Assessment of the Change in Hematological parameters in patients with chronic renal failure on maintenance hemodialysis

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المستخلص:

في مرض الكلى المزمن (CKD) يكون هناك تدهور تدريجي في وظائف الكلى قد ينتهي بالفشل الكلوي وبالتالي الحاجة الى تعويض ذلك بالغسيل الكلوي وهذا قد يؤدي الى آثار جانبية على مكونات الدم. ففقر الدم شائع في مرضى الفشل الكلوي المزمن (CRF) والخاضعين للغسيل الكلوي, فغالبا ما تتأثر مؤشرات الدم لدى هؤلاء المرضى.

هدفت الدراسة الى تقييم التغير في المؤشرات الدموية لمرضى الفشل الكلوي مقارنة بمجموعة من الاصحاء, اجريت هذه الدراسة بمركز مصراته لغسيل الكلى, حيث تم تجميع عينات الدم من عدد 40 مريض فشل الكلوي وخاضع للغسيل (سحب العينات يتم قبل جلسة الغسيل) 20 من الذكور و20 من الاناث وتجميع 20 عينة من اشخاص اصحاء كمجموعة ضابطة. تم اجراء اختبارات فحص المؤشرات الدموية باستعمال نظام MINDRAY BC-2800. اظهرت النتائج التأثير الواضح لغسيل الكلى على المؤشرات الدموية بانخفاض واضح في معظم المؤشرات التي تم فحصها لدى المرضى مقارنة

بالاصحاء حيت كان عدد كريات الدم الحمراء, الهيموجلوبين والهيماتوكريت لدى المرضى اقل المعدل الطبيعي وبفروق المعنوية كبيرة عن المجموعة الضابطة ($p < 0.05$), وكانت نتائج عدد الصفائح الدموية, متوسط هيموجلوبين الكرية ومتوسط تركيز هيموجلوبين الكرية اقل في المرضى ولكنها ضمن المعدلات الطبيعية مقارنة بالمجموعة الضابطة وكانت هناك فروق معنوية بين المجموعتين ($p < 0.05$), وكان متوسط حجم الكرية اعلى لدى المرضى وضمن المعدل الطبيعي عنه لذى الاصحاء والفروق المعنوية كذلك عالية ($p < 0.05$) بين المجموعتين, علاوة على ذلك كان عدد كريات الدم البيضاء متساو تقريبا ما بين المرضى والاصحاء ولم تكن هناك أي فروق معنوية ($p < 0.05$). وخلصت الدراسة الى ان لعملية الغسيل الكلوي تأثير واضح على المؤشرات الدموية والتوصية بأهمية فحص المؤشرات الدموية قبل الشروع في جلسات الغسيل.

Abstract

In chronic kidney disease (CKD), there is a progressive, irreversible deterioration in renal function that may end with renal failure, which can be substituted by maintenance hemodialysis (MHD), this can lead to side effects on the blood components. Anemia is a common manifestation in chronic renal failure (CRF) patients on MHD and is associated with a decline in the quality of patients' life, hematological parameters are usually, affected in those patients.

The study aimed to assess the changes in the hematological parameters of CRF patients in comparison with the healthy group. This study was

conducted at the Misurata dialysis center, blood samples were collected from 40 (20 males and 20 females) CRF patients undergoing hemodialysis before dialysis sessions and 20 samples from healthy subjects as a control group. The blood parameters were detected by the auto-analyzer MINDRAY BC-2800 system. The current study showed that the dialysis had an apparent effect on the hematological parameters, there was a decrease in most of the parameters investigated in the patients compared to the controls ($p<0.05$), RBCs count, Hb, and Hct of patients were lower than the normal, Plts, MCH, AND MCHC were lower in the patients but within the normal ranges, significant differences than the controls were reported ($p<0.05$), The MCV was higher but within the normal range in the patients than the controls with significant differences ($p<0.05$). Moreover, the Total WBCs count was nearly equal in both groups without any differences ($p>0.05$). We concluded that the dialysis process has a clear effect on the hematological parameters, and recommends the screening of hematological parameters before performing hemodialysis.

Background:

The kidney is with vital functions, it removes wastes and extra water from the blood, preserves electrolytes balance such as sodium, potassium, and calcium normally in the body [(1)], and also it controls blood pressure and stimulates erythropoiesis [(2)]. CKD and CRF are considered common medical issues and one of the leading causes of mortality worldwide [(3)]. the onset of Kidney failure can occur suddenly or slowly [(4)]

Various hematological parameters such as Red blood cell (RBC) count, total leukocyte count (TLC), platelet count, hemoglobin (Hb), and hematocrit (Hct) are altered in CRF patients on HD. These alterations are due to marrow suppression by retained uremic products and toxicity associated with hemodialysis [5], also as a result of decreased erythropoiesis mainly because of deficiency or reduction in erythropoietin (EPO) production, iron deficiency, aluminum intoxication, B12 and folate deficiency, and other factors such as increased hemolysis, and suppression of bone marrow hematopoiesis growth factors, anemia is a common feature that can be observed in most CKD and CRF patients associated with significant morbidity. Anemia caused by renal failure begins early and eventually increases as the destruction of the kidney progresses [6-8], also dialysis can cause adverse effects on the blood components, these effects may vary according to several factors such as age, gender, race, muscular activity, and the duration of dialysis [9, 10]**.** The toxic uremic environment in chronic renal failure is responsible for the decreased RBC life span. The contribution of the hemodialysis process to mechanical damage to the shortened life span is not clearly observed. Still, reductions up to 70% in total RBC survival have been reported in uremic patients [11]. Gastrointestinal bleeding, severe hyperparathyroidism, and systemic inflammation can also be considered causes of anemia in patients with CKD and CRF [12]. 75% of uremic patients who require dialysis have a hematocrit value of <30% and most of them are transfusion dependent [13].

According to Kidney Disease: Improving Global Outcomes (KDIGO) 2012 guidelines, diagnosis of anemia in adults and children under 15 years with CKD and CRF when the Hb concentration is ≤ 13.0 g/dl (130 g/l) in males, ≤12.0 g/dl (120 g/l) in females, and in children if Hb concentration is ≤ 11.0 g/dl (110 g/l) in children 0.5–5 years, ≤ 11.5 g/dl (115 g/l) in children 5–12 years, and ≤ 12.0 g/dl (120 g/l) in children 12–15 years [14]. The onset of anemia rises with age, which means that the anemia will also increase in CRF old patients [15, 16].

The alteration in the hematological parameters is one of the causes involved in the pathophysiology of anemia in patients with renal failure on maintenance HD. To improve these parameters, those patients need special concern, follow up and management, complete blood count as a routine analysis for the evaluation of anemia in is essential for them.

Aim:

As there is a lack of studies about the hematological profile of hemodialysis patients, this study was carried out to assess the hematological parameters and indices in a cohort of CRF patients on regular hemodialysis in the Misurata dialysis center in comparison with a healthy group.

Materials and Methods:

A total of 40 HD patients (20 males, 20 females) from Misurata dialysis center aged (30-70) old years, and duration of hemodialysis for more than six months three times a week for about 3 to 4 h per session, and 20 apparently

healthy individuals aged(20-60) old years were used as a control group during the period from November 2021 to January 2022. 3 ml of venous blood was collected from each one of the patients and the control group in an EDTA tube, mixed gently, and put on a shaker for complete blood count using the MINDRAY BC-2800 system auto-analyzer.

Statistical analysis:

Data collected were entered and processed in SPSS version 19 software. Data were expressed in percentages and mean with standard deviation, analyzed by paired t-test. A p-value of less than 0.05 was considered statistically significant.

Results:

The results of the current study revealed an apparent decrease in RBCs count, Hb level and Hct in hemodialysis patients compared to the healthy control group and there was a significant difference in the results of these parameters (p<0.05) between the two groups, the mean results of these parameters in the patients were (3.69±.410, 11.10±1.10, and 34.73±2.96 respectively) and the mean results of the same parameters in the healthy controls were (4.53±.396, 13.53±1.20, and 40.75±3.39 respectively). Furthermore, the results of Plts count, , MCH, and MCHC showed that the hemodialysis patients tend to have normal results but lower than the results of the healthy control group and there was a significant difference in the results of these parameters (p<0.05)

between the two groups, the mean results of these parameters in the patients were (159.63±79.494, 28.84±2.12, and 31.15±.82 respectively) and the mean results of the same parameters in the healthy controls were (281±92.423, 30.0±1.59, and 32.90±1.17 respectively), the results of HD patients 'MCV were higher than the results of the controls and there was a significant difference in the results of this parameter (p<0.05) between the two groups the mean MCV of the patients was (93.89±6.05) and the mean MCV of the controls was (90.5±5.04), while there was no significant difference (p>0.05) in the results of total WBCs count between the patients and the controls the results were (6.15±1.86) and (6.47±1.57) in the patients and controls respectively, the results of the investigated parameters of the patients and the healthy control group are showed in the table below.

Table: the results of the hematological parameters of patients and the healthy control group

No	Parameters (unit)	HD patients (mean ± SD)	Controls (mean ± SD)	t test—p value
1	RBC count ($X10^6$/ mm^3)	3.69±.410	4.53±.396	p<0.05*
2	WBCs ($X10^3$/mm^3)	6.15±1.86	6.47±1.57	p>0.05
3	Plts ($X10^3$/mm^3)	159.63±79.494	281±92.423	p<0.05*
4	Hemoglobin (g/dl)	11.10±1.10	13.53±1.20	p<0.05*
5	Hct (%)	34.73±2.96	40.75±3.39	p<0.05*
6	MCV (fl)	93.89±6.05	90.5±5.04	P< 0.05*
7	MCH (pg)	28.84±2.12	30.0±1.59	P< 0.05*
8	MCHC (g/dl)	31.15±.82	32.90±1.17	P< 0.05*

***Significant p value (<0.05)**

Discussion:

As mentioned anemia is a common feature that can be observed in CRF patients. In the present study, the results of the patients with chronic renal failure on regular HD indicate that most of them had moderate anemia, and also showed varying degrees of changes in hematological parameters. The RBCs count, Hb and Hct levels in these patients were significantly lower when compared to the levels in healthy controls and there were significant differences in the mean of these parameters between the two groups ($P<$ 0.05), this finding was in agreement with other studies [17-19]. The main factor for the decrease of these parameters is impaired erythropoietin production along with other factors that suppress marrow erythropoiesis and shortened red cell survival and may be due to hypervolemia as a result of the accumulation of waste fluid in the circulation [20-22].

Although often within the normal range, the means of Plts count, MCH, and MCHC levels in renal failure patients were significantly lower when compared to the levels in healthy controls, there were statistically significant differences between the means of these parameters between the two groups ($P<$ 0.05), the reduction in these parameters may not be related entirely to the HD procedure but may be a result of the position of supine and subsequent hemodilution caused by water redistribution from the extra-to intravascular space [23].

The results of the mean MCV of the patients (93.89±6.05) were higher than the mean MCV of the controls (90.5±5.04) and there was a significant

difference in the results of this parameter (p<0.05) between the two groups. Higher MCV is defined as greater than the median value of 90.8 fl [24], the increase of MCV is differently associated with a vitamin B12 or folate deficiency, alcohol consumption, hypothyroidism, and liver disease [25-28], and is often characteristic of underlying conditions such as nutritional deficiencies, drug use, or primary bone marrow disorders [29]. While the results of total WBCs count were normal in both groups without significant difference (p>0.05), the mean WBCs count was (6.15±1.86, and 6.47±1.576.47±1.57) in the patients and controls respectively, This was in accordance with the theory that the number of leukocytes in chronic renal failure patients was usually normal, but there was a function change that causes patients to have decreased body's defenses which can increase the risk of bacterial infection up to four times than the healthy population [30]. The hematological parameters are reduced in the patients and the most affected are erythrocyte indices as a result of the kidney disease. This represents apparent evidence of the importance of periodic follow-up and the necessity of routine laboratory evaluation for the effect of impaired renal function and dialysis on these parameters.

Conclusion:

Renal failure is associated with derangement in various hematological parameters, the results of present study showed changes in these parameters in patients with CRF on HD and most of them were with moderate degree of anemia. so regular evaluation of such parameters in CRF patients is

mandatory. Correction of these abnormalities help to reduce the morbidity and mortality related to renal failure. Also it is associated with different degrees of abnormality in hematological parameters that needs careful evaluation and management

Recommendations:

- The nature of the disease and its noticeable impact on the hematological parameters requires continuous follow-up and routinely evaluation of these indicators once per month, and if possible semimonthly.
- Clinicians have to take the appropriate precautions for dialysis procedures and thereby reduce anemia, thrombosis, hemorrhage, and related complications.
- The necessity of prescribing the necessary medicines, as well as providing the patients with nutritional supplements to reduce the incidence of anemia.

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Conflict of interest:

All authors declare that they have no conflicts of interest.

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