthyroid group

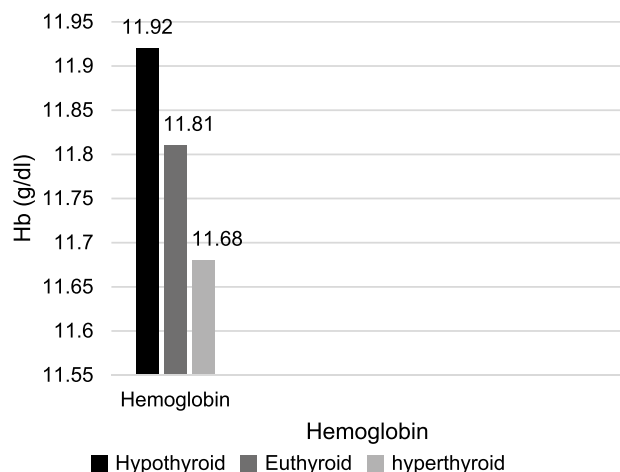


Figure-1. Hemoglobin levels

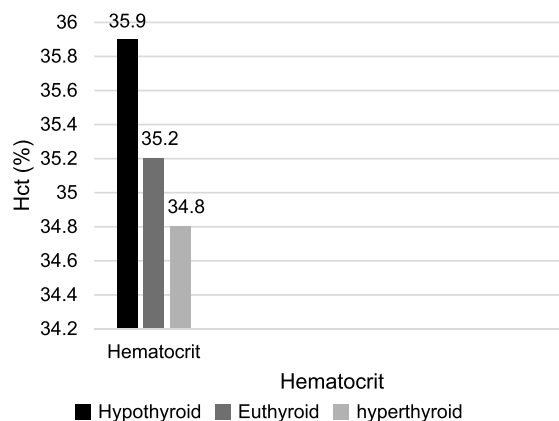


Figure-2. Hematocrit levels

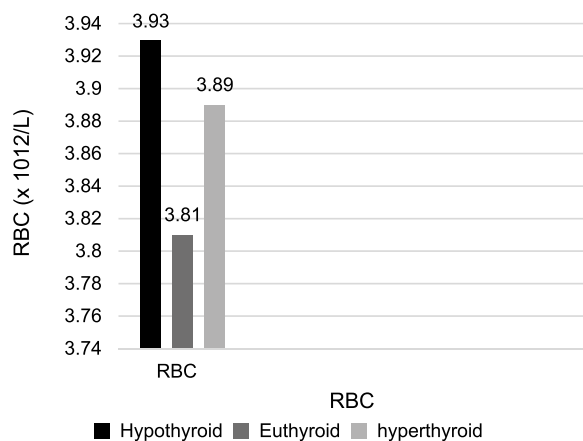


Figure-3. RBC count

DISCUSSION

Abnormal secretion of thyroid hormones cause a variety of effects on haematological parameters like raised red cell count, low Hb, decrease in WBC and platelet count. Some times decrease in all three hematopoietic cell lines (pancytopenia) is also seen because thyroid hormone is essential for development of hematopoietic cells.³

Our results showed that between hyperthyroid and euthyroid patients, the RBC count and Hct were statistically significant (p -value < 0.05). Among hyperthyroid and hypothyroid patients, statistically significant difference was noted in haemoglobin level (Hb) and haematocrit (p -value < 0.05), causing no statistically significant impact on any other indices. Among hypothyroid and euthyroid patients, none of the indices showed statistically significant value. MCV, MCH and MCHC remained statistically non-significant among all patient groups. We observed in our study among hyperthyroid patients, hb could be low, normal or high due to variation in erythropoiesis and adjustment in plasma volumes.

A study conducted by Refaat B, in Saudi Arabia, showed a significant decline in red blood cell (RBC) count, hemoglobin and hematocrit value in patients with disorders of thyroid hormone as compared to euthyroid subjects. These findings are consistent with the results of our study.⁹

Another study by Kawa and et al, reported the

clinical significance of dysregulation of thyroid hormones and hematopoiesis. They reported in hyperthyroid and hypothyroid patients a statistically significant increase in HCT and MCV in contrast to euthyroid subjects; an increase in the RBC count in hyperthyroidism while a remarkable decrease in the RBC count in hypothyroidism was seen and so related changes in values of Hemoglobin between hyperthyroid and hypothyroid group.²

The prevalence of anemia is found higher in overt hyperthyroidism in a study conducted by M'Rabet and Bensalah K, which is in line with findings of our study.¹⁰

A study by Dorgalaleh, analysing the effect of thyroid dysfunctions on red blood cell count and indices, disclosed that almost all the hematological indices (MCH, MCHC, Hb, and HCT) showed a statistical significance ($p=0.0001$) excluding RBCs ($p>0.05$).¹¹

A statistical significant difference was shown in MCV values in patients with abnormal thyroid in a study by Bashir et al.¹² MCV was found to be increased in hypothyroidism.¹² Whereas our study did not manifest this finding in hypothyroidism possibly because of some impediments like limited data due to small number of hypothyroid patient ($n=88$). The limitation of our study was small sample size, so trials on large sample size are needed in different tertiary care hospitals for analysis as different types of anemia and RBC abnormalities are present in patients of thyroid disorders.¹³

CONCLUSION

In disorders of thyroid gland haematological parameters should be monitored as RBC indices are affected by abnormal secretion of thyroid hormones.





Copyright© 09 Mar, 2022.

REFERENCES

1. Bianco AC. **Mini review: Cracking the metabolic code for thyroid hormone signaling.** *Endocrinol.* 2011; 152(9):3306-11. doi: 10.1210/en.2011-11s04

2. Kawa MP, Grymuła K, Paczkowska E, BaškiewiczMasiuk M, Dąbkowska E, Koziółek M, et al. **Clinical relevance of thyroid dysfunction in human haematopoiesis: Biochemical and molecular studies.** Eur J Endocrinol. 2010; 162(2):295–305. doi: 10.1530/EJE-09-0875
3. Salim E, Sheikh S, Ali U, Zubairi AM, Asim A, Khawaja S. **Impact of thyroid dysfunction on red cell indices in a tertiary care hospital.** Pak J Med Den. 2020;9(1):41-45 DOI:10.36283/PJMD9-1/009
4. Vanderpump MP. **The epidemiology of thyroid disease.** Br Med Bull. 2011; 99:39-51. doi: 10.1093/bmb/ldr030.
5. Khandelwal D, Tandon N. **Overt and subclinical hypothyroidism: Who to treat and how.** Drugs. 2012; 72(1):17-33. Doi: 10.2165/11598070-000000000-00000.
6. Kosenli A, Erdogan M, Ganidagli S, Kulaksizoglu M, Solmaz S, Kosenli O, et al. **Anemia frequency and etiology in primary hypothyroidism.** Endocrinol. 2009; 20:140. ISSN 1470-3947 (print) | ISSN 1479-6848 (online)
7. Iddah MA, Macharia BN, Ng'wena AG, Keter A, Ofulla AV. **Thyroid hormones and hematological indices levels in thyroid disorders patients at Moi teaching and referral hospital, Western Kenya.** ISRN Endocrinol. 2013. doi: 10.1155/2013/385940
8. <https://www.healthline.com/health/tsh-normal-range-by-age>.
9. Refaat B. **Prevalence and characteristics of anemia associated with thyroid disorders in non-pregnant Saudi women during the childbearing age: A cross-sectional study.** Biomed J. 2015; 38(4):307-16. doi: 10.4103/2319-4170.151032.
10. M'Rabet Bensalah K, Aubert CE, Coslovsky M, Collet TH, Baumgartner C, den Elzen WP, et al. **Thyroid dysfunction and anaemia in a large population based study.** Clin Endocrinol. 2016; 84(4):627 -31. doi: 10.1111/cen.12994
11. Dorgalaleh A, Mahmoodi M, Varmaghani B, Kiani Node F, Saeedi Kia O, Alizadeh Sh, et al. **Effect of thyroid dysfunctions on blood cell count and red blood cell indices.** Iran J Ped Hematol Oncol. 2013; 3(2):73-7. Epub2013Apr22. PMID: 24575274; PMCID: PMC3915449.
12. Bashir H, Bhat MH, Farooq R, Majid S, Shoib S, Hamid R, et al. **Comparison of hematological parameters in untreated and treated subclinical hypothyroidism and primary hypothyroidism patients.** Med J Islam Repub Iran. 2012 Nov; 26(4):172-8. PMID: 23482519; PMCID: PMC3562538.
13. Iddah MA, Macharia BN, Ng'wena AG, Keter A, Ofulla AV. **Thyroid hormones and hematological indices levels in thyroid disorders patients at Moi teaching and referral hospital, Western Kenya.** ISRN Endocrinol. 2013. doi: 10.1155/2013/385940

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Amna Arooj	Principal contributor, Conceptualization and design of re-search work, Data collection, Writing of manuscript statistical analysis.	
2	Maryam Rafiq	Conceptualization and design of research work, Data collection, Statistical analysis.	
3	Yasmeen Batool	Review of results and final approval.	
4	Qurat Ul Ain Tahir	Results analysis, Literature search.	
5	Fariha Muzammil	Statistical analysis, Interpretation of data.	