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The importance of some physiological markers in Tikrit City patients with beta thalassemia

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ABSTRACT

Background Thalassemia is a heterogeneous group of genetic disorders caused by a deficiency in the production of beta chains of hemoglobin. Objective of this study was to determine the evaluating variables, measuring hematological, biochemical, and physiological indicators in beta-thalassemia patients and comparing the results with healthy individuals in carriers of beta thalassemia in Tikrit, Iraq.

Patients and methods Fifty patients with beta thalassemia carriers who attended the laboratory department of Tikrit Hospital between August 2025 and February 2026 were included in this prospective cross-sectional study. Patients with microcytic hypochromic blood pictures underwent CBC testing, biochemical testing for T-protein, calcium, potassium, and ALP levels, as well as testing for serum iron and ferritin levels.

Results: There were no statistically significant differences ($p > 0.1$) in the current study's sex-specific outcomes. The current study's findings on age groups revealed statistically significant differences ($p < 0.02$) across the study groups. At a probability level of $p < 0.01$, there are statistically significant variations in hematological parameters. Additionally, the two research groups' total protein and potassium levels were found to be lower in patients than in healthy individuals, with statistically non-significant differences ($p < 0.05$). Serum iron and ferritin parameters showed statistically significant differences ($p < 0.001$) between the two study groups, although calcium and ALP levels showed statistically significant differences ($p > 0.05$) between patients and healthy individuals.

KEYWORDS: beta thalassemia, Hemoglobin, CBC, ferritin, iron, T-protein, Calcium and Potassium, ALP

1-INTRODUCTION

The most prevalent type of chronic hemolytic anemia is thalassemia, which is caused by a defect in one of the globin chains' production. It results from both qualitative and quantitative disruptions in globin chain synthesis; hence the term thalassemia refers to those who suffer from it, as globin chains are produced in reduced quantities (1). It can be classified according to, those who suffer from depression are called of decreased β-globin chains name beta thalassemia, while Production of the globin-α chain causes alpha thalassemia (2), and beta thalassemia is Clinically, it is considered one of the most dangerous and abnormal hemoglobin deficiency as a sign of genetic disorders. Hemoglobin is normal. Each year, 4 million newborns are born with beta thalassemia condition, which is typically accompanied by hemolytic anemia symptoms and linked to mortality (3). It is mostly found in the Mediterranean and Southeast Asia seas. It should be mentioned that children with beta-thalassemia may pass away before receiving a diagnosis in places with limited medical services (4). Beta-thalassemia intermedia, beta-thalassemia major, and beta-thalassemia minor are the three subtypes of beta-thalassemia. The number of copies of the defective genes inherited from the affected person's parents determines the clinical severity of anemia in these three categories (5). Although they may have slight anemia, patients with beta-thalassemia minor are typically asymptomatic carriers. The inheritance of secondary β-globin mutations is linked to variable degrees of clinical anemia in patients with thalassemia intermedia (6). Because of this, patients with beta-thalassemia need to receive the proper care and occasionally have blood transfusions in order to survive. However, there are risks and disadvantages to this treatment (7). Iron overload from repeated blood transfusions is stored as ferritin. Its buildup causes major problems, such as growth retardation, abnormalities of the jaw and face bones, and direct effects on the liver, spleen, kidneys, and heart (8). Physicians use iron chelating drugs, which can bind to iron by forming

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groups with non-transferrin iron in the plasma, to prevent these symptoms and negative effects (9). Deferoxamine is now the most widely used medication in Iraq's thalassemia treatment program. It is the first subcutaneous injection of an iron chelating agent. When taken orally as hard tablets, deferasirox is processed in the liver and eliminated in the stool (10).

Assessment of biochemical parameters: This included liver enzyme levels (ALT [alanine aminotransferase]. as well as an assessment of calcium, and an evaluation of iron (Iron) and ferritin (Ferritin). Evaluation of hematological parameters: The study includes a blood group analysis and the white blood cell count (Lymphocytes, Monocytes, Neutrophils as well as hemoglobin concentration (Hb), platelet count (PLT), and packed red blood cell volume (PCV).

2-MATERIALS AND METHODS

A total of 75 blood samples were collected from patients with beta-thalassemia at the Tikrit Teaching Hospital, which specializes in hematology. The sample included 50 patients with the disease and 25 healthy individuals, divided into 35 male and 40 female samples. The patients' ages ranged from 2 to 30 years, while the control group's ages ranged from2 to 30 years, During the period from August 2025 through February 2026, the biochemical study was conducted. Samples were collected by drawing 5 mL of blood, divided into two parts (2 mL each), and placed in tubes containing the anticoagulant diamine ethylene K3 tetraacetic acid, and the tubes were then gently shaken until the blood mixed with the anticoagulant. Blood tests were then performed on these samples, and the other portion of the blood (1 mL) was used for a complete blood count (CBC) and (2 mL) was placed in Clot Activator + Gel tubes and then placed in a centrifuge at 4000 rpm to obtain serum for use in biochemical tests A complete blood count (CBC) was performed on the SYSMEX XN 350 analyzer, which provides reliable results and is capable of generating 60–70 results per hour.

Biochemistry Tests

Phosphatase Enzyme Tests T-protein, Calcium, Potassium, ALP (Alkaline Phosphatase) Operation on the Cobas C311 System:

• Cobas C311 System: This system is characterized by its speed and high accuracy in generating results, as it processes 300 samples per hour.

Measurement of iron concentration in serum

Photometric Colorimetric Assay for the Quantitative Determination of Iron in Human Serum and Plasma Using Beckman AU Coulter Analyzers

Measurement of serum ferritin concentration

An immunoturbidimetric assay for the quantitative determination of ferritin in human serum and plasma using Beckman Coulter AU48 analyzers

Statistical Analysis

The statistical analysis was performed using the Way-One ANOVA statistical software (11).

3-RESULTS

Physiological and Biochemical Study

Comparison of Demographic Characteristics between the Two Study Groups

A total of 75 samples were collected, comprising 50 patients and 25 healthy individuals. The results of the current study showed no statistically significant differences ($p > 0.1$) between sex and the two study groups, as well as more males than females are affected by beta-thalassemia 30(60%) and 20(40%), respectively . Regarding age groups, the results of the current study showed statistically significant differences ($p < 0.02$) between the age groups and the study groups. The age groups 2–10 and 11–20 the highest percentages among patients 22(44%) and 18(36%) compared to the 21–30 year-old groups, which recorded the lowest percentages 10(20%). Among the healthy population, the age groups 2–10 and 11–20 recorded the highest percentages (32(43%) and 26(35%)), compared to the 21–30 years age groups, which recorded the lowest rates 17(22%) as shown in Table 1.

Table 1 Comparison of age and gender between the two study groups of thalassemia patients

Demographic Characteristics		Groups		Total	*P-Value*
		50 patients	25 healthy individuals	75	
Sex	**Male**	30(60%)	13(52%)	43(57%)	
	Female	20(40%)	12(48%)	32(43%)	**0.1**
	2-10	22(44%)	10(40%)	32(43%)	
Age	**11-20**	18(36%)	8(32%)	26(35%)	**0.02**
	21-30	10(20%)	7(28%)	17(22%)	

Comparison of hematological parameters between the two study groups

There are statistically significant differences at a probability level of $p < 0.01$ between the two groups, as shown by the results of the current study. Hematological parameters between the two study groups, the parameters WBC, LYPH, MID, and RDWa, PCT, P_LCR, and PLT Patients with elevated levels of compared to healthy individuals. As for the GRA, MCH, MCHC, RDWa MPV **and** P_LCR indices, the levels recorded were non-significant differences in patients compared to healthy controls, as shown in Table 2.

Table 2: Comparison of blood parameters between the two study groups of thalassemia patients

Blood Parameters	No.	**Mean**	**SD**	***P-Value***
WBC	50 patients	14.08	5.56	p<0.01**
	25healthy individuals	7.78	2.23	
LYM	50 patients	7.12	2.67	p<0.01**
	25healthy individuals	3.12	1.13	
MID	50 patients	0.98	0.32	p<0.01**
	25healthy individuals	0.38	0.19	
GRA	50 patients	5.35	1.41	0.05 NS
	25healthy individuals	4.39	1.51	
RBC	50 patients	2.78	0.75	p<0.01**
	25healthy individuals	4.76	0.48	
HB	50 patients	7.87	1.53	p<0.01**
	25healthy individuals	13.13	1.39	
HCT	50 patients	22.18	4.78	p<0.01**
	25healthy individuals	38.23	4.34	
MCV	50 patients	78.53	6.34	p<0.01**
	25healthy individuals	81.87	6.32	
MCH	50 patients	27.86	2.32	0.05 NS
	25healthy individuals	28.43	2.31	
MCHC	50 patients	35.97	1.34	0.05 NS
	25healthy individuals	33.87	1.41	
RDWa	50 patients	69.87	10.13	p<0.05*
	25healthy individuals	53.87	11.78	
PLT	50 patients	459.43	188.97	p<0.001***
	25healthy individuals	287.32	53.12	
MPV	50 patients	11.18	1.78	0.05 NS
	25healthy individuals	8.76	1.12	
P_LCR	50 patients	29.76	11.43	p<0.05*
	25healthy individuals	23.45	7.87	
PCT	50 patients	0.52	0.18	p<0.01**
	25healthy individuals	0.31	0.06	

Comparison of biochemical parameters between the study groups

The results of the current study indicate that there are statistically non-significant differences ($p < 0.05$) the two study groups. Total protein and Potassium levels were found to be low in patients compared to healthy individuals. As for Calcium and ALP levels were recorded statistically significant differences ($p > 0.05$) in patients compared to healthy individuals in the two study groups, as shown in Table 3 between the study group, as shown in Table 3.

Table 3: Comparison of biochemical parameters between the two study groups of thalassemia patients

Biochemical Parameters	No.	Mean	SD	*P-Value*
Total protein g/dL	50 patients	7.09	0.71	0.05 NS
	25healthy individuals	7.23	0.32	
Potassium mmol/L	50 patients	4.64	0.52	0.05 NS
	25healthy individuals	4.71	0.41	
Calcium mg/dL	50 patients	7.84	0.92	p<0.05*
	25healthy individuals	8.89	0.75	
ALP U/L	50 patients	195.74	57.11	p<0.01**
	25healthy individuals	119.87	51.65	

Comparison of serum iron and ferritin parameters between the study groups

The results of the current study indicate that there are statistically highly significant differences ($p< 0.001$) the two study groups. **serum iron** and **ferritin parameters** levels were found to be highly in patients compared to healthy individuals, as shown in Table 3 between the study group, as shown in Table 4.

Table 4: Comparison of serum iron and ferritin parameters between the two study groups of thalassemia patients

Parameters	No.	**Mean**	**SD**	***P-Value***
Iron **mcg/dL**	50 patients	176	59.3	< 0.001
	25healthy individuals	146	76	
Ferritin **ng/mL**	50 patients	145	144	< 0.001
	25healthy individuals	120	76	

Discussion

The results of this study showed a statistically significant increase ($P \leq$ **0.02**) in the incidence of thalassemia among the first age group compared to the second and third age groups, indicating that the prevalence of in the first age group, meaning that patients up to the age of 20 or older are prone to numerous complications, the most significant of which is iron overload, which affects the heart muscle, kidneys, and the endocrine glands, in addition to viral infections that lead to numerous deaths. This finding is consistent with previous studies conducted by Tawfeeq (12). As for gender, there is no significant difference ($P \leq 0.1$) between the sexes because thalassemia is a genetic disease transmitted from parents to children, regardless of gender. According to the questionnaire results, a significant increase in thalassemia was confirmed among consanguineous marriages, attributed to certain common tribal traditions, intermarriage, and a lack of openness to other families, particularly among those who marry their cousins. This was found during the study, and this result is consistent with the previous study conducted by Shafique et al.., (13).

Gharehdaghi et al. (14) showed that there was no significant difference ($P > 0.05$) between males and females among beta-thalassemia patients, and these findings were consistent with those of the current study. Banafa et al., (15) found that a higher proportion of participating patients were male (54.65%) compared to females (46.34%), with a significant difference ($P < 0.05$), and these results are inconsistent with the current findings. In contrast, Rambod et al. (16) reported a higher prevalence of beta-thalassemia among females in the study population (54.72% compared to males (46.27%). The reason for this difference may be related to the study population Ayyash and Sirdah (17) reported high levels of white blood cells and lymphocytes and a higher absolute count range (Mid) in patients compared to healthy individuals, and these findings were consistent with the current results. An increase in white blood cell count occurs in thalassemia due to hypoxia caused by severe anemia, which leads to the formation of in the bone marrow and the formation of red blood cells outside the bone marrow in the spleen and liver, which release immature red blood cells into the peripheral blood (18). B cells play a role in the production of autoantibodies and important lymphocytes that produce antibodies against transfused red blood cells, and are therefore of great importance for humoral immunity in thalassemia patients (19). Furthermore, Gharehdaghi et al. (14) that there were differences in hemoglobin levels, hematocrit, red blood cell count, and mean corpuscular volume (MCV) in patients compared

to healthy individuals, and these results were consistent with current findings. Rheological properties an important role in regulating blood flow in the microcirculation and the systemic circulation because blood viscosity is a can negatively affect circulatory failure and exacerbate it (20).

Hemolysis also contributes to iron overload, which leads to changes in the vascular endothelium and a state of vascular inflammation (21). It appears that blood transfusions and therapeutic interventions, such as splenectomy, influence the occurrence of such as thrombosis, heart attacks, and thromboembolic events due to a hypercoagulable state. Thalassemia patients who receive regular blood transfusions have a lower incidence of thromboembolic events compared to patients who do not rely on blood transfusions, and it appears that patients with intermediate thalassemia have an increased tendency to clot compared to patients with beta-thalassemia major. The results of our study were consistent with those of a study by Gharehdaghi (14) which showed lower levels of total protein, potassium, ALP,and calcium in patients compared to healthy individuals, whereas the study by Khaleel et al. (22) showed an increase in total protein levels in patients compared to healthy individuals; these findings are inconsistent with the current results. The decrease in levels may be attributed to dietary factors. The results of our current study showed decreased levels of calcium and potassium, and our findings are consistent with a study by Shaalan et al. (23), which demonstrated decreased levels of calcium and potassium in patients compared to healthy individuals.

With 95.5% of males and only 4.5% of females, the prevalence of iron excess was 8.4%, which is comparable to the rate of 10% reported by MUSTAFA et al. (24). Although serum ferritin and serum iron are commonly used and accepted indicators of the body's iron content, we did not consider the effects of acute phase reactions or other inflammatory conditions that could cause independent elevations in ferritin. As a result, anemia was present in 71.6% of the study patients, which is lower than that reported by Hasan (88.3%) (25). Therefore, subclinical inflammation may still have an impact on the outcomes (26).

5. CONCLUSION

We concluded that a significant increase was found in some hematological parameters in beta-thalassemia patients compared to healthy individuals, including WBC, MID, LYM, GRA, MCV, and PLT.As well as the study showed no statistically significant differences in the Total protein and Potassium parameters. While A significant increase was found in alkaline phosphatase (ALP) enzyme levels in beta-thalassemia patients compared to healthy individuals. Beta thalassemia trait patients are more likely to get iron overload, so it's critical to properly check their iron status.

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Authors' contributions
All the aspects of this study were fully the responsibility of each author and they were involved in data analysis, writing and editing of the article.

Conflict of interest
All authors declare that there are no competing interests.

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