Research Article

Evaluation of Red Blood Cells Parameters among Chronic Kidney Disease Patients in Shendi Town, Sudan

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Abstract:

Background: Chronic kidney disease is a worldwide public health problem. It is associated with various hematological abnormalities that lead to morbidity and mortality, as well as being the main cause of anemia. ***Objectives***: This study aimed to evaluate the hematological parameters (hemoglobin concentration, RBC count, HCT percent, RBC indices, and RBC distribution width) in chronic kidney disease patients. Also to describe the effect of disease duration on haemoglobin concentration and red blood cell count. ***Methods***: This is a case-control analytical study on 50 chronic kidney disease patients at Almak Neimer Hospital, Shendi City, Sudan. Hematological parameters, especially red blood cell parameters, were measured using standard techniques by using a CBC automated hematological analyzer (Mindary BC 3000) in chronic kidney disease cases, and the findings were compared with age- and sex-matched healthy group controls. Results were analyzed using SPSS 26 for Windows. ***Results***: The mean of hemoglobin concentration, hematocrit percent, red blood cell count, RBC indices, and RBC distribution width. Were reduced and statistically significant in chronic kidney disease patients compared to controls ($p < 0.05$). Also, the increased duration of the disease leads to a significant decrease in mean hemoglobin concentration, RBC count, and hematocrit percent. ***Conclusion***: Haematological parameters are deranged in patients with chronic kidney disease. Routine evaluation of these parameters is useful in the management of these patients.

Keywords: Chronic kidney disease, Anemia, Erythropoietin, Hematological parameters.

Introduction:

Homeostasis depends critically on normal renal function; in fact, conditions where renal function is compromised can be fatal **[1].** The clinical state known as chronic kidney disease (CKD) is brought on by a progressive loss of renal function over time. As per the 2007 U.S. Renal Data System (USRDS) Annual Data Report, 20 million Americans are at risk of developing chronic kidney disease (CKD), and one in nine persons in the country now has it. Early detection and treatment are crucial to avert consequences such as coronary vascular disease and ESRD **[2].** The statistics of the first quarter of the year 2021, for the National Center for Kidney Diseases, showed that in the country there are about 12,500 patients with terminal kidney failure, which is equivalent to about 250 patients per million people, and about 8,000 of these patients are subject to treatment in hospitalization. About 80 patients are treated with the continuous ambulatory net, and about 4,300 patients live with a transplanted Kidney **[3].** Many hemopoietic alterations are linked to renal disorders. The degree of renal impairment and anemia are correlated, and the primary cause of anemia is the failure of renal erythropoietin secretion. Hemolysis, prolonged blood loss, and bone marrow suppression due to retained uremic components are further factors **[4].** The prominent functions of the kidney are the removal of unwanted substances from plasma, filtering, and the blood controls the body's fluid balance, regulating the balance of electrolytes and secretion of hormones like EPO (Erythropoietin) which controls erythrocyte production **[5].** Anemia of chronic renal disease is associated with cardiorenal anemia syndrome. Foley et al. observed that for every 1-g decrease in hemoglobin concentration, a 42% increase in left ventricular dilatation is seen in patients with stage 5 CKD **[6].** Cardiovascular disease remains the most common cause of mortality in such patients, much greater than in the general population **[7].** Hospitalization and death rates for patients with chronic kidney disease (CKD) increased when hemoglobin fell to less than 11 g/dL, according to the Dialysis Outcomes Practice Pattern Study (DOPPS), which involved several nations **[8].** RDW measures the size variation of the circulating erythrocytes. Increased size variability of the erythrocytes is defined as anisocytosis and demonstrated as high RDW values on blood count readings **[9].** High RDW was found to be associated with adverse renal outcomes, CVD, and mortality in patients with CKD **[10,9,11].** According to epidemiological data from the Kidney Early Evaluation Program and the National Health and Nutrition Examination Survey 3, there is a rise in the prevalence of anemia in those over 61 who have Stage 3 CKD or above. According to the World Health Organization (WHO), 43% of people with chronic kidney disease (CKD)

have anemia **[12].** Hemoglobin (Hb) concentrations below 13 g/dl in males and postmenopausal women, and below 12 g/dl in younger women, are considered anemia according to the World Health Organization. This study evaluated Red Blood cell parameters among Chronic Kidney Disease Patients in Shendi Town, Sudan. Additionally, we sought to identify any potential causal relationships between these hematological markers, renal function, and comorbidity.

Materials and methods:

Study design:

This is a case-control analytical study that aimed to evaluate red blood cell parameters in patients with chronic kidney diseases. This study was conducted at El-mak Nemir University Hospital which is located in Shendi town in Sudan. Shendi is a town in northern Sudan on the east bank of the River Nile 150 km northeast of Khartoum (16°41'N 33°25'E). The area is inhabited by the Gaaleen Tribe.

Study duration:

This study was done during the period between March 2022 to February 2024.

Study population:

Patients with chronic kidney diseases.

Inclusion criteria:

Included patients of both sexes, of different ages, and known to have chronic kidney diseases.

Exclusion criteria:

Excluded patients with long-term systemic treatment with immunosuppressive drugs, major bleeding in the past three months, patients with HIV infection or Hepatitis virus, cancer patients, lactate women, or patients who had a blood transfusion in the past 3 months.

Sample size:

Eighty participants.

Study variable:

Depend on age gender and duration of disease.

Data collection tools:

The primary data was collected by using a questionnaire.

Sample processing:

2.5 ml of venous blood was taken from (50) patients with CKD and compared with (30) age and sex matching group (control), and transferred into an EDTA container. The sample was then sent as early as possible (maximum 3 to 6 hours) for analysis. For Red blood cells parameters were done, like RBC count, hemoglobin (HBG), hematocrit (HCT), RBCs indices (MCV, MCH, MCHC), and red blood cell distributed width (RDW-CV, RDW-SD) by the automated method by using Mindray hematology analyzer (Mindray bc-3000).

Data analysis and presentation:

Data collected in this study were analyzed using SPSS 26, chi-square test was used to assess the enter group's significance. Other

variables and outlier values were calculated and presented in the form of tables.

Ethical considerations:

The procedure of venous blood sampling was explained to patients who have chronic kidney diseases. All participants were informed about the research objectives and procedures during the interview period. A written valid consent was obtained from all participants. All result in high privacy and confidentiality.

Results:

50 whole blood samples were collected for chronic kidney disease patients, and the CBC was done for this sample. General Characteristics of patients with CKD revealed the gender majority of disease distributed among males (60%) more than females (40%). that the patients with age of (10-30) years comprised (8%), while those with age of (31-50) years were (40%), and finally the group with age more than 50 years were (52%). In addition to and based on the duration of the disease, the majority of the patients (52%) were in the chronic stage for more than one year, and those less than one year were (48 %).

Table 1: Show the gender distribution among the case population

Gender	Frequency	Percent (%)
Male	30	60.0
Female	20	40.0
Total	**50**	**100.0**

Table 2: Show the age distribution among the case population

Age	Frequency	Percent (%)
10-30 years	4	8.0
31-50 years	20	40.0
more than 50 years	26	52.0
Total	**50**	**100.0**

Table 3: Show the duration of disease distribution case population

Duration of disease	Frequency	Percent (%)
One year	24	48.0
More than one years	26	52.0
Total	**50**	**100.0**

Table 4: Show the incidence of another disease among the case population:

Other disease	Frequency	Percent (%)
Hypertension	31	62.0
hypertension and diabetic	5	10.0
No disease	14	28.0
Total	**50**	**100.0**

Table 5: Comparison of the mean and Std. Deviation of RBCs parameters in case group and control group

Parameters	Type	N	Mean	Std. Deviation	*P. value*
HBG	Case	50	10.110	2.3246	0.000
	Control	30	14.477	1.6385	
RBC	Case	50	3.5202	0.79768	0.000
	Control	30	5.0463	0.61027	
HCT	Case	50	32.002	7.5548	0.000
	Control	30	44.190	4.8771	
MCV	Case	50	91.290	5.4351	0.004
	Control	30	87.903	4.0166	
MCH	Case	50	28.794	2.0524	0.857
	Control	30	28.713	1.7258	
MCHC	Case	50	31.444	.8709	0.000
	Control	30	32.700	1.1905	
RDWCV	Case	50	16.340	1.3877	0.000
	Control	30	14.560	0.8877	
RDWSD	Case	50	53.488	4.3733	0.000
	Control	30	46.780	2.3855	

Table 6: Show frequency and percentage of anemia occurrence in renal failure patients

Gender	Anemia	No	Percent (%)
Male	Anemic	26	87
	Nonanemic	4	13
	Total	**30**	**60**
Female	Anemic	16	80
	Nonanemic	4	20
	Total	**20**	**40**

Table 7: Comparison of the mean and Std. Deviation of RBCs parameters in case group according to gender

Parameter		N	Mean	Std. Deviation	*P. value*
HBG	Male	30	10.227	2.3877	0.668
	Female	20	9.935	2.2760	
RBC	Male	30	3.5320	0.80225	0.900
	Female	20	3.5025	0.81123	
HCT	Male	30	32.240	7.8775	0.788
	Female	20	31.645	7.2288	
MCV	Male	30	92.220	5.1171	0.140
	Female	20	89.895	5.7274	
MCH	Male	30	29.060	1.9136	0.266
	Female	20	28.395	2.2350	
MCHC	Male	30	31.483	0.8350	0.700
	Female	20	31.385	0.9410	
RDW-CV	Male	30	16.003	1.2601	0.304
	Female	20	16.845	1.4475	
RDW-SD	Male	30	53.453	4.1675	0.946
	Female	20	53.540	4.7761	

Table 8: Comparison of the mean and Std. Deviation of RBCs parameters in case of group according to duration of disease

Parameters		N	Mean	Std. Deviation	*P. value*
HBG	One year	24	10.719	2.4459	0.053
	More than 1year	26	9.450	2.0336	
RBC	One year	24	3.7335	0.89137	0.048
	More than 1year	26	3.2892	0.62036	
HCT	One year	24	34.138	7.9843	0.036
	More than 1year	26	29.688	6.4461	
MCV	One year	24	91.854	5.4823	0.451
	More than 1year	26	90.679	5.4329	
MCH	One year	24	29.000	1.8389	0.466
	More than 1year	26	28.571	2.2801	
MCHC	One year	24	31.473	0.9804	0.809
	More than 1year	26	31.413	0.7543	
RDWCV	One year	24	16.350	1.5988	0.958
	More than 1year	26	16.329	1.1927	
RDWSD	One year	24	54.262	4.1676	0.196
	More than 1year	26	52.650	4.5231	

Table 9: Comparison of the mean and Std. Deviation of RBC parameters in case group according to age

Parameters		N	Mean	Std. Deviation	*P. value*
HBG	10-30 years	4	11.075	1.1843	0.350
	31-50 years	20	9.565	2.0551	
	More than 51 years	26	10.381	2.5982	
RBC	10-30 years	4	3.7350	0.36783	0.415
	31-50 years	20	3.3380	0.74864	
	More than 51 years	26	3.6273	0.87126	
HCT	10-30 years	4	34.525	4.1532	0.443
	31-50 years	20	30.400	6.3892	
	More than 51 years	26	32.846	8.6580	
MCV	10-30 years	4	92.500	4.7868	0.892
	31-50 years	20	91.320	6.3685	
	More than 51 years	26	91.081	4.9036	
MCH	10-30 years	4	29.625	1.7212	0.709
	31-50 years	20	28.715	2.2087	
	More than 51 years	26	28.727	2.0182	
MCHC	10-30 years	4	32.050	0.6608	0.355
	31-50 years	20	31.405	0.9439	
	More than 51 years	26	31.381	0.8324	
RDWCV	10-30 years	4	15.650	0.4655	0.124
	31-50 years	20	16.810	1.4149	
	More than 51 years	26	16.085	1.3806	
RDWSD	10-30 years	4	54.325	2.8016	0.904
	31-50 years	20	53.580	4.4076	
	More than 51 years	26	53.288	4.6498	

Discussion:

About one in ten persons in high- and middle-income nations suffer from chronic kidney disease (CKD), which is primarily brought on by diabetes, hypertension, or glomerulonephritis. Anemia, bone loss, and a higher risk of cancer and cardiovascular disease are among the complications associated with chronic kidney disease (CKD). In this study, the mean of Hb concentration (10.1 g\dl), mean of RBCs count (3.5) and mean of (32%), the mean of RBCs indices MCV(91.2 fl) and MCH (28.7 pg) and MCHC (31.4%), and red blood cell distribution width {mean of RDW-CV(13.8) and the mean of RDW-SD(4.3) in chronic kidney disease patients when compared with healthy control group give highly significant result with *P. value* (0.000 -0.000 -0.000-0.004 -0.000 – 0.000 -0.000)respectively, except in MCH result give insignificant variation with *P. value* 0.857. Also, the increase in the duration of the disease leads to a significant decrease in the mean of Hb concentration RBCs count, and HCT with *P. value* (0.053 – 0.048 – 0.036) respectively. The statistical analysis of results of this study showed that there was no significant variation in the mean of RBCs count, Hb, HCT, RBCs indices (MCV, MCH, MCHC), RDW-CV and RDW-SD in chronic kidney disease patients according to the gender (male and female)with *P. value* (0.900 – 0.668 – 0.788 -0.140 – 0.266 – 0.700-0.304 – 0.946) respectively. The statistical analysis of the results of this study showed that there was no significant variation in the mean of RBCs count, Hb, HCT, RBCs indices (MCV, MCH, MCHC), RDW-CV, and RDW-SD in chronic kidney disease patients according to the age (10-30, 31-50, more than 51) years with *P. value* (0.415 – 0.350 – 0.443 – 0.892– 0.709 – 0.355 – 0.124 -0.904) respectively. This result is similar to the study in 2016 in Sudan done by Raian Bakhet Yassein and her colleagues **[12].** The essential cause of decreased RBC counts which consequently decrease the Hb concentration and packed cell volume in chronic kidney disease is impaired erythropoietin production and other factors that suppress marrow erythropoiesis and shorten red cell survival **[12].** Also, our result is similar to the study in 2021 in Egypt study was done by Alshabrawy M.Abdelnabi *et al* at Zagazig University, Sharkia **[13].** Also, our result is similar in (RBCs, Hb, and HCT) to the study in September 2012 in India that was done by: Suresh M, Mallikarjuna Reddy N *et al*, at Nellore, Andhra Pradesh **[14].** Also, the results agree with the study in 2018 in Nepal a study done by Singh S *et al*, at Kist Medical College Teaching Hospital, Lalitpur **[15].** And finally, also this study is similar to a study in 2020 in Iraq, a study done by Hussein Mahdi Kadhim *et al* **[16].**

Conclusion:

The majority of cases are anemic patients with a hemoglobin concentration of less than 12 g\dl. There are highly significant decreases in the mean of Hb concentration, HCT, RBC count, and RBC indices in chronic kidney disease patients, when these results are compared with the healthy control group. There are association between an increase in the duration of disease with RBC parameters and a significant decrease in Hb concentration, HCT, and RBC count in chronic kidney disease patients.

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Conflict of Interest:

The author has affirmed that there are no conflicting interests.

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