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Reticulocyte Hemoglobin Content as a Best Indicator of Iron Deficiency in Female Patients with Diffuse Non-scarring Hair Loss

Zahraa Jasim and Hayder Aledan

Department of Medicine, College of Medicine, University of Basrah, Division of Dermatology,

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Iron deficiency is a well-documented cause of diffuse non-scarring hair loss. We aimed to find the best representative laboratory parameter for iron deficiency. This was a cross-sectional observational study conducted on 51 female patients with diffuse non-scarring hair loss and iron deficiency state. Iron deficiency was diagnosed as serum ferritin below 30 ng/ml, TSAT below 20% or CHr below 29 pg. Among 51 female patients with diffuse non-scarring hair loss with laboratory proven iron deficiency; low CHr was reported in 50 (98%) patients, low TSAT was reported in 43 (84.3%) patients, low serum ferritin was reported in 28 (55%). The reticulocyte hemoglobin content (CHr) shows the highest frequency of iron deficiency in patients with diffuse hair loss and iron deficiency state.

Keywords: Ferritin, hemoglobin, transferrin saturation, reticulocyte hemoglobin content, hair loss.

Iron deficiency is a well-known cause of diffuse non-scarring hair loss in women[1]. One of the rapidly diving cells in the body is the hair follicle matrix cells and iron is a cofactor for the ribonucleotide reductase which is the rate-limiting enzyme for DNA synthesis and, also is a regulator for multiple genes in the hair follicles[2]. Iron deficiency without anemia is far more prevalent and about two-folds higher than iron deficiency anemia and iron deficiency is more prevalent in women than men[3]. Iron deficiency with or without anemia is more common in menstruating women, black race, athletes, vegetarians and obese or overweight[4-8]. The most common cause of iron deficiency in premenopausal women is menstrual blood loss and in postmenopausal women is gastrointestinal blood loss[9, 10]. Laboratory markers for iron deficiency anemia include low hemoglobin levels, low mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH), increase red cell distribution width, decrease serum ferritin, decrease transferrin saturation (TSAT) and low reticulocyte hemoglobin content[11].

The purpose of the study is to evaluate the best laboratory markers of iron deficiency among women with diffuse non-scarring hair loss which was attributed to iron deficiency.

METHODS

This was a cross-sectional descriptive study conducted on patients with diffuse hair

Table 1. Baseline characteristics of the patients with diffuse hair loss and iron deficiency state (n = 51)

Characteristics	Values
Age (years)	28 ± 10.5
Females	51 (100)
Body mass index (BMI)	26.5 ± 5
Medical diseases	0 (0)
Iron deficiency state	51 (100)

Values are expressed as Mean ± SD, n (%). Iron deficiency state defined as serum ferritin below 30 ng/ml, transferrin saturation below 20% or reticulocyte hemoglobin content below 29 pg.

Table 2. Percentages of iron deficiency parameters in patients with iron deficiency state & hair loss (n = 51)

Iron deficiency parameters	Values
Low reticulocyte hemoglobin content (CHr)	50 (98)
Low transferrin saturation (TSAT)	43 (84.3)
Low serum ferritin	28 (54.9)

Values are expressed as n (%). Iron deficiency state defined as serum ferritin below 30 ng/ml, transferrin saturation below 20% or reticulocyte hemoglobin content below 29 pg.

loss consulted outpatient dermatology clinic at Al-Sader Teaching Hospital from November 1, 2020, to May 1, 2021. The study was approved by the Institutional Review Board of the University of Basrah and Ministry of Health. Patients more than 18 years old with diffuse hair loss and iron deficiency were included in the study. Iron deficiency state was confirmed by any one of the following parameters (serum ferritin below 30 ng/ml, transferrin saturation below 20% or reticulocyte hemoglobin content below 29 pg). Patients with coexistent vitamin D and zinc deficiency and other medical causes of hair loss such as thyroid disease were excluded from the study. Data were collected on patients' age, gender, body mass index and history of chronic medical diseases. Patients were examined for types of hair loss. Investigations were sent including complete blood count, serum ferritin, transferrin saturation (TSAT) and reticulocyte hemoglobin content (CHr). The CHr was reported from the CBC by using Siemens ADVIA 2120 (Siemens, Tarrytown, NY). Statistical analysis was descriptive in term of frequencies and percentages using SPSS version 25.

RESULTS

From November 1, 2020, to May 1, 2021, 51 patients with diffuse hair loss and iron deficiency were studied. Table 1 shows the baseline characteristics of the patients. The mean ages were 28 ± 10.5 years, all were females, the BMI were 26.5 ± 5 and all have no medical diseases. Table 2 shows the percentages of iron deficiency parameters in patients with iron deficiency state. Low reticulocyte hemoglobin content was reported in 98%, low transferrin saturation in 84.3% and low ferritin in 54.9%.

DISCUSSION

Of total 51 patients with hair loss and iron deficiency, reticulocyte hemoglobin content (CHr) showed the highest frequency of iron deficiency, followed by TSAT whereas serum ferritin showed the lowest.

Hemoglobin may be normal because iron deficiency state may occur without anemia. Both MCV and MCH reflect iron availability for erythropoiesis but they have certain limitations for diagnosis of iron deficiency state include the followings: they are a late finding, slow to change, not reflect iron availability for erythropoiesis and not helpful in assessing response to therapy[12-14]. Also, MCV may be normal in cases of iron deficiency during pregnancy, in an elderly with coexistent nutritional deficiency such as folic acid and B12 and in patients with medical diseases that already increase the MCV such as liver disease[15-17]. So, in our study because of these limitations and inaccuracy of both MCV and MCH, we don't use these parameters for assessment of iron deficiency state. Serum ferritin is required for diagnosis of iron deficiency, and it reflect iron store[15]. It is a stable glycoprotein and not affected by recent iron ingestion[18]. It is an acute phase reactant and increased in inflammatory conditions making it invaluable for diagnosis of iron deficiency[19]. In our

study, more than 50% of cases with proved iron deficiency state have normal or even higher serum ferritin so normal serum ferritin is not helpful to rule out iron deficiency state. Serum iron has many limitations for diagnosis of iron deficiency: it is affected by recent iron ingestion and has diurnal variation[20, 21]. The TSAT indicate iron deficient erythropoiesis rather than iron depletion state[13]. It is also reduced in inflammation[22]. The CHr measures the hemoglobin content of the newest RBCs thus indicating the iron availability over the previous 3-4 days so it reflect a real-time assessment of iron deficient erythropoiesis and assess response to iron therapy (23). Its levels are only slightly reduced in inflammation[24]. It is helpful in diagnosis of both absolute and functional iron deficiency state when serum ferritin and TSAT are unhelpful.

The study has many limitations. First, it is a cross-sectional descriptive study and not a prospective study or randomized controlled trial. Second, no control groups were taken so we can't determine the positive and negative predictive value of the tests studied. Third, no follow up measurement of these parameters to assess response to iron therapy.

CONCLUSIONS

The reticulocyte hemoglobin content (CHr) shows the highest frequency of iron deficiency in patients with diffuse hair loss and iron deficiency state.

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