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Assessment of Serum Hepcidin and Its Association with Hematological Parameters in Acute Lymphoblastic Leukemia

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Abstract

The most prevalent form of childhood cancer, acute lymphoblastic leukemia (ALL), is distinguished by the buildup of malignant cells and their multiplication lymphocytes in the bone marrow. Imbalances in immune expression and iron homeostasis are frequently observed in acute leukemia. The research experiments were carried out from December 2023 to November 2024 in the Biology Department of the University of Kufa's Faculty of Science. Individuals with acute lymphoblastic leukemia (ALL) who had treatment at the National Center for Teaching Laboratories Hospital in Baghdad Medical City and the National Hospital for Oncology and Hematology in Najaf. Since iron is a necessary component of blood cells, serum hepcidin levels are used to monitor the body's iron status. According to the study's findings, newly diagnosed ALL patients had noticeably higher blood hepcidin levels. Newly diagnosed acute lymphoblastic leukemia patients had noticeably higher white blood cell counts. In this study, individuals with acute lymphoblastic leukemia had low red blood cell counts.

Keywords: Acute lymphoblastic leukemia, hepcidin, RBCS, WBCs, Hb

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Introduction

The development of cancerous growths and the buildup of typically immature cells in the marrow cavity are hallmarks of acute lymphoblastic leukemia (ALL), a clonal disease that is among the most common blood cancers in patients (1,2). Cancer, particularly ALL, is a malignant disorder of cell growth that arises from multiple blood components, affecting B or T cells and their pathways of growth and differentiation (3,4). The prevalence of ALL types, where the B-cell population is 85%, the T-cell population is 10–15%, and the natural killer (NK) cell population is usually less than 1%, varies widely in incidence, which is worldwide (5,6). The disease typically affects children from birth to less than six years of age, but it also commonly occurs in older children and adults (7). On this basis, some patients may gradually deteriorate over months, and acute lymphoblastic leukemia (ALL) usually has a sudden clinical onset (8). Fever is a common symptom that can be brought on by a secondary bacterial infection or leukemia, as well as fatigue and exhaustion resulting from anemia (9). These symptoms are often associated with an increased number of leukemia cells and are the three most common laboratory abnormalities, especially in children with ALL. They are associated with thrombocytopenia and a lower number of neutrophils, with approximately 15% of young patients usually affected by an increased white blood cell count (10).

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Scientists have confirmed that cancer cells are usually prone to iron absorption, and their iron stores are low, which is evident in the blood count. Significant changes in iron stores may occur during leukemia through apparent regulation of the ferroportin-hepcidin axis, resulting in significant modifications in absorption, storage, transport, and excretion (11). At the same time, cancer cells may have an adhesive nature, and angiogenesis may occur with increased iron storage in the form of ferritin chains (12).

There is a link between reactive oxygen species (ROS), which result from excess iron, and the normal hematopoietic process, which ultimately leads to harmful cellular changes (13). The blood count of patients suffering from a group of malignant blood diseases may be low, changing the quantity of white or red blood cells, the kinds of white blood cells, and the quantity of platelets (14,15). Variations in red blood cell and white blood cell counts have a detrimental effect on the body's metabolism, important processes, and overall health rather than a good one (16,17).

Materials

Study Subjects

From December 2023 to November 2024, the research tests were carried out in the biology department of the University of Kufa's Faculty of Science. Patients with acute lymphoblastic leukemia (ALL) receiving treatment were included in the research sample at the National Center for Teaching Laboratories Hospital in Baghdad Medical City and the National Hospital for Oncology and Hematology in Najaf. The study included 90 children aged between two and eight years. They were divided into two groups: 55 patients with newly diagnosed ALL who had not received treatment and whose diagnosis was confirmed by pediatric hematologists, and 35 individuals who were in the control group and did not have any diseases that could interfere with the study. All patients and healthy controls gave informed consent.

Methods

Three milliliters of blood were taken from the patients and divided into two halves. The first half, containing two milliliters, was placed in anticoagulant-free gelatin tubes to prepare serum. The tubes were centrifuged for 10 minutes at 3500 rpm after being left to clot for 15 minutes at room temperature (25°C). Following serum separation, hepcidin was measured using human enzyme-linked immunosorbent assay (ELISA) kits and an ELISA reader, and the blood picture was measured using a complete blood count machine.

Statistical analysis

The data analysis was performed by SPSS version 20, where the t-test independent to compare patients and controls, and correlation was used in this study.

Results

Hepcidin

Children with acute lymphoblastic leukemia (ALL) and the control group (healthy group) had mean serum hepcidin levels, as shown in Figure 1. The findings of this Figure demonstrated a significant rise in the P-value, less than 0.05, in the hepcidin level in the ALL group, which reached (64.68 ± 1.451 ng/ml) compared to the control group, where their ferritin level reached (37.44 ± 0.8261 ng/ml).

Red Blood Cell count

Figure 2 shows the mean red blood cell count in the blood of children with acute lymphoblastic leukemia (ALL) and the control group (healthy group). The results of this table showed a significant decrease in the probability value (P-value), less than 0.05, for the number of red blood cells in the ALL group, which amounted to ($2.889 \pm 0.09610*10^6$) compared to the control group, where the number of red blood cells was ($4.516 \pm 0.07726*10^6$).

White Blood Cell Count

Figure 3. The Figure shows the mean white blood cell count in the blood of children with acute lymphoblastic leukemia (ALL) and the control group (healthy group). The results of this table showed a significant increase in the probability value (P-value)

of less than 0.05 for the white blood cell count in the ALL group, which amounted to ($48.42 \pm 5.627 * 10^3$) compared to the control group, where the white blood cell count amounted to ($8.704 \pm 0.3526 * 10^3$).

Hemoglobin level

Figure 4 shows the mean Hemoglobin level in the blood of children with acute lymphoblastic leukemia (ALL) and the control group (healthy group). The results of this table showed a significant increase in the probability value (P-value) of less than 0.05 for the Hemoglobin level in the ALL group, which amounted to (7.944 ± 0.1940), compared to the control group, where the Hemoglobin level amounted to (12.70 ± 0.1638).

Correlation Between Serum Hepcidin and Blood Profile in ALL

Table 1 shows the relationship between the level of Hepcidin in the blood of children with acute lymphoblastic leukemia (ALL). The results showed a positive relationship between Hepcidin and other blood parameters.

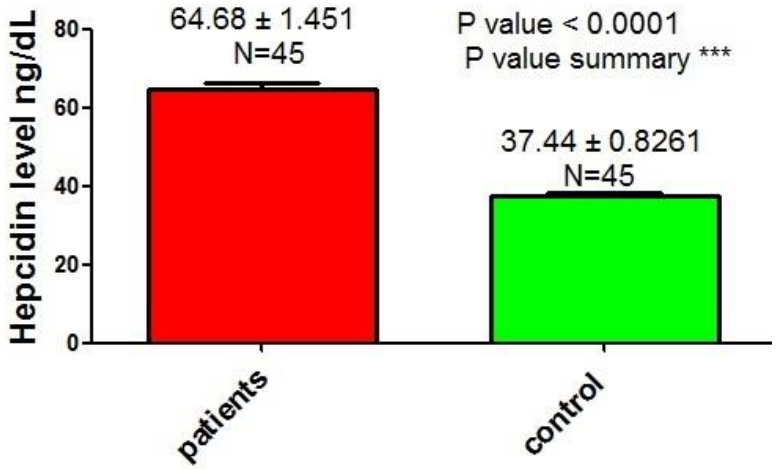

Figure 1 shows the level of hepcidin in the ALL group patients compared to the control group.

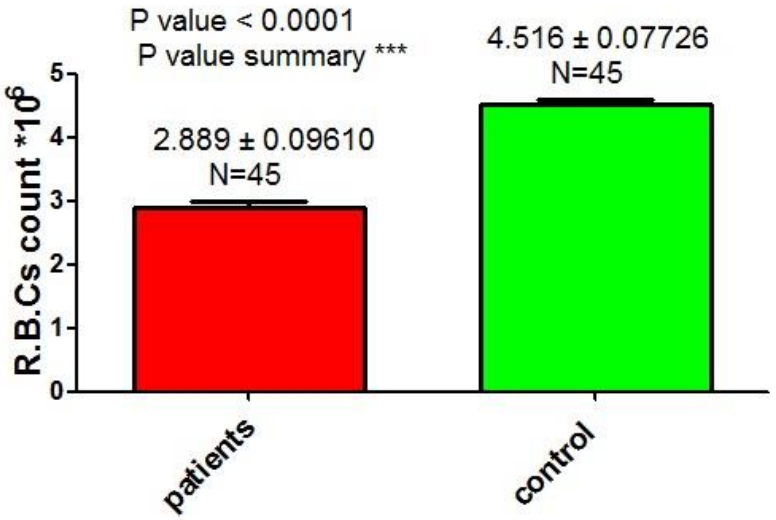

Figure 2: The red blood cell count in patients with ALL is shown compared to the control group.

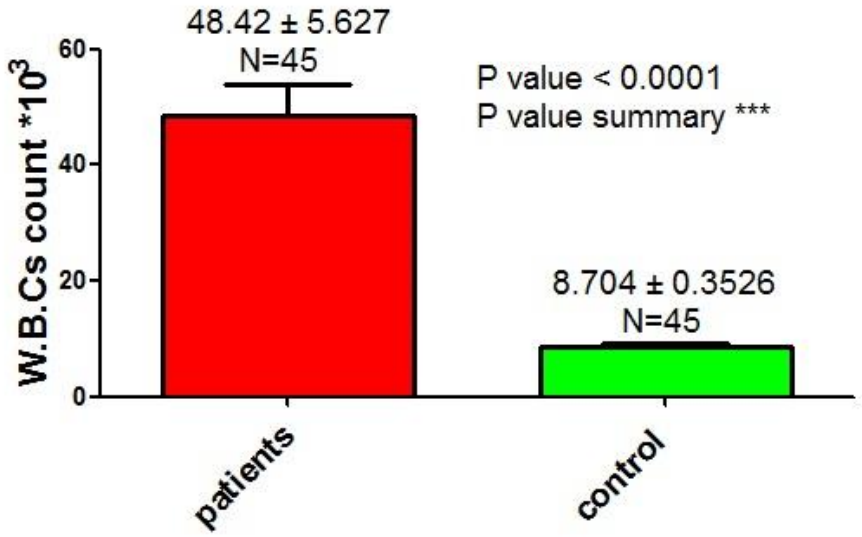

Figure 3. The white blood cell count in patients with ALL is shown compared to the control group.

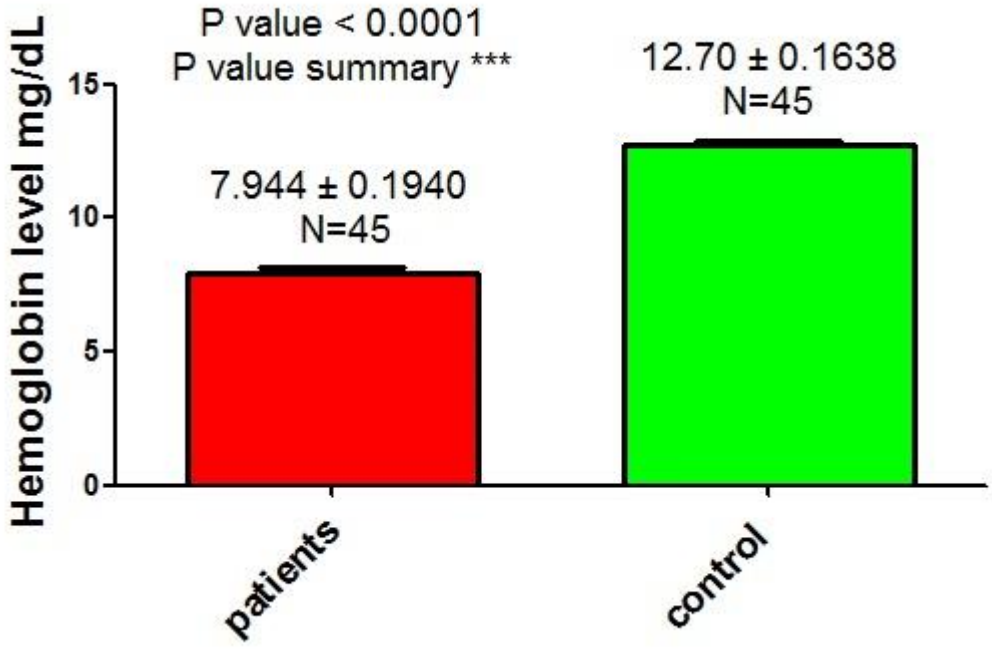

Figure 4. The Hemoglobin level in patients with ALL is shown compared to the control group.

Table 1 shows the relationship between the level of Hepcidin and blood parameters

No.	Title	R value	P value
1	Correlation Between Serum Hepcidin and red blood cells	0.551	0.0436
2	Correlation Between Serum Hepcidin and white blood cells	0.509	0.0861
3	Correlation Between Serum Hepcidin and Hemoglobin level	0.45	0.105

Discussion

Serum hepcidin levels in this study were significantly elevated among newly diagnosed ALL patients compared to age-matched normal individuals, consistent with (18). Hepcidin is a key regulator of iron metabolism, and its increase may be associated with chronic inflammation or iron metabolism disorders, which are common in cancer patients. Several studies have indicated that patients with elevated hepcidin levels tend to have a poorer prognosis compared to those with lower or normal levels (19). Additionally, several other studies have reported that serum hepcidin is significantly increased in acute leukemia and other hematologic malignancies, with important prognostic implications (20). In acute leukemia, the rate of serum hepcidin synthesis is increased. However, individuals with acute leukemia have high serum levels because the body is unable to rapidly remove excess ferritin from the blood (21). Iron overload, chemotherapy, and infection are potential causes of increased serum hepcidin levels in ALL patients (22).

In this study, white blood cell levels were significantly elevated among newly diagnosed acute lymphoblastic leukemia (ALL) patients compared to normal individuals of the same age. This is consistent with (23). Abnormal proliferation of immature lymphocytes (blast cells) occurs, leading to abnormally high white blood cell counts in the blood (24). This elevation may be an indicator of disease severity or the body's response to trying to compensate for a blood imbalance (25). In some cases, high white blood cells may be related to increased hepcidin, since infections and cancers affect iron metabolism and immune response (24).

Low red blood cell levels in this study among patients with acute lymphoblastic leukemia (ALL) are a common and expected finding, with several possible causes. In ALL, bone marrow suppression may be the cause. Normal blood cells in the bone marrow are replaced by

immature lymphoblasts, reducing red blood cell production. As you previously noted, elevated hepcidin in the study may limit the availability of iron needed for red blood cell production, exacerbating anemia. This study is consistent with the findings of (26).

Conclusion

This study examined the effect of a significant increase in the incidence of lymphocytic leukemia in the total lymph nodes of patients with B-cell lymphoma. A significant increase was found in the level of hepcidin and in the number of white blood cells, but there was a significant decrease in the number of red blood cells and the level of hemoglobin.

Conflict of interest: NIL

Funding: NIL

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