AlQalam
Alq J Med App Sci
https://journal.utripoli.edu.ly/index.php/Alqalam/index eISSN 2707-7179

Original article

Hematological Changes in Pre and Post Dialysis in Patients Undergoing Hemodialysis: A Comparative Study at Zawia Hospital

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ARTICLE INFO

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Received*: 01-09-2024*
Accepted*: 02-11-2024*
Published*: 09-11-2024*

Keywords*. Hematological Parameters, Hemodialysis, Chronic Kidney Disease.*

ABSTRACT

Chronic kidney disease (CKD) is a common condition that affects millions of people worldwide, and is responsible for high morbidity and mortality rates. The progression of CKD is associated with several serious complications and changes in blood composition. Thus, patients with CKD require dialysis to manage the disease. This study assessed the impact of haemodialysis on changes in pre and post haematological parameters in CKD patients. A cross-sectional study was carried out at Al-Zawiya Dialysis Hospital in Libya. Sixty patients with CKD were regularly undergoing haemodialysis three times a week. Data were analysed by SPSS 24.0 version. The study shows significant differences in blood parameters before-dialysis and after-dialysis levels. The mean WBC 6.22 × 10^3/µL to 6.03 × 10^3/µL, (p = 0.0045), the mean RBC 3.56 × 10^6/µL to 3.66 × 10^6/µL, (p = 0.001), the mean HCT in pre and post-haemodialysis was 32.01% to 32.71% (p = 0.018), the mean Haemoglobin 10.11 g/Dl in pre - dialysis to 10.32 g/dL post - dialysis (p = 0.027), the mean MCV 90.24 fL to 89.69 fL ,(p < 0.0001), the mean MCH in pre and MCH in pre and post-haemodialysis post- haemodialysis was 28.58 pg to 28.5 pg,(p < 0.0001), the mean MCHC in pre and post-haemodialysis (p = 0.003), and PLT was 241.08 × 10^3/µL to 240.46 × 10^3/µL in pre and post-haemodialysis, (p = 0.002). The different degrees of abnormality in haematological parameters in patients with renal disease under haemodialysis need careful evaluation and management. Routine assessment of these parameters is important in treatment and can help lower morbidity and mortality rates among these patients

Cite this article. *Albeshti F, AL-Hanish A, Altayyaib H, Ahmed M, Alajilani I. Hematological Changes in Pre and Post Dialysis in Patients Undergoing Hemodialysis: A Comparative Study at Zawia Hospital. Alq J Med App Sci. 2024;7(4):1174-1179.*
https://doi.org/10.54361/ajmas.247438

INTRODUCTION

Chronic Kidney Disease (CKD) has emerged as a public health issue in the recent past. Chronic kidney disease is more frequent to other chronic diseases, the prevalence ranging from 8% to 10% in adult [1.2] In 2017, approximately 700 million human beings had CKD, and 1. 2 million of them died CKD is among the top 12th leading causes of death. Worryingly, the death rate related to CKD has not decreased as significantly as other chronic diseases and indicated a projection of 4 million deaths by 2040 [3].

CKD is defined as a decrease renal excretory function (Glomerular Filtration rate (GFR) less than 60mL/min/1.73m^2) or proteinuria for more than 3 months [4-6], and has an impact on all physiological function of the body's systems. CKD was classified into five stages according the National Kidney Foundation Kidney Disease Outcomes Quality Initiative

(KDOQI) stage III was related to GFR 30 to 60 mL/minute, stage IV to GFR 15 to 30 mL/minute, and end renal stage(V) to a lower GFR from 15 mL/minute [7,8]. which leads to the need for dialysis or renal replacement treatment [9,10]. One the results of CKD that worsens with the disease severity is haematological dysfunction [11].

Anaemia is a common haematological complication of CKD due to the gradual drop-in glomerular filtration rate [9,11]. Anaemia can occur for a variety of other reasons, by-play from the main pathophysiological cause of anaemia, which is lower in endogenous erythropoietin production, this is the hormone that has an important role in erythropoiesis and is usually synthesized by the kidney in the juxtaglomerular system but 10% manufacture in the liver and another organ, other risk for anaemia include uremic, a lack of iron, a lack of vitamin B_{12} and folic acid, haemolysis, chronic blood loss, nutritional deficiency[7.9], gastrointestinal bleeding, systemic inflammation, and severe hyperparathyroidism [9,12,13]. The Stages CKD are associated with haematological abnormalities.

Low haemoglobin in CKD patients is more common and significant changes are also observed along with other blood parameters, such as RBC, HCT, Mean Corpuscular Haemoglobin Concentration (MCHC), RDW, Mean Corpuscular Haemoglobin (MCH), and Mean Corpuscular Volume (MCV). Haemodialysis (HD) is an advanced treatment plan for chronic kidney failure. An iron deficiency is common in humans with persistent kidney disorder; it impacts approximately fifty percentage of non-dialysis-related kidney disease and more than fifty percentage of human undergoing process dialysis [9]. In studies examined platelets outcomes, platelet stages have usually been measured before dialysis, 15–30 minutes during HD, and frequently after completion dialysis. The platelet count almost always recovers to pre-HD levels or slightly exceeds levels [14,15]. platelets may become significantly stimulated during HD. Platelet cell surface markers are indicators of platelet degranulation. Microbubbles may be involved in the stimulation caused by blood exposure to the circulating pump part [14]. Moreover, several factors such as nutritional deficiencies, hemoglobinopathies, and viral infections elevate the prevalence of anaemia and change its patterns in this environment [16]. The aimed of this study to evaluate the effect of pre and post dialysis and duration of dialysis on haematological parameter among patients with attending the Dialysis Centre at Zawia Hospital in Zawia City, Libya.

METHODS

Study design and setting

A cross-sectional descriptive, study was designed at Al-Zawiya Dialysis Hospital in Libya to examine the comparative of complete blood count in before and after dialysis among with chronic renal disease patients who attend at the hospital for haemodialysis regularly. Patients are undergoing dialysis three times a week. A total 60 patients were selected randomly from both genders and their ranged in age from 25 years to 60 years and the duration of dialysis ranged (less than 5 years, 5 to 10 years and more than 10 years age). Blood samples were collected in May to June 2024.

Sample Collection

Samples were collected in tubes containing an anticoagulant (EDTA) for measurements blood parameter of red blood cells count, hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin concentration, mean corpuscular hemoglobin concentration, white blood cells, and platelet count using the Sysmex-XP 300 electronic blood cell counter in the analysis laboratory of Al- Zawia dialysis Centre.

Data analysis

Data Analysis was performed using SPSS version 24. Differences between mean values and standard deviation were compared by using paired t- test, and Chi - square test changes are considered significant at the probability level ($P<0.05$) in all statistical test.

Inclusion Criteria

Patients with CKD who were from 25 years to 60 years and duration from less 5 years to more 10 years, Patients were selected randomly and all patient have diabetes and hypertension.

Exclusion criteria

We exclude the patients with history of blood transfusion during last three months, and patients with infection, inflammation, and dehydration also patients with end stage renal disease or with a history of kidney transplant.

RESULTS

The study Hematological changes in pre and post hemodialysis patients with chronic kidney disease. Was assume at Al-Zawiya Dialysis Hospital in Libya during the period from May to June 2024. 60 patients to evaluate the hematological

parameters and effect duration of dialysis in pre- and post-dialysis phase. Among of 60 patients 30 (50%) were male and 30 (50%) were female. The age of CKD patients ranged from 25 years to 60 years, regarding the hematological examination results while comparing the initial and the final values of blood tests, changes in several values were observed. The mean values and the mean differences of the white blood cells (WBC), Red blood cells (RBC), Hematocrit (HCT), Haemoglobin (HGB), MCV, MCH, MCHC, and Platelets count (PLT).

Table 1. Comparison of the haematological parameters before and after haemodialysis.

Variable	Pre	Post	Mean difference	Correlation	p-value
	Mean	Mean			
WBC (10^3/UL)	6.22	6.03	0.19	0.68**	**0.0045**
RBC (10^6/UL)	3.56	3.66	-0.1	0.71**	**0.001**
HCT (%)	32.01	32.71	-0.7	0.59*	**0.018**
HGB (g/dL	10.11	10.32	-0.21	0.54*	**0.027**
MCV (fL)	90.24	89.69	0.55	0.98**	**0.000**
MCH (pg)	28.58	28.5	0.08	0.96**	**0.000**
MCHC(g/dL)	31.65	31.76	-0.11	0.81**	**0.003**
PLT (10^3/UL)	241.08	240.46	0.62	0.70**	**0.002**

The results showed that, the WBC count in HD patients tended to decrease from 6.22 × 10^3/µL to 6.03 × 10^3/µL post-dialysis was observed, with a mean difference of 0.19. This change was statistically significant (p = 0.0045) and moderately correlated (r = 0.68). Regarding red blood cells in HD patients, RBC levels an increase from 3.56 × 10^6/µL to 3.66 × 10^6/µL the mean difference of -0.1 was significant (p = 0.001), with a strong correlation (r = 0.71). Furthermore, HCT values increase from 32.01% to 32.71% post-dialysis showing a mean difference of -0.7 and a significant p-value of 0.018, with moderate correlation (r = 0.59). However, some improvement was recorded in other blood parameter such as the Haemoglobin level which was observed to be increased significantly from 10.11 g/dL in pre-dialysis to 10.32 g/dL post-dialysis (p = 0.027) with moderate correlation (r = 0.54). In addition, there was MCV decreased from 90.24 fL to 89.69 fL, with a highly significant mean difference of 0.55 (p < 0.0001, r = 0.98) and MCH slightly decreased from 28.58 pg to 28.5 pg, showing a significant mean difference of 0.08 (p < 0.0001, r = 0.96) MCHC increased from 31.65 g/dL to 31.76 g/dL, with a mean difference of -0.11 (p = 0.003, r = 0.81). Finally, PLT decreased from 241.08 × 10^3/µL to 240.46 × 10^3/µL, with a mean difference of 0.62 (p = 0.002, r = 0.70). On the other hand, the study shows a significant coefficient correlation between hematology parameter level and the duration of hemodialysis in the patient CKD where the correlation significant (p-value ≤ 0.05), as shown in table 2

Table 2. Relationship between hematological variables (pre and post) dialysis by duration categories

Variable	Pre	Post	Mean difference	Person chi-square	p-value
	Mean	Mean			
WBC (10^3/UL)	6.22	6.03	0.19	0.39	**0.037**
RBC (10^6/UL)	3.56	3.66	-0.1	- 0.49	**0.022**
HCT (%)	32.01	32.71	-0.7	0.11	**0.082**
HGB (g/dL	10.11	10.32	-0.21	- 0.51	**0.018**
MCV (fL)	90.24	89.69	0.55	0.42	**0.035**
MCH (pg)	28.58	28.5	0.08	0.33	**0.041**
MCHC(g/dL)	31.65	31.76	-0.11	0.31	**0.052**
PLT (10^3/UL)	241.08	240.46	0.62	- 0.46	**0.029**

DISCUSSION

CKD affects the hematopoietic system, and its most common clinical manifestation is anaemia, which contributes significantly to the morbidity and mortality rates in CKD condition [10]. In this study, haematological parameters of 60 patients were evaluated before and after the haemodialysis. A dialysis is only a supportive treatment, and it does not treat the problem completely, as it provides an artificial alternative, when the kidneys are unable to eliminate of waste and fluids accumulated from the body effectively. However, the waste continues to accumulate in the blood between sessions may cause acute problems with severe morbidity, besides the operation of dialysis devices, the amount of damage to haematological parameters is significant. As a results, these indicators must be monitored both before and after dialysis in order to avoid problems and thereby lower the mortality rate. The main finding of this study is that HGB increased during HD relatively more than HCT accumulate in the blood between sessions [6,21].

The main finding of our study according to pre- and post-haematological parameters related to differences in the levels of RBC, haemoglobin, WBC and platelets were statistically significant (p=<0.05). Similarly, Majidaet et al., [3] observed that the means of RBCs, HCT, Hb, and RBC indices occurring in renal dysfunction before and after HD had a statistically significant difference ($p < 0.05$), which is in agreement with the results of our study.
Regarding WBC counts, our study revealed a significant decrease ($p = 0.0045$) from pre- to post-HD. This contrasts with the findings of Alghythan AK et al. [18], who reported significantly higher WBC counts after HD, which was attributed to the fact that patients are often hypervolemic at the beginning of HD, with low WBC levels. Furthermore, our study found that platelet counts showed decrease after the dialysis, with a significant difference between pre- and post-measures. This is in line with the findings from Alghythan AK et al. [18], Yenicerioglu et al. [19] and Pandian et al. [22], reported statistically significant decrease in platelet counts in post-HD states. In patients with renal failure, which showed a significant decrease in the number of platelets. This decrease may be due to a lack of erythropoietin secretion, which leads to a decrease in the number of platelets, because erythropoietin levels can affect the level of platelets, and due to of the similarity between erythropoietin and thrombopoietin, and the work of erythropoietin as a major regulator of platelets. Our findings were opposite to those of Majida et al [3], whose results demonstrated discrete platelets increase after procedure, while both pre and post averages were in normal range without a significant difference. Muhammad et al. [20] found no related between platelet counts and dialysis duration. The results of our study are also agreed with previous results [3.20]. A study revealed that RBC, HCT, Hb, and mean corpuscular haemoglobin concentration (MCHC) showed significant increase in post-HD compared to pre-HD, while MCV and total leukocyte count showed significant decrease. Also noted significant decrease platelets and mean corpuscular haemoglobin (MCH), which contrast with Muhammad et al. and Majida et al. [3,20], show that platelets and MCH did not significantly decrease in post-HD cases. While MCHC was significant increase in CKD patients compared to controls. After haemodialysis, RBCs, MCHC, HCT, increased significantly, due to the removal of excess liquid and waste products from hypervolemia through ultrafiltration, On the other hand, MCH and MCV decreased after haemodialysis, which is in accordance with findings of other authors [15].

CONCLUSION

Among the haematological parameters measured in this study, RBCs, HCT, and HB, MCHC values showed variation in chronic renal patients, having an increase after HD as compared to pre-dialysis states. The platelet count and WBC, MCV, and MCH were found to be decreased after dialysis as compared to pre-dialysis states. The different degrees of abnormalities found in haematological parameters of CKD patients require careful evaluation and management. Routine and neat assessments of these parameters are important in treatment and can help lower morbidity and mortality rates among these patients.

Acknowledgments

All the authors are thankful to the CKD patients and their caregivers for their cooperation and support to this study. Also, we are thankful to the physicians and staffs of the Al-Zawiya Dialysis Hospital, for their cooperation to this study.

Conflicts of Interest

There are no financial personal, conflicts of interest to declare.

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https://journal.utripoli.edu.ly/index.php/Alqalam/index eISSN 2707-7179

التغيرات الدموية لدى مرضى مرض الكلى المزمن قبل و بعد الغسيل الكلوي : دراسة مقارنة في مستشفى الزاوية

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الملخص:
مرض الكلى المزمن هو حالة شائعة تصيب ملايين الأشخاص في جميع أنحاء العالم، وهو مسؤول عن ارتفاع معدلات الإصابة والوفيات، ويرتبط تطور مرض الكلى المزمن بعدد من المضاعفات الخطيرة، ويعزز التغيرات في معايير الدم، ويحتاج مرضى مرض الكلى المزمن إلى الغسيل الكلوي لضرورة استمرار حياتهم و تحسين ادائهم الوظيفي الا انها تترك اثارا سلبية علي المريض. هدفت هذه الدراسة إلى تقييم تأثير غسيل الكلى على التغيرات في معايير الدم قبل وبعد الغسيل لدى مرضى الفشل الكلوي المزمن. أجريت دراسة مقطعية بوحدة الكلى التابعة لمستشفى الزاوية في ليبيا، حيث تضمنت 60 مريضًا يعانون من امراض الكلى المزمنة ويخضعون بانتظام لغسيل الكلى ثلاث مرات في الأسبوع و تم إجراء الاحصاء الوصفي عن طريق قياس النسب باستخدام برنامج SPSSالإصدار 24.0 . أظهرت الدراسة وجود فروق في معايير الدم قبل الغسيل الكلوي ومستوياته بعد و اوضحت نتائج التحليل الإحصائي حدوث ارتفاعا طفيف في متوسط تركيز الصفائح الدموية قبل غسيل الكلى الي ما بعد الغسيل (p 0.002 –value) و يشمل هذا الارتفاع ايضا الهيموجلوبين و القيمة المتوسطة في مرضى ما قبل غسيل الكلى الي ما بعد الغسيل (P < value- 0.027)و ارتفاع ضعيف في كريات الدم الحمراء وكان متوسط قيمة خلايا الدم الحمراء في ما قبل غسيل الكلى الي ما بعد الغسيل (p 0.001 –value) و وجد ارتفاع في متوسط تركيز الهيموجلوبين في كريات الدم الحمراء MCHC وكان متوسط قيمة MCHC في مرضى ما قبل غسيل الكلى الى ما بعد الغسيل (p 0.003) بينما كان الانخفاض ملحوظا في كلا من متوسط حجم الكريات الدم الحمراء MCV و MCH و كان متوسط القيمة في مرضى ما قبل الغسيل الي ما بعد الغسيل (p < 0.0001) , والانخفاض يشمل ايضا كريات الدم البيضاء وكان متوسط قيمة خلايا الدم البيضاء في ما قبل غسيل الكلى الي ما بعد الغسيل(P- 0.0045 Value). أن الدرجات المختلفة في المتغيرات الدموية لدى المرضى المصابين بأمراض الكلى و الخاضعين لغسيل الكلى تحتاج إلى تقييم ومتابعة , و التقييم الروتيني لهذه المعايير مهم في العلاج ويمكن أن يساعد في خفض معدلات الإصابة والوفيات .

الكلمات المفتاحية: المتغيرات الدموية , الغسيل الكلوي , مرض الكلى المزمن.