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Biochemical and Hematological Assessment in Patients With Thyroid Dysfunction

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ABTRACT

This investigation conducted for biochemical and hematological assessment in patients with thyroid dysfunction. The research was carried out at a laboratory in Baghdad, Iraq, and it is a case-control study. The sample was gathered from February 2023 through the years 2021 and 2022. About 250 individuals were a part of this study; 100 were hypothyroid, 100 were hyperthyroid, and 50 had normal thyroid function and complete blood counts. A total of three millilitres of whole blood and two millilitres of EDTA were obtained from each subject in an aseptic manner for the CBC. Also, 2 ml of blood was drawn for serum separation, these sera were used for evaluation T3, T4, TSH, AST, ALT, Urea and Creatinine by using kits purchased from Linear company, the procedures for all were done according to manufacturer instructions. The control group had considerably greater mean RBC, Hb, HCT, and MCH concentrations, while the hypothyroid group had significantly lower values. The hyperthyroid group showed no significant difference between MCV and MCH. There were no statistically significant MCHC results in either the hypothyroid or hyperthyroid groups compared to the control group. There was little difference in total lymphocyte and platelet counts between the control, hyperthyroid, and hypothyroid groups. Differential leukocyte count showed statistically significant differences between the hypothyroid and hyperthyroid groups. As seen in Table 2, the hypothyroid group had higher serum TSH levels ($p<0.05$), in contrast to the hyperthyroid group which exhibited lower levels ($p<0.05$). Alternatively, when contrasted with the control group, the hypothyroid group had lower T3 and T4 levels ($p<0.05$), whereas the hyperthyroid group had higher levels ($p<0.05$). Improvements in hepatic and kidney functions were seen in patients with hypo or hyperthyroidism as compared to the control group in this investigation. In conclusion, both hypothyroidism as well as hyperthyroidism affects on hematological and biomarkers for thyroid, liver and kidney

Keywords: Biochemical, Hematology, Kidney, Liver, Thyroid

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INTRODUCTION

When it comes to hematopoiesis and other aspects of metabolic processes, the thyroid gland is crucial. Patients with thyroid problems often have blood abnormalities as well, due to the critical role that thyroid hormones play in the RBC production and metabolism as well as all other components of blood Chandel et al., (2015); Jafarzadeh (2010).

In addition to subclinical thyroid function abnormalities, many patients present with other abnormalities, such as irregular lipid profiles or blood tests, heart problems, atherosclerosis, or other symptoms that can indicate a thyroid hormone shortage or abnormalities Cinemre (2009); Erikci (2009); Gullu et al., (2005); B. Qasim (2018); Qasim et al., (2019).

A prevalent clinical disease, anaemia affects a disproportionate number of women of childbearing age and the elderly, and its frequency in the general population may approach 10% in certain regions of the globe. A decrease in the quantity of Hb or RBCs causes the blood to be less able to transport oxygen to bodily tissues, a condition known as anaemia. According to the WHO standards, a haemoglobin level below 12.0 g/dL for men and 14.0 g/dL for women is considered anaemia. Normocytic anaemia is defined as an MCV between 80 and 100 fl, microcytic anaemia as an MCV between 80 and 100 fl, and macrocytic anaemia as an MCV of 100 fl or more Organization (2011); Szczepanek-Parulska et al., (2017); Tefferi, (2003).

Both directly and indirectly, thyroid hormones affect blood parameters by increasing erythropoietin synthesis and boosting erythrocyte precursors Szczepanek-Parulska et al., (2017).

Low iron levels impact haemoglobin levels in patients with thyroid abnormalities. Low folate and B12 levels impact haemoglobin and red blood cell counts in as many as 25% of these patients. Comorbid illnesses associated to bone marrow suppression may also induce anaemia Cinemre (2009).

Patients with thyroid problems may have many forms of anaemia; the most frequent of these is iron deficiency anaemia, while microcytic and macrocytic anaemia are less prevalent Szczepanek-Parulska et al., (2017)

According to several writers, thyroid dysfunction is often accompanied with anaemia; in fact, it is believed that over 50% of patients have blood abnormalities. Anaemia and other abnormalities of blood parameters are common symptoms of subclinical hypothyroidism Ashraf (2017)

Nutritional deficiencies and decreased thyroid hormones both contribute to anaemia in thyroid dysfunction patients. The latter causes a decrease in erythropoietin levels, which in turn reduces oxygen supply to tissues, and inhibits the stimulation of bone marrow erythrocyte precursors, all of which lead to anaemia Ashraf (2017); Schindhelm (2013)

This investigation conducted for biochemical and hematological assessment in patients with thyroid dysfunction.

METHOD

The research was carried out at a laboratory in Baghdad, Iraq, and it is a case-control study. The sample was gathered from February 2023 through the years 2021 and 2022. a total of around 250 individuals were involved: 50 of the patients had normal thyroid function and full blood counts, whereas the 100 had hypothyroidism and 100 with hyperthyroidism. Under strict aseptic circumstances, two millilitres of EDTA-anticoagulated blood and three millilitres of whole blood were drawn from these subjects for the CBC, respectively. Also, 2 ml of blood was drawn for serum separation, these sera were used for evaluation T3, T4, TSH, AST, ALT, Urea and Creatinine by using kits purchased from Linear company, the procedures for all were done according to manufacturer instructions. The SPSS version 24 statistical package was used for the study.

RESULT AND DISCUSSION

The control group had a considerably greater mean RBCs, Hb, platelet count, and total cellular volume, whereas the hypothyroid group had a significantly lower mean RBC count, MCV, and MCH. When comparing MCV and MCH, the hyperthyroid group could not identify any significant differences. There were no statistically significant MCHC results in either the hypothyroid or hyperthyroid groups compared to the control group. In terms of total leukocyte count and platelet count, neither the control group nor the hypothyroid group, nor the hyperthyroid group differed significantly from the other two (Table 1). Statistical analysis revealed that the hypothyroid and hyperthyroid groups had significantly different differential leukocyte counts (Table 1).

Table 1. Hematological Analysis In Studied Groups

Hematological Parameters	Control	Hyperthyroid	Hypothyroid
RBC (N x $10^6/\mu l$)	4.61 ± 0.52A	3.89 ± 0.68B	3.42 ± 0.38C
Hemoglobin (g)	14.01 ± 0.61A	11.4 ± 1.94B	9.17 ± 2.54C
Hematocrit (%)	40.96 ± 2.4A	33.83 ± 6.7B	28.27 ± 3.04C
MCV (fl)	84.68 ± 3.29A	81.63 ± 1.2B	80.39 ± 5.41C
MCH (pg)	28.96 ± 0.51A	28.32 ± 0.74A	27.15 ± 2.41B
MCHC (g/dl)	30.23 ± 1.05A	29.61 ± 5.91B	29.36 ± 1.35B
RDW (%)	12.59 ± 0.62B	13.78 ± 0.20A	13.29 ± 0.71A
TLC (N x $10^3/\mu l$)	8.23 ± 1.40A	7.47 ± 0.98B	7.84 ± 1.63B
Platelet (N x $10^3/\mu l$)	259.3 ± 108.2A	296.0 ± 24.5A	188.48 ± 36.07B

Table 2 shows that serum TSH levels were greater in the hypothyroid group ($p<0.05$) and lower in the hyperthyroid group ($p<0.05$). In contrast, Table 2 shows that compared to the control group, the hypothyroid group had lower levels of T3 and T4 ($p<0.05$) while the hyperthyroid group had higher levels ($p<0.05$).

Compared to the control group, individuals with hypo and hyperthyroidism exhibited improved liver and kidney functioning, according to the present research (Table 3).

Table 2. Thyroid Hormones Level In Studied Groups

Thyroid indices	Control	Hyperthyroid	Hypothyroid
T3 (ng/ml)	1.39 ± 0.01B	3.58 ± 0.13A	0.94 ± 0.01C
T4 (µg/dl)	8.93 ± 0.63B	15.24 ± 0.21A	3.01 ± 0.74C
TSH (µIU/ml)	2.14 ± 0.12B	0.32 ± 0.01C	8.95 ± 1.6A

Table 3. Some Biomarkers In Studied Groups

Biomarkers	Control	Hyperthyroid	Hypothyroid
AST (U/L)	8.27 ± 0.76C	28.3 ± 5.19A	22.6 ± 3.37 A
ALT(U/L)	14.20 ± 0.38 C	29.1 ± 8.85 A	21.54±4.41B
Urea (mmol/L)	13.1 ± 2.6 C	21.52±1.6 A	18.34±2.1 B
Creatinine (mg/dl)	0.85 ± 0.01 C	1.93 ± 0.24 A	1.65±0.02 B

Anaemia may be caused by thyroid dysfunctions, which impact red blood cells. Importantly, hypothyroidism and hyperthyroidism are these dysfunctions. Also, pancytopenia might be a result of them. Thyroid dysfunction is also associated with changes in haematological parameters such as RBC count, Hb, HCT, MCV, MCH, WBC, as well as platelet count Das et al., (1975). Therefore, in order to ascertain the association between thyroid disorders and alterations in blood counts, this descriptive cross-sectional research was conducted at a tertiary care facility. In comparison to the control group, the hypothyroid group exhibited a notable drop in Mean RBC count, haemoglobin, hematocrit, MCV, and MCH, as well as an increase in RDW (P-value 0.05). In contrast, the hyperthyroid group exhibited a decrease in Mean RBC count, haemoglobin, and hematocrit, as well as an increase in RDW. The hyperthyroid group showed no significant difference between MCV and MCH. Results from the MCHC did not vary substantially (P 0.05) between the control group and the hypothyroid and hyperthyroid groups. The total leukocyte count and platelet count did not vary significantly (P-value 0.05) among the hypothyroid, hyperthyroid, and control groups, according to the statistical analysis.

Das et al., (1975) found anaemia in individuals with hypothyroidism and hyperthyroidism when they examined peripheral blood smears. Golde et al., (1977). In their investigation to associate haematological parameters with thyroid hormones, Dorgalaleh et al., (2013) found no significant differences in RBC, TLC, or platelet count between the hypothyroid and hyperthyroid groups as compared to the control group. On the other hand, Hb, HCT, MCV, MCH, MCHC, and RDW were all significantly different. ("Clinical Relevance of Thyroid Dysfunction in Human Haematopoiesis: Biochemical and Molecular Studies," 2010) While the euthyroid group did not vary substantially in Hb and HCT, Geetha J P et al. found that RDW and MCV were significantly different from euthyroid individuals in hypothyroid and hyperthyroid patients Geetha & Srikrishna (2012).

Research by Kawa et al., (2010) found that, comparing the control group with individuals suffered from hyperthyroidism and hypothyroidism, the results had significantly different levels of RBCs, HCT, MCV, MCH, as well as MCHC Dorgalaleh et al., (2013)

As seen in Table 2, the hypothyroid group had higher serum TSH levels ($p<0.05$), in contrast to the hyperthyroid group which exhibited lower levels ($p<0.05$). On the other hand, T3 and T4 levels decreased ($p<0.05$) in the hypothyroid group compared to the control group, and increased ($p<0.05$) in the hyperthyroid group. Consistent with other research, our investigation found that experimental groups had well-established hypothyroidism and hyperthyroidism based on changed TSH, T3, and T4 levels on the third and sixth weeks Klecha et al., (2006); Serakides et al., (2005). This study's findings corroborated those of Altaher et al., (2013), which found that hyperthyroid patients had significantly higher T3 and T4 levels as comparing with control. In contrast, hyperthyroid patients had significantly lower TSH levels. A lower TSH level in individuals with hyperthyroidism is consistent with previous studies showing that higher thyroid hormones and a lower TSH level are key indicators of thyrotoxicosis. Graves' disease as well as toxic nodular goitre, which is linked to hyperthyroidism, account for the majority of thyrotoxicosis cases Gilbert (2017). According to prior research by Fadel, et al., (2001) on the onset of hyperthyroidism, a significant drop in TSH levels is often seen with an additional rise in T3, T4 levels. This agreed with the most recent findings.

Consistent with our findings, Ahmed et al., (2013) observed elevated SGOT and SGPT levels in 55 individuals with a diagnosis of hypothyroidism, 24 of whom were male and 31 of whom were female. In a study conducted at Manipal Teaching Hospital in Pokhara, Pandey Pandey et al., (2013) discovered that SGOT, SGPT, and ALP enzyme levels were higher in 30 individuals diagnosed with obvious hyperthyroidism and 30 individuals diagnosed with hypothyroidism. The increase was more noticeable in the group with hyperthyroidism than in the group with hypothyroidism. One hundred twenty-four women were identified as hypothyroid (77 as subclinical hypothyroid and 47 as overt hypothyroid), whereas one hundred twenty-two were listed as euthyroid (control). Consistent with their increase, our results for SGOT, SGPT, and ALP in the liver were reported by Yadav et al., (2013)

Results showed that urea levels were greater in 198 euthyroid people than in overtly hypothyroid subjects Tayal et al., (2009). Their results showed that elevated TSH levels and decreased T3 and/or T4 levels affected serum creatinine levels. Additionally, 98 subclinical and 89 overthypothyroid patients had elevated creatinine levels. The overt hypothyroid individuals in our research had elevated urea levels. This might be because of a reduction in renal clearance of uric acid or an increase in production caused by myopathy associated with hypothyroidism Yokogoshi & Saito (1996).

Two studies found that uric acid and blood creatinine levels were higher in 80 hypothyroid people Arora et al., (2009). There was a statistically significant increase in

creatinine and uric acid levels among 47 patients with overt hypothyroidism and 77 patients with subclinical hypothyroidism when compared to 120 healthy controls, which is in line with the findings of Saini et al., (2012). Our findings were in agreement with those of Wedaatalla and Abdella Wedaatalla & Abdella (2012), who found that urea levels were significantly higher in Sudanese women with hypothyroidism and hyperthyroidism (P< 0.05) when compared to those of the control group. Thirty individuals with newly diagnosed primary hypothyroidism had elevated blood creatinine and uric acid levels, as compared to euthyroid patients, according to Kumar Kumar (2013). Low glomerular filtration rate (GFR) and changes in renin activity may explain why hypothyroidism is linked to increased levels of uric acid and creatinine, according to the research. The hypothyroid person's rennin levels drop, which causes an increase in vascular resistance and a reduction in glomerular filtration rate (GFR) due to the effects of thyroid hormones on SVR and VSMC Ojamaa et al., (1996).

CONCLUSION

Both hypothyroidism as well as hyperthyroidism affects on hematological and biomarkers for thyroid, liver and kidney.

AUTHOR CONTRIBUTIONS

All authors played a role in the preparation of this article.

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