Middle East Research Journal of Microbiology and Biotechnology
ISSN: **2789-8644 (Print & Open Access)**
Frequency: Bi-Monthly
DOI: 10.36348/merjmb.2024.v04i01.003

KUWAIT SCHOLARS PUBLISHER
Website: http://www.kspublisher.com/
Email: office.kspublisher@gmail.com

Effect of Thyroid Dysfunctions on Complete Blood Count in Almatama Town-Sudan

Esra Hayder Abdelmagid[1], Hanan A. Mohammed[1], Elfatih Mohammed Abd Allah[1], Tibyan Abd Almajed Altaher[2], Ghanem Mohammed Mahjaf[3], Mosab Nouraldein Mohammed Hamad[4*]

[1]Department of Haematology, Faculty of Medical Laboratory Sciences, Shendi University, Sudan
[2]Department of Clinical Chemistry, Faculty of Medical Laboratory Sciences, Shendi University, Sudan
[3]Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Shendi University, Sudan
[4]Assistant Professor, Microbiology Department, Faculty of Medicine, Elsheikh Abdallah Elbadri University, Sudan

Abstract: ***Background***: Thyroid hormones have a crucial role in the metabolism and proliferation of blood cells. Thyroid dysfunction causes different outcomes on blood cells such as anemia, erythrocytosis, leukopenia, thrombocytopenia, and in rare cases causes' pancytopenia. It also alters RBC indices including MCV, MCH, MCHC, and RDW. ***Objectives***: This is a cross-sectional descriptive study conducted in Almatama town during the period from September 2021 to January 2022, aimed to assess the effects of hypothyroidism and hyperthyroidism on blood cell count and RBC indices. ***Materials and Methods:*** Fifty patients with thyroid disease (24 hyperthyroidism, 26 hypothyroidism) and 20 healthy subjects served as controls. Whole venous blood samples were collected in EDTA anticoagulant container, mixed well, transferred to the laboratory according to standard procedures to avoid contamination, and then automatically counted for complete blood counts. ***Results***: RBCs, HB, MCV, MCHC, and MCH, had statistically insignificant results in thyroid patients when compared with the control group (*P. value* 0.225,0.077,0.235,0.498,0.626) respectively. In hyperthyroid RBCs, HB, PCV, MCV, and MCH were statistically insignificant (*P. value* 0.388,0.951,0.123,0.575,0.148) respectively, and a statistically significant MCHC (*P. value* 0.0020). In hypothyroid HB, PCV, and MCH were, statistically significant (*P. value* 0.001,0.010,0.029) respectively, RBCs, MCV, and MCHC were, statistically insignificant (*P. value* 0.166,0.107,0.125) respectively. ***Conclusions***: The hematological parameters were affected by thyroid disease, In case of patients with unknown hematological dysfunctions, must be evaluated for thyroid hormones. The follow-up of patients with thyroid disorders should have the complete blood count and patients diagnosed with anemia should be considered for thyroid conditions before iron treatment. Cases of anemia that resist therapy should be investigated for the case of thyroid dysfunction.

Keywords: Hypothyroidism, Hyperthyroidism, TSH, Anemia, Blood parameters.

Research Paper

***Corresponding Author:**
Mosab Nouraldein Mohammed Hamad
Assistant Professor, Microbiology Department, Faculty of Medicine, Elsheikh Abdallah Elbadri University, Sudan

How to cite this paper:
Esra Hayder Abdelmagid *et al;* "Effect of Thyroid Dysfunctions on Complete Blood Count in Almatama Town-Sudan" Middle East Res J. Microbiol Biotechnol., 2024 Jan-Feb 4(1): 10-14.

Article History:
| Submit: 05.12.2023 |
| Accepted: 04.01.2024 |
| Published: 08.01.2024 |

INTRODUCTION

Thyroid hormones play an important physiological role in humans. Thus may regulate human hematopoietic in the bone marrow [1]. The association of thyroid disorders and abnormalities in hematology parameters is well known. In 1979 Fein showed that Graves's disease is associated with Anemia [2]. Hypothyroidism can cause certain forms of anemia on one hand or hyperproliferation of immature erythroid progenitor. On the other hand, the anemia is usually microcytic hypo chronic anemia of moderate severity [3]. In contrast, anemia is not frequently observed in patients with hyperthyroidism, whereas erythrocytosis is fairly common [2, 4]. As for white cells and thrombocytes are effects, slightly depressed total leukocyte counts like neutropenia, and thrombocytopenia have been observed in hypothyroidism patients [5]. These observations confirmed the association between thyroid gland dysfunction and hemopoiesis. Previous studies suggested that there is an essential relationship between the hypo thyroid state and low levels of iron, vitamin B12, and folic acid in the human body [3, 6]. Furthermore, it has been postulated that the influence

of TSH on hemopoiesis involves increased production of erythropoietin or hemopoietic factors by non-erythroid cells [7, 8]. However, a growing number of studies have demonstrated the direct effect of TSH in normal human and animal erythropoiesis [1, 9, 10]. On the other hand, anemia frequently is not seen in patients with hyperthyroidism, while there was erythrocytosis in this situation, but when anemia is present, may be morphologically similar to that observed in hypothyroidism. Patients with hypothyroidism have a decreased erythrocyte mass due to a reduction of plasma volume and may be undetectable by routine measurements such as hemoglobin concentration, whereas an increased erythrocyte mass is observed in most hyperthyroid patients [2, 11]**.** Alteration in other hematological parameters such as hemoglobin (HG), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), white blood cell (WBC) count and platelet count is associated with thyroid dysfunction is observed as well [12], but all changes return to normal if a euthyroid (normal) state is obtained. Pancytopenia is a rare side effect and its cause is not well understood. Immunological mechanisms have been offered for the decline of the lifespan of erythrocytes and platelets [5]. Because of the high prevalence of thyroid dysfunctions in the population, we attempted in the present study to evaluate the effect of thyroid dysfunctions, particularly cells and red blood cell indices.

MATERIALS AND METHODS

Study Design:

Across sectional descriptive study in Almatama town to evaluate hematological changes among thyroid patients. The study includes 50 samples with thyroid disease and 20 samples as a control group.

Study Area: The study is conducted at Alia hospital which is located in Almatama town in Sudan.

Study Duration: The study is conducted in the period from September 2021 to January 2022.

Study Population:

This study included fifty patients with thyroid disease and twenty normal individuals as a control group.

Inclusion Criteria: All patients with established thyroid dysfunction were included in the study.

Exclusion Criteria:

Patients with special diseases that could affect red blood cell indices and also with inappropriate samples were excluded from the study.

Blood Sampling: 2.5 ml of venous blood was taken from patients and transferred into an EDTA container.

Method:

CBC was done by using Mindray Haematology Analyzer (Mindray Bc-3000): inducted in 2020 [14].

Ethical Considerations:

Ethical approval for the study was obtained fro m the Board of the Faculty of Medical laboratory scienc e at Shendi University. The written informed consent fo rm was obtained from each guardian of the participant a s well as from the subject himself before recruitment int o the study. All protocols in this study were done accord ing to the Declaration of Helsinki (1964).

Statistical Analysis:

Statistical analysis was performed by SPSS sof tware. Statistical Independent T-test was used to evaluat e the significance of differences between the two groups . *P-value* < .05 was considered as a significant change.

RESULTS

This is a cross-sectional study conducted in Almatama town to evaluate the complete blood Count among patients with thyroid dysfunction. Data obtained comparing test to control are: HB = (11.6), PCV = (36.7), MCV = (84.8), MCH = (26.8), MCHC = (31.5), TWBCs = (6.1), PLT = (235), indicating statistically insignificant variation when cooperating with controls (Table 1). The data of duration are HB = (11.6), RBCs= (4.2), PCV=(36.7), MCV=(84.8), MCH=(26.9), MCHC=(31.6), TWBCs=(6.2), PLT=(236), which have statistically insignificant variation when cooperating with the control. The comparison between hyperthyroid with control group revealed that the mean of HB= (12.4), RBCs= (4.4), PLT=(231), TWBCs=(6.2), which have statistically insignificant variation, and MCHC=(32.8), which have statistically significant variation (Table 2). The comparison between hypothyroid with control group revealed that the mean of HB = (10.9), PCV= (35.6), MCH=(29), which have statistically significant variation, and RBCs=(4.3), PLT=(238), TWBCs=(6.1), which have statistically insignificant variation with the control group (Table 3).

Table-1: Comparison between Test and control in Hb, RBCs, RBCs indices and WBCs count and their subtype

Groups		***Mean***	***P. value***
Hb g/dl	Test	11.668	0.077
	Control	12.425	
RBCsx10^9	Test	4.385	0.225
	Control	4.578	
PCV %	Test	36.752	0.025
	Control	39.830	

Groups		***Mean***	***P. value***
MCV fl	Test	84.822	0.235
	Control	87.245	
MCH pg	Test	26.882	0.626
	Control	27.265	
MCHCg/dl	Test	31.570	0.498
	Control	31.195	
WBCsx10^9	Test	6.179	0.545
	Control	6.500	
Neutrophil	Test	50.965	0.006
	Control	60.585	
Lymphocyt	Test	39.304	0.009
	Control	31.020	
MID	Test	9.908	0.429
	Control	8.930	
Plateletx10^9	Test	235.32	0.861
	Control	238.50	

Table-2: Blood cells count and RBC indices in patients with hyperthyroidism

Groups		***Mean***	***P. value***
Hb g/dl	Test	12.4	0.951
	Control	12.4250	
RBCsx10^9	Test	4.4367	0.388
	Control	4.5775	
PCV %	Test	37.9125	0.123
	Control	39.8300	
MCV fl	Test	86.1042	0.575
	Control	87.2450	
MCH pg	Test	28.3708	0.148
	Control	27.2650	
MCHCg/dl	Test	32.8542	0.002
	Control	31.1950	
WBCsx10^9	Test	6.2371	0.641
	Control	6.5000	
Neutrophil	Test	51.2375	0.022
	Control	60.5850	
Lymphocyt	Test	39.6125	0.014
	Control	31.0200	
MID	Test	9.1164	0.830
	Control	8.9300	
Plateletx10^9	Test	231.83	0.718
	Control	238.50	

Table-3: Blood cells count and RBC indices in patients with hypothyroidism

Groups		***Mean***	***P. value***
Hb g/dl	Test	10.9462	
	Control	12.4250	0.001
RBCsx10^9	Test	4.3369	
	Control	4.5775	0.166
PCV %	Test	35.6808	
	Control	39.8300	0.010
MCV fl	Test	83.6385	
	Control	87.2450	0.107
MCH pg	Test	25.5077	0.029
	Control	27.2650	
MCHCg/dl	Test	30.3846	
	Control	31.1950	0.125

Groups		***Mean***	***P. value***
WBCsx10^9	Test	6.1250	0.541
	Control	6.5000	
Neutrophil	Test	50.7040	0.017
	Control	60.5850	
Lymphocyt	Test	39.0192	0.028
	Control	31.0200	
MID	Test	10.6385	0.276
	Control	8.9300	
Plateletx10^9	Test	238.54	0.999
	Control	238.50	

DISCUSSION

Thyroid gland as the largest and the most important endocrine gland of human body with the secretion of two hormones. Thyroid gland also has a crucial effect on erythropoiesis by induction of erythropoietin secretion and also proliferation of erythroid progenitors [1, 11, 13]. The most common thyroid dysfunctions, hypothyroidism and hyperthyroidism affect blood cells and cause anemia with different severity. These thyroid disorders also cause thrombocytopenia, leukopenia and even in rare cases cause pancytopenia (in hypothyroidism). Other blood indices including MCV, MCH, MCHC, Hb also could change during thyroid dysfunction [12]. Across sectional descriptive study in Almatama town to evaluate hematological changes among thyroid patients. The study includes 50 samples with thyroid disease and 20 samples as a control group. RBC, HB, MCV, MCHC, and MCH each showed statistically non-significant results in thyroid patients compared with controls (*P. value* 0.225, 0.077, 0.235, 0.498, 0.626). This result contradicts a study conducted by Ahmed and Mohammed in 2020: There was a significant difference between RBC, HB, MCV, MCHC, RDW, and WBC (*P. value* 0.000, 0.000, 0.001, 0.012, 0.002, and 0.027 respectively). The results were also consistent with PCV (*P. value* 0.025) in our study [15]. Many studies showed that platelets are also affected by thyroid dysfunction, but in this study we found that platelets were no significant correlation with thyroid dysfunction (*P. value* 0.861) this result is in agreement the same as the study done in 2020 [15]. Platelets are less affected by thyroid function status, this finding have been found in many other studies this may be due to the fact that platelets are non-nucleated and they have short life span with continuous rapid turnover [16]. The data when compared the hyperthyroid with the control group relieved RBCs, HB, PCV, MCV, and MCH statistically insignificant result (*p. value* 0.388,0.951,0.123,0.575,0.148) respectively, and a statistically significant MCHC (*P. value* 0.0020). In hypothyroid HB, PCV, and MCH were, statistically significant results when compared with the control group (*P. value* 0.001,0.010,0.029) respectively, RBCs, MCV, and MCHC were, statistically insignificant when compared with the control, *P. value* (0.166,0.107,0.125) respectively. According to obtained data we suggested that all patients with hypothyroidism and hyperthyroidism should be periodically evaluated for probably hematological changes.

CONCLUSION

The hematological parameters were affected by thyroid disease, In case of patients with unknown hematological dysfunctions, must be evaluated for thyroid hormones. The follow-up of patients with thyroid disorders should have the complete blood count and patients diagnosed with anemia should be evaluated for thyroid disorders before iron treatment. Cases of anemia that resist treatment should be investigated for the potential of thyroid dysfunction.

Sources of Funding:

There was no specific grant for this research from any funding organization in the public, private, or nonprofit sectors.

Conflict of Interest: Authors have declared that no competing interests exist.

REFERENCES

1. Golde, D. W., Bersch, N., Chopra, I. J., & Cline, M. J. (1977). Thyroid hormones stimulate erythropoiesis in vitro. *British journal of haematology*, *37*(2), 173-177.
2. Fein, H. G., & Rivlin, R. S. (1975). Anemia in thyroid diseases. *Medical Clinics of North America*, *59*(5), 1133-1145.
3. Horton, L., Coburn, R. J., England, J. M., & Himsworth, R. L. (1976). The haematology of hypothyroidism. *QJM: An International Journal of Medicine*, *45*(1), 101-123.
4. Corrocher, R., Querena, M., AM, S., & Sandre, D. (1981). Microcytosis in Hyperthyroidism: Heamatological Profile in Thyroid Disorders. *Haematogica*, *66*(6), 779-786.
5. Lima, C. S., Wittmann, D. E. Z., Castro, V., Tambascia, M. A., Lorand-Metze, I., Saad, S. T., & Costa, F. F. (2006). Pancytopenia in untreated patients with Graves' disease. *Thyroid*, *16*(4), 403-409.
6. Hines, J. D., Halsted, C. H., Griggs, R. C., & Harris, J. W. (1968). Megaloblastic anemia secondary to folate deficiency associated with hypothyroidism. *Annals of Internal Medicine*, *68*(4), 792-805.
7. Dainiak, N., Sutter, D., & Kreczko, S. (1986). L-trii

odothyronine augments erythropoietic growth factor release from peripheral blood and bone marrow leukocytes. *Blood*, *68*(6), 1289-1297.

8. Fandrey, J., Pagel, H., Frede, S., Wolff, M., & Jelkmann, W. (1994). Thyroid hormones enhance hypoxia-induced erythropoietin production in vitro. *Experimental hematology*, *22*(3), 272-277.
9. Malgor, L. A., Blanc, C. C., Klainer, E., Irizar, S. E., Torales, P. R., & Barrios, L. (1975). Direct effects of thyroid hormones on bone marrow erythroid cells of rats. *Blood*, *45*(5), 671-679.
10. Perrin, M. C., Blanchet, J. P., & Mouchiroud, G. (1997). Modulation of human and mouse erythropoiesis by thyroid hormone and retinoic acid: evidence for specific effects at different steps of the erythroid pathway. *Hematology and cell therapy*, *39*(1), 19-26.
11. Das, K. C., Mukherjee, M., Sarkar, T. K., Dash, R. J., & Rastogi, G. K. (1975). Erythropoiesis and erythropoietin in hypo-and hyperthyroidism. *The Journal of Clinical Endocrinology & Metabolism*, *40*(2), 211-220.
12. Kawa, M. P., Grymuła, K., Paczkowska, E., Baśkiewicz-Masiuk, M., Dąbkowska, E., Koziołek, M., ... & Machaliński, B. (2010). Clinical relevance of thyroid dysfunction in human haematopoiesis: biochemical and molecular studies. *European journal of endocrinology*, *162*(2), 295-305.
13. Fujita, H. (1975). Fine structure of the thyroid gland. *International review of cytology*, *40*, 197-280.
14. Operation manual auto hematology analyzer BC – 3000, online, available at (https://WWW.manualslib.com / manual / 1981843 / mindray – Bc – 3000 – plus.html) access at 12/1/2022.
15. Ahmed, S. S., & Mohammed, A. A. (2020). Effects of thyroid dysfunction on hematological parameters: Case controlled study. *Annals of Medicine and Surgery*, *57*, 52-55. doi: 10.1016/j.amsu.2020.07.008. PMID: 32714526; PMCID: PMC7374177.
16. Erikci, A. A., Karagoz, B., Ozturk, A., Caglayan, S., Ozisik, G., Kaygusuz, I., & Ozata, M. (2009). The effect of subclinical hypothyroidism on platelet parameters. *Hematology*, *14*(2), 115-117. doi: 10.1179/102453309X385124. PMID: 19298725.