A study of iron status in patients with chronic renal failure

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الخلاصة:

المقدمه: إن مرض فقر الدم يكون منتشرا لدى المرضى المصابين بالعجز الكلوي المزمن المعالجين بالديلزه وذلك لعدم قدرة الكليه على افراز هرمون الارثروبويتين ، الذي يقوم بتحفيز نخاع العظم لصنع الخلايا المولده لكريات الدم الحمراء. وفقا لذلك هؤلاء المرضى بحاجه الى العلاج بالحديد و هرمون الارثروبويتين لمنع حدوث فقر الدم لديهم.

الهدف: يهدف البحث لتقدير نسبة الهيموغلوبين في الدم وكذلك تقديرالحديد وارتباطاته في البلازما لدى مرضى عجز الكليه المزمن بنوعيهم، الذين يستخدمون الحديد كعلاج لفقر الدم والنوع الاخر الذين لا يستخدمونه.

طريقة العمل: شملت الدراسة خمسين مريضا من الذكور المصابين بعجز الكلية المزمن و أربعين ، المرضى انفسهم تم تقسيمهم الى مجموعتين حسب استخدامهم الحديد كعلاج لحالات فقر الدم إلى مجموعه اولى استخدمت الحديد كعلاج لفقر الدم وكان عددهم خمسه وعشرين مريض و مجموعه ثانيه لم تستخدم الحديد كعلاج لفقر الدم وكان عددهم خمسه وعشرين مريض ايضا. تم قياس نسبة الهيموغلوبين ، اليوريا و الكرياتنين والحديد وارتباطاته في الدم لجميع الاشخاص الذين شملتهم الدراسه وذلك باستخدام الطرق الكيميائيه السريريه .

النتائج: اظهرت الدراسه ان هناك انخفاض معنوي ($P<0.001$) بمستويات نسبة الهيموغلوبين بالدم وكذلك الحديد ومرتبطاته، و ان هناك زياده معنوية ($P<0.001$) في مقدار اليوريا والكرياتينين لدى المرضى عند مقارنتهم مع الاشخاص الاصحاء.

وكذلك اظهرت الدراسه انه عند مقارنة المرضى انفسهم باستخدام مجموعه منهم الحديد كعلاج لفقر الدم وعدم استخدام المجموعه الاخرى منهم الحديد، إن هنالك زيادة معنويه ($P<0.01$) بمستويات الهيموغلوبين والحديد ومرتبطاته لدى المرضى الذين استخدموا الحديد كعلاج عن النوع الاخر من المرضى الذين لم يستخدموا الحديد كعلاج.

الاستنتاج: اظهرت الدراسه ان معظم مرضى العجز الكلوي المزمن بحاجه للحديد خلال فترة معالجتهم بالديلزه.

Abstract:

Background: Iron deficiency anemia is the depletion of iron stores to the point that red blood cell (RBCs) production is impaired. Individuals with kidney failure are well confirmed to develop anemia. This is because their kidneys cannot produce enough erythropoietin, as well as other factors.

Objective:

The study was designed to evaluate the iron status and investigate the changes of its related parameters in patients with chronic renal failure (CRF).

Methods:

Fifty patients with chronic renal failure as well as 40 apparently healthy individuals (control group) were enrolled. Further classification of the patients were carried out depending on the iron supplementation, i.e,25 patients treated with iron supplementation and 25 patients without such treatment. Hemoglobin, serum urea,

creatinine, iron, total iron binding capacity (TIBC), and unsaturated iron binding capacity (UIBC) were determined in the patients and the control groups.

Results:

Significant (P<0.001) decreases of hemoglobin, serum iron, TIBC, UIBC, and significant (p<0.001) increases of serum urea and creatinine levels were obtained in the group of CRF patients when compared with those of the control group. The evaluation of the studied parameters in the two groups of CRF patients revealed significant (P<0.01) elevations of hemoglobin, serum iron, TIBC, and UIBC in the group of patients with iron supplementation when compared to those without such supplementation.

Conclusion:

The current study confirmed the need of iron supplementation for patients with CRF and demonstrate that such supplementation improve the iron status in this disease.

Introduction:

Iron deficiency anemia is the depletion of iron stores to the point that red blood cell (RBCs) production is impaired. It may develop due to various causes; the most prevalent of which is insufficient iron intake as a result of inadequate nutrition or an imbalanced diet in a population that has increased iron requirements[1,2]. Even when dietary iron intake is adequate, a deficiency can result from insufficient iron absorption. It is important to note that while iron deficiency is the main cause of anemia, other causes are involved in the development of anemia, i.e., chronic infections, e.g. tuberculosis, genetic conditions, e.g., thalassemia and sickle cell anemia, nutritional deficiencies, e.g., folate deficiency, and vitamin B12deficiency [3].

In patients with chronic diseases, including malignancies, inflammatory disorders, and chronic renal failure, anemia develops as a result of suppressed hemoglobin production. This condition is known as anemia of chronic disease [4]. Anemia may, in the absence of proteinuria, be the first sign of chronic renal failure. In the beginning, it is just a mild anemia not affecting the clinical state of the patient. With the progression of chronic kidney disease, anemia aggravates with the symptoms of weakness, tiredness and strain intolerance getting more pronounced. At the end stage of chronic renal failure (CRF), approximately 75% of patients have hemoglobin levels (Hb%) below 10 g/dl and approximately 25% of patients depend on transfusions. In patients approximately managed with dialysis, anemia may improve, however, it rather frequently remains the main hindrance to successful recovery of the patients [5,6].

Anemia in CRF patients is hypo proliferative and normochromic and normocytic erythrocytes are found in blood smears. Reticulocytes count is twice lower than the normal value. There may be a normal or slightly reduced ratio between erythroid cells and granulocytes in the bone marrow [7]. In chronic renal failure, the anemia that develops is frequently complex, it´s primary cause is inadequate production of erythropoietin by the diseased kidney [8].

Subjects and method:

This study was carried out in the Artificial Kidney Unit (AKU) in Al- Hakeem Hospital in Najaf. The study population composed of *ninety* men, their age range was (30-70 years). They were arranged in two groups.

The *first* group: consisted of *forty* male individuals who were clinically healthy.

The *second* group: consisted of *fifty* male patients with chronic renal failure, they were subjected to dialysis. This group was divided in to two subgroups according to iron supplementation:
The first includes the renal failure patients without iron supplement which consisted of *twenty five* male patients.
The second is the renal failure patients with iron supplement: consisted of *twenty five* male patients.

The whole blood hemoglobin (Hb%), serum urea, creatinine, iron and total iron binding capacity (TIBC), and unsaturated iron binding capacity (UIBC) were measured in the groups of patients and control individuals. The (Hb%) was determined by the cyanomethmoglobin method [9]. Serum urea concentration was estimated by using enzymatic method [10]. Serum creatinine was determined by kinetic method [11]. Serum iron , total iron binding capacity (TIBC), and unsaturated iron binding capacity (UIBC) were evaluated by using colorimetric method with Randox kits [12].

Results:

As shown in table 1, the concentrations of hemoglobin, serum iron, total iron binding capacity (TIBC) and unsaturated iron binding capacity (UIBC) were significantly ($P<0.001$) lowered while urea and creatinine levels were significantly ($P<0.001$) elevated in patients with CRF when compared with those of the control group.

The comparison of the group of CRF patients treated with iron supplementation with those without such treatment revealed significant ($P<0.01$) elevations of blood hemoglobin (Hb%), serum iron, total iron binding capacity (TIBC), and unsaturated iron binding capacity (UIBC) in the former of group with respect to the latter group. However, urea and creatinine concentrations did not exhibit significant changes among the two groups (table 2).

Table (1): the comparison between normal individuals and renal failure patients.

parameter	***Normal subjects N=40***	***Renal failure patients N=50***
Hb % (g/dl)	12.8 ± 0.32	* 6.5 ± 0.19
B. Urea (mg/dl)	41 ± 0.6	*187 ± 3.6
S. creatinine(mg/dl)	0.8 ± 0.02	*4.7 ± 0.8
S. Iron (µg/dl)	98 ± 2.3	*28 ± 1.5
S.TIBC (µg/dl)	345 ± 8.3	*220 ± 17.4
S. UIBC	28 ± 0.3	*13 ± 0.1

*P<0.001

Table (2): the comparison between two subgroups of renal failure patients.

parameter	*Renal failure patients (without iron supplement)*	*Renal failure patients (with iron supplement)*
Hb % (g/dl)	6.0 ± 0.09	* 10 ± 1.3
B. Urea (mg/dl)	196 ± 2.38	163 ± 4.6
S.creatinine(mg/dl)	5.2 ± 0.34	4.0 ± 0.8
S. Iron (µg/dl)	26 ± 0.27	*36 ± 0.5
S.TIBC (µg/dl)	204 ± 3.6	*238 ± 13.2
UIBC	12.8 ± 0.08	*15 ± 0.04

* P<0.01

Discussion:

Patients with renal failure may have a decreased dietary intake of iron that can contribute to the development of anemia [13]. This occurs when patients are encouraged to lower their intake of protein because of declining renal function. Decreasing protein (e.g., meat) intake reduces iron intake and depletes iron stores. Absorption of iron from the gastrointestinal tract may also be decreased Thus, multiple factors can contribute to inadequate total body iron stores in patients with chronic renal failure, a condition known as absolute iron deficiency[14].

Many studies have shown an inverse correlation between the red cell survival and serum blood urea nitrogen concentration. This could be demonstrated by the classical study where red blood cells from uremic individuals showed a normal life span when injected in normal individuals, the inverse (shortened red cell life span) could be demonstrated when erythrocytes from normal individuals where injected in uremic patients[1]. The most convincing demonstration that specific toxins(not necessarily urea) were responsible for the shortened red cell survival that obtained with the introduction of dialysis. which improves, to a limited extent, the anemia in chronic renal failure patients. Although this finding could not be attributed to prolonged red cell survival; rather a better utilization of iron (not increased serum levels)and red cell production seemed to be determinant. The patients showed diminished transfusion requirements after initiation of dialysis program [7].

In renal patients with certain, and particularly with the most sever stage of renal dysfunction, the need of erythropoiesis is increased due to shortened erythrocyte survival (60 to 90 instead of 120 days), blood loss and hemolysis. Damaged kidneys can not responed to reduced erythropoietin and therefore the plasma level of this hormone remains inadequately low in relation to anemia. The causes of this abnormality may be classified into: primary i.e, those associated with reduced erythropoietin production and erythropoiesis interference, increased hemolysis, and effects of management by dialysis [15].

In patients undergoing dialysis, blood loss, which can also contribute to anemia, occurs due to blood retention in the dialyzer and blood lines, frequent blood lines, frequent blood sampling, and vascular access complications. One study showed an average monthly blood loss of 167 to 226 ml and a monthly iron loss 57 to 78 mg among patients on hemodialysis. Blood drawing for laboratory testing resulted in

average monthly iron losses of 127 ml in a group of hemodialysis patients hospitalized for more than 2 days per month [16].

The results of this investigation confirm the need of iron treatment in CRF which improve the iron status, in association without significant changes.

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