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Short Article

The Relationship Between Severity of Hypothyroidism and Red Blood Cells Indices

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ABSTRACT

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Key words
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Background and Aims: Thyroid hormones have an important role in metabolism and regulation of the red blood cells (RBCs). Thyroid dysfunction induces various effects on blood cells such as anemia through reducing the oxygen metabolism. For the first time, we aimed to determine the effects of severity activation of hypothyroidism on RBCs indices in patients with hypothyroidism.

Materials and Methods: This study was performed on 79 patients with hypothyroidism. Initially patients' TSH level was determined by immunoassays method, and then according to TSH ranges (0.3-5.5 µIU/mL), patients were divided into two moderate hypothyroidism (45 individuals) (TSH 6-10 µIU/mL) and marked hypothyroidism (34 individual) (TSH>10 µIU/mL) groups. Then, complete blood count was measured by cell counter.

Results and conclusions: Data analysis revealed a statistically difference between the two groups of patient including moderate and marked hypothyroidism in RBCs count (4.46 versus 4.04 mil/L), hemoglobin (12.8 versus 12.3 g/dl) and hematocrit (39.8 versus 38.0 %) respectively. It seems that severly reduced hormones of thyroid may result in markedly decrease in RBCs count, hemoglobin and hematocrit. These finding are consistent with the fact that reduced thyroid hormones may cause anemia frequently through effect on cytokines involving erythropoiesis such as erythropoietin.

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Introduction

Follicles of thyroid gland store thyroid hormones including 3,5,3 triiodothyronine (T3) and thyroxin (T4) and release these hormones when thyroid stimulating hormone (TSH) is secreted by anterior pituitary. Thyroid hormones play an important role in various mechanisms including protein synthesis, bone maturation, and hematopoiesis in the bone marrow [1]. Nearly all tissues require thyroid hormone. Increased metabolic demand needs more erythropoiesis and blood oxygen capacity. Thyroid hormones affect tissues with high oxygen consumption thiough increased erythropoiesis. Erythropoietin (EPO) is the main physiological stimulator for erythropoiesis. The major EPO production sites are kidneys in adults [2]. Thyroid hormones have a direct effect on kidney functions and secretion of EPO. Studies have demonstrated thyroid-stimulated EPO through increased expression of Hif-1α [3]. There are elements of Hif-1α on EPO gene. Moreover, thyroid hormones increase the kidney blood flow and glomerular filtration rate. Therefore, hypothyroidism is associated with glomerulo-nephritis and chronic kidney disease and results in reduced erythropoietin. Studies have demonstrated that T4, T3-stimulated human red blood cells (RBCs) is accompanied by $Ca2^{+}$-ATPase activity and increased calcium efflux in erythrocyte [4].

Hypothyroidism is diagnosed by increased TSH and normal and/or decreased value of T4 or T3. Thyroid dysfunction induces various effects on blood cells such as anemia (normochromic-normocytic, hypochromic-microcytic or macrocytic). Moreover, a slightly depressed white blood cells (WBCs) count has been observed in hypothyroid patients [5]. Hypoplasia of hematological cells in hypothyroidism has also been reported. However, effects of hypothyroidism severity on RBC count and RBC indices have not yet been investigated. Furthermore, due to the high prevalence of thyroid disorders in Iranian population [6], this study was conducted to highlight the association of thyroid hormones and anemia, with particular emphasis on RBC count, hemoglobin and hematocrit. For the first time, we assessed the improvement of moderate cases and those with the highest TSH levels in RBCs indices.

Materials and Methods

This study was performed on 79 patients with hypothyroidism. Reference range for TSH was 0.3-5.5 µIU/mL; hence, we divided patients in two groups including 45 moderate hypothyroid (TSH>5.5 µIU/mL) and 35 marked hyperthyroid (TSH>10 µIU/mL). Two ml uncoagulated sample and Ethylenediamine-tetraacetic acid (EDTA) anti coagulated were taken from each patient to assay hormone test and complete blood cell count (CBC) respectively. TSH level of the patients was determined by immunoassays method (Elecsys instrument), and CBC was measured by Sysmex (kx 21N Japan).

Statistical analysis was performed by SPSS software. Statistical independent T test was

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used to evaluate the significance of differences between the two groups. P-value<0.05 was considered as a significant index.

Results and Discussion

In 45 patients affected with moderate hypothyroidism, mean age was 15.3 years (4 min; minimum, 42 max; maximum) with 26 and 19% female and male respectively. Moreover, mean age in 35 patients in the hyperthyroid group was 14.8 (6 min, 38 max) with 18 and 16% female and male respectively.

Comparison of the value of TSH in the two hypothyroidism groups was as follows: mean of 7.81 µIU/mL (min 6.2, max 10.32) and 28.83 µIU/mL (min 11.31, max 53.51) in a slight and severes cases of TSH respectively. Data analysis between the two groups of patients revealed statistical difference in RBC counts, hemoglobin and hematocrit. RBC counts in all patients in the two states including moderate and marked hypothyroid showed significant difference with 4.46 and 4.04 mil/L, respectively. Moreover, hemoglobin and hematocrit (HCT) were of statistically significant difference between the two groups (P-value<0.05). The hemoglobin value of moderate hypothyroidism was 12.8 and 12.3 for patients with severe hypothyroidism. HCT was 39.8 and 38.0 in the patients with various severity hypothyroidisms. However, no difference was observed for other RBC indices including mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW) (P-value>0.05) (Table 1 and Fig. 1).

The endocrine system, along with the immune systems and the central nervous, is responsible for the maintenance of hemostasis by mediating the internal environment. Like cytokines, hormones are involved in reproduction, growth and development of hematopoietic stem cells. Studies on patients suffering from hypothyroid has demonstrated marked reduction of RBC mas per Kg of body weight due to decline in erythropoetic activity of bone marrow and decreased count of erythroid cells [7].

Table 1. Comparison between blood cells count and RBC indices in patients with moderate and marked hypothyroidism

Index	Moderate Hypothyroidism	Marked Hyperthyroidism	P-value
Red blood cells (count×10^9)	4. 46±0.25	4.04±0.42	0.02
Hemoglobin (g/dl)	12.8±0.32	12.3±0.37	0.024
Mean corpuscular hemoglobin (pg)	28.6±2.2	28.2±2.37	0.13
Mean corpuscular hemoglobin concentration (g/dl)	31.1±2.3	30.6±1.95	0.1
Mean corpuscular volume (fl)	82.6±6.78	79.6±5.2	0.08
Hematocrit (%)	39.8±1.68	38.0±3.1	0.01
Red cell distribution width (%)	13.1±1.6	13.7±1.48	0.16

Data are presented as Mean±SD

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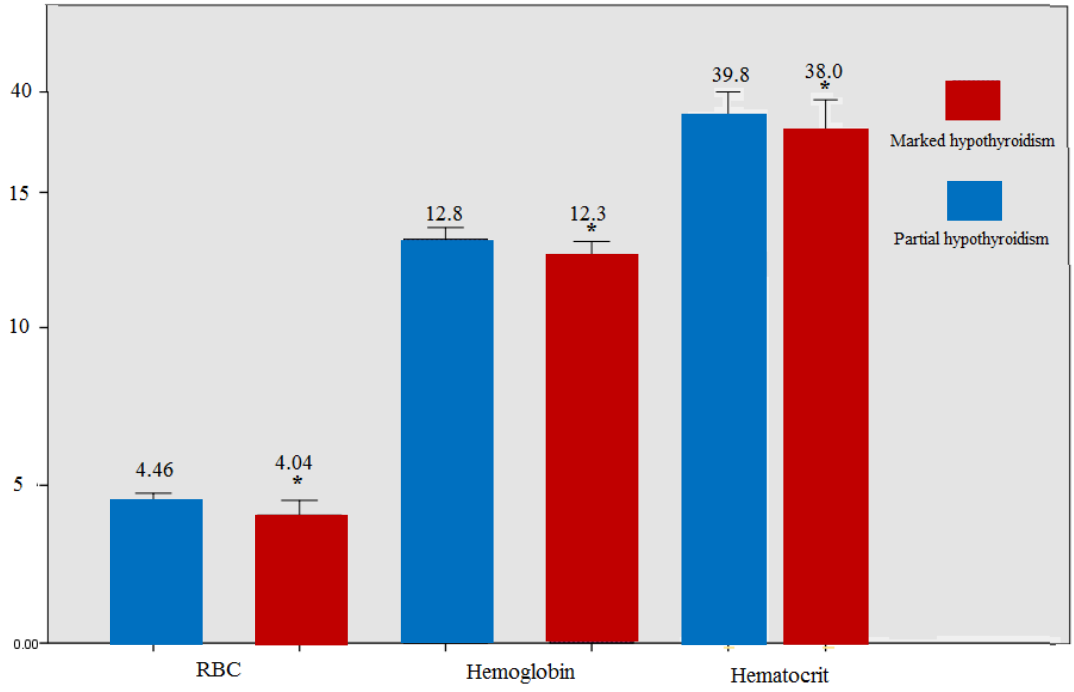

Fig. 1. Red blood cells (RBCs) parameters in patients with moderate and marked hypothyroidism. RBCs count×10^9, hemoglobin (g/dl) and hematocrit (%) between two groups are significantly different. *p<0.05.

Previous studies have investigated hypothyroidism and healthy individuals and/ or two groups including subjects with hypothyroidism and hyperthyroidism [8]. M'Rabet-Bensalah et al. reported that anemia is most observed in overt hypothyroidism (7.7%) [9]. Moreover, Omar et al. showed higher incidence of anemia accompanying hypothyroidism 57.1% [10]. However, we studied two groups including moderate and marked hypothyroidism cases. We demonstrated thyroid hormone influence on the rate of RBC and hemoglobin production and hematocrite. Thyroid hormones have been indicated to act directly on hematopoietic production. Studies have shown that T3 has a direct role in erythroid proliferation. As mentioned above, thyroid hormone has direct and indirect effect on erythroid progenitors. A moderate decrease in serum folate was observed in the patients suffering from hypothyroidism. Reduced serum folate can lead to increased MCV [11]. However, we observed normal MCV in the 2 groups of our study. There may be compensatory mechanisms in sustaining normal MCV.

The causes of anemia-related to hypothyroidism are various. For example Banday and el al. showed that iron deficiency occurrs in hypothyroidism [12]. However, primary causes of anemia, especially in marked hypothyroidism are mandatory to be detected. The current study showed that significantly reduced hormones of thyroid can result in markedly decrease in RBC count, hemoglobin and HCT. These finding are consistent with the fact that reduced thyroid hormones can lead to anemia generally through affecting cytokines involved in erythropoiesis such as erythropoietin.

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Conflict of Interest

The authors declare no conflict of interest.

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