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RESEACH ARTICLE

Effects of Haemodialysis on Laboratory Parameters of Chronic Kidney Disease Patients in Rasheed Shekoni Federal University Teaching Hospital

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Abstract

Background: The global burden of Chronic Kidney Disease (CKD) keeps increasing especially in low and middle-income countries like Nigeria. CKD leads to progressive irreversible deterioration of renal function that brings about laboratory changes in various parameters, particularly among hemodialysis patients. We aim to determine the haematological changes of CKD patients and the effects of hemodialysis on the laboratory parameters in a selected population in North-Western Nigeria. **Materials and Methods:** This is a comparative cross-sectional study of seventy-five (75) CKD patients attending the haemodialysis unit of a tertiary healthcare facility in Dutse, Jigawa state who were compared with seventy-five (75) healthy adults. Samples were run for full blood count using Sysmex automated three parts differential counter. The data obtained were analyzed using the IBM Statistical Package for Social Sciences version 21.0. **Results:** The overall mean age (± standard deviation) was 44.08 (± 9.58) years. Majority of the study participants are males (60%). Haemodialysis in CKD is significantly associated with reduced haematological parameters; red blood cell count, haemoglobin, haematocrit, red cell indices and platelet counts (p-value < 0.05) compared to the comparison arm. The white blood cell count does not appear to be affected (p-value >0.05). However, the absolute neutrophil count shows a statistically significant increase (p = < 0.05) in haemodialysis patients compared to the control group. **Conclusion:** CKD is associated with variable degrees of haematological abnormalities and hemodialysis further complicates these changes. Adequate laboratory evaluation and treatment of CKD patients receiving hemodialysis can result in reduced complications and improved health outcomes.

Keywords: Laboratory parameters, haematological changes, chronic kidney disease, haemodialysis

Introduction

Chronic kidney disease (CKD) is a global public health problem with an increasing burden and high cost of care especially in the third-world countries like Nigeria (Arogundade and Barsoum 2008). About 10% of the world population is affected by CKD and about a million die each year due to lack of access to affordable treatment (Global Kidney Foundation 2015, Mills *et al* 2015). The prevalence of CKD in Kano Nigeria was found to be 26% (Nalado *et al* 2016). CKD has been defined as a glomerular filtration rate (GFR) of <60ml/min per 1.73m^2, usually accompanied by features of uremia or a need for renal replacement therapy (National Kidney Foundation 2013). Dialysis remains the most common form of renal replacement therapy worldwide due to the high cost associated with transplantation and the difficulty in finding a compatible organ donor (Mohamed *et al.*, 2008). Chronic kidney disease is associated with progressive irreversible deterioration of renal function as a

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consequence of uremia which significantly affects both biochemical and haematological parameters. The commonest haematological change is anaemia which corresponds to the degree of renal impairment and occurs as a result of impaired erythropoietin (EPO) production which is solely (90%) produced by the kidneys (Chakravati *et al* 2017). Other contributing factors of anaemia in CKD include absolute iron deficiency or impaired absorption as well as ineffective use of iron stores due to increased hepcidin levels. Systemic inflammation, associated comorbidities, folate deficiency, shortening of red cell lifespan from uremia, gastrointestinal bleeding, and reduced bone marrow response to EPO due to uremic toxins are also implicated (Portoles *et al* 2021). Blood transfusion is unavoidable in CKD subjects, due to decrease in production of erythropoietin and thrombopoietin, consequently presenting with anemia, alongside low platelet count. (Ulasi et al 2010) Total leucocyte counts and their differentials, platelet count, bleeding time and prothrombin time are also negatively affected (Akinsola *et al 2000*). Thrombocytopathy occurs majorly due to the effects of uremia and other retained metabolic wastes. Therefore, there may be the need for assessment of platelet count which may necessitate transfusion of platelet concentrate. Where platelet transfusion is not feasible, selecting blood product that will not likely worsen the thrombocytopenia such as fresh whole blood will be beneficial in patients with severe thrombocytopenia. (Ali et al 2023). CKD patients are prone to increased cardiovascular morbidity and mortality due to numerous hematological and biochemical abnormalities which further make them more vulnerable if appropriate measures are not put in place. Several laboratory changes occur in CKD patients on hemodialysis (Nalado *et al* 2016, Akinsola *et al 2000*).

To our knowledge, there are few studies that looked at the effects of hemodialysis on laboratory changes in CKD patients in the study area, despite the moderately high rate of mortality from this disease. We therefore aimed to determine the haematological changes in CKD patients and the effects of hemodialysis on the parameters in Rasheed Shekoni Federal University Teaching Hospital (RSFUTH), a tertiary health-care centre that provides health-care services to patients in Jigawa state and serves as a referral centre to some parts of Bauchi, Kano and other neighboring states.

Materials and Methods

We conducted a comparative cross-sectional study on seventy-five (75) CKD patients and seventy-five (75) healthy adults (controls) attending the haemodialysis unit at RSFUTH from July to December 2022. Its dialysis unit operates with five (5) functional dialysis machines, with a record of over 500 registered CKD patients. Averagely, fifteen to twenty patients are dialysed weekly, and about 20% of the total transfused blood in the hospital is being provided to CKD patients in the dialysis unit.

The study participants were adults aged 18 - 65 years who agreed to participate in the study. The participants were confirmed, by history taking and from the information in their hospital record files, to have no other likely cause of anaemia apart from CKD. Samples for full blood counts were taken and run within 3 hours of collection using Sysmex XP 300 automated three-part differential counters. (Sysmex, 2012).

The instrument executes automatic analysis and displays the results on the LCD screen. Hemogram [measuring Hb level, hematocrit, white blood cell, platelet count and red cell indices including Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC)] was performed with Sysmex Hematology Auto Analyser which uses impedance principle as originally described by Wallace Coulter (1956).

The data obtained was analyzed using the IBM Statistical Package for Social Sciences version 21.0. The results generated are presented in tables as mean and SD. Student t-test was used for quantitative analysis and level of significance was set at $p < 0.05$.

Descriptive statistics are summarized as means for continuous variables and frequency (percent) for categorical variables for participants' demographics, we employed one-way ANOVA to model the association of hematological parameters in the study participants and their relationship with hemodialysis. The level of statistical significance was set at 5% in all the analyses.

Ethical approval to conduct this study was obtained from the Ethics Review Committee of Rasheed Shekoni Federal University Teaching Hospital (with approval ID

of RSSH/GEN/226/VII/12). A written informed consent was sought from the participants before the commencement of the data collection. The aim and benefits of the study were also explained to the participants. All the information provided by the participants is treated with utmost confidentiality.

Results

A total of 75 participants aged 18-65 years (mean 44.08 ± 9.58) and age and sex-matched controls were recruited for the study. Majority of them are males (60%), and most of the patients with CKD are in the age group 48-57 years as shown in Table 1. Data of the aetiology of CKD in study patients is presented in table 2.

Haemodialysis in chronic kidney disease is significantly associated with reduced haematological parameters; RBC, Hb, hct, red cell indices and platelet count (p-value = < 0.05) compared to controls. This decrease appears to be progressive relative to the number of hemodialysis sessions per week. The white blood cell count does not appear to be affected (p-value = > 0.05). However, the neutrophil count shows a statistically significant increase (p = < 0.05).

Table 1: Age and Gender Distribution of CKD Patients

AGE GROUP(YRS)	MALE	FEMALE	TOTAL NUMBER	Percentage (%)
18-27	2	2	4	5.3
28-37	9	6	15	20.0
38-47	16	10	26	34.6
48-57	17	11	28	37.3
58-67	1	1	2	2.7
TOTAL	**45**	**30**	**75**	**100.0**

Table 2: Etiology of CKD Observed among Participants on Hemodialysis

Clinical Data	Number of Subjects	Percentage of Subjects (%)
Primary Cause		
Hypertension	18	24.0
Diabetes Mellitus (DM)	10	13.0
DM with Hypertension	20	26.0
Drug Intake	6	8.0
Kidney Stone	2	2.7
Unknown	19	25.3
Total Number of Subjects	75	100

Table 3: Hematological Parameters in Hemodialysis Patients and Their Relationship with Hemodialysis

RBC count	Controls (mean value)	Predialysis (mean value)	Post dialysis (mean value)	P-value
RBC Count	5.26	3.16	2.67	P<0.005
Hb	14.61	7.70	6.78	P<0.05
Hct	39.70	23.34	20.65	P<0.05
WBC	7.05	7.30	8.58	P>0.05
Neutrophil	3.31	4.95	6.06	P<0.05
Lymphocytes	3.36	1.65	1.79	P<0.05
Mid	0.68	0.69	0.73	p>0.05
MCV	85.55	85.35	85.27	P>0.05
MCH	27.72	24.70	25.41	P>0.05
MCHC	37.00	32.89	32.56	P>0.05

Legend: RBC Count-Red blood cell count, Hb- Hemoglobin, Hct - Hematocrit, WBC – White blood cell count, mid- basophils, eosinophils and monocytes, MCV- Mean Corpuscular Volume, MCH- Mean Corpuscular Hemoglobin, MCHC- Mean Corpuscular Hemoglobin Concentration.

Discussion

Chronic kidney disease is a major public health problem and a major cause of morbidity and mortality. We conducted a comparative cross-sectional study on 75 CKD patients and 75 healthy people, most of whom are males (60%) with a preponderance of middle age group (48-57 years). This is similar to a study done by Chakravati (Chakravati *et al* 2017) and Chinwuba (Chinwuba *et al* 2010). The older age group and the male predominance can be explained by the underlying disease condition causing CKD; hypertension and DM as found in this study and many others (Chakravati *et al* 2017, *George et al 2015)* are aetiological factors of CKD which are more prevalent in older age group and have male predominance (Coresh 2003).

As previously documented (Chakravati *et al* 2017, George *et al* 2015, Obeagu *et al* 2018), we also observe that normocytic normochromic anemia is the main hematological abnormality in CKD patients. This is further worsened by hemodialysis. This pattern of anemia highlights decreases in the production of erythropoietin which is the main pathophysiological mechanism in anemia of CKD. Our finding is contrary to the report by Talwar et al (Talwar *et al* 2002) in which 60% of the patients have a microcytic hypochromic pattern of anemias. This can be explained by nutritional deficiencies or infectious diseases in this setting. Anemia is an independent risk factor of mortality.

The total white blood cells and their differentials of predialysis patients are slightly higher than in the control group and the process of dialysis further increases the WBC count. This is similar to a study done by Habib et al (Habib *et al* 2017) and Kaze et al (Kaze *et al* 2020). The increase in the count could be related to inflammation which occurs during CKD in the context of malnutrition, inflammation and atherosclerosis syndrome (Kaze *et al* 2020). High WBCs and their differentials are a strong and independent predictor of coronary risk with or without coronary heart disease and are associated with peripheral arterial disease and stroke (Madjid and Fatemi 2013). Elevated WBC and neutrophils have also been linked to a rapid progression to end-stage renal disease and cardiovascular morbidity and mortality (Reddan 2003). However, there is a significant decrease in lymphocyte count in both pre- and post-dialysis patients compared to the control group. This is similar to a study done by Obeagu et al and Habib et al. which reports that low lymphocyte count reflects a deterioration of nutritional status and is associated with a worse prognosis in CKD (Yuan 2019). Increased neutrophil count and decreased lymphocyte count are independent predictors of increased mortality in hemodialysis patients (Reddan 2003).

The platelet counts of pre and post-dialysis patients are lower than those in the control group and are statistically significant. This is similar to previous reports by Habib et al, and Kaze et al. Patients with CKD frequently experience thrombocytopenia and platelet dysfunction. Uraemia, blood loss, sepsis and heparin treatment may all contribute to low platelet count. Hemodialysis can cause thrombocytopenia due to the interaction of dialysis membranes with platelets triggering adhesion, aggregation and activation. (Van Blade RE et al 2012).

Conclusion: CKD is associated with variable degrees of haematological abnormalities and hemodialysis further complicates these changes. Adequate laboratory monitoring and treatment of CKD patients on dialysis can result in reduced complications and improved health outcomes.

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Authors' Contribution

NAY: contributed to conception and design; participated in data analysis and interpretation and wrote the final draft. ZI: contributed to conception and design, statistical analysis, and approved the final draft. AH: Took part in data collection, and statistical analysis, revised and approved the final draft. ZUI: Took part in data collection, and statistical analysis, revised and approved the final draft. AKG: Contributed to statistical analysis, revised and approved the final draft. SAG: Contributed to statistical analysis, revised and approved the final draft.

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