

Original Article**Thyroid Dysfunction and its Effect on Red Blood Cell Parameters****Samir Singh***

Department of Clinical Biochemistry, Kist Medical College and Teaching Hospital, Lalitpur, Nepal

Article Received: 8th September, 2021; Accepted: 12th December, 2021; Published: 31st December, 2021**DOI: <https://doi.org/10.3126/jonmc.v10i2.41777>****Abstract****Background**

Thyroid hormones are necessary for the growth and development, cellular differentiation, physiological function and metabolic regulation of almost all tissues in our body. Thyroid disorders are accompanied by alteration in hematological profile. This study aims to evaluate the effect of thyroid dysfunction on red blood cell parameters.

Materials and Methods

This case-control observational study was conducted in the Department of Clinical Biochemistry, KIST Medical College and Teaching Hospital (KISTMCTH), Lalitpur, Nepal from January 2021 to June 2021. Total number of recruited subjects was 248, out of which 67 were labeled as hypothyroid, 7 were hyperthyroid and 174 were euthyroid as control. Subjects for all three groups were between 16-93 years old. Thyroid hormone profile of patients was determined by Siemens ADVIA Centaur CP immunoassay analyzer and hematological parameters by automated hematology analyzer Sysmex XN-550. Results were analyzed by SPSS 21 software and a chi-square test was applied to see significant differences among the groups.


Results

The mean age of all study participants was 42.08±17.27 years and female constituted 74.6% of total subjects. Analysis of the data obtained a statistically significant difference in the mean hemoglobin ($p<0.001$) between hypothyroid and euthyroid groups. The difference was not significant for hemoglobin ($p=0.252$) among hyperthyroid and euthyroid groups. There was no statistical significant difference between thyroid cases and control for MCV, MCH and MCHC.

Conclusion

The current study concluded that thyroid dysfunction have a significant effect on red blood cell parameters. Hematological parameters should be evaluated in patient with thyroid dysfunction.

Key words: Anemia, Hyperthyroidism, Hypothyroidism

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Introduction

Thyroid gland regulates many of the body physiological functions including normal growth, tissue differentiation and metabolism [1]. The thyroid gland produces hormones namely triiodothyronine (T3), tetraiodothyronine or thyroxine (T4). These hormones influence nearly all the organ systems mainly by the binding of active form of T3 and T4 i.e. free T3 (fT3) and free T4 (fT4) to specific parts of nuclear receptor. Their secretion is regulated through thyroid stimulating hormone (TSH), which is released from the anterior pituitary gland [2,3].

Thyroid hormones have a direct effect on the blood parameters by stimulating the precursors of the erythrocytes and indirectly by enhancing erythropoietin production through hyper proliferation of immature erythroid progenitors and increase secretion of erythropoietin (EPO) by inducing erythropoietin gene expression [4,5]. Thyroid dysfunction is one of the most common endocrine disorders seen in clinical practice. The prevalence of thyroid dysfunction varies by age, sex, race/ethnicity, and geographically through variations in dietary iodine intake [6]. Among various thyroid disorders, hypothyroidism is most prevalent health issue as compared to hyperthyroidism [7].

Thyroid dysfunction can cause an alteration in other hematological parameters such as hemoglobin (Hb), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) [4,5,8]. Hypothyroidism may lead to anemia because of bone marrow repression and decrease in erythropoietin secretion, while the relationship between hyperthyroidism and anemia is less clear [9]. The aim of this study is to evaluate the effect of various types of thyroid hormone abnormalities on red blood cell parameters.

Materials and Methods

The present case-control observational study was carried out in the Department of Clinical Biochemistry in association with Department of Clinical Pathology at KIST Medical College and Teaching Hospital (KISTMCTH), Lalitpur, Nepal from January 2021 to June 2021. This study was ethically cleared by the Institutional Review Committee (IRC) of KISTMCTH. Informed consent was obtained from all the study participants. Patients presented to KISTMCTH within the time frame were enrolled in the study.

Patients with inherited blood cell disorders, chronic diseases, pregnancy etc. were excluded from the study. In the study done by Kulkarni VK [10], 65.9% patients RBC morphology was normocytic normochromic in hypothyroid patients. Using $n = z^2 pq/d^2$ with 6% error, sample size is calculated to be approximately 248.

All the subjects were divided into three groups mainly based on their thyroid function. The first group consisting of hypothyroid subjects ($n=67$), second group as hyperthyroid ($n=7$) and third group as euthyroid ($n=174$) with normal thyroid profile which is served as 'control group'. 3 mL of whole blood was collected from all the subjects in a plain vacutainer to measure serum fT3, fT4 and TSH by fully automated Siemens ADVIA Centaur CP immunoassay analyzer and 2 mL was collected in EDTA vacutainer for the measurement of Hb concentration, PCV, MCV, and MCH using Sysmex XN-550 automated haematology analyzer. The normal range of fT3, fT4 and TSH were 2.3-4.2 pg/mL, 0.89-1.76 ng/dL and 0.35-5.5 μ IU/mL respectively.

Statistical analysis was performed by SPSS 21 software while, mean and Standard deviation were calculated for quantitative variables. Percentages and frequencies were calculated for categorical variables and a chi-square test was applied to see significant differences among the groups. P value <0.05 was considered as a statistically significant.

Results

The mean \pm SD age (in years) of all the subjects ($n=248$) recruited for study was 42.08 ± 17.27 years. In the 67 patients with hypothyroidism, mean age was 47.24 ± 17.3 years and in 7 hyperthyroidism patients mean age was 40.43 ± 22.19 and in control group of 174 patients the mean age was 40.13 ± 17.06 years. Female alone constituted 74.6% of total population whereas male population constituted 25.4% only (Table 1).

Table 1: Table showing the descriptive analysis of hypothyroid, hyperthyroid and euthyroid patients

Cases/Control	Number (n)	Age, Yrs (mean)	Male (%)	Female (%)	fT3 (pg/mL)	fT4 (ng/dL)	TSH (μ IU/mL)
Hypothyroid	67	47.24	20.9	79.1	2.8 \pm 0.72	1.13 \pm 0.30	14.16 \pm 19.02
Hyperthyroid	7	40.43	42.9	57.1	4.29 \pm 2.35	1.7 \pm 0.86	0.13 \pm 0.11
Euthyroid	174	40.13	26.4	73.6	3.11 \pm 0.46	1.23 \pm 0.21	2.51 \pm 1.27



Comparison between hypothyroid and euthyroid groups revealed a statistically significant difference in the mean hemoglobin levels ($p < 0.001$) but no significant difference was found in the MCV ($p = 0.516$), MCH ($p = 0.077$) and MCHC ($p = 0.405$) as shown in Table 2. While comparing hyperthyroid and euthyroid, no significant difference was noted for red blood cell parameters including mean hemoglobin levels ($p = 0.252$), MCV ($p = 0.962$), MCH ($p = 0.783$) and MCHC ($p = 0.717$) as shown in Table 2.

Table 2: Comparisons of Red Blood Cell Parameters in Different Thyroid Dysfunction Groups

Comparison between Hypothyroid and Euthyroid				
Thyroid status	Hb (g/dL)	MCV (fl)	MCH (pg)	MCHC (g/L)
Hypothyroid	11.44±2.07	85.84±7.55	29.01±2.91	32.42±2.82
Euthyroid	13.79±1.91	85.16±7.18	28.26±2.98	32.14±2.04
p-value	<0.001	0.516	0.077	0.405
Comparison between Hyperthyroid and Euthyroid				
Hyperthyroid	12.94±2.07	85.29±4.92	28.57±1.13	32.43±1.72
Euthyroid	13.79±1.91	85.16±7.18	28.26±2.98	32.14±2.04
p-value	0.252	0.962	0.783	0.717

Discussion

Thyroid gland, a vital hormone gland, plays a major role in the metabolism, proliferation of hematopoietic cells, growth and development of the human body [11,12]. Hypothyroidism and hyperthyroidism are the most common thyroid dysfunctions that can lead to various effects on hematopoietic cells such as anemia, erythrocytosis, thrombocytopenia, leukopenia and pancytopenia. Significant changes in other red blood cell indices including MCV, MCHC, RDW and Hb could be seen during thyroid dysfunction especially in hypothyroidism [1,3,5]. Our study has demonstrated the high percentage of female (74.6%) as compared to male (25.4%). A study done in the western part of Nepal by Yadav RK et al. reported a higher prevalence of thyroid disorders in female (76.80%) [13]. In another similar study, the prevalence of thyroid dysfunction was found to be more common among women (80.41%) than among men (19.59%) [3]. In concurrence with our findings, several studies conducted by the different group of researchers had observed the similar increased female preponderance [1,2,4,5,8,14]. Data from the present study showed that the cases of hypothyroidism (27%) are higher than hyperthyroidism (2.82%) in overall study subjects which is similar to the recent study done by Diab N et al. in 2019 and others in 2013 [6,7,15].

The data that we obtained from our study showed that the values of Hb were statistically different between patients with hypothyroidism and euthyroidism ($p < 0.001$), but the values of MCV, MCH and MCHC were not statistically different between these groups. No statistical difference was seen in any of the red blood cell parameters between patients with hyperthyroidism and euthyroidism. In a study conducted by Uma Maheshwari K et al. in 2020, evaluating the variations in hematological indices in patients with thyroid dysfunction, the result revealed that almost all the red blood cell indices except for Hb ($p = 0.0001$) had no statistical difference between hypothyroid and euthyroid patients. But while comparing the values of MCV and MCH in hyperthyroid and euthyroid groups, a significant statistical difference was seen [1]. A similar study done in Pakistan by Salim E et al., red red blood cell indices were compared in patients with hypothyroidism and hyperthyroidism and revealed that Hb, MCV, MCH and MCHC values were not statistically different between these groups.³ Another study of Iran reported the effects of thyroid dysfunction on blood cell indices, the results revealed that almost all the hematological indices (Hb, MCV, MCH, MCHC, and HCT) except for RBCs ($p > 0.05$) had a significant statistical difference ($p < 0.05$) [5]. Many studies concluded that the low hemoglobin levels with thyroid dysfunction particularly hypothyroidism [14,16,17]. Thyroid hormones induce the proliferation of erythrocyte precursors both directly and through the augmentation of erythropoietin production. As a result, different forms of anemia might develop in the course of thyroid dysfunction [18,19].

Conclusion

In conclusion, hypothyroidism, the most common type of thyroid function abnormalities, has a significant effect on hematological parameters. Therefore, it is advisable to evaluate red blood cell parameters of patients with thyroid dysfunction. Due to the lack of previous research studies on the topic in Nepal, this study is subject to limitation.

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Conflicts of interests: None



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