RESEARCH ARTICLE / *Araştırma Makalesi*

Analysis of Hematological Parameters According to TSH Levels in Thyroid Patients

Tiroid Hastalarında TSH Düzeylerine Göre Hematolojik Parametrelerin Analizi

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Abstract

Introduction	In this study, it was aimed to investigate hematological parameters according to thyroid stimulating hormone (TSH) levels in thyroid patients.
Materials and Methods	Thyroid function tests and hemogram data of 5130 thyroid patients admitted to our hospital between January 2019 and August 2021 were analyzed retrospectively.
Results	There was no significant difference between hemoglobin, MCH, leukocyte, basophil and thrombocyte levels according to TSH levels. When compared in terms of MCV, a significant difference was found between group 1 (TSH<0.05) and group 2 (TSH=0.5-4.99) (p<0.001) and group 2 (TSH=0.5-4.99) and group 4 (TSH ≥10). When the neutrophil levels were compared, there were significant differences between group 1 and group 2, group 3 (TSH=5.0-9.99) and group 4. When the lymphocyte levels were compared, there were significant differences between group 1 and group 2 and group 3, and between group 2 and group 3. When monocyte and eosinophil levels were compared, there were significant differences between group 1 and group 4, group 2 and group 3. there were differences. When MPV levels were compared, there were significant differences between group 1 and group 4, and between group 2 and group 3. There were significant differences between the 3rd and 4th groups in terms of MPV levels.
Conclusion	It was determined that there was a significant difference between MCV, neutrophil, lymphocyte, monocytes, eosinophil and MCV values.
Keywords	Hemoglobin; Hematological parameters; Thyroid Stimulating Hormone.

Öz

Amaç	*Bu çalışmada tiroid hastalarında tiroid uyarıcı hormon (TSH) düzeylerine göre hematolojik parametrelerin araştırılması amaçlandı.*
Yöntem ve Gereçler	*Ocak 2019-Ağustos 2021 tarihleri arasında hastanemize başvuran 5130 tiroid hastasının tiroid fonksiyon testleri ve hemogram verileri retrospektif olarak incelendi.*
Bulgular	*TSH düzeylerine göre hemoglobin, MCH, lökosit, bazofil ve trombosit düzeyleri arasında anlamlı fark yoktu. MCV açısından karşılaştırıldığında, grup 1 (TSH<0.05) ve grup 2 (TSH=0.5-4.99) (p<0.001) ve grup 2 (TSH=0.5-4.99) ve grup 4 (TSH ≥10) arasında anlamlı fark bulundu. Nötrofil düzeyleri açısından karşılaştırıldığında grup 1 ve grup 2, grup 3 (TSH=5.0-9.99) ile grup 4 arasında anlamlı farklar vardı. Lenfosit düzeyleri açısından karşılaştırıldığında, grup 1 ile grup 2 ve grup 3 arasında, grup 2 ile grup 3 arasında anlamlı farklar vardı. Monosit ve eozinofil düzeyleri karşılaştırıldığında grup 1 ile grup 4, grup 2 ile grup 3 arasında anlamlı farklar vardı. MPV düzeyleri karşılaştırıldığında grup 1 ile grup 4 arasında, grup 2 ile grup 3 arasında anlamlı farklar vardı. MPV seviyeleri açısından 3. ve 4. grup arasında anlamlı farklar vardı.*
Sonuç	*MCV, nötrofil, lenfosit, monosit, eozinofil ve MCV değerleri arasında anlamlı fark olduğu belirlendi.*
Anahtar Kelimeler	*Hemoglobin; Hematolojik parametreler; Tiroid stimülan hormon.*

INTRODUCTION

The thyroid gland is an important endocrine organ located on both sides of the beginning of the trachea as the right and left lobes in the human body. Its main function is to influence many metabolic processes in the body. It makes up the majority of L-thyroxine (T4) and secretes thyroid hormones with a small amount of 3,5,3'-triiodo-L-thyronine (T3). The causes of primary hypothyroidism include Hashimoto's thyroiditis, atrophic thyroiditis, thyroidectomy, drugs, radiotherapy to the neck region, radioactive iodine treatment, retardation in thyroid gland development, and congenital disorders in thyroid hormone synthesis. Hypothyroidism, which is seen due to the insufficiency of the secretion of TSH from the pituitary, is called secondary hypothyroidism. Pituitary tumors, pituitary surgery, radiotherapy, infiltrative diseases, Sheehan syndrome are the most common causes of secondary hypothyroidism. Tertiary hypothyroidism develops as a result of insufficiency of thyrotropin-releasing hormone (TRH), which is synthesized and released in the hypothalamus, and is rare.[1–3]

The erythrocyte value is one of the parameters of hematological tests that shows the number of red blood cells in the blood. Erythrocytes, which have a lifespan of 120 days in a normal person, are the most numerous cells in the blood. Platelets have an important role in coagulation. Neutrophils are white blood cells that first appear when a bacterial infection occurs, protecting the body from infections. Neutrophils find harmful bacteria and viruses in the body and begin to fight to destroy them. Lymphocytes are named B and T cells according to their location in the body. The cells that are produced in the bone marrow and remain there are called B cells. These cells are about ¼ of the total lymphocytes. Lymphocytes that come out of the bone marrow and join the blood stream or are included in the lymphatic system are called T cells. Lymphocyte is the main component that makes up the body's defense mechanism. These cells; It protects the body against bacteria, viruses or foreign antigens.[4]

Thyroid diseases are a very common endocrinological problem in clinics. Thyroid diseases, as in other endocrine diseases, mainly progress with symptoms related to excessive production of hormonal activity or underproduction.[5]

Hematological disorders may occur in hypothyroidism. Decreased oxygen demand due to the slowdown of metabolism has the most adverse effects on erythrocytes, among hematological parameters, and causes a decrease in the total erythrocyte level.[6]

Since the effects of thyroid hormones on metabolism are very high, they also affect the levels of other blood parameters. Although there are studies on thyroid diseases, adequate studies have not been conducted on the hematological effects in severe hypothyroidism and other hypothyroid patients with TSH level of 10 μIU/L. Considering the pathogenesis of the disease, the clinical picture and test results in the patients; It is seen that TSH has effects on hematological values. In this study, it was aimed to investigate the effect of changing TSH levels on hematological parameters.

MATERIAL and METHODS

The data of the patients who applied to Sakarya University Training and Research Hospital between January 2019 and August 2021 and whose thyroid function tests and hemogram were studied were retrospectively analyzed. The study is a cross-sectional descriptive study. Age, gender and TSH values of 5130 patients were determined. The study included 991 patients with TSH value <0.5, 2,935 patients with TSH value 0.5 – 4.99, 756 patients with TSH value 5.0 – 9.99, and 448 patients with TSH value ≥10. This study was designed in accordance with the Declaration of Helsinki Principles and received approval from the Sakarya University Faculty of Medicine Ethics Committee on 04/09/2020. (Ethics no:71522473/050.01.04).

Complete blood count parameters

Hormone tests were performed on ARCHITECT I2000

SR (Abbott, USA), Hemogram tests were performed on CELLDYN 3700 (Abbott, USA).

Statistical analysis

Data analysis was performed by using SPSS-22 for Windows (Statistical Package for Social Science, SPSS Inc. Chicago IL, USA®Z). The variables were investigated using visual (histograms, probability plot) and analytical methods (Kolmogorov-Simirnov) to determine whether or not they are normally distributed. We performed analyses to describe and summarize the distributions of variables. Categorical variables were interpreted by frequency tables. The chi-square test was used to determine whether there was any difference between the groups in terms of quality variables. The continuous variables were expressed as mean and standard deviation or as median and interquartile range, depending on the normality of their distribution. Variables that were not normally distributed were compared using the Kruskal-Wallis test. When binary comparisons were required, Mann-Whitney U test was used. Normally distributed variables were compared using one-way ANOVA test. When an overall significance was observed, pairwise post-hoc tests were performed using Tukey's test. Levene test was used to assess the homogeneity of the variances. The statistically significant two tailed p-value was considered as $p<0.05$.

RESULTS

The age of 991 patients with TSH value <0.5 mIU/L was 49.4±16.4, the ratio of female to male was 839/162, the ratio of TSH value was 0.5 to 4.99 mIU/L was 2,909 patients 43.9±17.2, the ratio of female to male was 2,573 / 362, the ratio of 745 patients with TSH value 5.0 to 9.99 mIU/L was 44.7±16.4 year. The ratio of 16.4 female to male was 662/94, the age of 443 patients with TSH value ≥10 mIU/L was 45.7±18.0 female to male ratio was 341/107.

When compared in terms of age, group 1 (TSH<0.5) and group 2 (TSH=0.5-4.99) ($p<0.001$), group 3 (TSH= 5.0-9.99) ($p<0.001$) and group 4 (TSH≥10) ($p=0.001$), a significant difference was observed. There was no difference between group 2 and group 3 ($p=0.626$) and group 4 ($p=0.142$). In addition, no significant difference was observed between group 3 and group 4 ($p=0.752$).

When compared in terms of gender distribution, the number of male patients was 725 (14.2%), while the number of female patients was 4405 (85.8%), and there was a significant difference between both genders ($p<0.001$). While the 4th group was different from all groups in terms of gender, a significant difference was observed between the 1st group and the 2nd group. However, the difference between the 3rd group and the 1st and 2nd groups is not significant. When evaluated in terms of TSH levels, the difference between the groups was significant ($p<0.001$), and this difference was at the same level among all groups ($p<0.001$) (Table 1).

Table 1. Descriptive statistics of TSH levels

	TSH levels* (n=5090)				
Traits	**<0.5 (n=991)**	**0.5-4.99 (n=2935)**	**5.0-9.99 (n=756)**	**≥10 (n=448)**	**p value**
Age, years	49.4±16.4	43.9±17.2	44.7±16.4	45.7±18.0	**<0.001**
Gender, F/M (%)	839/162 (84.7/16.2)	2573/362 (87.7/12.3)	662/94 (87.6/12.4)	341/107 (76.1/23.9)	**<0.001**
TSH (mIU/L)	0.14 (0.03-0.31)	2.06 (1.23-3.21)	6.50 (5.62-7.73)	18.58 (12.69-37.95)	**<0.001**

TSH; thyroid-stimulating hormone.
*The results were expressed as median (interquartile range) due to the distribution feature of the variables.

There was no significant difference between group 1 (TSH<0.05) and group 2 (TSH=0.5-4.99) when compared in terms of MCV, and group 2 (TSH=0.5-4.99) and group 4 (TSH≥10) were found to be significantly different (p<0.001). (Figure 1).

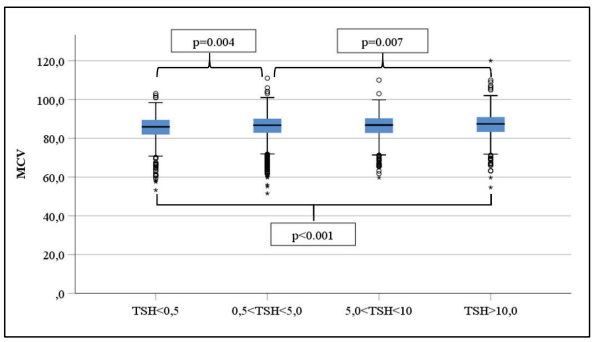

Figure 1. Comparison of groups according to MCV (fl)

When compared in terms of neutrophil levels, between Group 1 (TSH<0.05) and Group 2 (TSH=0.5-4.99), Group 1 (TSH<0.05) with Group 3 (TSH=5.0-9.9), and Group 1 (TSH=5.0-9.9) A significant difference was observed between (TSH<0.05) and group 4 (TSH≥10) (Figure 2).

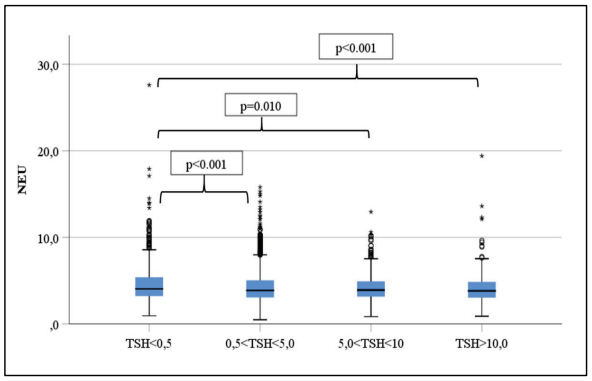

Figure 2. Comparison of groups according to neutrophil count (K/uL)

When compared in terms of lymphocyte levels, between group 1 (TSH<0.05) and group 2 (TSH=0.5-4.99) (p<0.001), group 2 (TSH=0.5-4.99) and group 3 (TSH=5.0-9.9) (Figure 3).

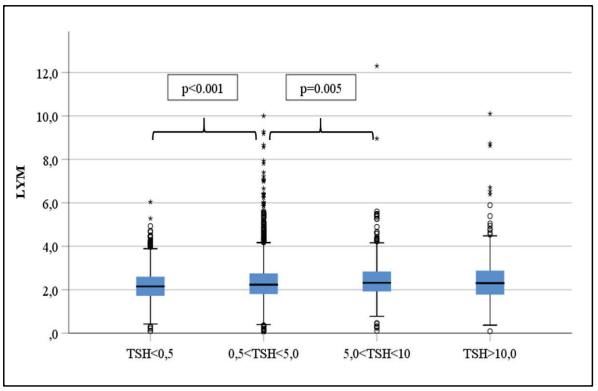

Figure 3. Comparison of groups according to lymphocyte count (K/uL)

When compared in terms of monocyte levels, a significant difference was found between group 1 (TSH<0.05) and group 4 (TSH≥10), and between group 3 (TSH=5.0-9.9) and group 4 (TSH≥10) (Figure 4).

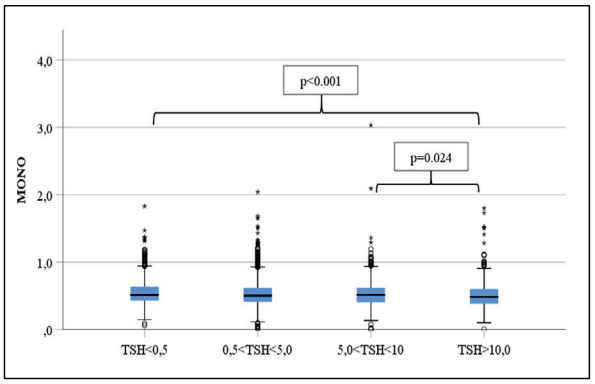

Figure 4. Comparison of groups according to monocyte count (K/uL)

When compared in terms of eosinophil levels, between group 1 (TSH<0.05) and group 4 (TSH≥10) (p<0.001), group 2 (TSH=0.5-4.99) and group 3 (TSH=5.0-9.9) significant difference was observed (Figure 5).

Compared in terms of MPV levels, between group 1 (TSH<0.05) and group 4 (TSH≥10) (p<0.001), group 2 (TSH=0.5-4.99) and group 3 (TSH=5.0-9.9) There was a significant difference between the 3rd group (TSH=5.0-9.9) and the 4th group (TSH≥10) (Figure 6).

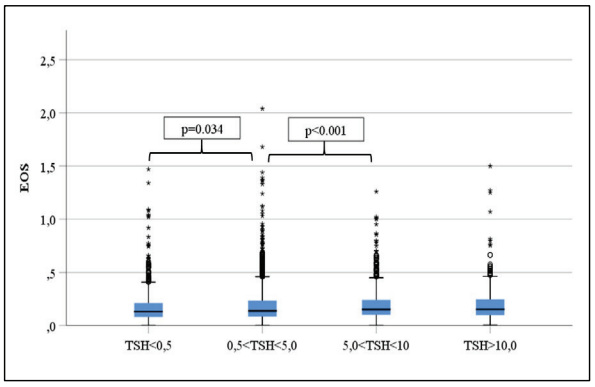

Figure 5. Comparison of groups according to eosinophil count (K/uL)

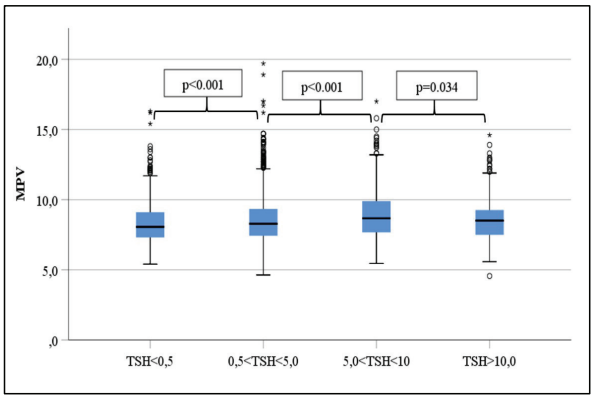

Figure 6. Comparison of groups according to MPV (fl)

Table 2. Comparison of groups according to hemogram parameters

	TSH levels* (n=5090)				
	<0.5 (n=991)	**0.5-4.99 (n=2909)**	**5.0-9.99 (n=745)**	**≥10 (n=443)**	**p value**
Hemoglobin	12.9 (12.0-13.7)	12.7 (11.9-13.6)	12.7 (11.9-13.6)	12.7 (11.7-13.6)	0.219
MCV, femtolitre	85.9 (81.9-89.6)	86.7 (82.8-90.1)	86.8 (82.7-90.4)	87.4 (83.2-91.0)	**<0.001**
MCH, pg	28.5 (27.1-29.9)	28.8 (27.2-30.0)	28.7 (27.0-30.2)	28.9 (27.2-30.5)	0.065
WBC, 103/mm3	7.16 (5.90-8.73)	7.02 (5.87-8.51)	7.02 (6.03-8.49)	6.94 (5.82-8.26)	0.245
Neu, 103/mm3	4.04 (3.21-5.40)	3.86 (3.06-5.04)	3.91 (3.15-4.93)	3.81 (3.03-4.85)	**<0.001**
Lym, 103/mm3	2.15 (1.72-2.60)	2.23 (1.80-2.75)	2.32(1.92-2.84)	2.30 (1.77-2.88)	**<0.001**
Mono, 103/mm3	0.51 (0.43-0.63)	0.50 (0.41-0.62)	0.51 (0.41-0.62)	0.48 (0.39-0.60)	**<0.001**
Eos, 103/mm3	0.13 (0.08-0.21)	0.14 (0.08-0.23)	0.15(0.10-0.24)	0.15 (0.10-0.25)	**<0.001**
Bas, 103/mm3	0.06 (0.05-0.08)	0.06 (0.05-0.09)	0.07 (0.05-0.09)	0.07 (0.05-0.09)	0.063
PLT, 103/mm3	250 (215-289)	254 (217-298)	255 (216-295)	247 (212-296)	0.062
MPV, femtolitre	8.06 (7.31-9.11)	8.28 (7.43-9.35)	8.67 (7.67-9.90)	8.51 (7.49-9.27)	**<0.001**

MCV; mean corpuscular volüme, MCH; mean corpuscular hemoglobin, WBC; white blood cells, Neu; neutrophil, Lym; lymphocyte, Mono; monocyte, Eos; eosinophil, Bas; basophil, PLT; platelets, MPV; mean platelet volüme.
*The results were expressed as median (interquartile range) due to the distribution feature of the variables.

DISCUSSION

Thyroid hormones are effective on organs and systems and many enzymes in the body. In addition, it has a role in many biochemical events that are effective in development and growth.[7] Thyroid hormones; It affects the metabolism of tissues and the rate of oxygen use, and both anabolism and catabolism of proteins are dose-dependent. Hypothyroidism significantly affects clinical and laboratory findings. As a result, abnormalities in some blood parameters related to the organs affected are observed. In this study, the hematological parameters of the patients were examined according to different TSH levels.

The prevalence of hypothyroidism is high and it is more common in women, 95% of the patients are women and it is often seen between the ages of 30-50.[8] The female to male ratio is approximately 7.2 females to 1 male.[9] In our study, the number of female patients was 4415, the number of male patients was 725, and the female-to-male ratio was determined as 6.08.

Multiple etiological factors, especially nutritional deficien-

cies and chronic diseases, cause anemia.[10] The most common cause of anemia is bone marrow suppression due to thyroid hormone deficiency and insufficient production of erythropoietin. It has been reported that the mean hemoglobin level of the hypothyroid group was statistically significantly lower than the hyperthyroid group.[11] In a study of 1950 hypothyroid patients included in the meta-analysis, the overall prevalence of anemia was found to be 33.77% with a 95% CI (21.53 to 52.95%), with the lowest prevalence rate 5.96% and the highest 62% in all studies,14 has been reported.[12] In a study conducted in patients with hypothyroidism, it was shown that anemia ranged from 23% to 60%.[13] In most studies, laboratories used the same anemia values (Hb below 12 g/dL for women and 13 g/dL for men).[14] On the other hand, some authors used a hemoglobin level of less than 14% in men and 12% in women[15] and less than 11 in women, regardless of gender, as criteria for defining anemia.[16] Hemoglobin and hematocrit values of hematological parameters performed in 68 patients with hypothyroid disease were not found to be statistically significant when compared with the control group.[17] In a study of 1500 hypothyroid patients, it was shown that anemia and hypothyroidism were associated, and in these patients, normocytic normochromic anemia and mild anemia were the most common types of anemia.[18] We also found that the hemoglobin values of the patients were below 13 g/dL according to the varying TSH levels and there was no significant difference between the groups.

Lymphocyte, thrombocyte and neutrophil levels are important blood parameters involved in inflammation. Today, it is used in many infectious diseases and tumoral formations.[19] In hypothyroidism, lymphocyte, granulocyte and platelet counts are normal. It was reported that thrombocyte values of the hypothyroid group compared to the hyperthyroid group were not statistically significant.[11] In a study conducted in Hashimoto patients with hypothyroidism, it was shown that there was no difference between age, neutrophil, lymphocyte, and platelet counts when compared with the control group.[20] In hematological studies performed in hypothyroid patients, platelet levels were found to be normal.[21] In our study, no significant difference was found between the platelet values of the patients according to different TSH levels.

In a study of leukocyte, neutrophil, and lymphocyte, which are hematological parameters, performed in 68 patients with hypothyroid disease, it was found that it was not statistically significant when compared with the control group.[17] In our study, it was determined that there was no significant difference between hemoglobin, MCH, leukocyte and basophil levels according to different TSH levels. However, there was a difference between MCV, neutrophil, lymphocyte, monocyte, eosinophil and MPV levels according to TSH levels.

CONCLUSION

According to the results of this study; It was determined that there was no significant difference between the Hb, MCH, WBC, basophil and platelet values of the patients according to different TSH levels, but there was a significant difference between the MCV, netrophil, lymphocyte, monocyte, eosinophil and MPV values.

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The authors declare no conflict of interest.

Disclosure statement

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Authors' Contrıbutions

MO: Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing. Conceptualization. SY: Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing. TD: Data Curation, Formal Analysis, Writing –Original Draft, Writing – Review & Editing.

Our study was initiated after permission from the Sakarya University Faculty of Medicine Ethics Committee (No: 04/09/2020-E.7734).

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